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An Exploratory Analysis of Technical Issues in Remote Education between International Medical Institutions

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Abstract. International education programs that use videoconferencing (VC) are common now and many are being implemented in the medical field. Irrespective of the value of the content, the learning process can be disrupted when technical quality of VC is compromised. In this study, a participatory design (PD) was used with focus group discussion between technical support staff to determine and classify the causes of technical issues in international remote medical education by VC. As a result, a quality of experience (QoE) -based framework was developed based on the technical issues raised. User behavior and three factors (context, human and system factors) influence technical errors, either preventing or creating difficulties, and affecting each other. For future prototyping of the PD process, it is suggested to have a flexible and specific operational procedure which considers variables of engineers' background.

Keywords: Information and Communication Technology · Medical Education · Participatory Design · Quality of Experience · Videoconferencing

1 Introduction

Videoconferencing (VC) is no longer a future technology and has become common even for medical education. A number of continuing medical education (CME) programs for physicians have used VC [1, 2]. Reducing the cost of travel and human resources for real-time conversation by VC benefits not only rural area programs, but also international programs [2]. Medical professionals get more opportunity to learn from foreign teachers and can exchange opinions via VC. VC technology also has limitations. No matter how rich the content, the learning process can be compromised by the failure of technical quality control, e.g. poor audio or image quality [3]. Besides the quality, technical issues like delayed or freezing of signal transmission can occur [4]. These limitations can be considered to come from the improper interaction between system and people who use VC systems. Therefore, the contribution of dedicated engineering staff is considered important in managing the technical aspects of medical educational programs [4, 5]. MacLeod, et al., mentioned that medical educational programs using VC are hard to organize without a multi-disciplinary team, although this team is not

always considered in the literature [6]. The work of these professionals is often treated as invisible, and the perspective of technical staff supporting international medical education by VC has not been investigated. For the purpose of having adequate communication through VC, this study centered on technical quality control in practical use of VC, and explored technical issues that can interfere with international remote medical education from the perspectives of technical support staff who work for international medical educational programs that use VC. To determine and classify the causes of technical issues, a participatory design (PD) based focus group discussion was used with participants who share this defined area of interest.

2 Methods

The goal of this study was to identify and classify the causes of technical issues in remote medical education by VC from the perspective of technical support staff. To achieve this goal, PD-based focus groups were organized as an exploratory study [7, 8]. According to Spinuzzi, most PDs have three basic stages [9]. This research comprised the first two stages of the PD method: initial exploration as Stage 1, and discovery process as Stage 2. Stage 3 is considered in the discussion session of this paper.

Four focus group discussions which included a total of 19 participants who had experienced taking care of technical matters in remote medical education by VC were held. As the initial exploration, all participants took care of technical matter in eight medical educational sessions by VC which used still images and video clips as medical content during the first three days. Then, the discovery process took place using focus group discussions consisting of two parts. Before each part of focus group discussion starts, general outline and the detail of each part were explained. The outline and duration of each part of group discussion are described in Table 1. After each part of group discussion, presentation to share the results to other groups were held. For these sessions, technical issues were defined as three phenomena caused by technical matters: participants could not see or hear the VC, participants missed the opportunity to speak, or proceedings of the VC were disturbed. There was a moderator in each group to lead the discussion.

Table 1. The outlines of the focus group

Section	Detail	Minutes	
		Part 1	Part 2
Individual work	Participants were distributed with independent colored sticky notes in each team, and were asked to write their ideas as many as possible. Part 1: technical issues that can happen in telemedicine session Part 2: sources of technical issues	10	10
Group discussion	Participants explained their ideas which were written in sticky notes, and similar ideas were grouped together. Part 1: the most critical issue in each group Part 2: key findings through the discussion	35	45

The focus groups were recorded by video camera and voice recorder. The lead author transcribed discussions and presentations. In addition to those records, all sticky notes were collected. Thematic analysis was used on all transcriptions [10]. Transcriptions and sticky notes related to technical issues were coded, then printed and cut into paper strips for the purpose of finding groups. These groupings were verified by the authors for the purpose of enhancing the validity. Classification of groups was made in terms of quality of experience (QoE), which is defined as the degree of delight or annoyance of the user of an application or service [11].

3 Results

Sticky notes were divided into three: direct trigger of technical issues (technical error), preventers (user behavior) and factors (context, human and system factors). These have sub-categories, and affect – or are affected by – some of the others (Fig. 1). Table 2 indicates comments of each category in the focus group discussions. Factors can influence technical errors in two ways: either through direct influence/approach, or by interfering with user behavior, which prevents technical errors.

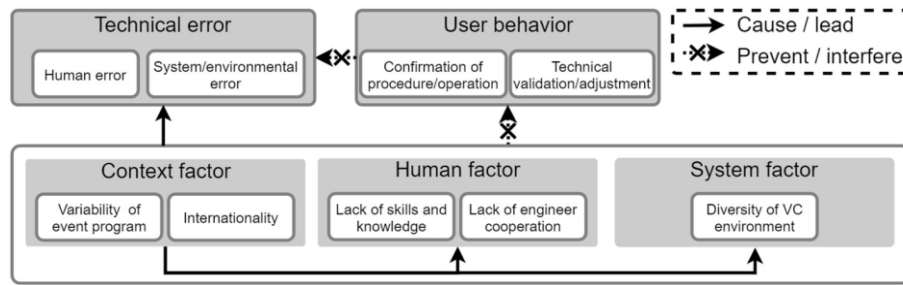


Fig. 1. Framework outlining causes of technical errors and issues

3.1 Technical error

There is technical error which is the direct trigger of technical issues during real VC sessions. These comprised human error and system/environmental error.

Human error refers to difficulties with technical operation, which included forgetting to do something during VC. This can happen when doctors or engineers do not know how, when, and what to use in order to operate equipment.

System/environmental error is another sub-category of technical error. As system error, there were malfunctions and incorrect settings in equipment, and equipment was sometimes incorrectly wired. Environmental errors included: noise from outside, back-lighting due to the limitation of layout or other inappropriate signals due to the surroundings. This sub-category can also be divided into two: controllable errors, which can be prevented by appropriate preparation, and uncontrollable errors like power failure or fiber breakdown outside of the institution.

Table 2. Comments of each category

Technical Error	
Human Error	Good equipment or bad equipment. But, if you don't know how to use that, everything[anything] can happen.
System/Environmental Error	Mic and audio cables need to be tested before the session.
	The room is beside the classroom [...]. The noise from student involve the conference system.
User behavior	
Confirmation of procedure/operation	[...] basic information we provided like how to use the mic, how to mute, and how to present. This kind of basic things [is] we need to inform to the presenter or participants of the other sites.
Technical validation/adjustment	[...] during the connection test, they use only headphone. And I asked the local engineer [whether] that [room] will be the final venue. So, they said they will use larger venue and they will use audio mixer. So, I scheduled another test with using actual equipment that they will use.
Context factor	
Variability of event program	Clear information should [be] give[n] to the participants (engineer) before the session starts.
Internationality	I think we are looking at a communication gap [...]. Communication gaps involve a factor of language, message of mails [...].
	In the morning, [...] one room (a person in a remote site) did not come and contact [...], maybe because of time zone.
Human factor	
Lack of skills and knowledge	Echo, that is practical. [...]. Every year, [...] a new hospital [is] also participating. They don't have a proper idea, this echo.
Lack of engineer cooperation	[Whether] the engineer [is] active or not. If he [is] active, we will be good. If lazy, more problems.
System factor	
Diversity of VC environment	Sometimes if they use bigger venue, venue [requires] to use audio mixer, [...] that [leads] sound problem.

3.2 User behavior

In this manuscript, user behavior refers to tests that prevent technical errors by confirmation of procedure/operation, and technical validation/adjustment. Both are required to be done before the VC session. Despite the importance of user behavior for VC, it is not usually completed due to factors stated in the next section.

Confirmation of procedure/operation means that engineers at each institution need to know what they should do and how to do it to prevent human error. It is evident that this depends on the event program and environment.

Technical validation/adjustment of the network and all equipment that will be used for the VC can prevent controllable system/environmental errors. Given sufficient time and opportunity, engineers may find some malfunctions, incorrect settings or wiring, then diagnose and solve these problems. Even though all the equipment works well, it is sometimes necessary to adjust the layout and setting in the VC room, taking into account the characteristics of each environment and what is available at remote sites.

Because engineers need to test both system and environment, this cannot be completed if the condition at a site is different to what will be used for the actual VC.

3.3 Context factor

Variability of event program which affects technical requirements of VC belongs to context factors. Engineers at each institution may not understand what to do before and during VC if they do not receive clear information beforehand. This can then affect user behavior and human error. In addition to this, variability of technical requirements by event program sometimes affects human and system factors, making engineers feel unprepared when faced with an unfamiliar system or environment.

Internationality can affect user behavior and thus also belongs in this sub-category. There are cultural and physical difficulties that require teamwork between institutions when an international VC is organized. In terms of the cultural aspect, some or all engineers need to use their non-native language for communication. In such cases, the quality and quantity of information conveyed may be reduced in comparison to the use of home languages. Furthermore, some engineers hesitate to communicate using a second or third language. Time differences between countries can also cause communication delays in email or other text communication and can be a barrier to arranging the schedule.

3.4 Human factor

Lack of skills and knowledge is one of the sub-category of human factor. In addition to audio, visual, and network, the skills and knowledge of integration of these endpoints are required for VC although the skills and knowledge of engineers differ widely between participating institutions. In addition to leading to technical errors, this lack of skills and knowledge can interfere with user behavior. It is difficult for inexperienced engineers to know what technical validation/adjustment should be done and how to do it. Confirmation of procedure/operation is also a challenge when the technical organizer provides only rough technical information about the things to do during VC at each site to inexperienced engineers.

Lack of engineer cooperation requires a different sub-category to lack of skills and knowledge. Technical operation is an extra job for some engineers who may be too busy to prepare sufficiently (user behavior). In another case, some engineers hesitate to communicate with others even though they are available for preparing and operating VC technically.

3.5 System factor

Diversity of VC environment is this system factor. There is a range of different facilities and equipment between connecting institutions. Not all institutions have a VC-customized room and not all rooms are suitable for VC in terms of layout, light or sound. These environmental limitations can also cause system/environmental errors. Inappropriate equipment can also be one of the factors. Sometimes function (e.g. echo cancellation) and other specifications are not well matched with characteristics of the room.

There are technical asymmetries not only between equipment at different sites but also with the integration between them considering the scale of room which can be a variable in the procedure for technical validation/adjustment leading to technical errors. It is sufficient to arrange only a laptop with a headset when there is only one person at a site. However, a bigger screen, microphones that can be shared, and an audio system that distributes an audio source into a VC endpoint and speaker are needed as participants at an institution grow in number. Furthermore, complicated integration between equipment can cause human error and confusion for operators, or system/environmental errors like plugging in an invalid jack.

Discussion

This research classified the causes of technical issues in the VC system in medical education using a PD method that included technical support staff. As a result, a framework was developed indicating that there are technical errors that are the direct triggers of technical issues, user behaviors that prevent technical errors, and factors that causes technical errors and interfere with user behavior. Although there were several uncontrollable technical errors, most of the sticky notes written by participants showed that these can be controlled by user behavior which takes place before the event. Thus, appropriate user behavior is presumed to improve QoE of remote medical education by VC. Based on the results, the effect of factors interfering with user behavior can be treated as variables.

Internationality from context factors, and lack of engineer cooperation from human factors are variables which make communication between institutions difficult. Regarding to this problem, the simplified standardization of operational procedure for user behavior is considered to assist engineers who have various background. However, it is difficult to realize it since there are other variables in medical education by VC: variability of event programs from context factor, lack of skills and knowledge from human factor, and diversity of VC environments from system factor. Skowronek, et al. mentioned that asymmetry is one of the challenges for multiparty VC while easy setup is an important factor for QoE [12]. One of the solutions to these difficulties is to classify these variables and consider a semi-order manual or checklist containing the responsibilities of each institution per event. It may be difficult for engineers even to imagine the necessity of validation, adjustment and control of unfamiliar aspects. Thus, it is suggested to point out these challenges and support them. VC environments can be classified according to the range of participants gathered from the samples. Classifying the environmental scale could minimize the disagreements related to VC image between participants. VC can be carried out regardless of the scale of venues, i.e. presentation from a laptop on an office desk to a large congress venue, and sometimes participants misunderstand the image of VC room setup especially when it is their first time. From a PD perspective, this could be Stage 3: prototyping [9].

Conclusion

A PD-based focus group discussion with technical support staff was held for the purpose of exploring the causes of technical issues in remote medical education by VC. A QoE-based framework for technical issues was devised. There are factors causing technical issues and interfering with the preventative activities designed to reduce technical issues. Suggested topics for future research include: flexible and specific operating procedures; considering difficulties experienced by engineers, and the variability of operational procedures for VC. The findings in this research are considered to be the subject to be solved in practical use of international VC in not only medical education but also other fields.

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References

1. Allen, M., Sargeant, J., Mann, K., Fleming, M., Premi, J.: Videoconferencing for practice - based small - group continuing medical education: Feasibility, acceptability, effectiveness, and cost. *Journal of Continuing Education in the Health Professions* 23, 38-47 (2003)
2. Curran, V., Rourke, L., Snow, P.: A framework for enhancing continuing medical education for rural physicians: A summary of the literature. *Med Teach* 32, e501-e508 (2010)
3. Coventry, L.: Video conferencing in higher education. *Support Initiative for Multimedia Applications* (1995)
4. Lockhart, J., Vowles, B., Edgar, S.: Multi-site videoconferencing teaching in south east Scotland region: Continuing medical education. *J Health Sci* 6, 288-295 (2018)
5. Shimizu, S., Kudo, K., Antoku, Y., Hu, M., Okamura, K., Nakashima, N.: Ten-year experience of remote medical education in Asia. *Telemed e-Health* 20, 1021-1026 (2014)
6. MacLeod, A., Kits, O., Mann, K., Tummons, J., Wilson, K.W.: The invisible work of distributed medical education: Exploring the contributions of audiovisual professionals, administrative professionals and faculty teachers. *Adv Health Scis Educ* 22, 623-638 (2017)
7. Lunt, P., Livingstone, S.: Rethinking the focus group in media and communications research. *J Commun* 46, 79-98 (1996)
8. Sanders, E.B.N., Stappers, P.J.: Co-creation and the new landscapes of design. *CoDesign* 4, 5-18 (2008)
9. Spinuzzi, C.: The methodology of participatory design. *Tech Commun* 52, 163 (2005)
10. Braun, V., Clarke, V.: Using thematic analysis in psychology. *Qual Res Psychol* 3, 77-101 (2006)
11. Brunnström, K., Beker, S.A., De Moor, K., Dooms, A., Egger, S., Garcia, M.-N., Hossfeld, T., Jumisko-Pyykkö, S., Keimel, C., Larabi, M.-C.: Qualinet white paper on definitions of quality of experience. (2013)
12. Skowronek, J., Schoenberg, K., Berndtsson, G.: Multimedia conferencing and telemeetings. In: Möller, S., Raake, A. (eds.) *Quality of experience: Advanced concepts, applications and methods*. pp. 213--228. Springer, Switzerland (2014)