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ORIGINAL ARTICLE

Challenges in Embracing Virtual Reality from Healthcare Professional's Perspective: A Qualitative Study

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ABSTRAK

Realiti maya (VR) dalam bidang kesihatan merupakan konsep yang agak baharu dan kajian terhadap pandangan profesional kesihatan (HCP) tentang potensinya harus dilakukan. Kami berhasrat untuk mengkaji persepsi HCP berkenaan dengan kebolehlaksanaan dan penggunaan VR dalam penjagaan kesihatan. Kajian kualitatif telah dijalankan dalam kalangan HCP di sebuah institusi perguruan perubatan di Lembah Klang, Malaysia dari Mac hingga Julai 2021. Perbincangan kumpulan berfokus telah diadakan menggunakan soalan separa berstruktur yang terdiri daripada empat kategori iaitu utiliti, latihan, pembangunan dan sumber serta cabaran yang telah dibangunkan secara deduktif sebelum kajian. Peserta dianalisis menggunakan pengekodan tematik. Data tersebut ditunjukkan dalam bentuk kategori, tema dan petikan. Tujuh doktor, empat profesional kesihatan bersekutu dan empat pegawai sains ialah antara lima belas responden. Sejumlah 16 tema telah diperoleh daripada empat kategori yang dikaji iaitu penggunaan, tujuan, modaliti baharu, pengalaman individu, keselamatan pesakit, keselamatan jurulatih, penyeragaman latihan, logistik, interaktiviti, kos kepada pengguna, potensi, sokongan pengurusan, had, pembiayaan, kekurangan kepakaran dan pemikiran kurang peduli. Selain daripada isu keselamatan, kos teknologi VR yang tinggi dijangka menjadi lebih mampu dimiliki pada masa hadapan. Penyakit siber juga membimbangkan. Kajian ini menunjukkan bahawa VR boleh digunakan dalam pendidikan dan amalan penjagaan kesihatan jika beberapa faktor kritikal

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dipertimbangkan, termasuk peningkatan pembiayaan, pemikiran yang lebih baik, peningkatan keterlihatan, kesedaran tentang sumber yang tersedia dan peningkatan kerjasama antara pakar teknikal dan subjek. Memandangkan VR bertindak sebagai simulasi, VR memastikan keselamatan pelatih, guru dan pesakit sambil membenarkan latihan yang lebih fleksibel dalam pelbagai senario klinikal.

Kata kunci: latihan, pendidikan, penjagaan kesihatan, persepsi, simulasi

ABSTRACT

Virtual reality (VR) in healthcare is relatively new concept and the views of healthcare professionals (HCPs) on its potential should be studied. We set out to investigate the perception of HCPs concerning VR's feasibility and utility in healthcare. An exploratory qualitative study was conducted among HCPs in a medical teaching institution in the Klang Valley, Malaysia from March until July 2021. Focus group discussions were held using semi-structured questions consisting of four categories i.e., utility, training, development and resources and obstacles were developed deductively prior to the study. They were analysed using thematic coding. The data were presented in the form of categories, themes and quotes. Seven doctors, four allied health professionals and four science officers were among the fifteen respondents. A total of 16 themes were derived out of the four categories which were usage, purpose, new modality, individual experience, patient safety, trainer-trainer safety, training standardisation, logistic, interactivity, cost to consumers, potentiality, management support, limitation, funding, lack of expertise, and mindset ignorance. Apart from safety concerns, high VR technology costs were expected to become more affordable in the future. Cybersickness was also of a concern. This study demonstrated that VR was feasible in healthcare education and practice if several critical factors were considered, including increased funding, a more favourable mindset, increased visibility, awareness of available resources and increased collaboration between technical and subject matter experts. As VR acts as simulation, VR ensures trainee's, teacher's and patient's safety while allowing more flexible training in a variety of clinical scenarios.

Keywords: education, healthcare, perception, simulation, training

INTRODUCTION

Virtual reality (VR) is being as one of the simulations modalities is fast becoming a significant tool in the Industrial Revolution 4.0 (IR4.0) in several industries (Mahdy et al. 2020). Enormous funds have been allocated for the development of VR. North America dominated global market for Augmented Reality (AR) and VR due to greater adoption of advanced

technology and sophisticated infrastructure. Meanwhile, countries such as China, Japan and India, the Asia Pacific region are anticipated to exhibit a higher growth rate or compound annual growth rate over the forecast period of 2018-2025 (Anon 2019). These countries of Asia Pacific region are expected to contributes 33% to the growth rate of AR and VR healthcare market during that period (Anon 2019).

In the healthcare industry, the use of VR can be applied in education, health services or healthcare system planning. Although gaming industries have been monopolising the advancement of VR technology by variety of games, the healthcare industry has also been actively researching the use of VR technologies as a valuable tool, especially in medical education and training (Hsieh & Lee 2018). The potential usage of VR can be extended in the therapeutic and diagnostic aspects of patient care.

Even though VR has developed extensively with the incorporation of haptic technology, the usage of VR in the healthcare sector is rather minimal. VR is seen to be largely accepted in teaching and learning but its usage in other aspects such as therapy or diagnosis are relatively scarce (Vozenilek et al. 2004). Healthcare professional's (HCPs) perception regarding to the utility of VR in other aspects needs to be explored to reduce the negative perception as hindrance to accept this technology.

The current method delivering clinical education and training is not only labour intensive but also involves direct patient contact (Spencer et al. 2000). Furthermore, during the current COVID-19 pandemic, healthcare education specially clinical teaching, is severely disrupted. This is because clinical premises such as wards, operation theatre, emergency rooms, clinics and laboratories have become out of bounds to healthcare students. In addition, the rdemand for training through VR becomes paramount as it gives infrequent opportunity to train in real case scenarios such as resuscitation or uncommon surgical procedures. As with other simulation modalities, VR provides the opportunity to train repetitively until competence is achieved, in a safe environment for both trainer and trainee, whilst eliminating the need to experiment on real patients (Bhatti & Ahmed 2015).

We set out a qualitative study to explore the Malaysian HCPs' perspective on the challenges and willingness to embrace VR technology in healthcare. We hypothesised there is a lack of knowledge on know-how and accessibility to the VR technologies and the developers. Nevertheless, we felt that HCPs were willing to embrace VR as one of the instruments in carrying out their responsibilities.

MATERIALS AND METHODS

Study Design and Setting

This was an exploratory qualitative study which was conducted among HCPs including doctors, nurses, paramedical and science officers in the Faculty of Medicine, Faculty of Dentistry, and tertiary teaching hospital of the Universiti Kebangsaan Malaysia

(UKM). The study was carried out in the form of focus group discussions (FGD) using semi-structured questions. The study was approved by the UKM medical research and ethics committee (JEP-2021-613), funded by the UKM industrial grant (FF-2021-384) and was conducted from April 2021 to Jan 2022.

Participants

Participants were selected through purposive sampling from various HCPs who were staffs of the two faculties and affiliated under the teaching hospital. These professionals were regularly involved in institutional teaching activities. All HCPs from the three institutions who worked throughout the research period were eligible. Non-permanent employees and unregistered trainees were excluded from the research. Consent was taken prior to the interview.

Interviews

Data were collected through FGD using semi-structured questions based on an interview protocol. All interviewers were briefed about the protocol and vignettes to ensure consistency. The FGD was conducted in three groups and each session lasting between 90 to 180 minutes was recorded. An iterative questioning approach was used whereby new issues and themes that emerged were included in the later discussion. Researchers also asked probing questions at their discretion to explore new emerging themes. The interviews were conducted until saturation was achieved and no new themes emerged.

Data Analysis

Recorded audio from the FGD was transcribed verbatim by a professional and cross-checked by the researchers to ensure accuracy and subsequently verified by the participants. The transcripts were analysed using thematic coding as suggested by Merriam (2009). The analysis was performed with caution and the researchers compared each interview through triangulation of data from each group. The categories were then obtained according to the objectives of the study. The categories were created deductively. Three basic steps were involved in conducting content analysis: identifying codes, creating themes and grouping the themes inductively into four categories.

The transcriptions were loaded into the NVivo 12 software (QSR International 2021) to assist in data management and analysis. The transcriptions were repeated to reinforce further understanding of the contextual meaning. Texts with the same central meaning were segmented into meaning units and sorted out from the transcriptions. Codes were then assigned to the meaning units to represent threads from the dimension of healthcare virtual reality (hVR). Meaning units which shared the same manifested threads and contents were divided into themes. Accumulation and comparison of themes were performed by the researchers to explore similarities and differences in the participants'

perceptions. Subsequently, codes were sorted together into themes. The entire texts were examined, and each theme was categorised appropriately by the researchers according to the content and the contextual meaning. The data were presented in the form of categories, themes and quotations which were related to them.

RESULTS

General Overview

There were 15 respondents in this study, which were divided into three focus groups. Participants comprised of seven doctors, four allied health professionals and four science officers. Ten were from the Faculty of Medicine, three were from the Faculty of Dentistry, and two were from the teaching hospital of UKM. The sociodemographic data of the respondents were displayed in Table 1.

Table 1: Sociodemographic profile of participants

	N (%)
Gender	
Male	5 (33.3)
Female	10 (66.7)
Age (years)	
<30	1 (6.7)
30-50	13 (86.6)
>50	1 (6.7)
Length of Service (years)	
< 5	1 (6.6)
5-10	7 (46.7)
>10	7 (46.7)
Designation	
Medical / Dental Officer	7 (46.6)
Allied health professional	4 (26.7)
Science officer	4 (26.7)

Four categories were deducted namely VR utility, training, development & resources, and obstacles. Out of these four categories, 16 themes emerged as shown in Tables 2-5. There were five themes under VR utility, i.e. (i) usage; (ii) purpose; (iii) new modality; (iv) individual experience; and v) patient safety, as shown in Table 2. All respondents were interested and willing to use VR in their various types of work, be it in the clinical or healthcare education setting.

Four themes appeared under the training category, i.e. (i) safety; (ii) standardisation of training; (iii) logistics; and (iv) interactivity. Virtual reality was believed to provide safety for both trainers and trainees. In the aspect of training, everyone was willing to use or explore VR and its potential in their educational activities. It was agreed that VR had good potential in healthcare training because it allowed exploration of new modalities in teaching and learning (T-L), facilitating the understanding and visualisation of certain topics, raising the confidence level among trainees, reducing the risk to patients and avoiding medicolegal issues associated with training (Table 3).

Three themes were addressed under the development & resources category, i.e. (i) cost of VR to consumers; (ii) potential of VR in healthcare; and (iii) support from management. The majority felt that VR technology was expensive, however, in the long term, it might become cheaper. The majority of respondents thought that more funds should be allocated for the development of surgical-based VR (Table 4).

From the perspective of obstacles

Table 2 : Summary of utility category, themes and quotations

Category	Themes	Quotations
Utility	Usage	…the usage of VR for learning has started in other countries, other than its use in the gaming world (P1) … high risk procedures …(P9) VR can be used in various aspects of the medical field (P1)
	Purpose	…yeah I think it can improve their confidence if they can know the anatomy and the skills prior to actually seeing the patients, so actually can improve their confidence which can translate into better patient management I think (P15) …yeah, lifelong. So even as trainers we are learning how to teach better, and for students I think definitely they'll improve their skills (P15) …in my past experience we used the VR or AR in (our) communication with patient(s) (P14) …major complications can be reduced (P14) … to prepare students, be it nursing, paramedical or medical, to enter the real world …(P1)
	New modality	… an attractive platform, something new, innovative, attracts interest …(P4) … can be done repeatedly, whenever and wherever …(P4) "… mother can interact with her deceased child …" (P5)
	Individual experience	…back in my Master program … they actually use VR in teaching of anatomy. in (the) dissection hall basically (P14) …I obtained this exposure mostly from the virtual world where there are many courses or learning …(P4)
	Patient safety	…safety also better because like it doesn't involve patient safety (and) can avoid unnecessary complications, while you are learning the skill (P15) … say he or she uses VR to reduce the risk to patients …(P3)

to VR application in healthcare, four themes were extracted, i.e. (i) limitation; (ii) funding; (iii) lack of expertise; and (iv) mindset and ignorance. The majority of the respondents felt that funding was the main stumbling block followed by the mindset of administrators and trainers in the development and usage of VR in the healthcare fraternity (Table 5).

Table 3: Summary of training category, themes and quotations

Category	Themes	Quotations
Training	Safety	… there is a need, and the safety features of VR are obvious – it can provide the element of safety during the teaching process between the teacher and student (IMS-P1) …will provide enhanced safety features to the trainer and also the trainee (P1) …if he used VR repeatedly, it would boost his self-confidence…knowledge and high confident level…if a trainee made a mistake during training with VR, the trainer can immediately correct him… it will reduce the risk (P3)
	Standardisation of the training	…when the VR is repeatedly played, the teaching becomes standardised (P4) …because I feel there are standardised steps in VR (P3)
	Logistic	… don't need to obtain or prepare equipment, assistants, and so on (P1) …actually, it reduces the workload, maybe the manpower that you need (P15)
	Interactivity	…two-way communication must be included (P1) …the feedback element must be included in our VR (P1)

Table 4: Summary of development & resources category, themes and quotations

Category	Themes	Quotations
Development & Resources	Cost of VR to consumers	… development of the application requires high cost (P4) … but I feel if there are several providers this will become cheap. Of course, initially it (VR) is expensive … With competition it becomes cheap. Technology eventually becomes cheap (P10)
	Potential of VR in healthcare	… because its usage … involves high technical skill …(P1) … surgery also because technically it is much more complicated (P5) … In fact, training of lab technician will also benefit from VR (P2)
	Support from management	… I am of the opinion that management will certainly invest, top management will support … (P2) … the top management will support (P1) … if we have a good proposal, I mean with strong justification and the necessary details, I think the top management will support (P2)

DISCUSSION

Virtual reality is a rapidly progressing technology. We set out to assess the application of this technology in the field of healthcare. We conducted a qualitative survey among a homogenous group of healthcare workers, appraising their views on various aspects of hVR. Out of the four categories, 16 themes emerged from the FGD.

Table 5: Summary of obstacle category, themes and quotations

Category	Themes	Quotations
Obstacle	Limitation	… some people cannot use VR for a prolonged period of time (P4) … my brother gets vertigo (P4) … there may be complications such as dizziness or visual problems (P4) … no soft skill whatsoever (P3)
	Funding	… I think can put it like two … obstacles, one is (the) financial part, another … is mindset. So (with regard to the) financial part I think (it) can be arranged, maybe like government funding or something, because at the end of the day we are (a) government centre, if we can get enough support from the universities and all, you can definitely develop or acquire one (P15) …for me, actually it's much … easier than all those clinical based and simulation (training), but the thing is I think for current trend because it's not very well developed, I think cost will be the problem (P13)
	Lack of expertise	… I have seen (VR) in conference but very limited, so far in Malaysia I have never come across any (P15) … maybe we don't have leaders from amongst content experts in this technology (P3)
	Mindset and ignorance	… I think can put it like two … obstacles, one is (the) financial part, another … is mindset (of the management). Another thing is the mindset of trainers as well, if they are willing (to) accept new challenges and (a) new system in teaching, maybe they can incorporate it in (P15) … maybe rather senior lecturers are resistant to changes like this (P1) "…the biggest obstacle right now I think (is the) lack of exposure to VR in healthcare. I myself wouldn't know where to get it…therefore when there is (lack of) awareness … lack of exposure it will result (in the) lack of demand to use VR" (P5)

Under the 'usage' theme in utility category, there was only three participants had first-hand experience in using VR, but most of the respondents were eager to embrace VR in their respective practice either in clinical services or healthcare education. All respondents agreed that VR can be used in many healthcare disciplines but mainly for training and education. Similar findings were observed in other studies (Dyer et al. 2018; Vozenilek et al. 2004; Yau et al. 2021). However, the usage of VR for other purposes had also been reported in multiple studies (Kizil & Joy 2001; Krummel 1998). It was considered to be applicable to all types of healthcare personnel, ranging from students to professional workers. The participants believed that numerous medical connected disciplines were promising grounds for VR module development. This was supported by Ammanuel et al. (2019) in their study about creating 3D models for radiologic images as VR medical education modules.

There are several purposes for integrating VR in healthcare such as boosting confidence and skills, as preventing complications and enhancing communication with patients (Lesch et al. 2020; Thomsen et al. 2017). This significant benefit of VR serves to shorten the learning curve of the trainee (Janse et al. 2013). Another advantage was that learning through VR was capable of improving students' preparedness for the real world (Michalski et al. 2019; Ogbonna 2020). However, some students might encounter problems when using a VR head-mounted device (HMD), which may hinder their achievement of the intended outcome (Laviola 2000).

As a new modality for T-L, VR serves as an attractive and innovative platform that attracts interest (Kamińska et al. 2020). One of the advantages of training using VR is that it allows deliberate practice (Bhatti & Ahmed 2015; Park et al. 2007). Besides, VR also adds a whole new dimension to interactivity, for example, an experiment showed the interaction between a mother and her deceased child using VR to provide psychological comfort and closure to a bereaved mother (Corporation 2020).

Traditionally, most medical students learn anatomy through cadaveric dissection. Despite the opportunity for hands-on learning, cadaveric orientation is not pragmatic in relation to present-day imaging such as ultrasound, computed tomography (CT) scan and magnetic resonance imaging (MRI). This is in contrast to VR anatomy, where the anatomical orientation can be manipulated (Seo et al. 2017). Therefore, learning anatomy through VR helps students to understand better and orientate themselves faster to real-life human anatomy.

The impact of VR on enhancing patient safety was highlighted frequently throughout the discussion by researchers (Kizil & Joy 2001). This can be contributed either at pre-engagement or during patient engagement. During pre-engagement, a surgeon can rehearse the surgery prior to the operation and avoid experimenting surgically on patients (Zhao et al. 2012). While during patient engagement, a psychiatrist who uses

VR to treat patients with phobia can avoid the trauma of real-life psychiatric intervention (Botella et al. 2017).

In terms of training, VR was believed to provide safety for both trainers and trainees. The majority of respondents agreed that VR could improve trainer-trainee safety not only physically but also medico-legally, through the prevention of real patients for practice by novices. Many studies had come to the same conclusion about trainer and trainee safety (Fertleman et al. 2018; Kizil & Joy 2001). Other than that, VR also facilitates training from the perspective of logistics and resources. For example, in conducting disaster training, VR provides many advantages compared to field simulation, economising preparation in terms of time, equipment and manpower. Training can be organised anytime, in any weather regardless of rain or shine. The type of disaster is fully customisable and easily switched from one to another such as train derailment, fire, landslide and more with well-prepared VR modules.

Virtual reality promotes confidence among trainees which were attributable to repetitive practice, direct immediate feedback and more personalised training (Buckley et al. 2012). The respondent stated that using VR repeatedly would boost his knowledge and self-confidence where a mistake committed during training can be corrected without jeopardising any patient. Since VR is part of simulation-based teaching, feedback or debriefing serves to enhance trainee performance and facilitate their learning curve (Van De Ridder et al. 2008).

Coping with stress through VR training is another interesting point. For example, in the case of driving an ambulance where the trainee's emotional state and decision-making can be evaluated safely by the trainer from the comfort of the control room when the trainee was practising using VR. This eliminates the risk to the trainee and the trainers that was posed by a real-life driving evaluation. This was supported by Ruthenbeck & Reynolds (2015) where their study mentioned that through simulation, participants can practice according to their own pace and be able to practice repeatedly in a safe environment.

Virtual reality usage might minimise human interaction verbally. However, this can be overcome through other means such as providing verbal interaction during training. Given the significance of the humanistic factor in teaching and learning, this is an important consideration (Smith & Neff 2018). This perceived shortcoming of VR should trigger more researches in the future to make VR more verbally interactive for users. Perhaps, the integration of artificial intelligence or verbal response into VR modules might open up a new avenue for the usage of VR in the medical field.

All respondents agreed that the capital cost of VR was substantial, which was supported by Fernandes et al. (2006). However, the majority were optimistic that the cost will become cheaper with the competition among an increasing number of providers. We believed that the universities and lecturers will realise a favourable return of investment (ROI) in the long term.

The university will reap the benefits of a higher-quality education, which will attract more foreign students. In addition, there would be fewer overhead costs compared to current practices, whereby the majority of waste, which from the training disposal plus wear and tear of the training simulators are not recyclable. In terms of subject preparation time and the expenses of offering physical courses, VR modules can assist lecturers in preparing complicated course such as disaster response medicine.

Virtual reality has a huge potential in surgical-based specialties because it involves highly technical skills as suggested by the respondent (Gallagher et al. 2005; Krummel 1998). This is attributable to the variety and complexity of procedures in the surgical field. On top of that, the global expenditure on VR is expected to rise substantially in the next few years (Anon 2020). Therefore, all participants agreed that the highest allocation should be aggregated to VR system developers in creating surgical-based procedures.

Support from institutions' top management is undoubtedly paramount in facilitating the progress of VR. A good proposal with strong justifications is important to garner support from the top management. An example of a renowned institution that has adopted VR as part of healthcare practice is Duke University School of Medicine (Anon 2010).

Funding is one of the obstacles to implementing VR as a modality in healthcare practice and training (Ivanova 2018). The cost depends on whether the institution remains merely as a user or developer of VR content. The basic funding for VR goes into obtaining the infrastructure, acquiring VR equipment, human resource & expertise and maintenance cost (Ivanova 2018). All this varies from country to country but surely will consume the funding of the institution that wishes to engage VR. Nonetheless, on an optimistic note, VR technology will become more affordable with time in line with the law of demand and supply (Gale 1955).

A change in mindset is another obstacle that needs to be addressed. A negative mindset that refuses to embrace change is common among potential users, administrators, managers and trainers. Even though it was widely assumed that senior trainer's hesitant to embrace VR, current literature reveals that this negative mindset appears to transcend age and rank throughout the academic field (Shao & Lee 2020).

Side effects of using VR are another point that need to be addressed. The problem exists even though the affected number is small. Among the symptoms of cybersickness are nausea, vertigo, dry eyes, dizziness, visual problems, loss of spatial awareness, disorientation, eye soreness and seizure (Huygelier et al. 2019; Lewis 2018). These issues need to be addressed to improve the acceptance of VR. Several measures can be deployed to circumvent this issue, for example, limiting VR exposure time and using VR only when truly necessary (Sharples et al. 2008).

For VR to develop and propagate,

the ecosystem requires good collaboration between the VR technical expert and the subject matter expert (Morvan 2019). However, we learned from the interview that there seemed to be a dearth of knowledge, technical skill and leadership among Malaysian HCPs on the availability of VR providers. This ignorance about VR resources or lack of awareness, are needed to be imperatively addressed because the presence of VR provides in Malaysia are not visible to potential users or institutional administrators. This ignorance among institutional management and trainers poses an obstacle to the growth of the VR industry.

There are several limitations in this study. First, it was a single centre study. However, our institution is one of the country's premier higher education institutions and trainees come from all over the country. Hence the FGD had participants from all regions. Second, most participants had no prior VR experience. Their sole information and experience came from books or peers. Moreover, two of the three individuals had VR exposure in gaming, whereas just one had VR exposure in healthcare training overseas. This limitation is unavoidable, as the hVR development level in the country is slow.

CONCLUSION

Malaysian HCPs are aware and eager to use VR technology since it has a definite function in both training and clinical practice, particularly in maintaining patient and trainer-trainee safety. They seemed to lack information on VR development and access to VR developers. Nonetheless, VR has a huge potential, especially in surgical-based specialties and allied sectors.Stronger collaboration between VR technological specialists and healthcare subject matter experts, more funding, positive mindset, increased exposure, and understanding of available resources were required to make healthcare VR practicable. This report provided crucial direction, emphasis, and preventive measures for growing the healthcare VR industry, notably in Malaysia.

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