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Perceived usefulness and ease of using virtual reality during physiotherapy–A cross-sectional survey from physiotherapists perspective

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ABSTRACT

Background: Virtual reality (VR) is a cutting-edge technology that consists of a sophisticated user-computer interface that allows for real-time visualization and interaction by using both visual and auditory sensorial channel. The implementation of inclusive innovation using VR in health services should be considered and hence, this study is conducted to investigate the perceived usefulness and ease of using VR during physiotherapy among Malaysian physiotherapists.

Materials and methods: A cross-sectional a survey through social media, with an adapted questionnaire about the perceived usefulness and simplicity of adopting VR during physiotherapy is distributed to physiotherapists in Malaysia. In total, 102 physiotherapists participated in this study. Frequency and percentage are used to analyze the data of questionnaire items.

Results: Overall 62% agree that using VR would enable to accomplish tasks more quickly, 63% finds it improve job performance, 57% believes that VR would increase my productivity. 59% enhance the effectiveness on the job. 64% easier to do my job, 61% VR useful in job. Regarding perceived ease of use 57% accepts learning to operate VR would be easy for me, 55% find it easy to get VR to do what physiotherapist want it to do, 53% agrees that interaction with VR would be clear and understandable, 54% agree that it is flexible to interact with, 54% agree to be become skillful using VR and lastly 55% agree it is easy to use.

Conclusions: The majority of Malaysian physiotherapists find VR slightly useful for inclusive innovation in physiotherapy, improving work efficiency and performance. However, some remain neutral regarding its overall usefulness. They also find VR neither easy nor difficult to use in terms of inclusivity.

Keywords: virtual reality, physiotherapy, technology, digital intervention, inclusive innovation

INTRODUCTION

Virtual reality (VR) is a cutting-edge technology that consists of a sophisticated user-computer interface that allows for real-time visualization and interaction by using both visual and auditory sensorial channels [1]. It can simulate presence of a physical in actual or imaginary environments. To execute activities inside this simulated world, users normally control avatars, recreations of their human bodies in digital form [2]. There are three key features that VR possesses, which are immersion, presence, and interactivity. Immersion is described as quantifiable overview of technology from an analytical perspective that is irrespective of user's interpretation. Presence is described as a psychological condition in which the virtual objects are perceived as real objects in either sensory or non-sensory forms. Interactivity is described as the degree to which users can change the type and content of a mediated environment in real time [3].

Users can have different degrees of immersion and it depends on the type of VR systems. Non-immersive systems are the most basic and inexpensive category of VR implementations, which use desktop computers or laptops to recreate images of world. Semi-immersive systems, which can provide users with a more realistic environment, use perspective projection that is integrated to the users' head position to provide stereo image of a three-dimensional (3D) view on monitor. Immersive systems, which utilize multiple sensory output instruments such as head mounted displays, able to provide users with a full simulated experience by enhancing stereoscopic view of the virtual world through

users' head movement, along with audio and haptic devices [4].

VR technologies are currently applied in different fields, including architecture design, automobile industry, flight simulation, military training and in medical field [5]. In medical field, VR has played a role in treating several clinical conditions, including anxiety disorders, phobias, eating disorders, post-traumatic stress disorder, autism, acute and chronic stage pain management. VR also has been used in rehabilitation and healthcare education [6]. For rehabilitation, VR technology is extensively used in patients with neurological disease (e.g., Parkinson's disease and stroke), as well as in orthopedics (e.g., burns), pediatrics (e.g., cerebral palsy) and other medical conditions [1]. Recently, there is one review that has evidence to prove the potential of VR in improving outcomes including pain, functional ability, and muscular strength after incorporated in exercise therapy [7].

VR was rated highly acceptable by parent caregivers for their hospitalized child with cancer. Patients expressed high levels of satisfaction with VR intervention when experiencing only minor side effects [8]. Other than that, there is also one study showed that eight out of 12 studies that looked at physiological outcomes found a beneficial impact on physical fitness, balance, muscle strength and limb function in patients that received VR as intervention [9].

During this pandemic most of the patients cannot receive physical therapy. This is due to the social distancing and the restrictions associated to it were implemented. To overcome this, one research has been done to determine feasibility and acceptability of VR-based physical therapy. The results have shown that patients have high acceptability and feasibility towards using VR as intervention [10].

VR-based therapy has been found to improve motor control, balance, strength, gait, and psychological and rehabilitative outcomes [9, 11-14]. Over the past decades, VR clinical application papers published were increased gradually and the usage of VR has been hailed as a huge success. However, careful consideration to tackle difficulties such as expenses, theoretical immaturity and lacking technical standards in study design and pilot trials is required to increase the clinical importance of findings [6].

However, VR methods have been used less frequently in medicine, particularly in education and care, due to clinicians' lack of expertise and understanding of this technology [15]. The research aimed to explore the perceived usefulness and ease of using VR among physiotherapists in Malaysia to enhance the innovative interventions.

MATERIALS AND METHODS

Study Design and Population

This research has used a quantitative, descriptive, cross-sectional study design to assess Malaysian physiotherapists' perceived usefulness and ease of using VR during physiotherapy. For each participant, an informed consent form was given to state their willingness to participate in the study. The research was conducted throughout the states in Malaysia.

The Malaysian physiotherapists were included from any public or private healthcare institution or working overseas with minimum working experience for least one year with any level of qualification. But participants will be excluded if physiotherapists not practicing the profession for more than five years.

Primary Outcome Instrument and Procedure

The primary outcome instrument is a questionnaire adapted from final measurement scales for perceived usefulness and perceived ease of use [16]. The adapted questionnaire with Cronbach's alpha was 0.98 for perceived usefulness and 0.94 for perceived ease of use, used to examine the perceived usefulness and perceived ease of use of VR during physiotherapy rehabilitation from physiotherapist's perspective.

It is composed of three sections: section A–demographic data, section B–perceived usefulness of using VR during physiotherapy, and section C–perceived ease of use of using VR during physiotherapy. Section A includes items such as subject's age, gender, education level, working location, physiotherapy setting and field, and number of years worked as a physiotherapist. The responses for section B and section C will be set in a seven-point Likert format ranging from low to high level of perceived usefulness and ease of use. Section B and section C will have individual scores each to facilitate interpretation.

Following validation and acceptance, the questionnaire converted in the google form as an online survey distribution platform and distributed to the intended participants. Participants were asked to complete a three-section questionnaire. The data were collected for two months. Only subjects that meet the inclusion and exclusion requirements will be considered eligible. The data will then be gathered, compiled, and evaluated before the final interpretation and conclusion are formed (**Figure 1**).

Data Collection and Statistical Analysis

Descriptive data such as age, gender, education level, working location, physiotherapy setting and field, and number

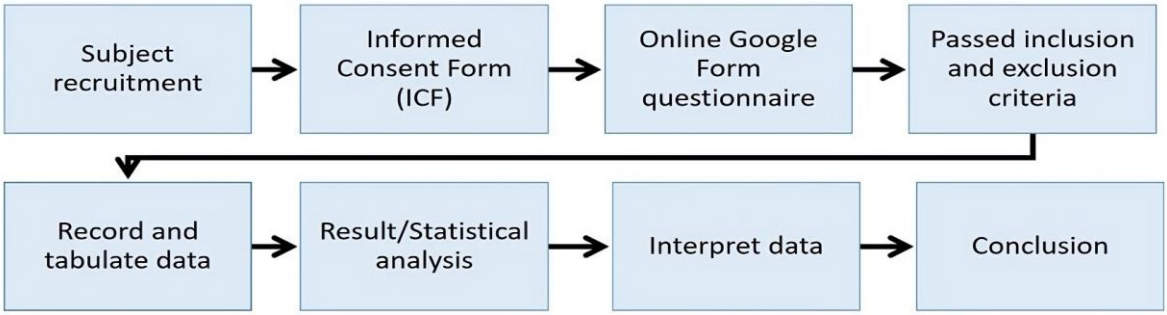

Figure 1. Flowchart of research process (Source: Authors' own elaboration)

Table 1. Participants' demographic data

Variables	n (%)
Age	
Less than 20 years old	0 (0.0)
20-25 years old	21 (20.6)
26-30 years old	53 (52.0)
31-35 years old	22 (21.6)
36-40 years old	3 (2.9)
More than 40 years old	3 (2.9)
Gender	
Male	46 (45.1)
Female	56 (54.9)
Education level	
Diploma	29 (28.4)
Degree	69 (67.6)
Master	4 (3.9)
PhD	0 (0.0)
Working experience	
1-5 years	60 (58.8)
6-10 years	32 (31.4)
11-15 years	8 (7.8)
16-20 years	1 (1.0)
More than 20 years	1 (1.0)
Working settings	
Public hospital	11 (10.8)
Health clinic	13 (12.7)
Private healthcare	52 (51.0)
Private practitioner as entrepreneur	16 (15.7)
NGO	3 (2.9)
Higher education settings	7 (6.9)
Working location	
Northern region	27 (26.5)
Central region	18 (17.6)
Southern region	33 (32.4)
East coast	10 (9.8)
East Malaysia	14 (13.7)
Working field	
Neurological physiotherapy	28 (27.5)
Musculoskeletal physiotherapy	39 (38.2)
Cardiorespiratory physiotherapy	7 (6.9)
Pediatric physiotherapy	8 (7.8)
Women health physiotherapy	1 (1.0)
Geriatric physiotherapy	8 (7.8)
Sports physiotherapy	10 (9.8)
Other specialty	1 (1.0)

of years worked as a physiotherapist will be analyzed and represented as a percentage with a frequency distribution. Data on perceived usefulness and ease of using VR during physiotherapy rehabilitation represented in frequency and percentage was collected. Statistical package for social sciences version 22 was used for statistical computation.

RESULTS

A total of 130 participants took part in this research during two-month. Throughout the research, one participant refuse to sign the informed consent form, and 26 participants do not meet the inclusion criteria. Out of 26 participants, 16 participants are not working physiotherapists, and another 10 participants, who are working physiotherapists, do not have at least one year of working experience in physiotherapy field. Other than that, one participant is excluded from this research due to working location is not in Malaysia.

Finally 102 participants data were included for this result analysis, more than half of them aged in between 26 to 30 years old, with number of 53 participants (52%), followed by 22 participants (21.6%) aged in between 31 to 35 years old, 21 participants (20.6%) aged in between 20 to 25 years old, three participants (2.9%) aged in between 36 to 40 years old, and three participants (2.9%) aged more than 40 years old. The participants are constituted by 46 male physiotherapists (45.1%) and 56 female physiotherapists (54.9%). Most of them work in private healthcare settings (n=52, 51%) and held a degree qualification I majority (n=69, 68%) and had worked for one to five years (58.8%) (**Table 1**).

In **Table 2**, measuring perceived usefulness of using VR during physiotherapy, there are total of six questions. Overall 62% agree that using VR would enable to accomplish tasks more quickly, 63% finds it improve job performance, 57% believes that VR would increase my productivity. 59% enhance the effectiveness on the job. 64% easier to do my job, 61% VR useful in job.

In **Table 3**, regarding perceived ease of use, 57% accepts Learning to operate VR would be easy for me, 55% find it easy to get VR to do what physiotherapist want it to do, 53% agrees that interaction with VR would be clear and understandable, 54% agree that it is flexible to interact with, 54% agree to be become skillful using VR and lastly 55% agree it is easy to use.

DISCUSSION

In this study, we aimed to determine the perceived usefulness and ease of using VR during physiotherapy among Malaysia physiotherapists. 30.4% of participating physiotherapists claimed that using VR would slightly likely enable them to complete tasks quickly. This may be because VR provides instructions for patients to follow, reducing the need for physiotherapists to explain. 25.5% of physiotherapists remained neutral, suggesting that using VR does not speed up or slow down the progress of intervention. However, more than half of participating physiotherapists (n=62, 60.8%) claimed that using VR would likely enable them to complete tasks quickly. VR has the potential to reduce the time spent in

Table 2. Perceived usefulness (n [%])

Questions	EU	QU	SU	NLNU	SL	QL	EL
Using VR in my job would enable me to accomplish tasks more quickly.	1 (1.0)	6 (5.9)	7 (6.9)	26 (25.5)	31 (30.4)	24 (23.5)	7 (6.9)
Using VR would improve my job performance.	1 (1.0)	8 (7.8)	2 (2.0)	28 (27.5)	32 (31.4)	25 (24.5)	6 (5.9)
Using VR in my job would increase my productivity.	1 (1.0)	6 (5.9)	9 (8.8)	29 (28.4)	29 (28.4)	20 (19.6)	8 (7.8)
Using VR would enhance my effectiveness on the job.	1 (1.0)	6 (5.9)	6 (5.9)	30 (29.4)	30 (29.4)	22 (21.6)	7 (6.9)
Using VR would make it easier to do my job.	1 (1.0)	3 (2.9)	4 (3.9)	30 (29.4)	32 (31.4)	25 (24.5)	7 (6.9)
I would find VR useful in my job.	1 (1.0)	2 (2.0)	6 (5.9)	32 (31.4)	30 (29.4)	21 (20.6)	10 (9.8)

Note. EU: Extremely unlikely; QU: Quite unlikely; SU: Slightly unlikely; NLNU: Neither likely nor unlikely; SL: Slightly likely; QL: Quite likely; & EL: Extremely likely

Table 3. Perceived ease of use (n [%])

Questions	EU	QU	SU	NLNU	SL	QL	EL
Learning to operate VR would be easy for me.	2 (2.0)	1 (1.0)	9 (8.8)	33 (32.4)	27 (26.5)	21 (20.6)	9 (8.8)
I would find it easy to get VR to do what I want it to do.	1 (1.0)	3 (2.9)	10 (9.8)	33 (32.4)	24 (23.5)	24 (23.5)	7 (6.9)
My interaction with VR would be clear and understandable.	0 (0.0)	5 (4.9)	8 (7.8)	36 (35.3)	23 (22.5)	22 (21.6)	8 (7.8)
I would find VR to be flexible to interact with.	2 (2.0)	3 (2.9)	13 (12.7)	30 (29.4)	25 (24.5)	23 (22.5)	6 (5.9)
It would be easy for me to become skillful at using VR.	2 (2.0)	4 (3.9)	8 (7.8)	34 (33.3)	26 (25.5)	20 (19.6)	8 (7.8)
I would find VR easy to use.	1 (1.0)	4 (3.9)	7 (6.9)	35 (34.3)	26 (25.5)	20 (19.6)	9 (8.8)

Note. EU: Extremely unlikely; QU: Quite unlikely; SU: Slightly unlikely; NLNU: Neither likely nor unlikely; SL: Slightly likely; QL: Quite likely; & EL: Extremely likely

treatment sessions, allowing for more interventions to be provided using the remaining time saved. However, a different study showed that all participants were able to complete tasks quickly and accurately when using VR [17], possibly due to different types and levels of immersion of VR system.

In a study showed that using VR, youth performed better during driving simulations compared to normal training [18]. For the component "job performance," 31.4% of participating physiotherapists claimed that using VR would slightly likely improve their job performance. This may be due to the variety of programs available in VR, allowing physiotherapists to choose the best program to combine with the current treatment plan and speed up the recovery rate. 27.5% of physiotherapists remained neutral, suggesting that using VR does not have any positive or negative effects on job performance. However, more than half of participating physiotherapists (n=63, 61.8%) claimed that using VR would improve their job performance. VR has the potential to improve physiotherapists' performance when treating patients, making them more trustworthy and reliable for patients.

The "increase productivity" component was assessed using the statement "using VR in my job would increase my productivity". Of the participating physiotherapists, 28.4% claimed that using VR would neither likely nor unlikely or slightly likely increase their productivity. Those who responded with neither likely nor unlikely believed that VR had no significant impact on their productivity, while those who responded with slightly likely might be able to treat other patients while the current patient was receiving VR treatment. Moreover, 19.6% of physiotherapists believed that using VR would quite likely increase their productivity, possibly due to the effectiveness of VR in treating their patients, enabling them to treat more patients and have more time to complete their tasks. In general, more than half of the participating physiotherapists (55.8%) believed that using VR would improve their productivity, which suggests that VR could potentially enhance productivity in physiotherapists, thereby increasing their individual value. Additionally, a study indicated that workers who experience immersive VR can improve their productivity during work [19].

Around 30% of physiotherapists surveyed felt that using VR would neither likely nor unlikely or only slightly likely enhance their effectiveness on the job, indicating that they do not see much improvement using VR during physiotherapy. However, 21.6% felt that using VR would quite likely enhance their effectiveness, possibly due to better-than-expected outcomes seen in patients after VR intervention. Overall, more than half of the physiotherapists surveyed believed that using VR would enhance their effectiveness on the job, suggesting that VR has the potential to produce expected or even better outcomes for patients. Another study also showed that VR can effectively improve students' results in teaching software programming [20].

According to the survey, over 60% of participating physiotherapists believed that using VR would make it easier to do their job, possibly due to the removal of unnecessary processes and a streamlined approach that saves time and energy. However, around 30% of physiotherapists surveyed felt that using VR would neither likely nor unlikely make their job easier, while 31.4% claimed that it would only slightly likely make it easier. The latter group may feel that VR has a minor impact on their workload, possibly because patients are able to understand and use VR interventions easily, thus reducing the workload of the physiotherapists. It should be noted that another study found that 60% of participants believed that VR made their job easier [21], which contrasts with the results of this study. The statement "I would find VR useful in my job" was used to determine the overall perceived usefulness of VR in physiotherapy. Approximately 30% of physiotherapists surveyed felt that they would neither likely nor unlikely find VR useful, suggesting that its use does not significantly impact their job. Another 29.4% felt that they would only slightly likely find VR useful, possibly due to its ability to help accomplish tasks quickly, improve job performance, increase productivity, enhance effectiveness on the job, and make the job easier, albeit not to a significant extent. However, overall, more than half of the physiotherapists surveyed felt that they would find VR useful in their job. These results are in contrast with another study, where 84% of participants found VR training useful, especially when changing medical modalities [22].

For perceived ease of using VR during physiotherapy, six components are measured, including easy to learn, controllable, clear and understandable, flexible, easy to become skillful, and easy to use. 32.4% of the participating physiotherapists claimed that learning to operate VR would neither likely nor unlikely be easy for them, while 26.5% of the participating physiotherapists claimed that learning to operate would slightly likely be easy for them. If compared generally, more than half of the participating physiotherapists (n=57, 55.9%) claimed that learning to operate VR would likely be easy for them. This means that physiotherapists can easily learn how to operate VR, hence speeding up the process of preparing VR intervention for patients. Another study showed that all 20 participants found that VR guides are slightly better in terms of learning [23].

The component "controllable" was measured using the statement "I would find it easy to get VR to do what I want it to do." 32.4% of participating physiotherapists claimed that they would neither likely nor unlikely find it easy to control VR, while more than half of them (53.9%) claimed that they would likely find it easy to get VR to do what they want it to do. This suggests that physiotherapists are able to express their plan of treatment through VR and modify VR program according to

patient's condition. Another study has shown that VR intervention is controllable, as therapists have full control over the avatar's appearance, emotion, and voice, as well as the environment [24]. The component "clear and understandable" was measured using the statement "My interaction with VR would be clear and understandable." 35.3% of participating physiotherapists claimed that their interaction with VR would neither likely nor unlikely be clear and understandable, while more than half of them (51.9%) claimed that their interaction with VR would be clear and understandable. This suggests that when the physiotherapist is more familiar with VR interface and controls, patients are able to understand the interaction between physiotherapists and VR more clearly. However, in another study, participants reported difficulty in understanding the performance metric of a VR simulator [25].

According to the study, the component of flexibility in VR is measured using the statement "I would find VR to be flexible to interact with," and 29.4% of participating physiotherapists claimed that they would neither likely nor unlikely find VR to be flexible to interact with. This suggests that sometimes VR is non-adjustable and unable to adapt to different conditions. However, more than half of the participating physiotherapists (n=54, 52.9%) claimed that they would likely find VR to be flexible to interact with, indicating that VR is adjustable and has the potential to adapt to different conditions. Similarly, the component of easy to become skillful in using VR is measured using the statement "It would be easy for me to become skillful at using VR," and more than half of the participating physiotherapists (n=54, 52.9%) claimed that it would likely be easy for them to become skillful at using VR. This suggests that VR is actually easy to be mastered with time and effort put into learning and research. Another study also showed that participants found it easy to master the controller-based VR locomotion during intervention [26], but there is a bias as the participants have experienced using controllers before. This can be addressed by excluding such participants in the study's criteria. The component "easy to use" is measured by the statement "I would find VR easy to use". More than half of the participating physiotherapists (53.9%) claimed that they would likely find VR easy to use in their job, although some physiotherapists sometimes face difficulty when using VR during physiotherapy. VR is easy to learn, controllable, flexible to interact with, able to produce clear and understandable interaction and easy to master, which was supported in a study that participants somewhat agreed that it is easy to use VR using the same questionnaire as this study [27]. In Malaysia, strategies should be developed for creating new digital tools, utilizing them, and overcoming the low acceptance of the various healthcare institutions due to the expense, conventional interventions, and time commitment [28, 29]. There are some limitations to this study. First, the type of VR and the devices used by the physiotherapists are not included into the questionnaire. Other than that, the number of physiotherapists take part in this study are from Malaysian. Global perspective studies can be done in future. The definition of VR and its example are not listed out in questionnaire, which can be considered in future studies.

Through this study, it is recommended that the research regarding VR can be done in real life with patients or physiotherapists experiencing VR. Only by experiencing, they will give the best feedback and by that, strengths and weaknesses of VR can be reflected full.

CONCLUSIONS

During physiotherapy session, majority of Malaysia physiotherapists find VR slightly useful in aspect of work more quickly, improve job performance, increase productivity, more effective in job and make job easier. However, some of them find it neither useful nor not useful in overall. They also find it neither easy nor not easy to use VR during physiotherapy in all aspects measured, including easy to learn, controllable, clear and understandable interaction, flexible to interact, easy to master and in overall ease of use. In conclusion, Malaysia physiotherapists remain neutral in overall usefulness and ease of using VR during physiotherapy. Further studies with larger samples are needed to explore its effectiveness, and greater awareness and adoption of VR as an inclusive innovation tool among Malaysian physiotherapists is necessary.

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Declaration of interest: No conflict of interest is declared by authors.

Data sharing statement: Data supporting the findings and conclusions are available upon request from the corresponding author.

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