Virtual Reality to Train Diagnostic Skills in Eating Disorders. Comparison of two Low Cost Systems

José GUTIÉRREZ-MALDONADO[1], Marta FERRER-GARCÍA, Joana PLA-SANJUANELO, Antonio ANDRÉS-PUEYO, Antoni TALARN-CAPARRÓS
University of Barcelona, Spain

Abstract. Enhancing the ability to perform differential diagnosis and psychopathological exploration is important for students who wish to work in the clinical field, as well as for professionals already working in this area. Virtual reality (VR) simulations can immerse students totally in educational experiences in a way that is not possible using other methods. Learning in a VR environment can also be more effective and motivating than usual classroom practices. Traditionally, immersion has been considered central to the quality of a VR system; immersive VR is considered a special and unique experience that cannot achieved by three-dimensional (3D) interactions on desktop PCs. However, some authors have suggested that if the content design is emotionally engaging, immersive systems are not always necessary.
The main purpose of this study is to compare the efficacy and usability of two low-cost VR systems, offering different levels of immersion, in order to develop the ability to perform diagnostic interviews in eating disorders by means of simulations of psychopathological explorations.

Keywords. Virtual reality, virtual patients, education, eating disorders, diagnostic skills.

Introduction

The diagnostic interview in psychology involves a series of skills that require sound training. Enhancing the ability to perform differential diagnosis and psychopathological exploration is important for students who wish to work in the clinical field, as well as for professionals already working in this area. This training should be provided under guidance from a professor in controlled settings that mimic real-life situations as closely as possible. In the initial stages, interaction with real patients should be avoided.

A variety of learning mechanisms are available, but many of them are not used adequately in traditional educational methods and fail to address a particular student's "preferred" learning style. We all learn more and retain more when information is

[1] Corresponding Author: José Gutiérrez Maldonado. University of Barcelona. Paseo Valle de Hebrón, 171, 08035 Barcelona jgutierrezm@ub.edu

presented to us multiple times, preferably through multiple channels. Virtual reality not only adds to the variety of educational delivery mechanisms, but specifically addresses the areas in which traditional methods are least successful; VR can draw students inside the simulations, immersing them totally in educational experiences that cannot be carried out using other methods [1].

Virtual Reality (VR) environments are engaging, and facilitate comprehension by situating learning materials in a context. Learning in a VR environment can also be more effective and motivating than traditional classroom practices [2, 3, 4]. The evidence of its use in training (aircraft simulators, military training, etc.) is compelling. VR provides trainees with simulations of real life situations where they can learn by doing in a safe educational context, and allows trainers to gradually increase the difficulty of the problems be solved in training tasks, thus facilitating the process of learning by guiding students towards their optimal performance.

Traditionally, immersion has been considered central to the quality of a VR system. Immersive VR is considered a special and unique experience which is not achieved by three-dimensional (3D) interactions on desktop PCs. In other words, high levels of immersion increase the realism of the experience, which in turn enhances its effectiveness. However, authors are also interested in looking for situations in which highly immersive systems are unnecessary. Although specific immersive technology displays can improve outcomes, other factors may be equally or more beneficial. Indeed, some authors have suggested that if the content design is emotionally engaging, immersive systems are not always necessary [5]. Therefore, although immersive systems undoubtedly play an important role in reproducing life-like situations, other aspects are equally important.

Typical VR systems comprise different graphical user interfaces for human–computer interaction that vary according to the level of immersion required. The most basic level involves exposure to virtual environments on computer screens, with peripheral input devices (e.g., a keyboard or a computer mouse) used to interact with them. At the other extreme are technologically advanced systems such as Head Mounted Displays (HMD) that simulate binocularly overlapped images and create the illusion of a three-dimensional world. Although HMDs can increase the user's immersive experience, they have several drawbacks. For example, they may be impractical in the educational setting; educational centers are often reluctant to include VR interventions in their daily practice if this involves the use of expensive or technically complex instruments. Another concern is the possible side effects of HMDs, such as simulator sickness or visual fatigue. In addition to these practical issues, the price of immersive HMDs with a good tracker system is generally prohibitive. However, low-cost immersive HMDs have appeared on the market in recent years, among them the Oculus Rift and Samsung VR Gear. These devices allow greater immersion at relatively economical prices. However, despite the development of low-cost HMDs, a certain level of technical knowledge is still needed to use them properly and may present a barrier to their wider educational use.

The main purpose of this study is to compare the efficacy and usability of two low-cost VR systems offering different levels of immersion for training students in diagnostic interview skills by means of simulations of psychopathological explorations in patients with eating disorders. Previous research has shown these simulations are more effective in training differential diagnosis skills than traditional methods based on role-playing [6].

Methods

In the virtual environment created, learners conduct a clinical interview with different Virtual Patients (VPs). Each VP presents a specific eating disorder. In this simulation, skills of differential diagnosis are taught via a series of diagnostic interviews conducted with the VPs. The objective of the interviews is to obtain enough data to formulate a diagnosis. To do so, users select the most suitable question at each stage of the interview; the system informs them how accurate their choice is, and the VP responds to their questions. At each stage users decide whether to continue asking questions or whether they have enough information to formulate a diagnostic hypothesis. If they select the correct diagnosis at any given time during the interview, the system will only accept it if the VP has been fully examined (fig. 1)

Figure 1. Virtual interview: The VP appears on the left screen while the question choices and the diagnosis hypothesis are displayed on the right screen.

Fifty-two undergraduate students participated in the study. Participants were randomly assigned to one of the following conditions: differential diagnosis skills training using the simulated interviews with an immersive system (Oculus Rift DK1), or training using the simulated interviews with a non-immersive system (stereoscopic computer screen: Acer Aspire 5738DG laptop with a 15.6-inch screen).

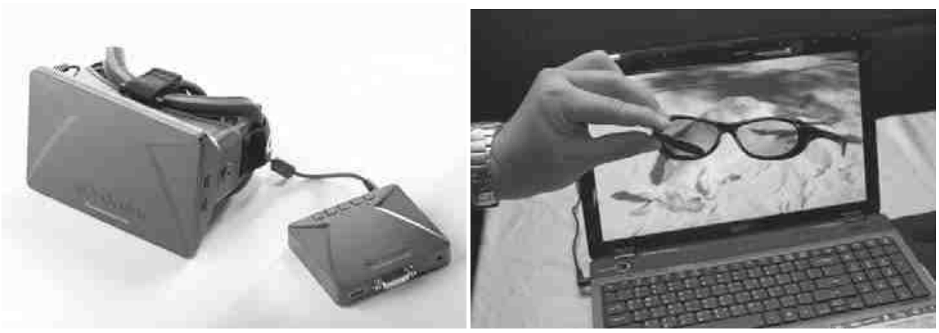

Figure 2. Oculus Rift DK1 (left), and Acer Aspire 5738DG laptop (right)

Students in both groups were requested to attend one 50-minute session in the laboratory. Each student received from the professor in charge a basic explanation of the main characteristics of eating disorders. Later, students had to interact with the VPs who presented the disorders.

The effects of the two different training systems on the students' learning were compared. Students in both groups carried out a diagnostic interview skills test (50 written questions; the final score was calculated taking into account the correct answers converted onto a 10 point-scale). Usability was assessed with the Software Usability Measurement Inventory (SUMI) [7]. Only the items on the inventory that were applicable to our software were considered for data analysis: *2. I would recommend this software to my colleagues; 3. The instructions and prompts are helpful; 5. Learning to operate this software initially is full of problems; 7. I enjoy my sessions with this software; 12. Working with this software is satisfying; 13. The way that system information is presented is clear and understandable; 17. Working with this software is mentally stimulating; 19. I feel in command of this software when I am using it; 26. Tasks can be performed in a straightforward manner using this software; 27. Using this software is frustrating; 29. The speed of this software is fast enough; 32. There have been times in using this software when I have felt quite tense; 42. The software has very attractive presentation; 44. It is relatively easy to move from one part of a task to another; 48. It is easy to see at a glance what the options are at each stage.*

Results

Effectiveness

After confirming the homogeneity of the two groups in age and gender, a t-test for independent samples was conducted to evaluate the differences between the scores obtained by students in the HMD and computer screen groups in the diagnostic interview skills test. The scores obtained by the two groups were very similar. Mean scores were 8.5 points (SD=1.27) in the immersive system (HMD displays) group and 8.07 (SD=1.26) in the non-immersive system (stereoscopic computer screens) group. The difference between the mean scores was shown to be non-significant by the t test ($t=1.20$; $p=0.23$)

Usability

In each of the items on the SUMI, participants had to select one of three options: agree, undecided, or disagree. Table 1 shows the distribution of choice observed for each of these options in each question.

To obtain an overall usability score, on items 2, 3, 7, 12, 13, 17, 19, 26, 29, 42, 44, and 48 positive answers (agree) scored 1 point, "undecided" answers scored 0 points, and negative answers (disagree) were assigned a score of -1. In items 5, 27 and 32, on the other hand, negative answers (disagree) were assigned a score of 1, positive answers (agree) a score of - 1, and "undecided" answers scored 0 points.

Table 1. SUMI frequencies

	Frequency (%)					
	Agree		Undecided		Disagree	
	HMD	CS	HMD	CS	HMD	CS
2. I would recommend this software to my colleagues	92.3	84.6	7.7	15.4	0	0
3. The instructions and prompts are helpful	100	92.3	0	7.7	0	0
5. Learning to operate this software initially is full of problems	0	0	7.7	3.8	92.3	96.2
7. I enjoy my sessions with this software	80.8	73.1	19.2	23.1	0	3.8
12. Working with this software is satisfying	76.9	80.8	19.2	19.2	3.8	0
13. The way that system information is presented is clear and understandable	96.2	92.3	3.8	7.7	0	0
17. Working with this software is mentally stimulating	76.9	69.2	23.1	19.2	0	11.5
19. I feel in command of this software when I am using it	80.8	76.9	15.4	15.4	3.8	7.7
26. Tasks can be performed in a straightforward manner using this software	84.6	84.6	11.5	7.7	3.8	7.7
27. Using this software is frustrating	3.8	0	15.4	7.7	80.8	92.3
29. The speed of this software is fast enough	61.5	73.1	34.6	19.2	3.8	7.7
32. There have been times in using this software when I have felt quite tense	19.2	15.4	0	3.8	80.8	80.8
42. The software has very attractive presentation	84.6	57.7	11.5	30.8	3.8	11.5
44. It is relatively easy to move from one part of a task to another	69.2	76.9	19.2	15.4	11.5	7.7
48. It is easy to see at a glance what the options are at each stage	61,.5	53.8	23.1	38.5	15.4	7.7

HMD: Head Mounted Display; CS: stereoscopic computer screen

The scores on this global measure of usability were similar in the two groups (mean= 8.8, SD= 3.74 in the HMD group; and mean= 8.69, SD= 2.13 in the computer screen group; t test: t=0.13, p=0.89).

Discussion

No differences were found in either effectiveness or usability in this study of the immersive and non-immersive systems of skills training in psychopathological exploration of eating disorders through virtual simulations. Given the greater complexity and higher cost of immersive systems, non-immersive systems appear to be a promising VR alternative for developing these skills in trainee professionals.

Nevertheless, although the difference was not statistically significant the immersive system was slightly more effective. These results indicate the need for further studies in this field using larger sample sizes.

Although the HMD used in this study can be considered immersive, its features are still those of a prototype (Oculus Rift DK1). Although it has a wide viewing angle, its resolution is reduced. Recently, versions have appeared with enhanced features at no extra cost. The present study needs to be replicated with larger sample sizes and using newer versions of this type of HMD, such as the Oculus Rift DK2 or Samsung Gear VR devices, in order to confirm the existence of differences in effectiveness and usability compared to non-immersive devices.

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References

[1] Bell, J.T., Fogler, H.S. The Investigation and Application of Virtual Reality as an Educational Tool, Proceedings of the American Society for Engineering Education (1995)

[2] Fominykh, M., Prasolova-Førland, E., Morozov, M., Smorkalov, A., Molka-Danielsen, J. Increasing Immersiveness into a 3D Virtual World: Motion-tracking and Natural Navigation in vAcademia, IERI Procedia, Volume 7, 2014, Pages 35-41, http://dx.doi.org/10.1016/j.ieri.2014.08.007

[3] Monahan T., McArdle G., Bertolotto M.: Virtual reality for collaborative e-learning. Computers and Education 50 (4) (2008), 1339–1353

[4] Trindade J., Fiolhais C., Almeida L. Science learning in virtual environments: a descriptive study. British Journal of Educational Technology, 33(4) (2002).

[5] Baños, R. M., Botella, C., Garcia-Palacios, A., Villa, H., Perpiñá, C., & Alcaniz, M. Presence and reality judgment in virtual environments: a unitary construct? CyberPsychology & Behaviour, 3(3) (2000), 327-335.

[6] Gutiérrez-Maldonado, J. & Ferrer-García, M. Are virtual patients effective to train diagnostic skills?: a study with bulimia nervosa virtual patients., in Nadia Magnenat-Thalmann; Enhua Wu; Susumu Tachi; Daniel Thalmann; Luciana Porcher Nedel & Weiwei Xu, ed., 'VRST' , ACM, (2013), 267.
[7] Kirakowski, J & Corbett, M. SUMI: The software measurement inventory, British Journal of Educational Technology 24 (1993), 210-212.