Virtual Intelligent Agents to Train Abilities of Diagnosis in Psychology and Psychiatry

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Abstract. The diagnostic interview in Mental Health Sciences involves a series of abilities that require sound training. This training should be provided under guidance from a professor in controlled settings that mimic real-life situations as closely as possible, but in the initial stages the interaction with real patients should be avoided. Precisely, the objective of this study was to develop a system constructed with artificial intelligence and 3D design applications that creates an environment in which the trainee can interact with a group of simulated patients. These virtual patients are realistic objects that can interact in real-time with the user using a series of parameters that define their verbal, emotional and motor responses. From them the trainee must obtain the data needed to make an accurate diagnosis. The high level of flexibility and interactivity increases the trainees' sensation of participating in the simulated situation, leading an improving of the learning of the skills required.

Keywords: Virtual Reality, Artificial Intelligence, Training, Diagnostic Interview, Psychology, Psychiatry.

1 Introduction

From the development of the electronic methods of communication, healthcare professionals used the information and communication technologies (TIC's) in the field of the sanitary attention, thus for example the telegraph, the telephone, the radio, the television, etc. have been used by the medicine from the half XIXth Century. However, in the last years a great advance in the development of the new technologies had been produced. These advances are changing the ways in which people relate, communicate, and live. Thus, technologies that were hardly used 10 years ago, such as the internet, e-mail or video teleconferencing, are becoming familiar methods for diagnosis, therapy, education and training. All this is leading to the appearance of a new field, the e-health, whose main objective is the use of the TIC's in order to improve all the processes related to the sanitary attention.

Recent advances in educational technology are offering an increasing number of innovative learning tools that are having a significant impact on the structure of healthcare professionals' education in many ways. Among these Virtual Reality (VR) and Artificial Intelligence (AI) are getting higher importance in the educational ambit and professional training, nowadays.

Virtual Reality integrates real-time computer graphics, body tracking devices, visual displays and other sensory inputs to immerse individuals in computer-generated virtual environments (1). From this definition it can be derived the two basic properties of a virtual reality system, these are: immersion and interaction. The term immersion refers to the stimulation of the different sensorial channels of the user. This is usually achieved by means of visual, auditory or haptic devices. But virtual reality is also interactive, virtual reality not imply a passive visualization of a virtual world, the user can interact with it and, what is more important, the virtual world responds in real time to those actions. VR by means of their two basic properties creates an illusion in the user of being physically inside the virtual world. Precisely, this sense of presence can have positive effects on task performance (figure 1).

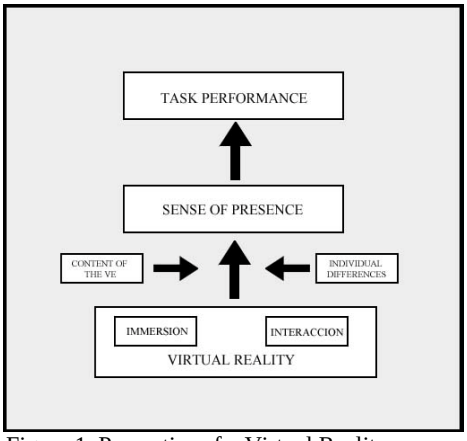

Figure 1. Properties of a Virtual Reality system

In the other hand, Artificial Intelligence permits the design of intelligent agents that can engage in a natural dialogue with the human (2), understanding the motives and emotional states of the user. One of the most striking features of this human-computer interaction is to use anthropomorphic characters, to readily attribute human qualities to the machine (such as personality traits, moods, etc.) (3). Precisely, in the field of mental health care, for a good human-computer interaction, is essential that an intelligent machine can display emotions. When using AI healthcare students can engage in a natural interaction with a virtual patient (that should display a wide range of moods), understanding more deeply their beliefs, motives and emotions, and providing a realistic setting in which she can learn specific skills such as those involved in the diagnostic interview. This should facilitate that this learning can be generalized more easily to the real world situations. In summary, VR and AI provide

the possibility to experience the learning situation as a real context, which in turn promotes the experiental learning. As suggested by several authors (4, 5, 6) these new technologies represents a promising area with high potential of enhancing and modifying the learning experience. It's important to take into account the advantages that mean these tools characteristics (7):

- Immateriality; because its raw material is the information.
- Interactivity; that allows subjects not to be passive receivers of information, but active and conscious processors of it.
- They have high parameters of image and sound quality
- Instantaneous, because it facilitates the rapidity to the access and interchange of information, breaking space-temporary barriers.
- They have a higher influence on process than on products.
- And the possibility of interconnection.

A growing body of research in education demonstrates that the use of e-health tools can enhance learning in numerous domains (8). These emerging technologies can provide a rich, interactive, engaging educational context, supporting experiential learning. VR and AI allows the student to learn by doing, through first-person experience (9, 10). This active process enhances the learning, thus it seems that students can assimilate the concepts more accurately when they have the freedom to navigate and involve in self-directed activities within their learning context. These tools also provide high similarity with real life situations but does not expose the student to situations for which s/he is still not prepared. Furthermore, in the case of the mental health care, it must be noted that practice with real patients during the studies is very difficult, so a good alternative is to train students with simulated patients, which approaches more to reality than traditional methods (such as textual books). Knowledge obtained by training abilities by means of e-health tools has to be generalized to real situations in order to be successful. As pointed by Thorndike (11), it's reasonable to think that the more similar to reality is the simulation, the more is the probability of transferring the knowledge acquired to the real situation.

Another important characteristic to stand out is the possibility of self-learning and over-learning provided by these tools, since the student can repeat the situation as many times as she wants. It's also an activity almost totally guided by the student, which promotes the development of operational and formal thinking, because it facilitates the exploration of different possibilities. This kind of educational method also adapts to the student's pace, timetable and needs. These tools also make it possible to graduate the difficulty of the problems to be solved, facilitating learning by bringing subjects progressively closer to the solution.

From a constructivist perspective is assumed that students are not only active processors of information, but also significant constructors of it. This mean allows the student to advance in the acquisition of knowledge at his own rhythm according to his previous knowledge and attitudes. VR and AI provide a tool for developing instruction along constructivist lines and an environment in which learners can

actively pursue their knowledge needs. As pointed by McGuire (12) this active learning process allows the user to understand the world though an “ongoing process of making sense out of new information by creating their own version of reality instead of simply receiving the author’s view”.

Besides these advantages, it must be pointed that any new method of education implies automatically an increase of student’s attention towards it. This higher motivation has positive effects in concentration, interest, and effort employed by the student (13).

1.1 Simulations and Healthcare

One of the applications of these new tools is the possibility to create simulations (14). As we commented before, these simulations facilitate the realization of practices in environments of easy control for professors and students. They provide the opportunity of making first-person, non-symbolic experiences, since immersive environments allow to construct knowledge from direct experience by giving the participants the illusion of “being there” in a mediated environment. VR and AI technology provides learners with the possibility to reflect and get a deeper understanding of the process through which a person can reach a knowledge of the world. Furthermore, these flexible and open tools can be used by professors in different contexts and designed learning situations.

Today, in healthcare, virtual simulations are frequently used for professional training of many kinds (15). Current applications are mainly related with medical and surgical training such as simulators for temporal bone dissection (16), virtual endoscopy simulator (17), simulator for training esophageal intubation (18), orthopaedic surgery (19), mastoidectomy simulation (20), a VR training and assessment of laparoscopic skills (21) and so on. The objective of these applications is seek to train a single set of skills within a simulation that is highly realistic and anatomically correct.

Despite this, surprisingly, to date only exists one application for training mental health professionals. This application, called “The Bus Ride” was presented by the Janssen Pharmaceutica Products LP in the 155th Annual Meeting of the American Psychiatric Association. The realistic virtual experience is directed to educate healthcare professionals about the symptoms experienced by a psychotic patient. The realistic virtual-reality experience puts the learner on a city bus and surrounds them with the same visual and auditory hallucinations that experience a patient with schizophrenia.

Thus, due to the lack of applications directed to train mental health professionals, the objective of this study was to develop an application with the aim to train healthcare professionals in the skills implicated in the clinical diagnostic interview.

2 Materials and Methods

2.1 Instruments

2.1.1. Software

To develop the virtual environments, tools of two kinds were used:

- Modelling and animation tools: the scenario, virtual elements and animated 3D objects were constructed with 3D Studio Max 6. The People Putty program was used to design and animate the virtual characters. Adobe Photoshop 6.0 was used to create the textures and images.

- Interactive development applications: Virtools Dev 2.5 Educational Version was used to combine the objects and characters created with the different graphic design tools, and to integrate them with textures and sound. It was also used to make the environments interactive and to facilitate browsing.

- Artificial Intelligence: To create the interactive agent, the Vhuman Program and Artificial Intelligence Markup Language (AIM) were used.

2.1.2 Hardware

These computer interviews can be presented on a computer screen or on a more immersive system comprising Head Mounted Displays (HMD) plus tracking devices or in a projection screen (figure 2). It must be pointed that several studies have reported improved learning with more immersive systems like the HMD or project screens.

Figure 2. View of the HMD and the projection screen.

2.2 Procedure

2.2.1 Linguistic Corpus

The first stage of the development involved the compilation of a linguistic corpus from which the contents of the simulated interviews was later extracted (that is, the virtual patients' questions and answers). The DSM IV-TR diagnostic trees (23) were used as basic sources of information.

A linguistic corpus was produced that corresponded to the main diagnostic groups on axes I and II of the APA classificatory system. In the following stage the corpus was applied to generate the agents that would simulate the answers of patients corresponding to different, specific diagnostic categories from each of the main diagnostic groups: anxiety disorders, psychotic disorders, mood disorders and personality disorders (table 1).

Table 1. Main diagnostic groups and specific disorders represented in the simulated interviews.

Diagnostic Group	**Specific Disorders**
Psychotic disorders	Schizophrenia Schizoaffective disorder Schizophreniform disorder Delusional disorder
Mood disorders	Bipolar I disorder Bipolar II disorder Cyclothymic disorder
Anxiety disorders	Generalized anxiety disorder Obsessive compulsive disorder
Eating disorders	Bulimia Nervosa disorder
Somatoform disorders	Hypochondriasis
Personality disorders	Borderline personality disorder 1 Borderline personality disorder 2

2.2.2 Simulated Interviews

A virtual office was created in which the learner can realize a clinical interview to different virtual patients via a videoconference (figure 3). From the corpus linguistic 13 virtual reality patients were represented. Furthermore a chat boot was created, this robot can respond in real-time to a wide range of student questions (figure 4). As it was commented before each of these patients had a specific mental disorder that corresponds to some of the most prevalent diagnostic groups such. Skills of psychopathological examination are taught via a series of diagnostic interviews realized to these virtual patients.

Figure 3: View of the virtual office

Figure 4: View of the chat boot

3 Results

On entering "Simulated Interviews 3.1" the user enters within a virtual reality office in which she can freely move around it. When the student wants to start the clinical interview, she can sit in front of two screens. Here she can conduct a videoconference. In the screen of the left appears the virtual patient, whereas in the screen situated on the right will appear the questions, the diagnostic hypothesis and, in general, all the feedback that provides the system. It's important to note that the clinical interview is the starting point of the psychopathological exploration, and one of its principal goals is to generate diagnostic hypothesis. From these hypothesis the psychologist starts an investigation process to corroborate or refute them by applying tests and designing specific strategies to obtain information in each case.

Precisely, the objective of the simulated interviews is to obtain enough data to formulate a diagnosis. To do so, the student selects the most suitable question at each stage of the interview; then the system informs him/her how accurate his choice is, and the virtual patient responds to his/her questions. Each list of alternatives of questions contains a button called "HYPOTHESIS"; when the student presses it a list of possible diagnoses appears, from which s/he selects the one s/he considers best for the case in question. The student decides at each stage whether to continue asking

questions or whether s/he has enough information to formulate a diagnostic hypothesis. If s/he selects the correct diagnosis at any given time during the interview, the system will only accept it if the patient has been adequately examined. Once the student gives the correct diagnosis, at a suitable moment of the interview, s/he will be able to formulate a prognosis.

Also a bot named Alex was created. These virtual agent was an extensive modification of the ALICE bot (http://www.alicebot.org) developed by Richard Wallace. This bot consists of a set of AIML content files. The original ALICE bot was a female robot. Hence we edited the AIML files in order to change the bot's personal characteristics to that of a patient with a Generalized Anxiety Disorder. This was accomplished by deleting all references to being a robot. Instead, Alex was programmed to simulate a real patient. In this case healthcare students can freely interact with this bot in order to investigate his mental disorder.

4 Future Projects

In future we will compare the efficacy of virtual reality as an educational tool in psychology students. In this study we will evaluate the students acceptation of this resource by measuring its usability and utility. Moreover we will compare subjects' performance in a test designed to measure the acquired knowledge and abilities related with differential psychopathological in two groups: Virtual reality, and a more traditional approach based in role-playing techniques.

In the future version "Simulated Interviews 4.0" we will also integrate both virtual reality and artificial intelligence in a single application.

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