A Low-Fidelity Serious Game Authoring Tool and Educational Network to Facilitate Medical-Based Cultural Competence Education

by

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A Thesis Submitted in Partial Fulfilment
of the Requirements for the Degree of

Master of Science

in

The Faculty of Business
and Information Technology

University of Ontario Institute of Technology
December 2015

Dedicated to Sarah, Saif, and Rayaa.

Acknowledgments

The journey that has been my Masters, has been a refreshing experience and wouldn't have been possible without the ample support of my supervisor Dr. Bill Kapralos. As a teacher, you not only impart knowledge, but also kindle enthusiasm.

I would also like to thank my committee members, Dr. Khalil El-Khatib, Dr. Patrick Hung, and Dr. Pejman Mirza-Babaei for their valuable feedback and immense guidance. Jessica Clarke (Graduate Program Coordinator at UOIT), for being patient with my continuous queries, David Rojas and Kinga Eliasz (at the Wilson Center), for guiding me whenever I was stuck.

My projects wouldn't have looked good without the amazing artwork done by Kristopher Maddeaux and Thomas Gaudi. Hon-Leung Fung (IT Specialist at UOIT), for your round the clock availability, and for the long discussion on server related issues which had nothing to do with my work but boosted my learning curve. A special thanks to Dr. Ruth Simpson and Dr. Manon Lemonde (Faculty of Health Sciences) for helping me recruit participants for the experiments.

I would also like to thank my family in Canada who have taken care of all my needs in the last two years, especially Khala for letting me lock myself in the room and focus on my work. My family in Pakistan who have spent these years without me. My parents who have been a huge motivation in my life. My fiance Dr. Rukham Ajaz for her continuous support and encouragement.

Abstract

Here I present Fydlyty, a web-based, low-fidelity serious game for medical-based cultural competence education and training. Fydlyty includes a scenario editor and dialogue editor which has the ability to build conversations, interpret responses, and respond to questions/answers from the game player. These responses are based on predefined cultural characteristics of the virtual character (avatar), and on different moods that the avatar may express depending on the situation. In addition to its educational purposes, Fydlyty has been developed as a research tool to examine the role of graphical-based fidelity in the learning process. Furthermore, to facilitate debriefing through a community of learners, the OPEN educational network is introduced. OPEN is designed to provide the instructor with flexibility to frame a learning process, thereby teach, evaluate, and attain feedback from the students. The experiments conducted provide evidence that both these tools can be used for cultural competence training in health professions education.

Keywords: Serious games, cultural competence, fidelity, scenario editor, dialogue authoring tool, virtual simulation, internet-based learning.

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Chapter 1

Introduction

The past two decades have witnessed a growing interest in the use of simulation in many different industries. Each one of these disciplines defines simulation according to their specific view of it. Gaba argues that simulation is a technique and not a technology, having a sole purpose of replicating real-life scenarios in a controlled environment [38]. These imitations are a way through which participants learn, enhance, and sharpen their new or existing skills. Simulation is nothing new and has been used for thousands of years by the military [80], and healthcare practitioners [22], amongst others. One might criticize the simplicity of the earlier existing simulators or even argue about the fidelity (the degree of realism and technical complexity of models [28]),of the design, but by no means can the facts be neglected that these simulators provided a habitat for the participants in which they acquired new skills or refined existing ones.

Simulations are closely associated with play, which is a behavior emitted by an individual who is not motivated by the final result of the behavior [34]. In other words, play refers to the engagement in an activity only for the purpose of recreation and enjoyment. When play is formalized with concrete rules, objectives that push the player to compete, and present a problem that must be solved by taking some action, it is called a game. Games have proved to be a vital educational function for nurturing our learning capabilities and providing us with a solid platform to prepare for real-world scenarios. For example, chess has been used for centuries by many different civilizations for strategic skill training [101]. Moreover, games can also be classified by the components required to play them. One of the branches of games which electronically manipulate images produced by a computer program on a display is known as video games.

Today, the video game industry is one of the fastest growing sectors in the U.S economy [47] and it is expected that the total global video game revenue will keep growing at a rate of 5.7% annually, to reach $93.18 billion by 2019 [82]. Gaming industry revenue has already surpassed the film and music industry revenue. Games such as Grand Theft Auto V (GTA V) not only revamped gaming records but also set new standards for the entertainment industry by grossing more than $800 million in worldwide sales in its first day and $1 billion in three days of its release [52]. In the past, the sole purpose of video games may have been to provide personal and social entertainment, but this trend has gradually changed. With tremendous amount of scientific research conducted in this area, the potential value of video games for learning seems to be very prominent [12]. A subset of videos games called serious games have been re-appropriated for educational and training purposes [110].

1.1 Serious Games

Video games can be defined as "story, art, and software", programmed together to provide leisure and entertainment [125]. A branch of video games that also involves pedagogy, is known as serious games (see Figure 1.2). The relationship between serious games, games, and simulations is demonstrated by Becker et al. in Figure 1.1 [13]. Serious games thereby can be classified as a subset of games, and all games can be classified as (virtual) simulations.

Serious games can be defined as video games that entertain, inform and equip the game player with a particular skill-set [8]. More formally, a serious game is an interactive computer application which may or may not have a significant hardware component and comprises of: (i) a challenging goal, (ii) an interface that entertains and/or engages the player, (iii) incorporates concepts of scoring, and (iv) facilitates learning of a new skill or knowledge that can be applied in the real world [60]. In the broadest sense, the fundamental purpose of these games is to educate or train the end user [37]. The military has been the most consistent supporters and developers of serious games [30]. For decades, they have been investing in games that represent and construct their content and views [97]. The first likely serious game was Battlezone which was designed to train military gunners. Although Battlezone was not a successful game, this was a facade to an era where gaming and virtual reality became the focus of instructional design. The rationale behind this approach most certainly seems to be the viable, economic, safe, and also ethical alternative provided by serious games in comparison to traditional training methodologies
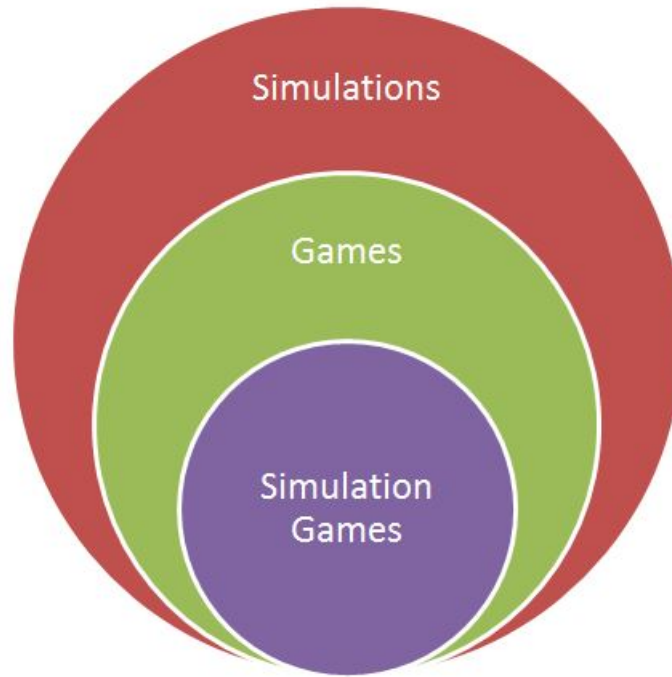
Figure 1.1: "Classification of Simulation Games" by Becker et al. shows that all simulation games are games, whereas all games are simulations [13]. Here simulation games refer to serious games.

[109]. More recently, serious games have been applied to (i) language learning [59], (ii) health professions education [115], (iii) scientific education [70], and (iv) business training [66], amongst other domains. Within each of these domains, serious games may be applied to facilitate education and training on a wide variety of topics.

Serious games "leverage the power of computer games to captivate and engage players/learners for a specific purpose such as to develop new knowledge or skills" [25]. When dealing with subject matter, high engagement corresponds to better results [94]. Other than providing a highly engaging environment to promote learning new skills, serious games also allow replicating scenarios which might be difficult (even impossible) to experience in real life. Klopfer et al. [64] while describing the "role of play" in a child's life, presents the learner with five levels of freedom: (i) freedom to fail, (ii) freedom to experiment, (iii) freedom to fashion identities, (iv) freedom of effort, and (v) freedom of interpretation. Serious games provide these levels of freedom to game players as well [57]. Furthermore, in the field of medicine, serious games can be used from solving routine tasks to diagnosing health-based issues and facilitating physical rehabilitation. Moreover, serious games can also facilitate communication [46], and conflict resolution and avoidance [83] in a clinical environment.
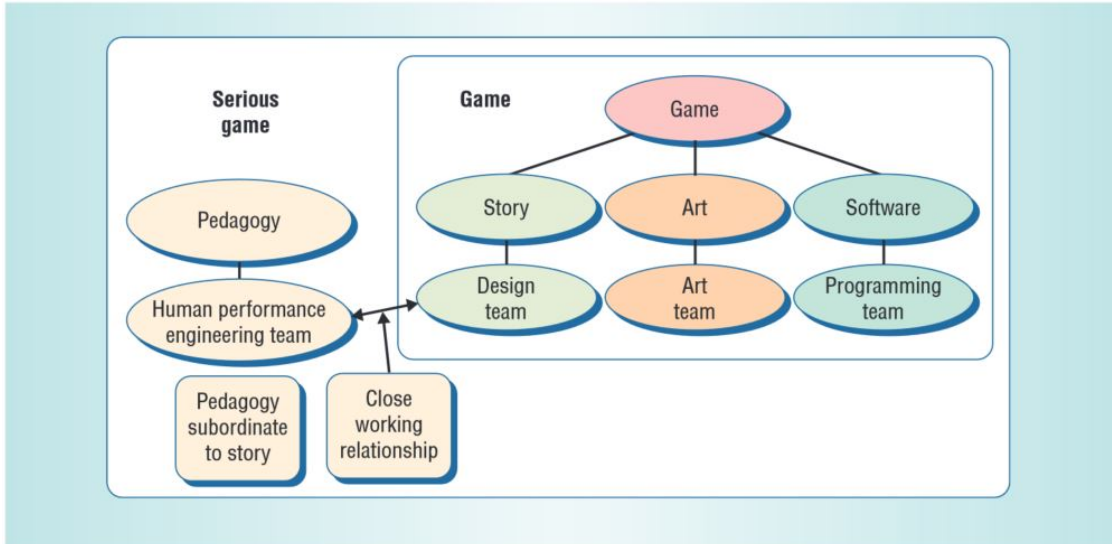
Figure 1.2: Serious games are video games which combine story, art, and software, to educate, train, and inform the game players. Taken from [125].

1.1.1 Cultural Competence

Cultural competence in health-care has been broadly defined as the ability of health-care providers and organizations to understand and integrate individual values, beliefs, and behaviors that are shaped by various factors including race, ethnicity, nationality, language, gender, socioeconomic status, physical and mental ability, into the delivery and structure of the health care system [26] [92]. Various factors such as (i) race, (ii) ethnicity, (iii) nationality, (iv) language, (v) gender, and (vi) socioeconomic status, amongst others may influence the values, beliefs, and behaviors of the patients [92]. In a multicultural society such as Canada and the United States, where the annual immigration rate is very high, cultural competence is an important skill for health-care practitioners. Moreover, these skills can lead to better communication between the health-care professional and patient, which is very important to avoid patient dissatisfaction, misdiagnosis, and poor outcomes [65]. However, research indicates that medical education is not keeping pace with the changing composition of the patient population in culturally diverse societies such as Canada [7] even though the quality of care is compromised when health-care providers do not respond appropriately to patient cultural factors [42][61].

In the past, techniques such as curriculum-based [114], and patient-centered [48] cultural competence training have been used to train medical students, resulting in effective cross-cultural communication. Also a more contemporary approach is the development of virtual patients (VPs) [53]. VPs are defined as interactive computer

programs which simulate a real-world scenario between a health-care professional and a patient. During these simulations, learners take on the role of a health-care professional to obtain history, perform a physical exam, and make diagnostic and therapeutic decisions [50]. Even though these computer simulations are immensely valuable and possess numerous educational benefits, they are limited by their cost and their monotonous nature. As a result, educational and medical institutions often have difficulty creating, maintaining and using these tools [50].

1.1.2 Simulation Fidelity

Fidelity in simulation has been used interchangeably to describe how closely the simulator or the simulated experience expresses the "real thing" [67]. Although there is no single definition of fidelity, Noble describes fidelity as a concept that defines the level of realism illustrated by a simulator or a simulated experience [74]. In the context of serious games, fidelity denotes the extent to which the appearance and/or behavior of the simulation matches the appearance and behavior of the real system [45]. Ker and Bradley divide fidelity into two components: (i) psychological fidelity, and (ii) physical fidelity. Psychological fidelity denotes the degree that the skills inherent in the real task being simulated are captured within the simulation [62]. Physical fidelity covers the degree of similarity between the training situation and the operational situation which is simulated [45] [62]. Physical fidelity can be further divided into equipment fidelity that denotes the degree that the simulation replicates reality and environmental fidelity that denotes the degree that the simulation replicates the sensory cues [62]. In health-based education, where high-technology simulation has risen in popularity, the perception of fidelity is still vague. Here, simulation fidelity is believed to be unidimensional, and higher levels of fidelity is assumed to have greater learning outcomes [11]. In pursue of such designs, it is seen that educators and developers of health-based games tend to sideline more important aspects of game designing, such as: (i) training goals, (ii) instructional content, and (iii) game design [11]. Norman et al., while comparing a high-fidelity simulator versus a low-fidelity simulator, noted that both the simulators resulted in consistent improvement in performance as compared to the control group [75]. Furthermore, no significant advantage of the high-fidelity version was seen over the low-fidelity version, concluding that the level of fidelity required is based on the task at hand, the learning outcomes, and the simulator rather than, what looks good.

1.2   Purpose of this Work

Computers have dramatically changed the way humans receive and perceive information. The global Internet market captures approximately three billion users, connecting roughly 40% of the world today [43]. In 2013, 83.8% of U.S. households reported computer ownership, with 78.5% of all households having a desktop or laptop computer, and 63.6% having a handheld computer. Furthermore, 74.4% of all households reported Internet use, with 73.4% reporting a high-speed connection [36]. Today data over the Internet can be accessed, processed, and transferred to a large audience with just a click of a button. Using such capabilities of the World Wide Web (www), my work examines opportunities to provide a scenario editor and a dialogue authoring tool that can be used across cultures to model instructional content as a low-fidelity web-based serious game for students and trainees to learn and implement cultural competence skills. By leveraging the benefits of a serious game (i.e., a specific challenge or goal, a scoring system, and an engaging interface), I aim to overcome the limitations of the current approaches and enhance health-based education in an important sector of cultural competence education.

Furthermore, within the scope of this thesis, I also explore Internet-based learning (IBL) as an important educational tool to provide debriefing to game players using serious games for cultural competence training. IBL is a growing area of research that has experienced broad and rapid adoption by educators in a wide variety of disciplines. IBL can formally be defined as the use of electronic media and information and communication technologies in education [21]. IBL permits a global audience to convene over a single platform (irrespective of time and location), to access educational content, and tailor instructions based on the individual learners' needs. Educational networks are a particular type of IBL which provide widespread accessibility, ease in performing operations, and a diverse educational content [44]. An educational network can be described as a social network (such as MySpace, Facebook, or Twitter, amongst others) which is used in an educational environment or for the purpose of education [49]. By developing an educational network, I bring together students and instructors/experts from various disciplines to collaborate and share instructional content. Doing so I examine the usability of observational practices while using serious games for cultural competence training. In addition, I also examine the applicability of employing the educational network to facilitate serious game-based debriefing.

1.2.1 Hypothesis

Using the scenario editor, the level of environmental fidelity can be varied to design different virtual characters (VCs). For example, a VC may express a range of facial expressions, body language, or spoken dialogue in response to the player's actions in the game. Using these characteristics, I will examine the user experience and satisfaction of game players while playing the low-fidelity serious game, whilst the VC illustrates a distinct level of environmental fidelity. Here, the level of fidelity is defined with respect to audio and visual cues and more specifically, with respect to facial expressions, body language, and spoken dialogue. The first design will illustrate a VC with a full body representation. However, facial expressions for the VC are limited and there is no sound (spoken dialogue). In contrast to this, the second VC will include spoken dialogue and an emphasis on facial expressions will be stressed during the game play. Furthermore, to explore the feasibility of employing Internet-based learning for debriefing, the game play of each participant will be recorded and made available to an educational network where peers can then examine the game play and provide feedback on it. The described analysis will be derived from three different experiments. The hypothesis of each of these experiments is as follows.

Experiment One

In the first experiment of this thesis, it is hypothesized that in a low-fidelity environment, a high level of environmental fidelity (e.g., VCs that exhibit facial expressions and spoken dialogue) will result in greater user satisfaction and experience as compared to no audio and lower fidelity graphical cues.

Experiment Two

In the second experiment I use audio cues and a high level of environmental fidelity to hypothesize that the low-fidelity serious game can be used as a cultural competence training tool for health professions education.

Experiment Three

In the third experiment, I use an online educational network to debrief the users from Experiment Two, and promote collaborative learning. Here it is hypothesized

that the educational network can be used as a tool for debriefing serious game play sessions.

1.2.2 Thesis Structure

The remainder of this thesis is organized as follows. In Chapter 2, a background/literature review is provided. This includes an overview of serious games with respect to: (i) web-based learning and simulation, (ii) virtual humans, (iii) cultural competence training using virtual humans, and (iv) dialogue authoring tools. The cultural competence serious game is described in detail in Chapter 3. An overview of the game, its components, and how the game is played is presented. Chapter 4 describes an educational network developed to encourage observational practice and collaborative learning. An overview of the different modules is presented in this chapter. Chapter 5 describes the first study conducted to investigate the user satisfaction and engagement while playing the game in different levels of fidelity. Here the experimental method and the results of the study are presented. The second study is described in Chapter 6. In this chapter the experimental procedure, the results obtained from running the experiment, and a discussion of the implication of these results (if any) are discussed. Chapter 7 describes the third study which examines the use of an Internet-based learning platform as a tool to facilitate debriefing. Concluding remarks, and plans for future research are presented in Chapter 8.

Chapter 2

Related Work

Serious games are tools which enhance the learning process through play, and enable the game player to experience scenarios that usually are expensive and high-risk to replicate [71]. These games provide us the opportunity to fail, try again, and improve, in a way that failure becomes part of the fun and an important aspect of learning [41]. Many serious games are tailored to one or a limited number of scenarios thus limiting their use and cost-effectiveness. With the growing demand for employing serious games as educational tools in various disciplines, it is vital for game developers to provide a generic platform that can be used to address a large variety of audience (e.g., health-care practitioners, military officers, and educators, amongst others). This provides an opportunity to use and reuse gaming components (e.g., models, scripts, and scenarios, amongst others) as building blocks for new games. Here previous work presented in this domain, that encourages interoperability and provides a platform to developers and educators to utilize and build similar games upon, therefore saving time, resources, and money is examined. I conclude with a summary of the issues in the presented work, and discuss an approach to facilitate cultural competence training through serious games.

2.1   Web-based Learning and Simulation

The rising popularity of computing devices and particularly mobile-based devices such as laptops, tablets and smartphones, and the accessibility of an Internet connection makes web-based learning a more appealing option for educators and professionals. The rise of Web 2.0 emphasized user-generated content, usability, and interoperability. In addition high-speed, affordable Internet has helped to

connect the world together, and advanced programming techniques have given rise to cutting edge platforms that can be used to develop diverse web-applications. One such example is web-based serious games, which are also gaining in popularity. Studies examining the appreciation of web-based serious games in comparison with "traditional" approaches show that students favor the serious game approach more, even if the scores remained similar [102]. The low production cost and high accessibility of web-based games provide a rich tool for serious game designers.

Woodment [118] [119] is a fine example of a browser-based serious game where collaborators come together to work as a team and learn about managing critical situations. The developers of Woodmen apply the design principles and patterns of commercial Massively-Multiplayer Online Games (MMOGs) [91]. Here, a match is played between two teams, each consisting of three players, to manage a virtual logging company. Each member of the team is given a role and a number of tasks to complete. As soon as the tasks are complete a winning team is announced. Similarly, Mind the Game [5] is another web-based serious game used to enhance decision-making skills. The game was used to compare paper-based versus digital gaming experience. The results suggested that the digital game players felt more challenged and experienced positive emotions during game play, albeit the activity felt less competitive. These serious games are environment independent and can run on browsers such as Internet Explorer, Firefox, Safari, and Mozilla-based browsers. The screenshot in Figure 2.1 shows an instance of Woodment running on the Safari browser. Supporting applications on multiple platforms requires constant update and adaptation of new and improved methodologies. In an ever changing, technologically advanced society, it is very challenging to stay up-to-date with the current technological trends. Torrente et al. present an open-source, high-level game authoring tool, which can be used by users to build low-profile games without using any technical skills [108]. In pursue of making it a widely accessible tool, the authors state how they had to remodel their system architecture from scratch due to Java being an obsolete technology for Web clients. However, their new revisions now support modularity, extensibility, and multiple platforms that can be used by developers to build games for various fields such as: (i) health (ii) science, and (iii) education, amongst others.

To analyze the role of virtual patients (VPs), in health-care education, Oladosu et al. developed a web-based Aboriginal Virtual Patient (AVP) system to train medical students regarding real-life clinical scenarios, for the purpose of medical training, education, and assessment [78]. The main features of the system include: (i) a login interface, (ii) AVP case, (iii) medical intervention, and (iv)

Figure 2.1: Woodment is an environment independent serious game which can run over various browsers. Taken from [118].

feedback interface. The medical intervention, shown in Figure 2.2, includes the medical procedure which the user follows to treat the patient. Once the treatment is complete, the system generates feedback based on the results of the medical intervention provided by the student compared to an expert rating. Moreover, investigating the usefulness of the system, the study highlights the effectiveness of using virtual characters (VCs) in serious games over real patients using the following measures: (i) accessibility, (ii) privacy, (iii) accuracy, (iv) security, (v) skill acquisition, and (vi) availability.

2.2 Virtual Humans in Serious Games

A computer simulated world where a real-life environment is depicted (e.g., interview preparation [4], combat casualty care [35], amongst others), won't be complete without its inhabitants. To make these worlds seem more realistic and believable, serious game developers exhibit virtual humans [68]. With the advancement in technology and hardware units, creating characters which replicate human-beings is highly achievable. The more challenging aspect however is to equip these virtual beings with human-like characteristics including social and cognitive intelligence,
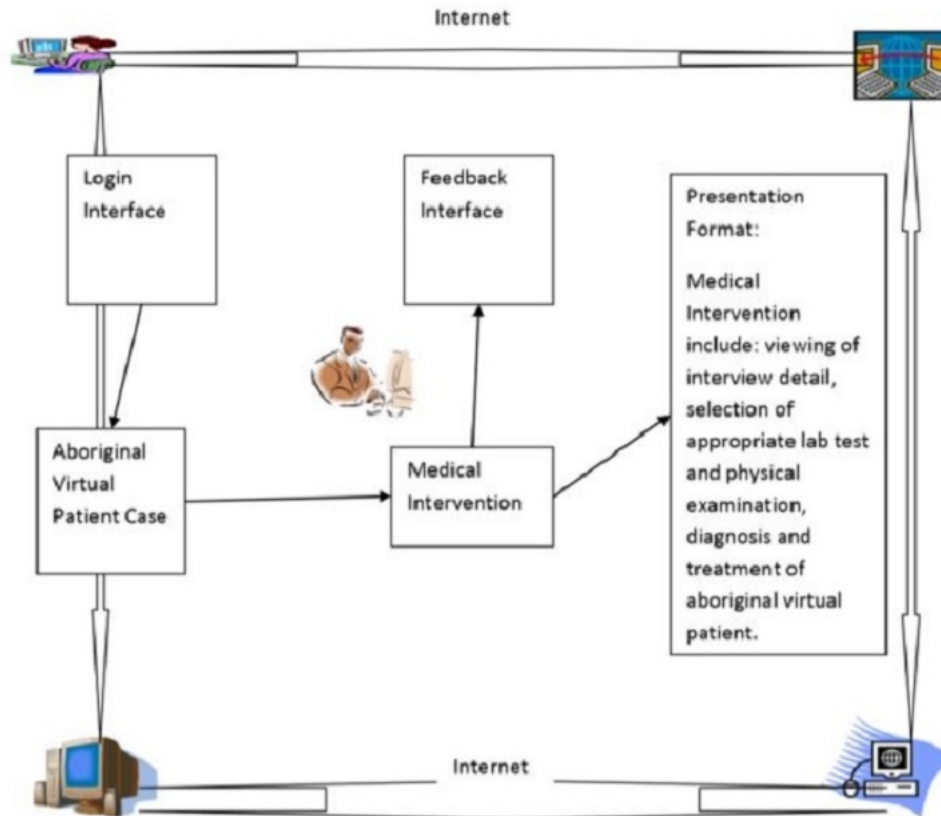
Figure 2.2: The architecture for the web-based Aboriginal Virtual Patient (AVP) system, shows the flow of different modules. Taken from [78].

personality, and emotions, amongst others. Zeilke et al. [124] developed a serious game for the U.S military in which the living world environment represents rural and urban Afghan culture and the goal of the game is to increase the players expertise within this culture. The game player here is a socially active member of the society and his/her individual actions not only affect the attitude of a virtual non-player character (NPC), but also the society at large. The goal of the game is to: (i) win over NPCs by following the cultural norms of the virtual environment, and (ii) characterize NPCs emotional mood (i.e. happy, sad, angry or frustrated) based on their actions and interactions in the living world. This virtual world is asymmetric and non-linear, hence making it similar to the real-world, where inhabitants have an unpredictable behavior. The architecture described in the paper uses a Random People Generator (RPG) to construct NPCs randomly, based on the demographics data. As shown in Figure 2.3, using the RPG, each physical component of the virtual character (hair, facial hair, eyes, ears, upper and lower torso, and feet) is treated as an individual entity. These components are combined together to form a physically diverse, and culturally accurate member of the society. Further, these NPCs are also given human-like abilities for example, to run

Figure 2.3: Unique and culturally accurate NPCs are created by combining different entities of the virtual characters body. Taken from [124].

errands, gossip with the game players virtual character and other NPCs, socially be aware of their surroundings, and prioritize tasks based on their daily routine.

Similar to this, Facade [69] uses low-fidelity computer graphics to render a virtual couple (see Figure 2.4). The player's actions in the virtual world influence the course of the conversation and events that would occur during the scenario. This is a good example of a serious game that integrates a broad and shallow approach towards natural language processing (interaction between a computer and human (natural) language). Facade gives the user an interactive experience of human relationships. The user, from a first person perspective, is witness to the ups and downs of another couple's relationship. The user can interact with the NPCs using sentences in text format or by using the mouse and clicking on objects present in the virtual world. The game player here is given no direction and is free to play according to his/her will. The NPCs respond to the player's open-ended questions or statements very quickly making it a highly immersive yet low-fidelity visual environment.

Rickel and Johnson's [85] agent character Steve (Soar Training Expert for Virtual Environments) is another example where virtual humans are used to teach users team training and collaboration. In this game, each Steve is visible to the game

Figure 2.4: Facade represents Grace and Trip, an attractive and materially successful couple in their thirties, who have invited their friend over to spend some time. Taken from [69].

player from above the upper torso (see Figure 2.5). As multiple Steve's can run within the same scenario, each agent therefore needs to be different from the other. In an attempt to keep each Steve unique, the Steve is configured with a different shirt, pair of eyes, hair, and skin color. Furthermore, teams in the game must communicate with one another using audio cues (speech), therefore to distinguish between the voices of each agent, the speech rate, base-line pitch, and vocal tract size are also altered to achieve a distinctive audio quality for each Steve.

2.3 Cultural Competence Training Using Virtual Patients

Computer simulation and virtual reality provide innovative and pragmatic educational tools that not only help in learning proficiency but also provide a safe environment for learners. The use of virtual patients (VPs) in medical education is one such example where VPs have been used to improve intercommunication between health-care practitioners and patients. Oladosu et al. present a serious game for pre-clinical learning, which aims to teach novice doctors clinical skills and help them to familiarize themselves with real-life patient problems [77]. To educate students regarding medical conditions, the serious game presents the game
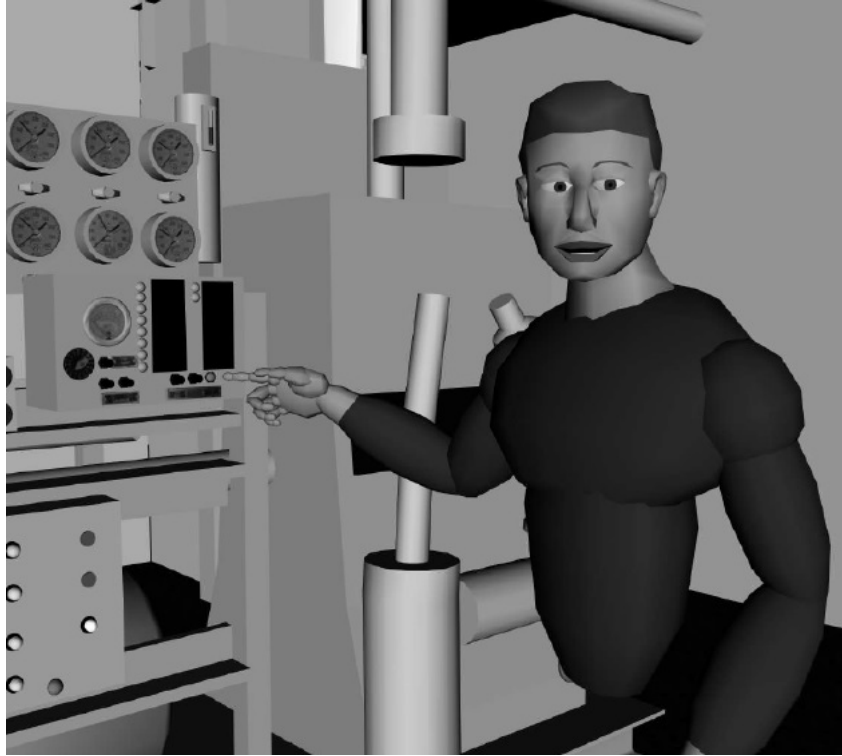
Figure 2.5: The agent Steve (Soar Training Expert for Virtual Environments) cohabits with human students to collaborate with them on training scenarios. Taken from [85].

player with different scenarios (see Figure 2.6) which the students have to solve. Even though the work is limited and focuses on symptoms of certain diseases, the mobile-phone platform makes it a highly accessible tool in a community of learners who are well versed with using smart-phone technology.

Effective communication between the doctor and patient can improve health-care outcomes, whereas ineffective communication leads to misdiagnosis, delayed diagnosis, malpractice litigations or even be life threatening for the latter [32]. VPs are often compared with standardized patients (SPs). Originally known as programmed or simulated patients, SPs are "lay persons trained to replicate a clinical encounter consistently and realistically." [100]. SPs were used to teach and evaluate clinical skills by enacting a scenario in which a simulated patient requires medical assistance [10]. Actors role-playing these scenarios may have no specific medical background, or only some prior training to allow them to evaluate the student's performance [100]. Compared to these traditional approaches, VPs have many advantages such as: (i) efficiency, (ii) standardization, (iii) easy accessibility and interactivity, (iv) decrease in instructor workload, (v) repository of diverse yet challenging scenarios, and (vi) personalized learning with immediate feedback in a non-threatening experimental environment, amongst others [89].
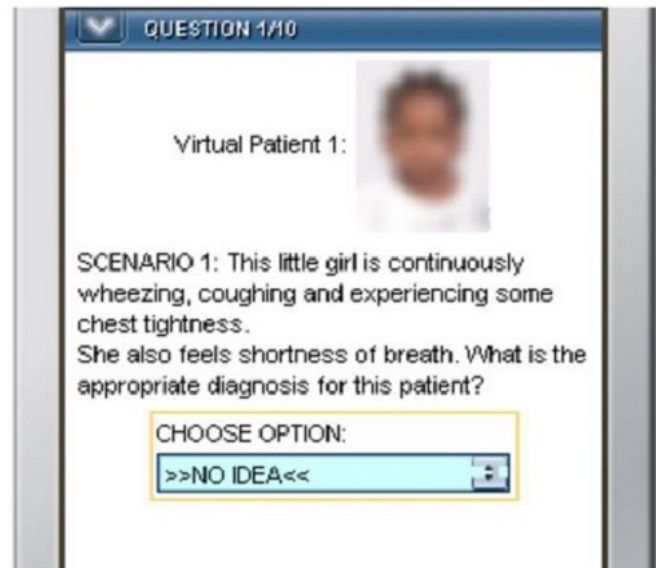
Figure 2.6: A mobile-phone serious game educates novice doctors by presenting them with a scenario of a VP they have to diagnose. Taken from [77].

Stevens et al. introduced a serious game where second-year medical students taking on the role of a practitioner, evaluate a VP with abdominal pain. To assist the game player, a virtual instructor is also present in the scenario (see Figure 2.7) [99]. The game aims to teach medical students history taking and communication skills in a safe and controllable environment. Similar to this, the VP Sita (a 24 year old Indian girl) is created by Sakpal and Wilson [88] for nursing students to understand culture and cultural competence. Here the goal is to draw answers to a list of already prescribed questions. Both of the games described use a static script-based approach whilst communicating between the VP and the game player. However, these dialogues are in the form questions hence lack higher order communication skills such as empathy, negotiation, and conveying bad news.

Having limited dialogue scripts is a huge drawback when the intent is to create an immersive virtual environment. To solve this problem, Imison and Hughes [53] propose a method to enhance the VPs dialogue script by creating low-fidelity, student generated VPs. This method uses existing software to build new VPs. It is cost efficient and can be applied to any form of case-based learning. Their method states: (i) document suitable case(s), (ii) create decision tree using the concept-mapping program, Visual Understanding Environment (VUE), (iii) upload output from (ii) in Labyrinth (editor for use-cases), (iv) evaluate VP(s), and (v) run discussion session(s). Even though the approach applied is very elegant and easy to use, it still has a strong learning curve attached. Further, the method described is also very long and involves multiple people who may not always be available for the completion of the process.

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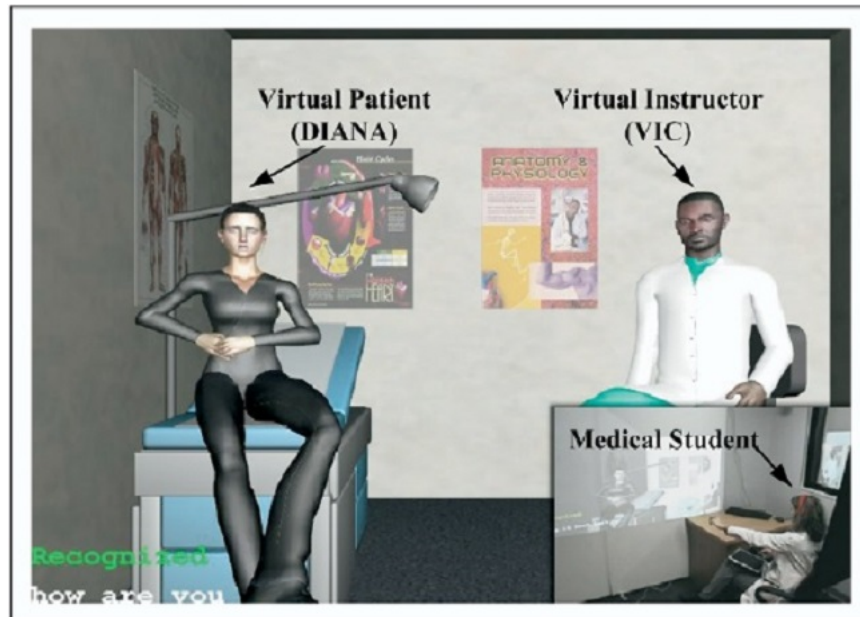
Figure 2.7: The virtual patient DIANA, along with the virtual instructor interacts with the game player in the setup shown. Taken from [99].

In effort to create VPs in a virtual world, Conradi et al. [20] proposed a 3D immersive environment using Linden Lab's virtual world, Second Life (SL) [87]. This virtual world illustrates different sections of the university to provide paramedic students a realistic environment to which they can relate to (see Figure 2.8). This 3D environment is suitable for professionals who are in different parts of the world and require access from a remote destination. Players joining remotely can also communicate with the VP through text-based chat or by using their mouse as an input device. These actions will trigger responses from the VP which will help to proceed in the virtual world. The project aims to establish a standard for developing VPs in the future, which they hypothesize will allow educators to create new scenarios without the help of clinical experts.

2.4 Dialogue Authoring Tools in Serious Games

Dialogue authoring tools are the backbone of any interactive game in which virtual characters communicate with the game player using natural language. Johnson and Valente [58] present their project for learning a foreign language and culture. Their tool, Tactical Iraqi, has been used to train U.S. soldiers and marines prior to their deployment in Iraq. They present the development of a set of collaborative authoring tools that support agile development for such games. However, the tool is only for subject matter experts and requires programming expertise. The scenario and dialogue authoring tool, Tide (Tactical language Interactive Dialogue
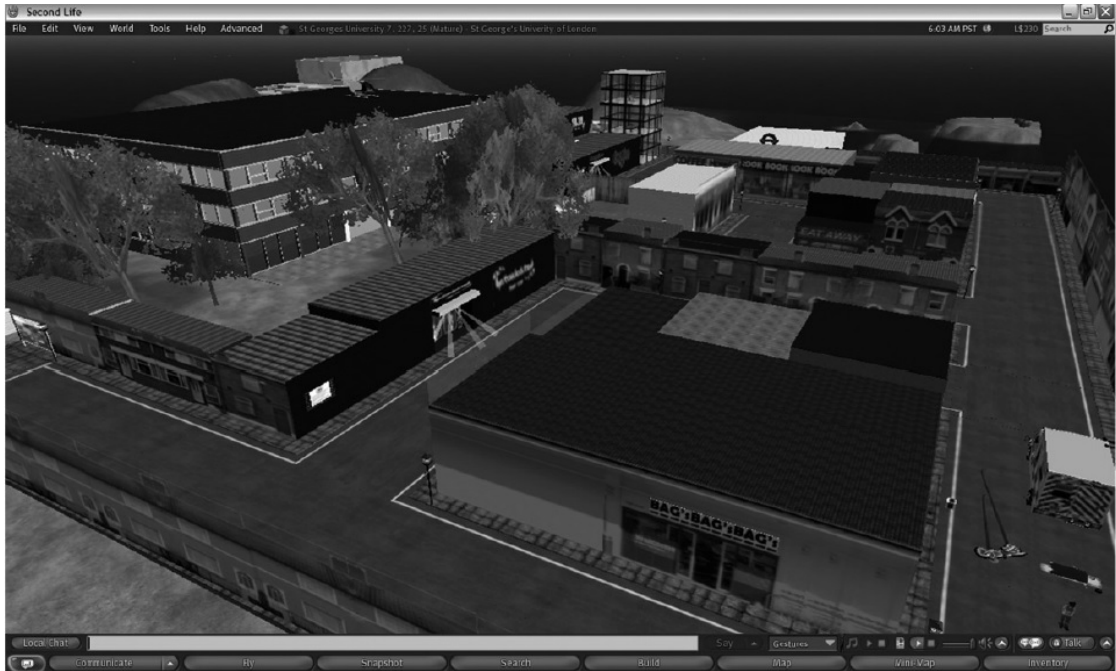
Figure 2.8: The virtual world includes a hospital, underground station, benefits office, night clubs, a street accident scene and orientation area. Taken from [20].

Editor), provides the author a number of methods to build complex dialogues out of smaller parts and components. The key elements specified by Tide are utterances and acts that the user performs. The tool also allows the user to specify dialogues in two main ways: (i) scripts, and (ii) interactive dialogues.

Doulamis et al. [31] presents an architecture for a 3D serious game whose aim is to raise the motivation and interest of cultural heritage amongst the "younger generation". The serious game is modeled around the site of a museum, and the goal of the game is to solve a treasure hunt by collecting artifacts. Every time a new artifact is found, the player is presented with a question that they have to answer. The system is comprised of a visualization, a content management, and an artificial intelligence (AI) module. The visualization module and the Content Management System (CMS) are both built using the QUEST3D engine [2], which allows the educator to design various learning materials using basic programming skills. The CMS organizes the tasks that the user will encounter during game play. These tasks are structured using a pre-planned decision tree thus providing the designer a good balance between the range of possible actions and the developers control over the scenario.

The AI module, divides the environment into three levels. These three levels comprise of: (i) dialogue, (ii) interaction, and (iii) living background. All NPCs by default belong to the background level. As the game player moves within the

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virtual world, their level of interaction changes depending on the distance between the VC and NPC. Interactions between the VC and NPC can only take place in the interaction level. It is essential to understand that the perception as described here, refers to an AI component in a serious game. According to Anderson et al. [3], the AI component is restricted to dealing with only three tasks in a serious game, and more specifically, (i) decision making, (ii) path finding (planning), and (iii) steering (motion control). Of these three tasks, decision making is the only one where intelligence strongly applies.

Dialogue authoring tools not only render dialogues based on a continual script but can also be programmed to make decisions and therefore intelligently drive and direct the conversation. This allows each instance of a given scenario to be fundamentally distinct from its predecessor based on the choices made by the dialogue authoring tool. Decision trees here are an integral part of this system. Decision trees (as shown in Figure 2.9) [81] for dialogue management can be built using finite state machines (FSM). FSMs arrange the behavior of an AI entity into logical states. Each state in the machine corresponds to a behavior. At any given instance of time, only one state can be active. DEAL [17] is a dialogue management system presented by Brusk that investigates the possibilities to create a language learning system for conversational training which uses game play elements to produce an immersive virtual environment. DEAL is implemented using components of the Higgins project for automated speech recognition system (ASR) [96] and the dialogue manger (DM) is implemented using State Charts XML (SCXML) [112]. SCXML is a markup language which provides a generic state-machine based execution environment. This DM can be classified into the same category as dialogue authoring systems made by using a FSM. The project presents a trade between a player and a NPC. The trade is modeled in three phases: (i) opening, (ii) middle and (iii) end. This system also includes a negotiation component, to ensure that the NPC can provide a counter-offer to the players bid. The paper contributes towards making life-like VCs which possess human abilities like emotions, visual appearances and natural language.

Another example of using a finite state machine- (FSM-) based approach in a dialogue system is described in an experiment where the author tries to realistically connect personality to a 3D character, not only on an expressive level but also on the level of dialogue and perspective [33]. The system can be used according to the dialogue grammar defined and also by using a plan-based or collaborative approach. In this system, the conversations are modeled using a non-deterministic
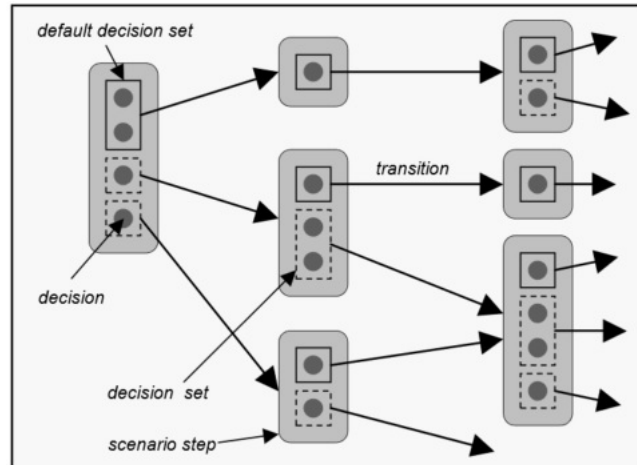
Figure 2.9: Decision Trees. An interactive scenario is defined by using decision trees. Each step is connected to another scenario step. Taken from [81].

finite state machine. Similar to DEAL, the dialogue system here consists of a FSM kernel and a set of modules connected via an interface.

Brusk and Lager [16] provide multiple reasons for the gaming industry to utilize state charts in XML (SCXML). They state that FSMs can be used to control the flow of the game and SCXML provides hierarchy and concurrency. Further, SCXML along with voiceXML form a very powerful combination in various runtime environments. Moreover, SCXML can also be extended to handle AI in serious games, that too in an intuitive and straightforward way. As an example, the decision tree (see Figure 2.10) can easily be converted in a SCXML document as shown in Figure 2.11. However, using a FSM in dialogue authoring systems also has a few drawbacks. These state machines can turn out to be very complex and hard to maintain. Otherwise, if too easy they can become predictable for the user.

2.5 Summary

Susi et al. [101] state the contradiction the term "serious game" provides. More specifically, if both words are defined separately, it is clear that the first reflects the purpose and the latter talks about a fun based voluntary activity. The work previously defined in the section above, discusses a vast paradigm of research projects with objectives very distant from one another, however in the perspective of serious games all these projects share a common ground. These games provide a powerful and meaningful context to learn novice and advance level skills in a fun and entertaining way.
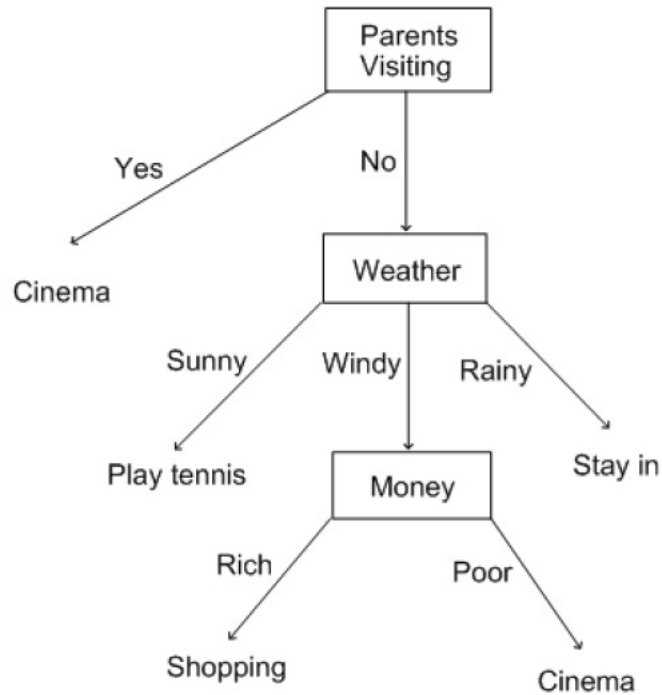
Figure 2.10: Decision Tree inspired by SIMS [16].

```
<transition event="situation">
  <transition cond="Eventdata.visiting==yes"
              target="Cinema"/>
  <transition cond="Eventdata.visiting==no">
    <transition cond="Eventdata.weather==sunny"
                target="PlayTennis"/>
    <transition cond="Eventdata.weather==windy">
      <transition cond="Eventdata.money==rich"
                  target="Shopping"/>
      <transition cond="Eventdata.money==poor"
                  target="Cinema"/>
    </transition>
    <transition cond="Eventdata.weather==rainy"
                target="StayIn"/>
  </transition>
</transition>
```

Figure 2.11: The decision tree converted to a SCXML document [16].

Despite the many benefits associated with serious games there are a number of issues related to their development that should be addressed before they become more widespread. One of the issues pertains to fidelity; that is, how realistic the virtual environment that the serious game is centered on must be in order to ensure effective learning, while another issue pertains debriefing and more specifically, how can debriefing be facilitated within a serious gaming environment?

The literature presented here, provides a good overview of the theory under consideration. There are plenty of serious games which relate cultural competence with virtualization. In the past, curriculum-based and patient-centered cultural competence training approaches have been applied to teach health-care practitioners cross-communication and cultural competence skills. However, the learning objectives, along with teacher and student experience have vivid the actual perspective and opened rooms of convergence and inconsistency [114]. An alternative approach adapted was to introduce VPs in a clinical environment. These serious games from a first-person or role-playing perspective help a medical practitioner to achieve and formulate some specific skill-sets. Despite of being a swift and novel approach to aid cultural competence skills, there are a few shortcomings of this approach. The limited dialogue and scenario scripts, suppress the ability of portraying an asymmetric environment. Dialogue scripts described are usually questions, which limit the immersion of the player and the ability to learn through general comments, interpersonal communication, and small talk. A few methods propose to solve this by using state charts. The drawback of this can be its complex nature (if a huge scenario is presented) or being too predictable (if the scenario is too easy).

Long development life-cycles and huge production budgets may make certain serious games an excellent and workable tool in the commercial world, but unfortunately every project does not have the luxury of time and money. Even a high-scale project such as Facade played for the sixth or seventh time becomes predictable. The dialogue scripts starts becoming redundant and the scenarios can be anticipated. Therefore, the gaming industry requires ready-to-use frameworks which can develop commercially viable products, and in the process enhance the capabilities of these platforms. Furthermore, the cultural competence serious games do not exemplify emotional modeling. VPs lack emotional traits which are an important entity when teaching cultural competence and are practically evident in all sorts of human communication.

In light of these problems, I present a scenario editor and dialogue authoring tool which can not only be used to enhance cultural competence skills in medical

students, but also to enact an extensive variety of scenarios that involve communication between two or more people. The scenario editor can be used by educators, professionals, and experts to build interesting storylines, each one having its own context, scene, and characters. The proposed system is a web-based application that is easily accessible to educators and students around the world.

Chapter 3

The Serious Game Fydlyty

Fydlyty is a low-fidelity, cultural competence web-based serious game intended to serve as a teaching tool for medical students, and practitioners. The goal for the user/trainee is to successfully complete a dialogue script associated with a scenario, focusing directly on the mood and cultural background of the virtual character (VC). The game provides a set of predefined responses to the user/trainee, who has to select the most suitable one in reference to the current scenario. Doing so, the system invokes another VC response. Selecting each response correctly allows the user to accumulate further points and move ahead in the conversation until the scenario ends. The serious game also includes a mechanism to allow educators to add new scenarios to the existing database, and to provide the user/trainee feedback based on his/her selections at the end of each session.

Fydlyty is not limited to a single scenario, but can be used to replicate a wide variety of real-world scenarios involving a dialogue between two or more parties (e.g., hostage negotiation, interview preparation, and language learning systems). To attain variability and robustness, I have decomposed the problem domain into smaller but significant components. To explain this in more detail and for the sake of simplicity and better understanding, I have chosen to illustrate the game with a specific scenario whereby the player, taking on the role of the health-care provider (a physician in this particular scenario), examines a female VC, Jade Wilson, sitting in the doctor's office. This particular scenario has been selected from a list of already existing doctor-patient excerpts related to cultural competence [19]. This example will be used in the consequent sections for an overview of the serious game Fydlyty.
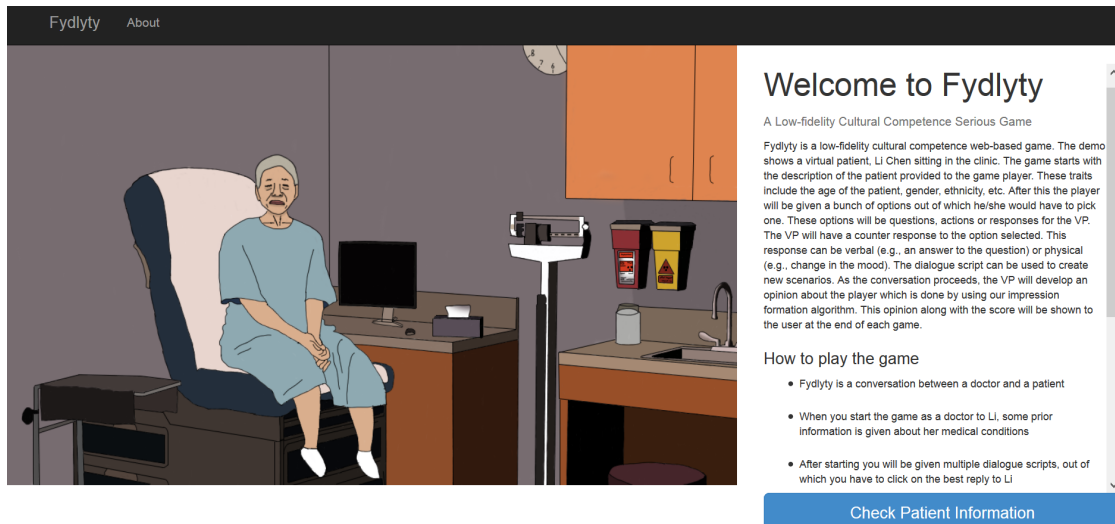
Figure 3.1: The original game which shows a VC, Li Chen, sitting in the doctor's office with a chief complaint of "toothache like" chest pain. Taken from Khan et al. [63].

3.1 Original Game

Fydlyty started as a prototype project with a scenario that highlighted an 83 year old retired nurse, Li Chen, who has a long history of hypertension and is presented to the doctor (game player taking on the role of a medical doctor), with the chief complaint of substernal "toothache like" chest pain (see Figure 3.1). The original version of the game revolved around the same VC, and the only change which an educator could have performed was to add a new dialogue script to the scenario. However, this could only be accomplished using the administrative panel (see Section 4.1.9). In this version of the game, emotions (neutral, upset, and angry) were presented to the user through graphical illustrations (see Figure 3.2). The feedback at the end of each scenario was based on displaying the dialogue script, along with the VC's mood which the dialogue triggered (see Figure 3.3). In a preliminary and informal study consisting of four Computer Science students from the University of Ontario Institute of Technology (UOIT), the participants suggested that they did not think that the feedback provided was sufficient and improvements should be made so that the game could be used with medical student/practitioners. They also noted that due to the size of the illustration on the screen, it was hard to determine expressions immediately.

The full overview of the original game has been published [63] and will therefore, not be described here in great detail.
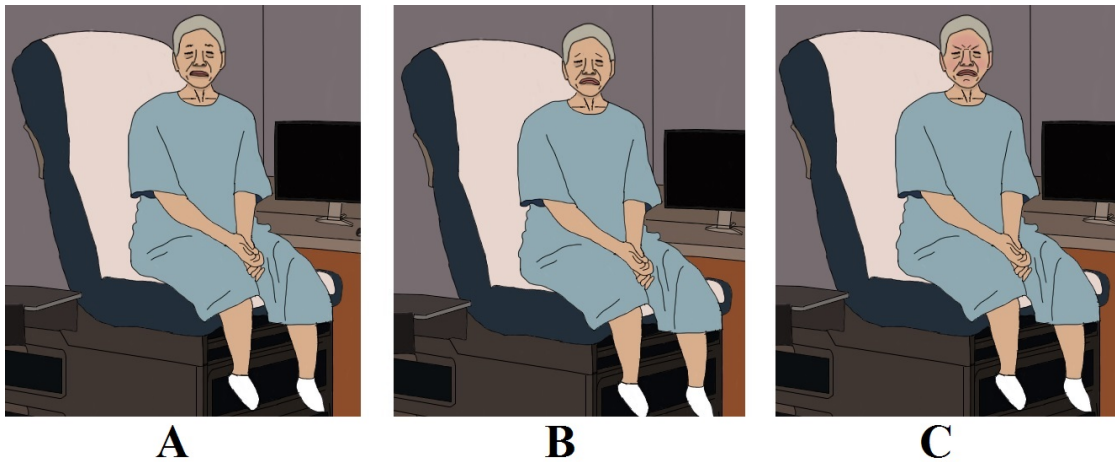
Figure 3.2: The VC exhibits three moods A) neutral, B) upset, and C) angry. Taken from Khan et al. [63].

Figure 3.3: The feedback provided at the end of the scenario, displayed the dialogue script along with the specific mood associated with the game players selection. Neutral, upset, and angry are represented by green, yellow, and red respectively. Taken from Khan et al. [63].

3.2 Overview

To facilitate a diverse audience of educators, curriculum-designers and students studying in various disciplines, I have revamped the original system (described in the previous section), such that it can now be used to design various cultural competence scenarios using existing educational content (e.g., dialogue scripts), and vary the level of environmental fidelity based on the requirements of the educator. Here I present the different modules of the system in detail regarding the new design with respect to: (i) the virtual character, (ii) game users, (iii) scenario editor, (iv) dialogue authoring tool, and (v) debriefing.

3.2.1 Virtual Character

The goal of this game is to provide a platform that can assist players to replicate a real-life scenario, which can help them to improve cultural competence skills in a safe yet affective environment. The player interacts with the system through the VC. The VC in Fydlyty is defined under two levels of environmental fidelity: (i) basic, and (ii) advanced. More specifically, environmental fidelity is defined with respect to facial expression, body language, and voice-based dialogue of the VC. The VC in the advanced fidelity level includes facial expressions and voice-based dialogue, both of which are missing in the basic fidelity level but the VC does exhibit body expressions (see Figure 3.4). The illustration in Figure 3.4 shows the facial features of a VC. The eyes, lips, and forehead of the VC are clearly visible to the game player, providing enough cues to judge any exhibited emotions. On the contrary, even though in the illustration in Figure 3.5, the full body of the VC is present, it is difficult to judge any facial expressions. In this example, the body language is a convenient form of expressing ones gratitude or disapproval. Nonetheless, both VCs can be categorized as low-fidelity designs at least with respect to graphical fidelity. For the purpose of this study, the VC in Figure 3.4 (supported by audio cues) is considered higher (advanced) level of environmental fidelity, whereas, Figure 3.5 will be the lower (basic) level of environmental fidelity.

Figure 3.4: A contrast in visual cues is depicted from the illustrations in a low-fidelity environment. A VC with prominent facial features to highlight different moods.

Figure 3.5: A contrast in visual cues is depicted from the illustrations in a low-fidelity environment. The VC relies primarily on body language to highlight different moods.

3.2.2 Game Users

Fydlyty has been designed to address two different types of users' (i) educators/curriculum designers, and (ii) students/trainees. The educators are the privileged users who have access to creating scenarios, modifying dialogue scripts, and assessing the overall progress of each student. On the contrary, the students are the game players who take the role of the character (in our example a medical professional such as a doctor or a nurse), assigned to them by the educators, and play the game. Every new user begins by taking on the role of a student. It is the duty of the database administrator to assign privileges to individual accounts so that the account holders can take on the role of an educator as well.

3.2.3 Scenario Editor

Every computer game is developed by connecting individual components together [14]. As an example, consider Microsoft's famous game 3D Space Cadet Pinball. The maze used in the game can be imagined as one big entity which can further be divided into many smaller components such as: the number of bumpers and their position, color of the light on the maze, and awards/points at hitting a wormhole, amongst others. Fydlyty follows a similar approach.

I divided the game into smaller individual components which can be used and reused to develop new instances of a scenario. The scenario editor provides the educator the power to design and experiment with new and creative ideas. The scenario editor (see Figure 3.6) design is based upon: (i) background, (ii) characters (whose mood can be either neutral, upset, or angry), (iii) script, and (iv) role of the game player. The background is represented by images (JPEG or PNG) which are rendered at the interface level when each scenario is loaded. Similar to the background, the VC is also comprised of a set of image files or avatars created using Crazy Talk [55]. As described in greater detail in Section 3.3, Crazy Talk is an animation tool used to create realistic avatars. Each set of the VC images (files) represents three different moods (i.e., neutral, upset, and angry). In the game these images are rendered in a seamless manner so that the game player cannot determine any change on the screen during game play. Depicting different moods also provides the game player immediate feedback, and more specifically, with a sense of achievement (when the mood is positive), or concern (when the mood is negative).

Figure 3.6: Scenario editor. A variety of components are available to the educator to develop a scenario.

The script that each scenario is based on consists of: (i) context, (ii) scene, and (iii) dialogues. The context describes the circumstances that form the setting of the event so that the game player can fully understand and assess the environment. The scene describes the characters involved in the event and the location where it will occur. Finally, the dialogues, which are uploaded using a comma-separated version (CSV), describe the narrative between the game player and the VC, are described in greater detail in the following section.

3.2.4 Dialogue Authoring Tool

The Dialogue Authoring Tool (DAT) has two primary functionalities: (i) manage dialogues (read, write, and update) in the database, and (ii) propose different variations of each dialogue to the educator when a new dialogue script is uploaded in the system. The original dialogue script is uploaded by the educator as a CSV file. The DAT reads the original dialogues from the file and saves each dialogue with reference to its parent. This hierarchy of dialogues can be viewed as a parent-child tree structure (see Figure 3.7).
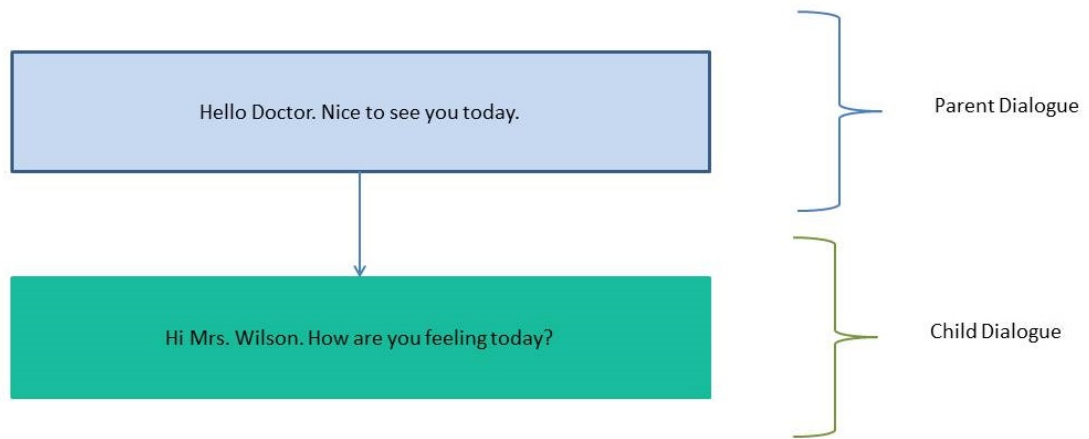
Figure 3.7: The DAT reads the dialogue script and saves the dialogue as a parent-child structure in the database.

Once the original hierarchy is saved in the database, the DAT will then create different variations of each game player's dialogues that were previously stored (child dialogues are color coded green in Figure 3.7). The DAT now refers to a predefined list of phrases which it will use to replace the original phrase with. Depending on the number of alterations, the new mood (upset or angry) is associated with the dialogue (see Figure 3.8). Currently, every possible dialogue does not yet have an associate version. Furthermore, it cannot be expected that each version of a dialogue will be completely correct and factual. To overcome this problem, each dialogue is editable (see Figure 3.8), making it the educator's added responsibility to ensure that the final dialogue script is grammatically, and factually correct.

When the educator submits the final dialogue script, the DAT traverses over the updated version of the dialogue script to save new dialogues with reference to their parent dialogue. The initial tree structure is further enhanced to have multiple child dialogues (see Figure 3.9). Referring to Figure 3.9, it is evident that the parent dialogue "Hello doctor! Nice to see you today." has three child dialogues. Each dialogue is saved as a separate entry and has one mood (neutral, upset, or angry) associated with it. This association is at the database level. For simplicity each mood is color coded in this example.

3.2.5 Debriefing

Debriefing is a time to reflect and look back at events that occurred during game play, and to make sense out of them [98]. Debriefing is provided to the users to let them know how they are performing in the game. Therefore, it is vital

PROPOSED DIALOGUE SCRIPT

Character type	Normal	Upset (Proposed Dialogue)	Angry (Proposed Dialogue)
Virtual Character	Hello Doctor. Nice to see you today.		
Game Player	Hi Mrs. Wilson. How are you feeling today?	Hi Ms. Wilson. How are you feeling today?	Hi Mrs. Wilson. How are you feeling today?
Virtual Character	A bit better.		
Game Player	That is good to hear. Are you still feeling nauseous?		
Virtual Character	I haven't felt sick to my stomach since you switched my medication.		
Game Player	Great. So your test results came in this morning.		
Virtual Character	It is about time. Is it good news or bad?		
Game Player	I guess it is a bit of both. Which do you want first?		

Figure 3.8: Proposed dialogues for upset, and angry mood based on the original script.

Figure 3.9: Once the scenario is saved, a parent dialogue can have multiple child dialogues associated to it. Each child dialogue will represent a mood of the VC.

that the system provides the users' with immediate debriefing at the end of each scenario. In Fydlyty there are primarily two techniques used to facilitate debriefing: (i) a summary of the game play at the end of each scenario, and (ii) using the Observational Practice and Educational Networking (OPEN). In this section the first approach is examined only. OPEN will be discussed in more detail in the succeeding chapters.

Once the game player reaches the end of the scenario, the system redirects the user to the debriefing page. The debriefing page (see Figure 3.10) displays a summary of the session from the start to the end. I have divided this into two sections (as labeled in the Figure 3.10). The first section (labeled as 1 in the figure) provides an overview of the user, the scenario he/she played, and the time in seconds taken to complete the scenario. The second section is directly related to the game play.

It shows (i) the VC's dialogue (if the game player started the conversation, then the response of the VC), (ii) the choices the game player was given during the game, (iii) the response he/she chose out of the choices given, and (iv) the mood of the VC after the choice was made by the game player.

As shown in Figure 3.10, there are four sets of dialogues between the VC and the game player. The conversation starts with the VC saying "Hello Doctor. Nice to see you today.". In response, the game player was provided three options; "Hi Mrs. Wilson. How are you feeling today?", "Hi Miss Wilson. How are you feeling today?", or "Come sit Jade.". The game player chose the second option which caused the character's mood to change to "Mad". For quick readability, the labels for the characters moods are color coded; green for normal, yellow for mad, and red for angry. The entire session can be examined through this report.

3.3   Game Play

In the scenario I have chosen to illustrate, at the start of each session, the game player, taking on the role of a health-care provider (a physician in this particular scenario), begins the game by examining a VC, Jade Wilson, sitting in the clinic. The virtual world is viewed through the user's point-of-view (e.g., first person perspective) and therefore no part of the player's body is visible during the entire game. A conventional mouse is the primary source of input from the user to the system. The screen-capture of the index page shown in Figure 3.11, depicts the VC on the left of the user's screen while on the right of the screen, the preliminary description of the patient is provided to the game player. These traits include: (i) name of patient, (ii) gender, (iii) marital status, (iv) role of player, (v) context, and (vi) scene.

The patient information section initially displays the name of the patient, so that while conversing the player can connect with his/her subject. Players in the game can make mistakes by referring to the patient with the incorrect name thus potentially offending the patient. Similarly, scenarios can be built upon by varying the gender, and marital status as well. The next trait, the role of player, informs the game player about the role that the VC is performing in the scenario. The context and scene provide a short introduction to the game, motivation behind it, objectives, and cues of how to proceed forward in the game. This basic information helps the user familiarize him/herself with the game environment before starting the actual conversation. At the bottom, a counter keeps track of the time elapsed from the start to the end of the conversation. Also a comment box is used

Figure 3.10: At the end of each scenario, the game player is shown a summary of the entire session.

to provide cues to the game player during the session. This is another method of providing immediate feedback to the game player during the scenario.

After obtaining the VC's information, the player proceeds by clicking on the 'Start Game' button at the bottom of the page. From this point onwards, all choices made by the user/trainee add to the success/failure of the conversation. Figure 3.12 illustrates the different components comprising this page. At the top right section is the VC console (labeled at A in Figure 3.12). This console shows automated replies from the VC so that the trainee reads and accordingly chooses his/her next

Figure 3.11: Patient information screen shows the information regarding the scenario and the patient, Jade Wilson.

reply to. The next section (labeled B in Figure 3.12), lists a pool of potential replies for the VC. The user can choose one of the many replies by simply clicking on to the desired choice. These options can be questions, actions, or responses for the VC. The VC will have a counter response to the selected option. This response can be verbal (e.g., an answer to the question), physical (e.g., change in the mood), or both. Verbal responses will be shown in the VC console, whereas, physical responses will be depicted by the change in expressions on the VCs illustration.

As previously discussed, the VCs in Fydlyty span around the idea of varying the audio and graphical (visual) fidelity, therefore, comprising of two distinct simulations. The VCs shown in Figure 3.13 and Figure 3.14 are one such example. Both VCs represent a different level of immersion. In Figure 3.13, the three moods (neutral (A), upset (B), and angry (C)) are illustrated by body movement more than facial expression. Furthermore, no audio support is provided. Whereas in Figure 3.14, facial expression as well as audio plays an important role in conveying the mood of the VC to the trainee.
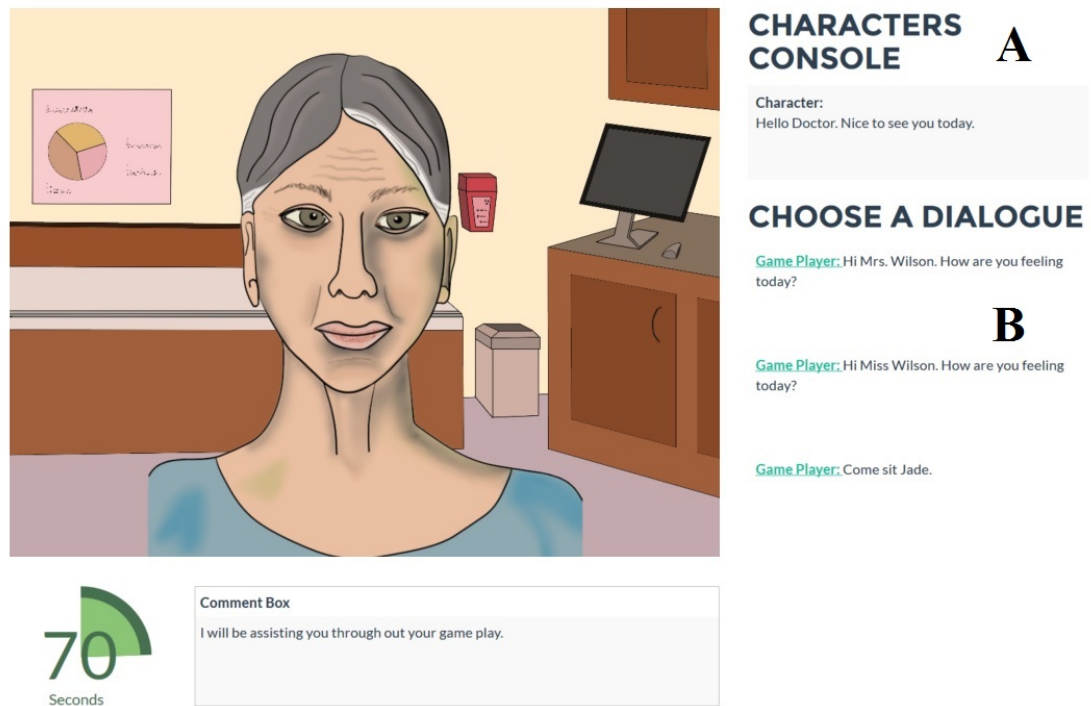
Figure 3.12: VC Console (A), and choices for game player (B).

3.4 Technical Details

Fydlyty is a web-based serious game developed on the open-source Django framework [105] and utilizes the Model View Controller (MVC), design pattern. Django is a high-level web framework used for backend code organization. It is developed using the Python programming language [111]. The framework encourages rapid-application development with a clean and pragmatic design. All the illustrations shown in the game are created 'in-house'. The animations for the advanced level avatar are accomplished using the facial animation software Crazy Talk [55]. Crazy Talk is a powerful tool that employs voice and text to vividly animate facial images. The Interactive Plug-in is an add-on for Crazy Talk, that allows developers to convert and export Crazy Talk avatars for web-based application (see Figure 3.15). These assets can be shown on any browser screen using the unityweb plug-in. The Interactive Plug-in also provides a set of avatar APIs to control the on-screen animations. These controls include: (i) avatar control (show, hide, fade), (ii) animated script control (play, pause, stop), and (iii) look-at and gaze (direction and gaze of avatar), amongst others.

While Crazy Talk is a very useful tool to create realistic avatars, it may become hard to manage with respect to dialogue scripts which can consist of many dia-

37
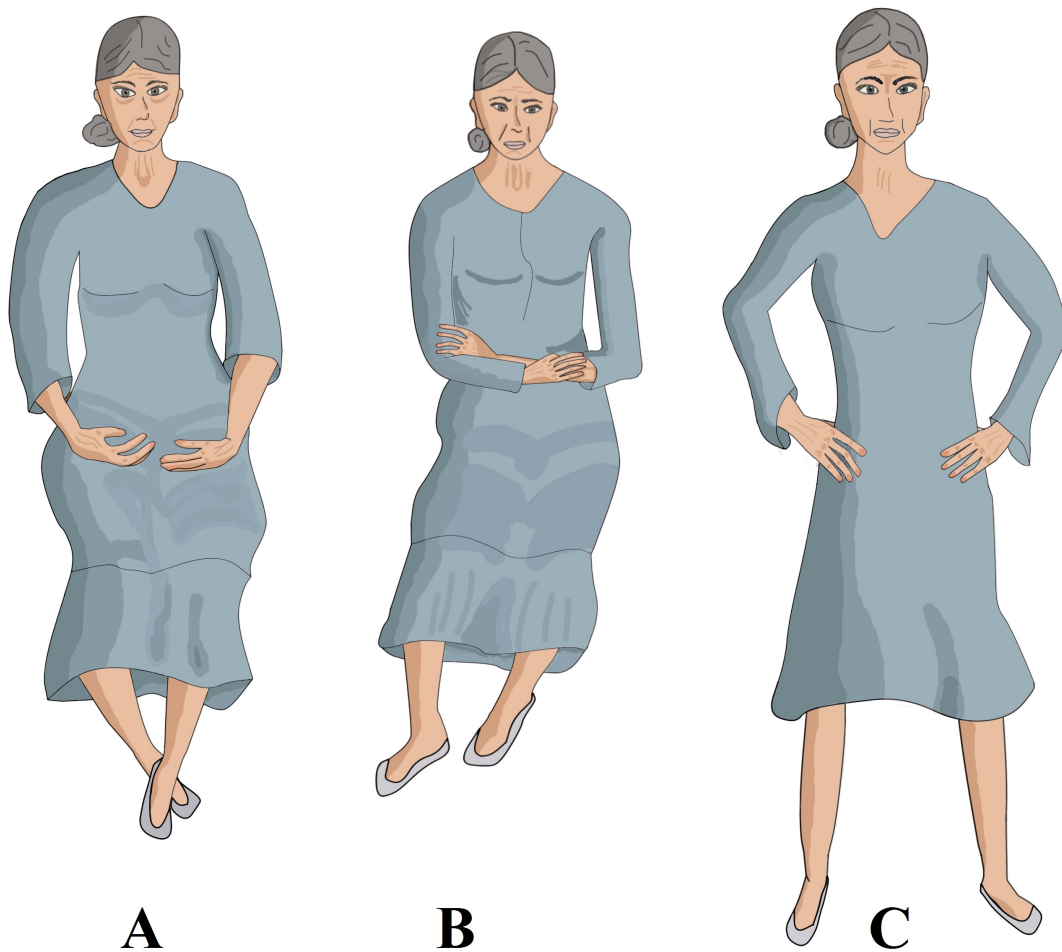
Figure 3.13: A) neutral, B) upset, and C) angry.
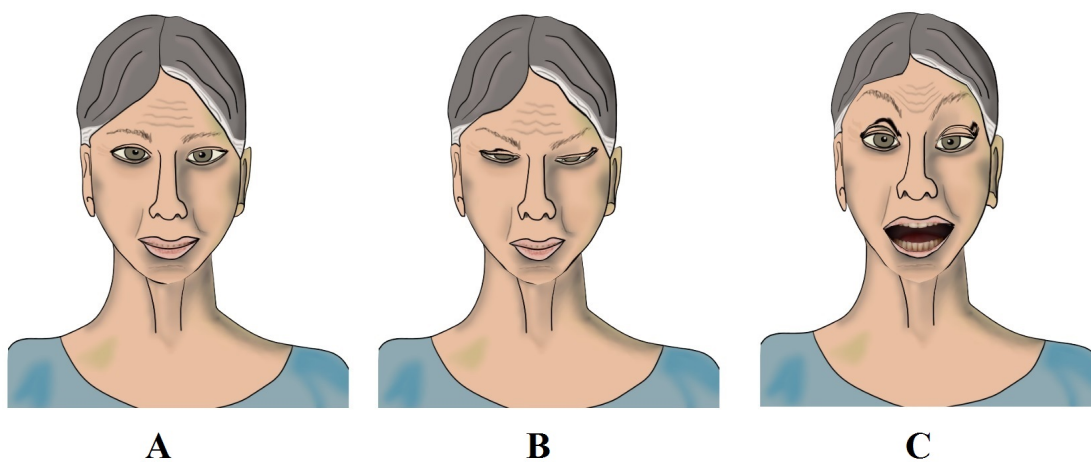
Figure 3.14: A) neutral, B) upset, and C) angry.
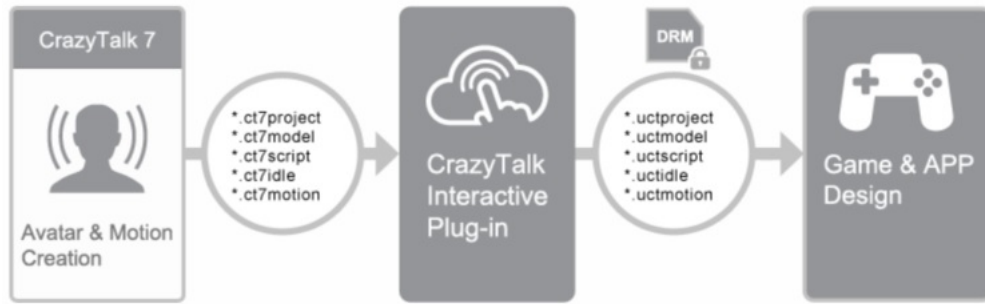
Figure 3.15: Crazy Talk Interactive Plug-in workflow [55].

logues. To keep it simple for the educator, Crazy Talk was only used to develop three different types of animations (i.e. neutral, mad, and angry) without any voice-over. All of the VC dialogues stored in the database are dynamically converted (during game play) to audio files using Google Text to Speech (GTTS) [54]. As a result, the educator does not have to be concerned about creating audio files or syncing the audio with the animation. This minimizes the number of files an educator will have to create and save for each scenario. In addition, the same animation now can be reused in another scenario with another dialogue. Furthermore, GTTS also supports many different dialects such as Arabic, Danish, Italian, Japanese, Mandarin, and Swedish, amongst others. This can be used variably to create scenarios which are tougher and require more concentration. The only challenge is to synchronize both files to provide the game player an illusion that the source of the audio and video is the same. This is accomplished by employing some intelligent front-end code.

The front-end code organization is performed using Twitter Bootstrap [79]. Bootstrap is one of the most popular front-end frameworks for developing responsive designs. Bootstrap provides Fydlyty the power to run on different screen resolutions and browsers without having to worry about cross-browser compatibility, inconsistent interface design, and unfriendly screen resolution. Furthermore, since the entire scenario is played in a single browser session, Ajax is an integral part of the system. Ajax is a programming technique used to send and retrieve data from the server asynchronously and is performed using jQuery [84]. The relational database management system, MySQL [120] is also used to store the data provided by the educator whilst creating a scenario.
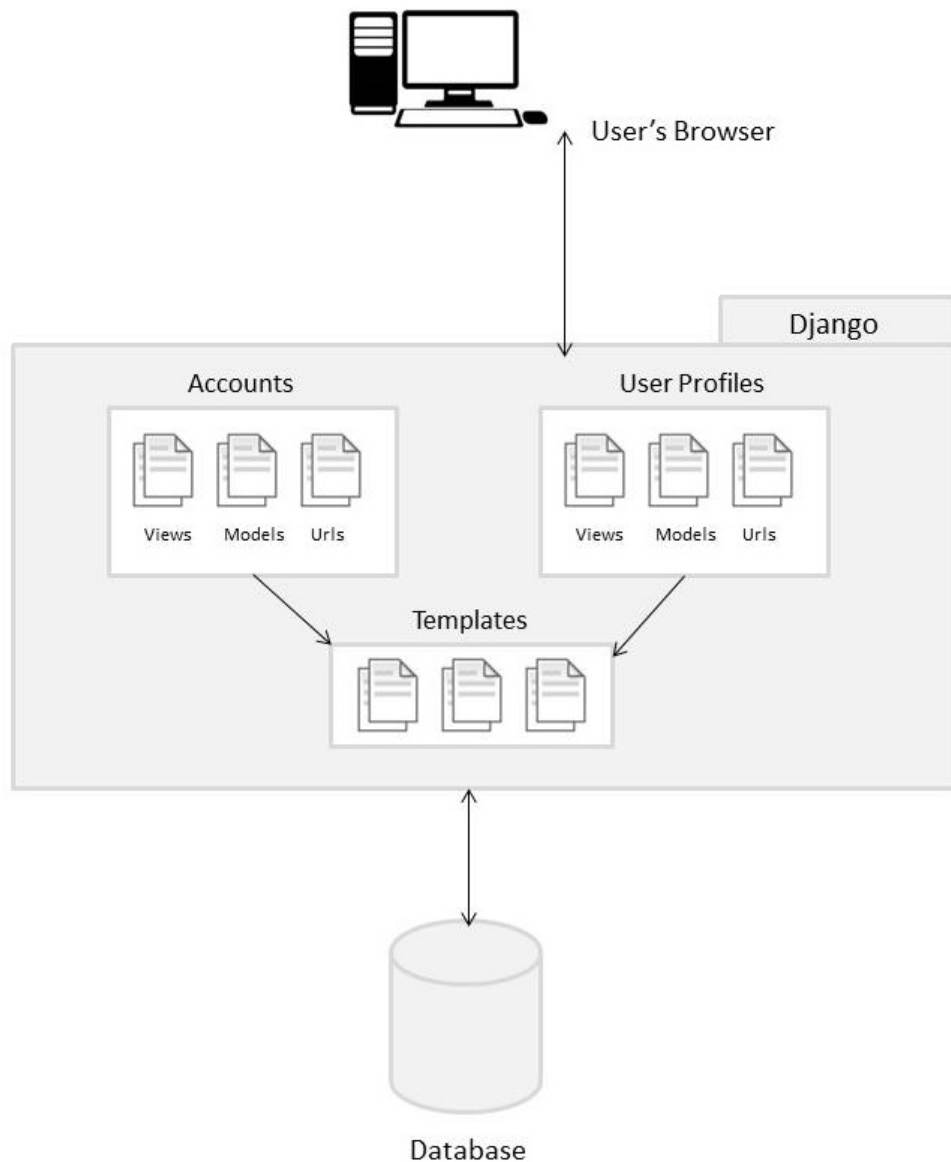
Figure 3.16: The application architecture of Fydlyty.

3.4.1 Application Architecture

Figure 3.16 illustrates the application architecture of Fydlyty. With an incoming request from a user's browser, the URL dispatcher maps the requested URL to a function and calls it. The caching framework checks to see whether a cached version of the requested page exists and if it does, the cached version is returned and all further steps can be bypassed. The system is further divided down into smaller and manageable sub-applications; Game and Accounts. Each sub-application contains its view, model, and URL files. The view file contains functions to perform requested actions which typically involve reading and writing to the database. The model file defines the schema and the interactions with the schema. Finally the

URL files contain a mapping between URL patterns and functions in the view file. Furthermore, the data is contained in a relational database (MySQL). Templates refer to HTML pages which can be either static (delivered to the user exactly as stored) or dynamic (interactive and animated). While rendering dynamic pages, the Django template language [106] is used to synchronize the server-end and presentation logic. After performing the task requested by the user, the view returns an HTTP response object to the web browser. The data in the response object is then presented on the screen of the user using Cascading Style Sheets (CSS) [113]. CSS is a style sheet language which describes how elements in a markup language (e.g., HTML or XML) should be presented on the user's browser.

3.4.2 Database Schema

The database schema describes the structure of the database, and the factual data that can be stored in the database. The database schema for Fydlyty is shown in Figure 3.17.

Scenario

Scenario is the primary entity of Fydlyty and forms the structure of each game. An instance of Scenario consists of the following fields:

1. Scenario ID: Unique identifier for each instance.

2. Title: String type title for each Scenario.

3. Type: A choice field which specify the scenario type. The choices are: (i) basic scenario, or (ii) advance scenario. Basic scenario is the default option.

4. Background: An image field (JPEG or PNG) which illustrate where the scene takes place.

5. Role: Describes the role of the game player in the scenario.

Character

Scenario has a one-to-many relationship with a Character. The entity refers to the basic design for the VC and stores information related to it. An instance of Character consists of the following fields:

1. Character ID: Unique identifier for each instance.

2. Scenario ID: Forms a one-to-many relationship with Scenario.

3. Name: String type name for the VC.

4. Gender: A choice field for the VCs gender. The choices are: (i) male, (ii) female, or (iii) I don't want to say. The default value is NULL.

5. Marital Status: A choice field for the marital status of the VC. The choices are: (i) single, (ii) in a relationship, (iii) engaged, (iv) married, (v) widowed, (vi) separated, (vii) divorced, or (viii) I don't want to say. The default value is NULL.

6. Image: An image field (JPEG or PNG) which illustrate the VC.

7. Mood: A choice field which describes the mood of the VC uploaded in the image field. The choices are (i) neutral, (ii) upset, or (iii) angry. The default value is neutral.

Script

Scenario has a one-to-many relationship with Script. The entity contains information about a particular game instance. An instance of Script consists of the following fields:

1. Script ID: Unique identifier for each instance.

2. Scenario ID: Forms a one-to-many relationship with Scenario.

3. Context: A description of the circumstances that form the setting of the event.

4. Scene: A description of the characters involved in the event and the place where it will occur.

Dialogue

Script has a one-to-many relationship with Dialogue. The entity contains information about a particular dialogue instance. An instance of Dialogue consists of the following fields:

1. Dialogue ID: Unique identifier for each instance.

2. Parent ID: A recursive relation-ship with another instance of Dialogue.

3. Script ID: Forms a one-to-many relationship with Script.

4. Utterance: A string type that contains the actual dialogue.

5. Character: A choice field for who the dialogue belongs to. The choices are: (i) game player, or (ii) virtual character. The default value is game player.

6. Mood: A choice field which describes the mood of the VC uploaded in the image field. The choices are (i) neutral, (ii) upset, or (iii) angry. The default value is neutral.

CTFile

Script has a one-to-many relationship with CTFile. The entity refers to the advance design for the VC which is built using Crazy Talk. An instance of CTFile consists of the following fields:

1. CTFile ID: Unique identifier for each instance.

2. Script ID: Forms a one-to-many relationship with Script.

3. Name: String type name for the VC.

4. Gender: A choice field for the VCs gender. The choices are: (i) male, (ii) female, or (iii) I don't want to say. The default value is NULL.

5. Marital Status: A choice field for the marital status of the VC. The choices are: (i) single, (ii) in a relationship, (iii) engaged, (iv) married, (v) widowed, (vi) separated, (vii) divorced, or (viii) I don't want to say. The default value is NULL.

6. Mood: A choice field which describes the mood of the VC uploaded in the image field. The choices are (i) neutral, (ii) upset, or (iii) angry. The default value is neutral.

7. Idle: A file field to store the Crazy Talk idle file for the VC.

8. Model: A file field to store the Crazy Talk model file for the VC.

9. Motion: A file field to store the Crazy Talk motion file for the VC.

10. Project: A file field to store the Crazy Talk project file for the VC.

User

The User class represents the users' in the system. An instance of User consists of the following fields:

1. User ID: Unique identifier for each instance.

2. Username: Unique string type name representing each users' instance.

3. Email: An email field which checks the validity of every entry. The email address must have a domain part to it.

4. Password: The password is encrypted and then stored in the password field.

5. Is Staff: A Boolean field to check if the user has administrative rights or not.

UserProfile

The UserProfile has a one-to-one relationship with User. It contains all the information required to build a users' profile in Fydlyty. An instance of UserProfile consists of the following fields:

1. UserProfile ID: Unique identifier for each instance.

2. User ID: Forms a one-to-one relationship with User.

3. Role: A choice field specifying the role of the user in the system. Choices are: (i) student, or (ii) educator. Student is the default option.

3.4.3 Deployment

Fydlyty is deployed on an in-house production server placed in the GamerLab at University of Ontario Institute of Technology (UOIT). The production environment for hosting Django is set under Windows Internet Information Services (IIS8) [23]. The Microsoft Web Platform Installer (Web PI) [24] manages the communication between IIS and the Django application through the FastCGI protocol [1]. The web site is configured on port 8004 and can be accessed using the URL http://www.fydlyty.com.
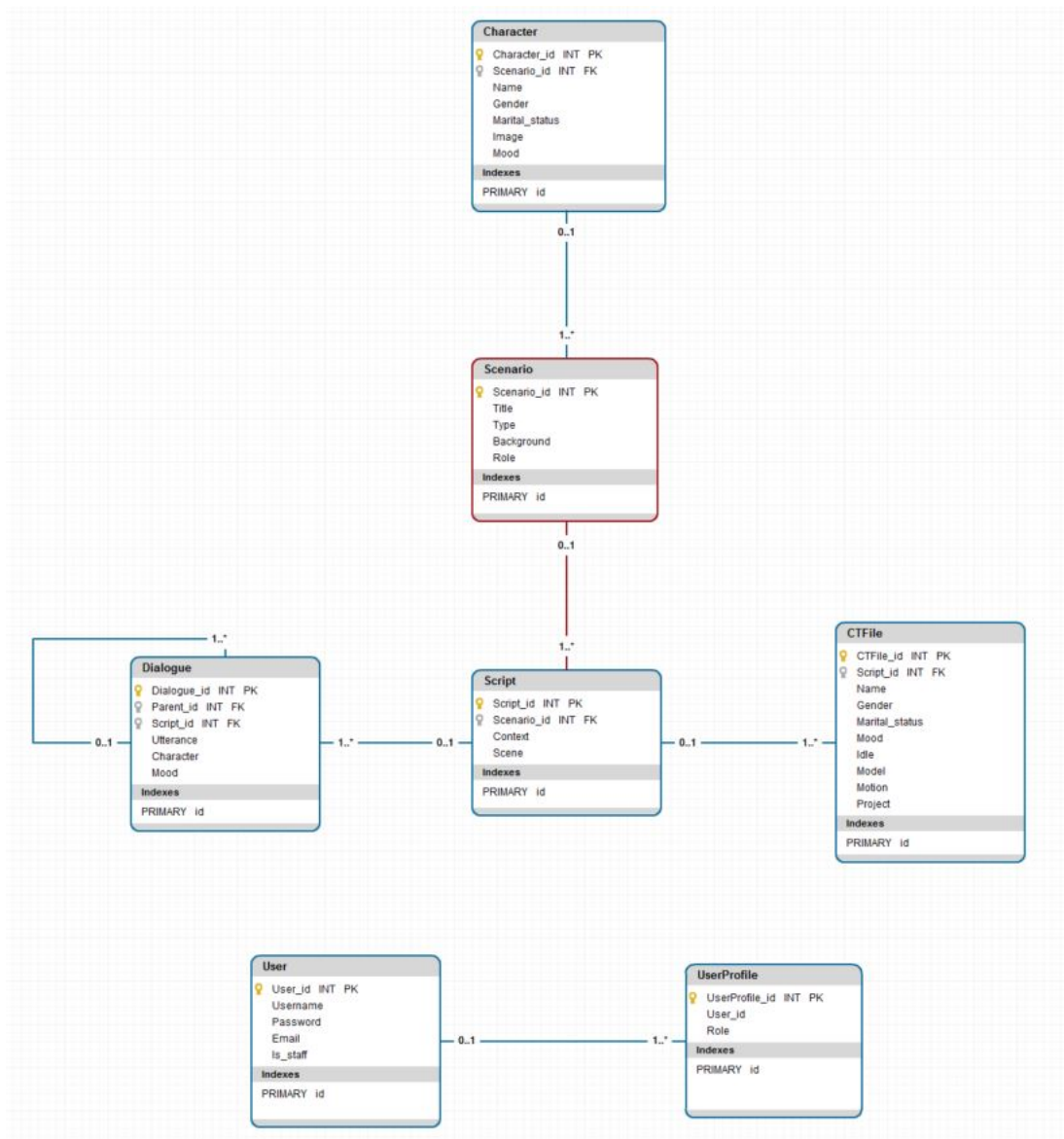
Figure 3.17: The schema for Fydlyty shows the interconnectability of different models inside the system.

Chapter 4

Observational Practice and Educational Networking (OPEN)

Collaborative learning using the Internet as a means of communication has been used for many years. Educators and students without the notion of time and space can convene to a single platform and benefit from the rich instructional content available. Here I present one such Internet-based learning (IBL) platform, the Observational Practice and Educational Networking (OPEN), which encourages: (i) student participation, (ii) discussion, (iii) engagement, (iv) creativity, (v) openness, and (vi) collaboration amongst other dimensions. My tool is for curriculum-designers, educators, students, trainees, and practitioners, amongst others who want to learn, contribute to others learning, present their work and obtain feedback from professionals working in the same domain. Therefore, OPEN can be used to facilitate debriefing, including debriefing after using a serious game.

4.1   Overview

OPEN was originally designed to support health professions education, and to allow a community of learners to access educational and instructional content, communicate with peers and subject-matter experts, and provide/receive feedback asynchronously [86]. This version was previously used to study the role of web-based learning in clinical skill acquisition for novice learners (see Figure 4.1) [18]. Here the aim was to understand the attitude and behavior of undergraduate medical students on the use of an IBL. The results suggested that the use of a web-
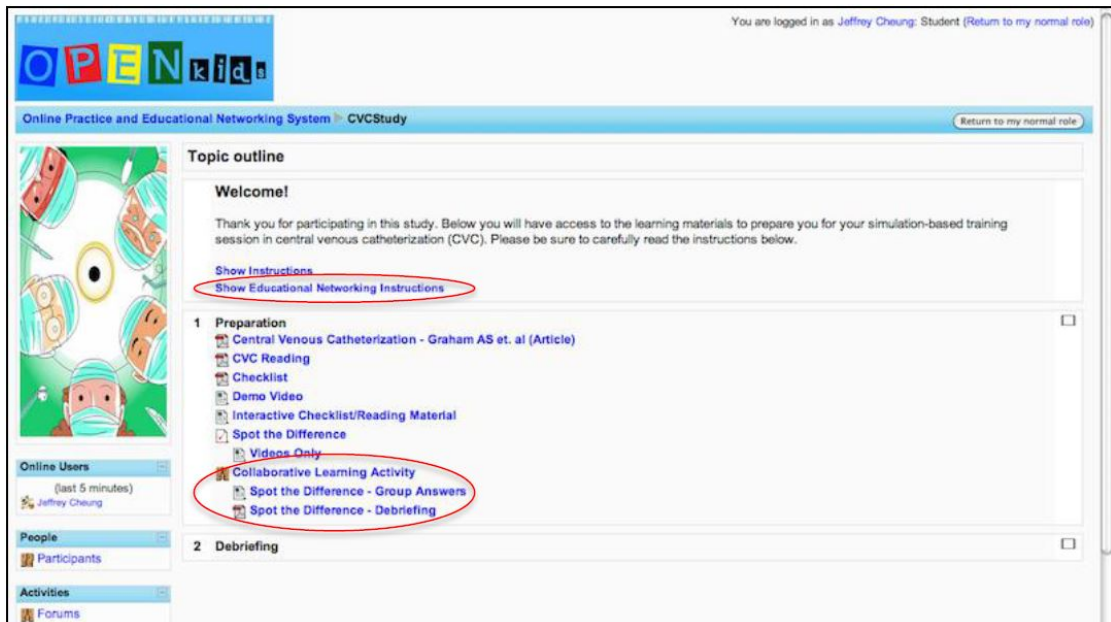
Figure 4.1: The Observational Practice and Educational Networking (OPEN) website shows a course as would be seen by participants in the group. Taken from [18].

based educational platform encouraged students to prepare for learning sessions, and video-based activities provided a fun and engaging experience.

Even though the outcomes of the previously described study were in favor of using an IBL platform, the limitations of the existing design did not allow flexibility, interoperability, and a wide range of instructional modeling. For this purpose, OPEN was re-developed to provide more flexibility and command to the instructors such that it can be used extensively in other areas of interest as well. In doing so I changed the development platform on which OPEN was previously built upon, remodeled the system architecture, and added new features to enhance the usability of OPEN. The purpose of OPEN has always been to bring together students and experts/instructors (e.g., to develop a learning community) and to provide a platform to examine the effectiveness of using such a tool in education. Since re-developing OPEN, it has been used in various studies to test learning clinical skills through pre-recorded student videos [117] [116]. These recordings are available for the students, trainees, and experts, amongst others, hence allowing them to rate and comment on the surgical procedure performed. In the following sections, the functionalities of OPEN from a technical perspective are examined and discussion of the different aspects of the system are provided.

Figure 4.2: Existing users' can use their username and password to sign-in to the system, whereas, new users' can sign-up using the sign-up form available on the landing page.

4.1.1 New Users

Users' who do not have access to OPEN can sign-up by completing the Sign-Up form (see Figure 4.2) on the landing page of the web-site. The form requires some basic information (email address, first name, and last name) along with a unique username and password which in the future will be used to sign-in to the web-site. New users also have to accept the "Terms & Conditions" of the OPEN service to proceed. Since users' can post their course-related content and provide feedback, anonymous requests to access the system are not allowed.

OPEN categorizes users into two groups: (i) students, and (ii) educators. Every new user in the system begins as a student. It is the added responsibility of the database administrator to provide a user with educator access. As described in greater detail below, students and educators have different functionalities in OPEN.

4.1.2 User Profiles

Users' are provided with a personal profile page that displays any information that they have added regarding themselves, and the courses in which they are enrolled in (see Figure 4.3). The personal information on the profile page shows the user's: (i) display image, (ii) address, (iii) city, (iv) country, (v) phone, (vi) email, (vii) date of birth, and (viii) web URL. The user can edit these fields by clicking on the

Figure 4.3: The user profile page shows the user's personal information and lists the courses that he/she is enrolled in. The user can edit the profile or add a course by clicking on the edit and add button respectively.

edit button next to his/her profile. The fields on the edit page (see Figure 4.4) are pre-populated by the data the user has previously added to the profile, and can be updated and saved.

4.1.3 Courses

OPEN is structured around courses. Educators can add a new course to the list of existing courses while students can register in available courses, view resources, and participate in various studies related to a course. Each course has its own set of details and resources. An example of a course page is provided in Figure 4.5. In this example, the course is titled 'Serious Game Development', and the details of the course include (i) course code, (ii) institute where course is being offered, (iii) start date, (iv) end date, and (v) description. The resources, which can be accessed using the top menu, include (i) PDF, (ii) videos, (iii) forums, and (iv) quizzes. All resources in the course are uploaded by an educator and students assigned to the course can only view these resources (i.e., they cannot modify any of the resources).

Both educators and students can 'Add a Course', however, the functionalities for both users' is different. Educators can add a new course to the existing database (see Figure 4.6). Whereas, when students' add a new course , they are shown a list of available courses in which they are not already enrolled (see Figure 4.7).

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Figure 4.4: The edit profile page is pre-populated by the exiting data. The user can make changes to one or all of the fields.

Figure 4.5: The course detail page shows information regarding the course and its resources.

Figure 4.6: An educator can add a new course to the existing list of courses.

Figure 4.7: Students are shown a list of available courses and can select one or many courses.

Once the user clicks on the add button (available next to the course name), the system displays a confirmation dialogue box, accepting it adds the course to the list of students courses (see Figure C.2).

4.1.4 Portable Document Format

The Portable Document Format (PDF) page shows a list of PDF resources added by an educator to a specific course (see Figure 4.8). Clicking on each link opens the file using the PDF viewer in the browser. The user can view the PDF file in the browser, print it or download it using the respective buttons at the top of the screen (see Figure C.1). For now only PDF files can be added and accessed using the OPEN system. This is done so that users using any hardware device (e.g., personal computers, tablets, and mobile-phone, amongst others) can access the content without having any trouble.

Figure 4.8: The list of PDF resources associated with a course.

4.1.5 Videos

The video page, similar to the PDF page, shows a list of video resources that were uploaded by the educator for the specific course. Clicking on each resource, plays the video in a new page (see Figure C.3).

4.1.6 Forums

A forum is a public space for educators and students to interact with one another, and comment or post feedback regarding the videos posted in this section. The forum tab displays a list of forums that were created by the educator for a course. To add a new forum to the list, the educator clicks on the 'Add' button at the top right hand corner of the forum page. Figure C.4 shows the form to add a new forum. The educator can (i) enter a title for the new forum, and (ii) upload a video to be displayed on the new forum. Once the process is successfully completed, the student can view the newly created forum by selecting it in the forums resources (see Figure 4.9).

The forum page displays a video associated with the forum and users are able to add comments to that particular video. The user comments are displayed in chronological order (most recent last) and display: (i) user's avatar (if no avatar was uploaded, then a default image is displayed), (ii) full name, (iii) date of post, and (iv) user's comment. This discussion thread helps the users to interact with

Figure 4.9: The forum displays a video and comments by the users' regarding the video.

one another on the web-site. Users can (i) post feedback, (ii) ask questions, or (iii) answer queries from other users which are related to the video in the forum. Doing so builds an environment of collaborative learning, as well as helps students analyze how a number different methods can be applied to solving the same task.

4.1.7 Quizzes

To reinforce learning, an educator can add a quiz to a course which the students can attempt to complete. By clicking on the quizzes tab, a student is directed to the quiz page (similar to Figure 4.8). On this page, quizzes which have not been previously attempted are displayed in chronological order (most recent first). When the student opens the quiz to attempt it, the contents of the quiz are displayed on to the screen (see Figure 4.10). Each quiz consists of two categories: (i) video, and (ii) questions. The questions (right of the screen in Figure 4.10) are further split into three different categories: (i) multiple choice, (ii) Likert scale, and (iii) open-ended. These categories provide the instructor flexibility and variation to test the learning and attain feedback from the students.
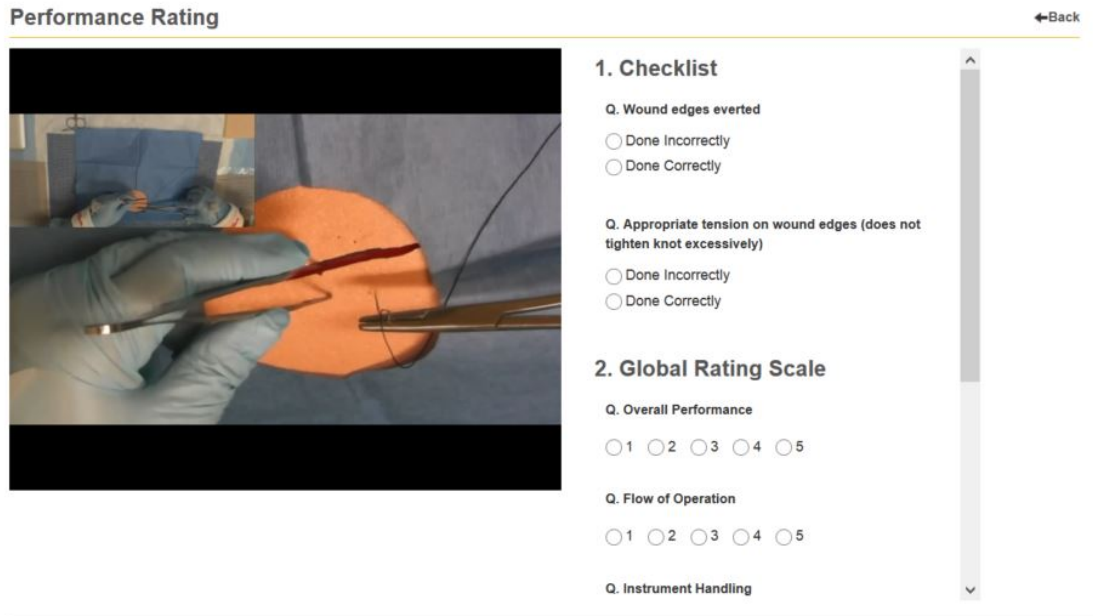
Figure 4.10: A quiz can be used to test the learning of the students or to attain feedback.

To add a new quiz, the educator can click on the 'Add' button on top right hand corner of the quiz page. Adding a new quiz is a four part process which starts by entering some basic information about the new quiz and then adding three different types of question sets. The basic information for a quiz includes: (i) title, (ii) an associated video, and (iii) description (if any) (see Figure C.5). Once this information is provided, the next parts are related to adding questions to the new quiz. Figure 4.11 shows the three different types of questions: (i) multiple choice, (ii) Likert scale, and (iii) open-ended, which an educator can add to a quiz.

Multiple Choice Questions

With multiple choice questions (MCQs), a student is asked to select a best possible answer from a list of choices. As shown in Figure 4.11 (A) the maximum number of choices that the educator can link to a question is four, while the minimum is one. If no choice is associated with a MCQ, the system considers the input void and ignores the question. To reuse existing questions, a question bank at the bottom of the screen is displayed. The educator can simply click on a question to select it or hold the CTRL key on the keyboard to select multiple questions. If the question bank does not include a particular question, the educator can simply add a new question along with its corresponding choices. Once submitted, next time this new question will be displayed in the question bank. To add multiple
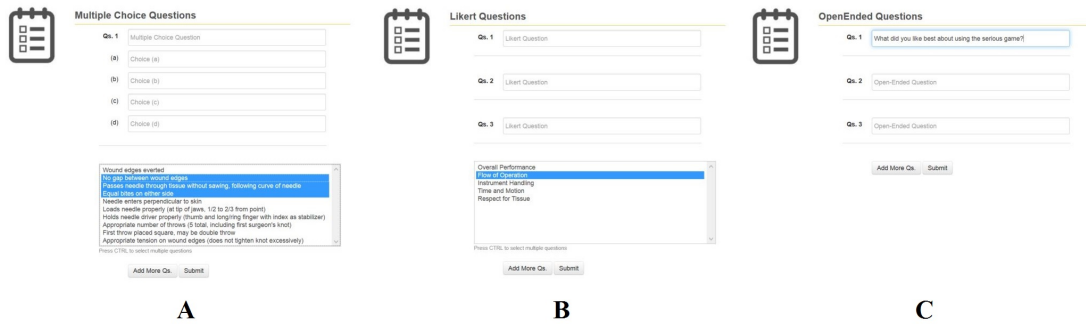
Figure 4.11: Three sets of questions can be added to a quiz (A) Multiple Choice, (B) Likert Scale, and (C) Open-ended.

questions at once, the educator can click on the 'Add More Qs.' button at the bottom of the page.

Likert Scale Questions

The Likert scale is a psychometric scale where a student is offered five pre-coded responses [39]. Using this, the educator allows students to express how much they agree or disagree with a statement. Similar to MCQs, an educator can add new Likert questions, or select existing ones from the question bank (see Figure 4.11 (B)). The five point scale is a default and cannot be changed, although the educator can describe the pre-coded responses.

Open-Ended Questions

Unlike MCQs or Likert scale questions, open-ended questions are unstructured questions that provide students the opportunity to think analytically and critically, and express their opinion regarding the problem in discussion. The educator can add open-ended questions using the question form shown in Figure 4.11.

4.1.8   Debriefing

At the end of each quiz, the user is provided with feedback regarding their overall performance. Figure 4.12 shows one such instance. Each question in the quiz is displayed with the original choices provided. The choice selected by the student is compared against an expert rating (already uploaded to the system by the educator) and is highlighted as green if correct otherwise it is red. The system also summarizes the user's performance in the quiz by displaying the score (total correct answers against total questions) and the overall rating compared to other

Figure 4.12: Selected students are provided feedback at the end of each quiz. The feedback page displays the student rating against an expert rating.

users who attempted the same quiz. Feedback at the end of a quiz is an optional functionality. The educator ultimately decides if a student should be provided feedback or not.

4.1.9 Administrative Panel

The administrative panel is an interface designed for the database administrator (DBA) to manage the content in the system (see Figure 4.13). The DBA can view the data and relationships between different entities stored in the database. Moreover, the DBA can also add, update, or delete instances.

4.1.10 User Analytics

OPEN provides two types of analytics: (i) page views, and (ii) visitors. The page views store the URL of the web-page and the time when it was requested from a user's browser, whereas the visitors section stores information regarding the user who visited the web-site. The information that is stored about the user includes: (i) user's session key, (ii) username, (iii) session start time, (iv) session completed or not, (v) total time spent on site, (vi) user's IP address, and (vii) the user agent (see Figure 4.14). To ensure that the total time spent of the web-site does not include the inactive time, each session is automatically ended if the inactive time for the user exceeds 30 minutes. An educator can perform many different analytical techniques on the data provided to obtain further user information.

Figure 4.13: The admin panel shows the data and relationship between entities stored in the database. The DBA can add, update, or delete these entries.

Figure 4.14: Analytical operations on the data stored regarding each user visiting the web-site can be helpful to determine characteristics about the users' on the web-site.

4.2   Technical Details

Similar to Fydlyty, OPEN was developed on the open-source Django Framework [105] and utilizes the MVC (Model View Controller) design pattern. The front-end code organization is also accomplished using Twitter Bootstrap [79]. The data storage is divided into two storage devices; relational database and cloud storage. For a relational database I employed MySQL [120] whereas, for cloud storage, the Amazon Simple Storage Service (Amazon S3) [6] is employed. Files uploaded into the system (PDF, image, video, etc.) are stored on the cloud storage. All other data is stored on the relational database.

4.2.1   Application Architecture

Figure 4.15 illustrates the application architecture of OPEN. With an incoming request from a user's browser, the URL dispatcher maps the requested URL to a function which belongs to a sub-application and calls it. OPEN is developed by combining smaller applications, which are distinct in functionality, yet depend upon one another for the successful completion of various operations. The sub-applications in OPEN include: (i) accounts, (ii) user profiles, (iii) course, (iv) institute, and (v) quiz. Each sub-application contains a set of files which perform certain functionalities, define the structure of the database, and map URL's onto functions. As shown in Figure 4.15, all the sub-applications contain views, models, and URLs. In the views file, programmers can write Python functions that take a web request, apply some arbitrary logic, and return a web response. This response can be the HTML content for a web page, a redirection, or an XML document, amongst others [107]. The models contains information regarding the essential fields and behavior of the data which will be stored in the database. Finally the URLs keeps a list of URL patterns which the user can request. These URL patterns are mapped to Python functions (stored in the views files) and can be used to perform a number of procedures.

For the end-users to interact with the application, an interface is required. In OPEN, I store all such information in the templates directory (see Figure 4.15) which any sub-application can access. A template is a text document or a normal Python string that is marked-up using the Django template language [106]. Furthermore, the framework stores data into storage devices: (i) relational database, and (ii) cloud storage. The Python database API [107] provides an interface for the developer to create, retrieve, update, and delete objects from the database.
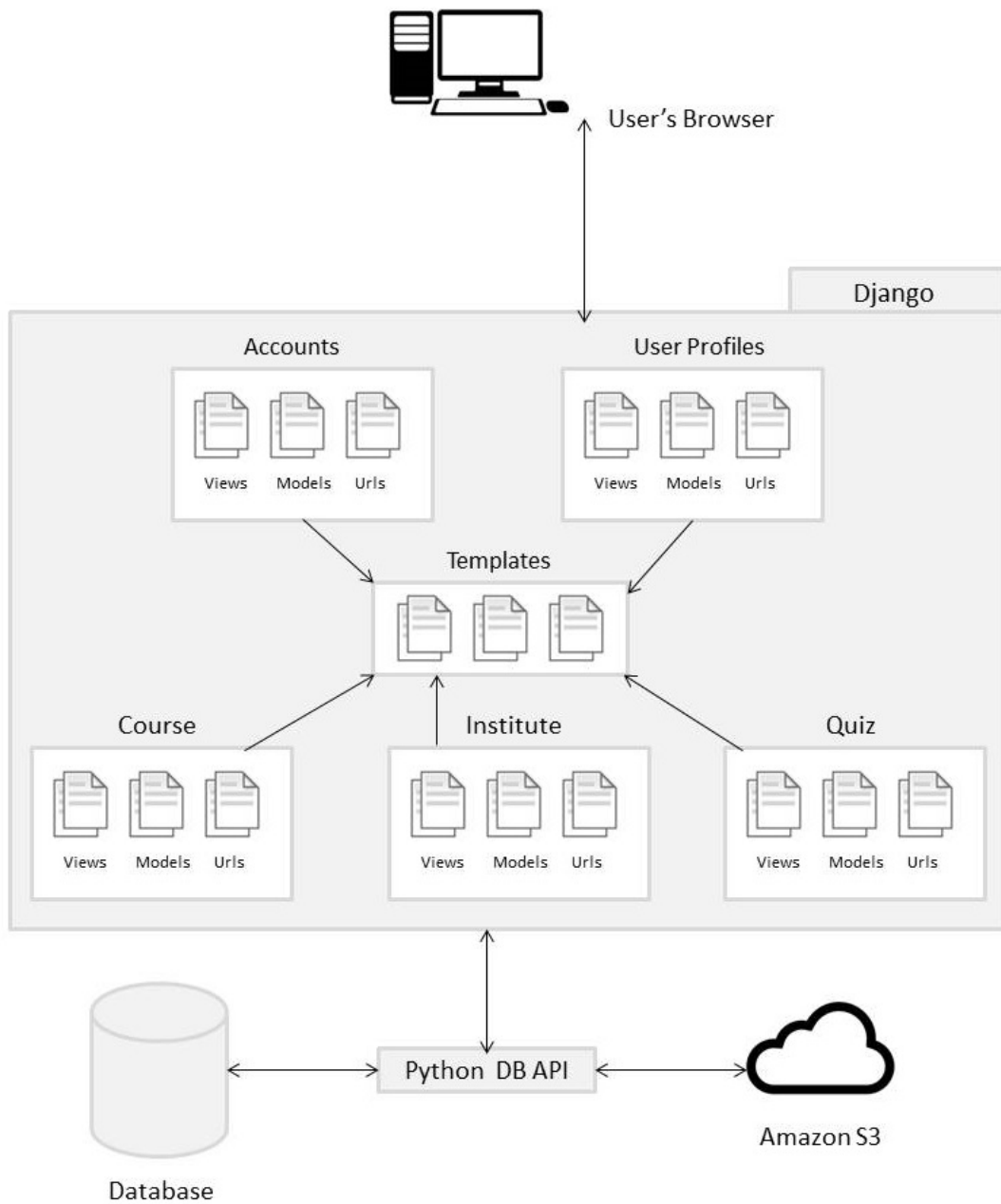
Figure 4.15: The application architecture of OPEN.
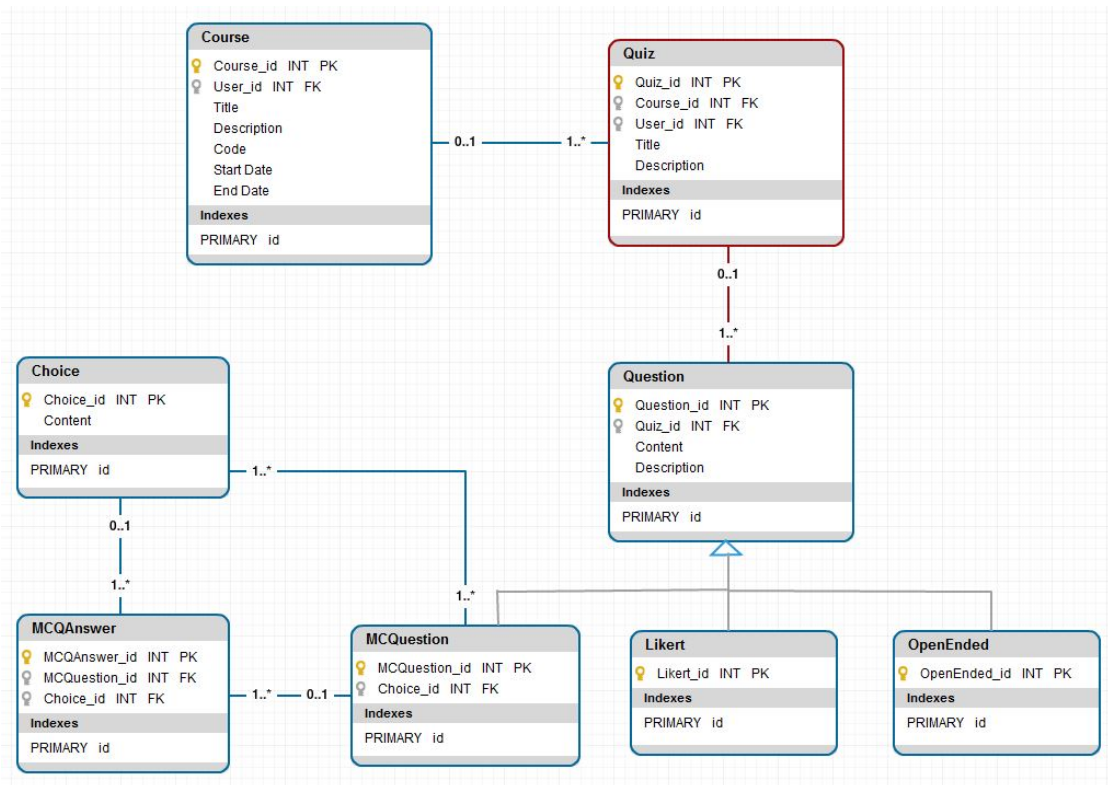
Figure 4.16: The schema for the quiz module.

4.2.2 Database Schema

As described in the previous section, OPEN is developed by combining multiple interconnected sub-applications. For simplicity and better understanding, in this section a description focusing on the database schema of the quiz module only (see Figure 4.16), is provided.

Course

The Course class represents the courses in the system. An instance of Course consists of the following fields:

1. Course ID: Unique identifier for each instance.

2. User ID: Forms a one-to-many relationship with User.

3. Title: String type title for each course.

4. Description: Text field for any related information.

5. Code: String type course code for each course.

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6. Start Date: Date type field for start of course.

7. End Date: Date type field for end of course.

Quiz

A Course has a one-to-many relationship with Quiz. The entity represents quizzes related to courses. An instance of Quiz consists of the following fields:

1. Quiz ID: Unique identifier for each instance.

2. Course ID: Forms a one-to-many relationship with Course.

3. User ID: Forms a one-to-many relationship with User.

4. Title: String type title for each quiz.

5. Description: Text field for any related information.

Question

A Quiz has a one-to-many relationship with Question. The entity is a parent to specific genres of questions. An instance of Question consists of the following fields:

1. Question ID: Unique identifier for each instance.

2. Quiz ID: Forms a one-to-many relationship with Quiz.

3. Content: String type content of each question.

4. Description: Text field for any related information.

MCQuestion

MCQuestion is a child class of Question. An instance of MCQuestion consists of the following fields:

1. MCQuestion ID: Unique identifier for each instance.

2. Choice ID: Forms a one-to-many relationship with Choice.

Likert

Likert is a child class of Question. An instance of Likert consists of the following fields:

1. Likert ID: Unique identifier for each instance.

OpenEnded

OpenEnded is a child class of Question. An instance of OpenEnded consists of the following fields:

1. OpenEnded ID: Unique identifier for each instance.

Choice

Choice has a one-to-many relationship with MCQuestion. An instance of Choice consists of the following fields:

1. Choice ID: Unique identifier for each instance.
2. Content: String type content of each choice.

MCQAnswer

MCQAnswer represents the correct choice for a MCQuestion. An instance of MCQAnswer consists of the following fields:

1. MCQAnswer ID: Unique identifier for each instance.
2. MCQuestion ID: Forms a one-to-many relationship with MCQuestion.
3. Choice ID: Forms a one-to-many relationship with Choice.

4.2.3   Deployment

OPEN is deployed on the same server as Fydlyty, therefore, the specifications for the server remain the same (see section 3.3.3). OPEN is configured on port 8003 and can be accessed using the IP address `http://199.212.33.115:8003/`.

Chapter 5

Experiment One: A Comparison of Two Low Fidelity versions of the Fydlyty Serious Game

A user-based experiment was conducted to gauge user perceptions regarding Fydlyty's user interface and to examine user satisfaction and engagement with Fydlyty. The purpose of the study was to obtain input regarding the user interface and in the process determine if the player was more engaged in the game environment, while playing in the basic or advanced level of fidelity. Participants were divided into two groups and each group played one version of the game, after which their engagement and user satisfaction was quantified by using previously validated self-reporting tools. The results of this study help us develop a better understanding regarding the effect of fidelity on player engagement and satisfaction within a low-fidelity environment. This can be of vital importance when developing low-fidelity cultural competence serious games such as Fydlyty (described in Chapter 3).

5.1   Participants

The participants were comprised of 30 volunteer students (21 male, 9 female) from different universities including the University of Ontario Institute of Technology (UOIT) and the University of Toronto (U of T). These students were either enrolled in Computer Science (20 students) or Health Science (10 students) programs. The minimum, maximum and average age of the participants was 20, 40, and 26 years respectively. I did not participate in the experiment and the experiment abided by

the University of Ontario Institute of Technology Research Ethics Review process for experiments involving human participants (UOIT REB #13-054).

5.2   Experimental Method

The game was developed to be played from the user's personal space, using their personal computer, and facilitated by an Internet connection. To achieve this purpose, Fydlyty was deployed on to an in-house server at UOIT (see Section 3.4.3) and participants were encouraged to use their personal computers to access and play the game from August 15, 2015 - September 20, 2015. However, if the participants were not comfortable with using their own computers or if there were any technical reasons that prevented the game from running on their system, then they were provided an Alienware 14 laptop with an extended 21" display. The game ran on the Mozilla Firefox browser.

Prior to the experiment, participants were randomly assigned to either Group A, which played the basic fidelity version (see Section 3.2.1), or Group B, which played the advanced fidelity version (see Section 3.2.1). The groups were counter-balanced to ensure any bias was minimized, if not eliminated completely. The participants were provided a script by email which included: (i) information about the game, (ii) research domain, and (iii) user credentials (see Appendix A.2). Participants were also provided a step-by-step tutorial PDF document, to teach them how to navigate to the game screen (see Appendix A.2).

After entering the URL `http://www.fydlyty.com` in the browser, an account login page was displayed to the participant (see Figure C.6). Entering the username and password provided in the email redirected the user to the homepage that provided information about: (i) the game, (ii) scenarios, and (iii) the author (see Figure C.7). The homepage provided the opportunity for participants to familiarize themselves with the website's environment. The homepage also displayed an avatar developed using Crazy Talk. In addition, any missing plug-in which may have hurdled the rendering of the avatar could have spotted and fixed before playing the actual game. The 'Play' button, located in the top menu bar takes the participant to the scenario page where a list of scenarios (posted by the educator for the participant) are displayed. For the purpose of this study, each participant was capable of seeing one scenario only. Basic and advanced levels were coded as Scenario X and Scenario Y respectively and the title of the scenario was Scenario 1 or Scenario 2 respectively (see Figure C.8).

Once the participant completed the game, he/she could either replay it (no restrictions were placed on the number of times the participant could replay the game) or complete a brief questionnaire. Along with demographic questions, the questionnaire comprised of a subset of questions from: (i) Questionnaire for User Interaction Satisfaction (QUIS) [76] and (ii) Game Engagement Questionnaire (GEQ) [15] (see Appendix B.1).

5.2.1 Demographic Questions

Demographics are characteristics of the population that help determine the factors that may influence the participants response, and opinion. To gather the background information regarding the participant, a demographic-based questionnaire was provided to them. Here participants were asked questions regarding their: (i) age, (ii) sex, (iii) field of study/profession, and (iv) gaming experience.

5.2.2 Questionnaire for User Interaction Satisfaction

The Questionnaire for User Interaction Satisfaction (QUIS) [93], is a tool developed by a multi-disciplinary team of researchers to assess users' subjective satisfaction with specific aspects of the human-computer interface and is highly reliable across many types of interfaces [93]. The purpose of the QUIS is to "assess users' subjective satisfaction with specific aspects of the human-computer interface and several open-ended questions" [93]. For this experiment, the QUIS-based questions were classified into four categories: (i) system reactions, (ii) graphics and sound, (iii) learning to play the game, and (iv) system capabilities. The user could answer each of these question on a 10-point Likert scale. In addition, 12 "open-ended" questions were also included to gather user feedback regarding the Fydlyty serious game.

5.2.3 The Game Engagement Questionnaire

The GEQ provides a psychometrically strong measure of the level of engagement elicited while playing video games. Engagement indicates the level of involvement of a game player in the game [15]. Statistical results indicate the GEQ to be a very appropriate tool for the measure of engagement [15]. The GEQ consists of 19 questions (see Figure 5.1), which the participant can respond to with one of the following options: (i) No, (ii) Maybe, or (iii) Yes. Each response has been assigned a numerical value: (i) No = 0, (ii) Maybe = 1, and (iii) Yes = 2. The

aggregate of the responses (the total GEQ score) is directly proportional to the player's engagement. Therefore, higher GEQ scores indicate higher engagement and lower GEQ scores indicate lower engagement. Furthermore, the GEQ measures engagement at four different levels: (i) immersion, (ii) absorption, (iii) presence, and (iv) flow. These terms are defined as following:

Immersion

Immersion is defined as "a psychological state characterized by perceiving oneself to be enveloped by, included in, and interacting with an environment that provides a continuous stream of stimuli and experiences." [95]. Therefore, immersion can be understood as a feeling of actually being present/part of the virtual environment [121].

Absorption

Absorption is defined as "a disposition for having episodes of 'total' attention that fully engage one's representational (i.e., perceptual, enactive, imaginative, and ideational) resources." [104]. This is achieved when the sense of reality is heightened and the player is completely engaged in the environment [56] [104].

Presence

Witmer and Singer defined presence as "the subjective experience of being in one place or environment, even when one is physically situated in another." [122]. Given the appropriate conditions, presence can be understood as an experience for video game players of being inside the virtual environment [15].

Flow

Flow is the term which defines "a psychological state in which the person feels simultaneously cognitively efficient, motivated, and happy." [72]. Furthermore, flow can be described by the feeling of enjoyment felt by the game player when a balance between one's gaming skills and given challenge is achieved [27] [72].

	Questions	Engagement Measure
1	I lose track of time	Presence
2	Things seem to happen automatically	Presence
3	I feel different	Absorption
4	I feel scared	Absorption
5	The game feels real	Flow
6	If someone talks to me, I don't hear them	Flow
7	I get wound up	Flow
8	Time seems to kind of stand still or stop	Absorption
9	I feel spaced out	Absorption
10	I don't answer when someone talks to me	Flow
11	I can't tell that I'm getting tired	Flow
12	Playing seems automatic	Flow
13	My thoughts go fast	Presence
14	I lose track of where I am	Absorption
15	I play without thinking about how to play	Flow
16	Playing makes me feel calm	Flow
17	I play longer than I meant to	Presence
18	I really get into the game	Immersion
19	I feel like I just can't stop playing	Flow

Figure 5.1: Game Engagement Questionnaire. Responses are No=0, Maybe=1, Yes=2. Taken from [15].

5.3 Results

In this section I analyze the data collected by running the experiment. The section has been divided as follows: (i) participants game experience, (ii) QUIS-based scores, and (iii) game engagement scores.

5.3.1 Participant Game Experience

The participants were asked several questions regarding their prior video game experience. The majority of the participants (72%) spent less than ten hours playing video games each week (see Figure 5.2). When asked which platform they primarily play video games on, 11 participants wrote mobile phones/devices and eight wrote computers (see Figure 5.3). The participants also enjoyed playing video games from a variety of genres. The most popular ones were shooter games (first- or third-person perspective) (see Figure 5.4).

Figure 5.2: Hours each week the participants spent playing video games.
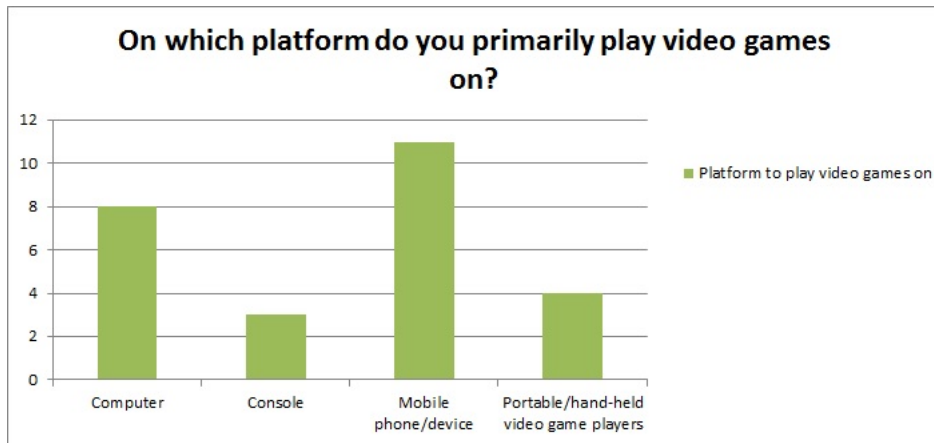
Figure 5.3: Platform participants primarily use to play video games.
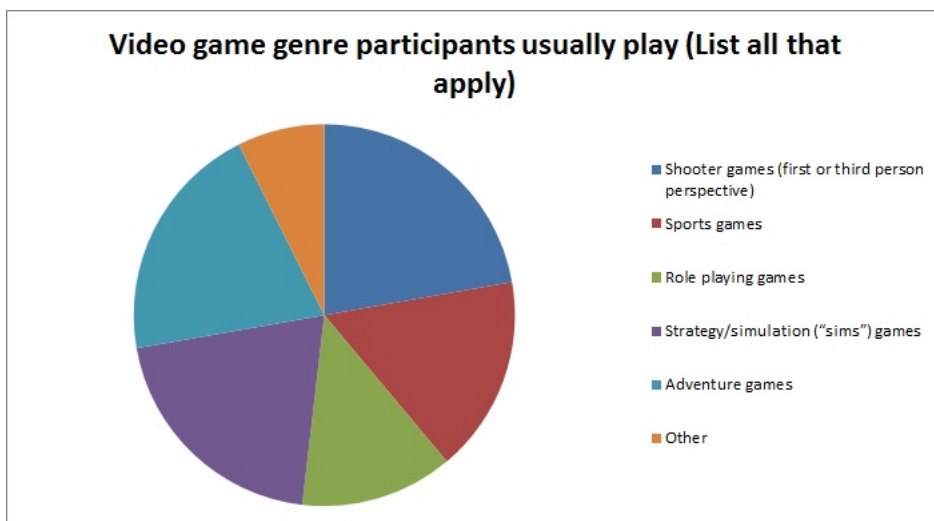
Figure 5.4: Genre of video games that participants usually play (list all that apply).

5.3.2 QUIS-based Scores

The results for each category of QUIS (i.e. (i) system reactions, (ii) graphics and sound, (iii) learning to play the game, and (iv) system capabilities), represent the average of the participants response. A graphical summary of the results is provided in Figures 5.8 - 5.11.

Group A Results for User Satisfaction

Figures 5.5 - 5.8 present a graphical summary of the average values of the QUIS-based categories for participants from Group A (Scenario 1). The overall reaction of the participants regarding the system was very encouraging. To a great extent the participants claimed that interacting with the system was very easy (7.6), and was a wonderful experience (6.6). With respect to graphics, when asked if the arrangement of information on the screen was logical, an average value of approximately 8.0 resulted indicating that participants were pleased with the arrangement of information Fydlyty's. Similarly, to a great extent, participants believed that the amount of information displayed on the screen was adequate (7.1). Furthermore, the average response for the quality of graphics was low (5.7).

The participant responses for the category "Learning to play the game" were highly ranked, suggesting that the operations were easy (7.9), getting started with the game was not stressful (7.5), and the time required to learn the game was very short (7.8). Furthermore, participants also received feedback at each step (6.7) and these steps were performed in a logical sequence (7.7). The lowest and highest average response in this category was 6.7 and 7.9 respectively.

Finally, in response to system capabilities, to a great extent the participants felt that the speed of the system, the response time, and the rate of display of information on the screen was fast enough (approximately 7.0 each). Also the average perception of the system reliability was 6.9.

The results for the open ended subset of questions (see Figures 5.9 - 5.10), represent the percentage of users who chose one of the five possible answers on the 1-5 point Likert scale. Examining the participants response shows that the objectives of the serious game were clear and easy to understand. The participants were able to relate the scenario to a real-life situation and were provided enough cues to progress in the virtual world. Approximately 93% of the participants claimed that they did not have any difficulty in interacting with the VC within the serious game.
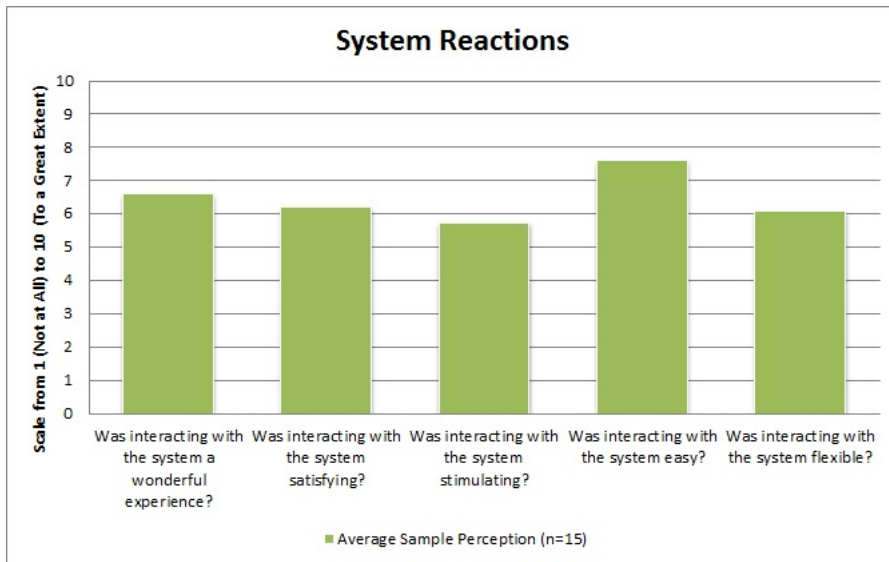
Figure 5.5: Group A Results: "System Reactions".
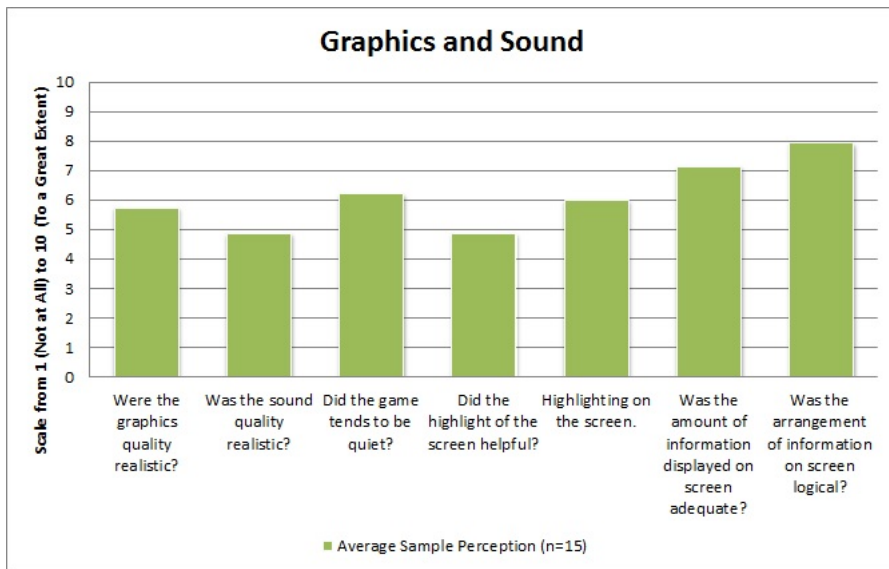
Figure 5.6: Group A Results: "Graphics and Sound".
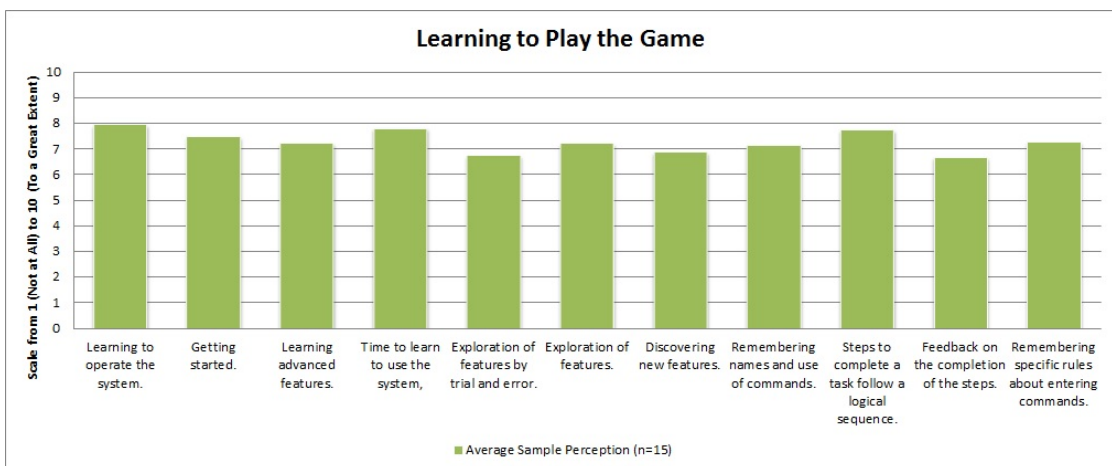
Figure 5.7: Group A Results: "Learning to Play the Game".
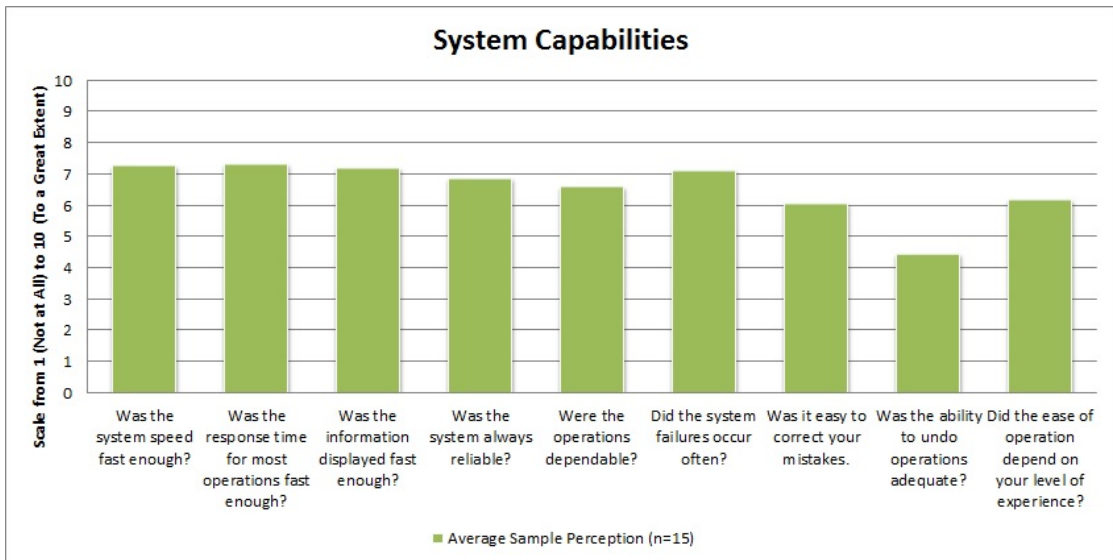
Figure 5.8: Group A Results: "System Capabilities".
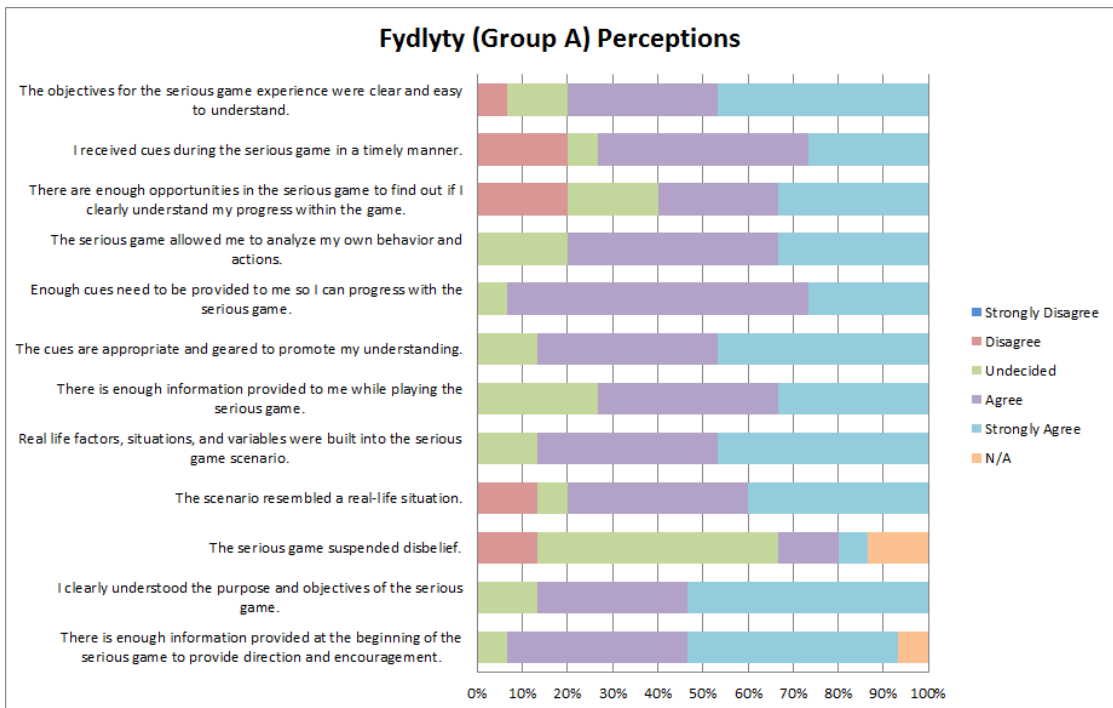
Figure 5.9: Group A Results: "User Perceptions".

However, the majority of the participants (53%) were indecisive when asked if the serious game suspended disbelief or not.

Group B Results for User Satisfaction

The QUIS-based scores for the participants in Group B (Scenario 2) are shown in Figures 5.11 - 5.14. The average scores for the overall system reaction suggest that the majority of the participants felt that the interaction with the system was
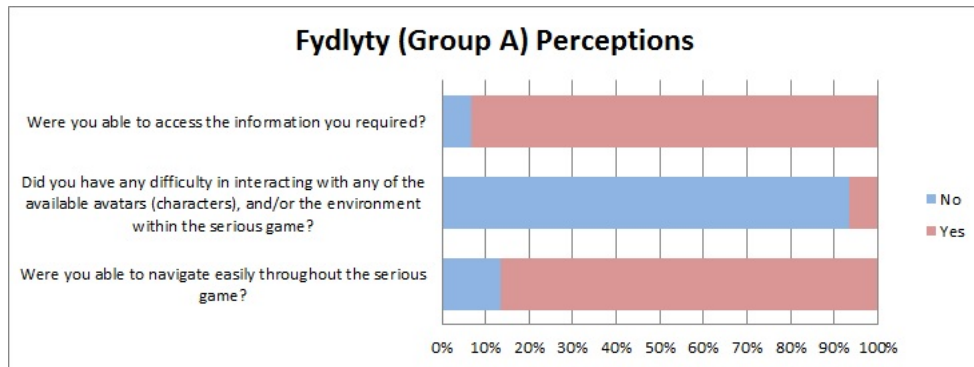
Figure 5.10: Group A Results: "User Perceptions".

very easy (7.5), a wonderful experience (6.1), and satisfying (6.4). Furthermore, to a great extent, the participants felt that the information displayed on the screen was adequate (6.5) and the arrangement was logical (7.0). However, when asked if the graphics and sound quality was realistic, the responses were fairly low (3.8 and 4.7 respectively).

Group B suggested that learning to play the game was quite simple. The average perception to learn to operate the system and the time required to learn to use the system was approximately 8.0. Also to a great extent, the participants claimed the that tasks were completed following a logical sequence (7.5), and feedback was readily provided at the completion of each task (6.5).

The participant responses to each question in the system capabilities section was approximately between the averages 7.0 - 8.0. The majority of the participants believed that the system was fast (7.5), the response time was low (7.1), and the system was very reliable (7.7). Also the participants believed that as they gained experience playing the game, the operations became easier to perform (7.5).

Similar to Group A user perception scores, the results for the open-ended subset of questions represents the percentage of users who chose one of the five possible answers on a 5-point Likert scale (see Figures 5.15 - 5.16). Examining the responses shows that the objectives of the serious game were well understood by the majority of the users (73%) and cues during the game were provided in a timely manner (80%). Also the serious game conveyed a real-life scenario which the participants could relate to (73%). A majority of the participants also believed that an appropriate amount of information was provided at the start of the game (80%). Participants did not to have any difficulty in interacting with the VC presented in the serious game (87%). However, the participants were left indecisive when asked if the serious game suspended disbelief or not (53%).
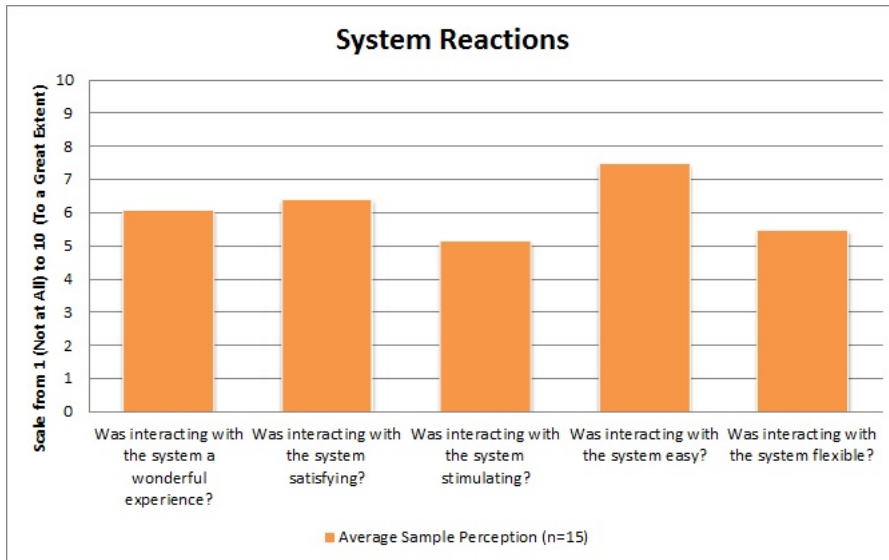
Figure 5.11: Group B Results: "System Reactions".
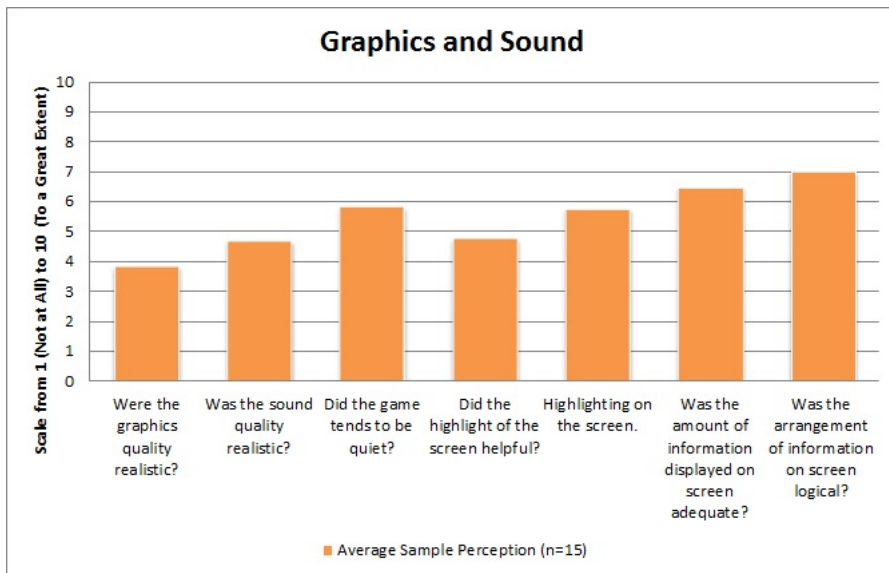
Figure 5.12: Group B Results: "Graphics and Sound".
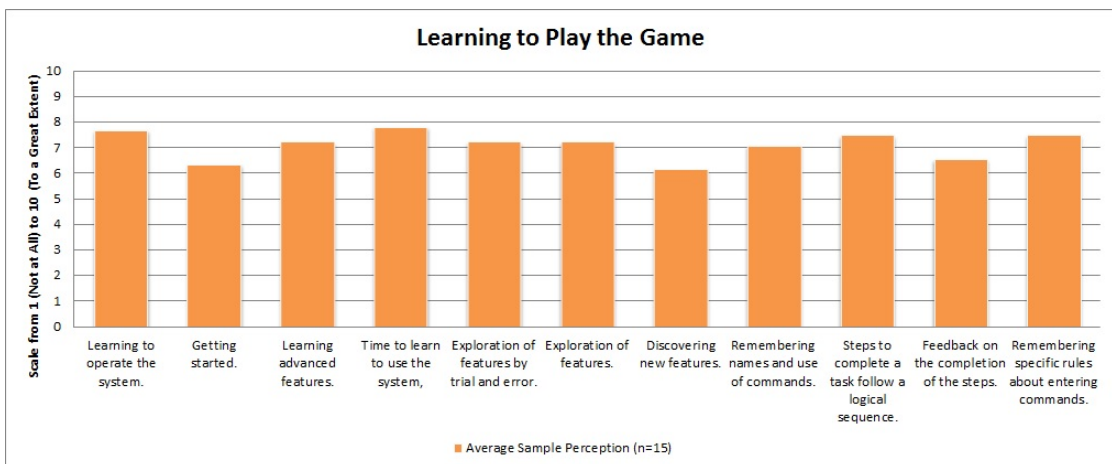
Figure 5.13: Group B Results: "Learning to Play the Game".
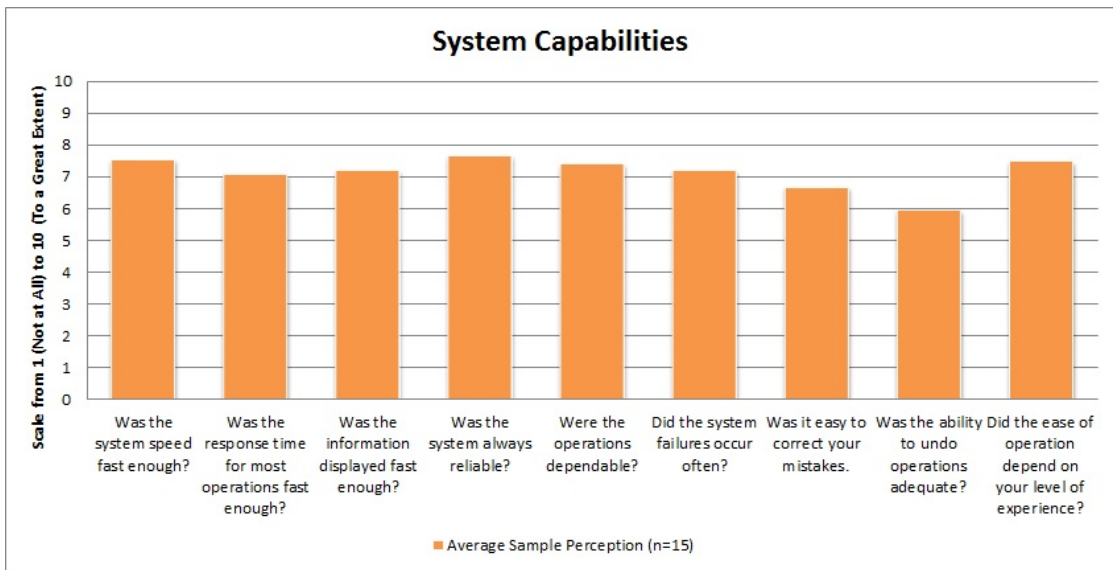
Figure 5.14: Group B Results: "System Capabilities".
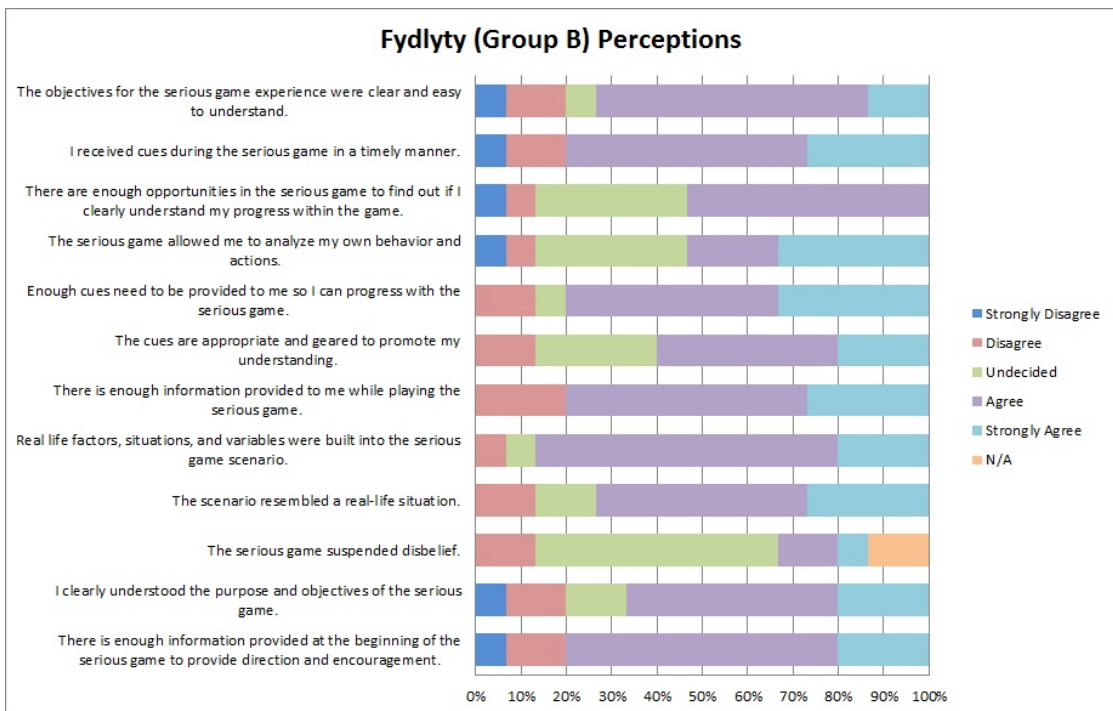
Figure 5.15: Group B Results: "User Perceptions".
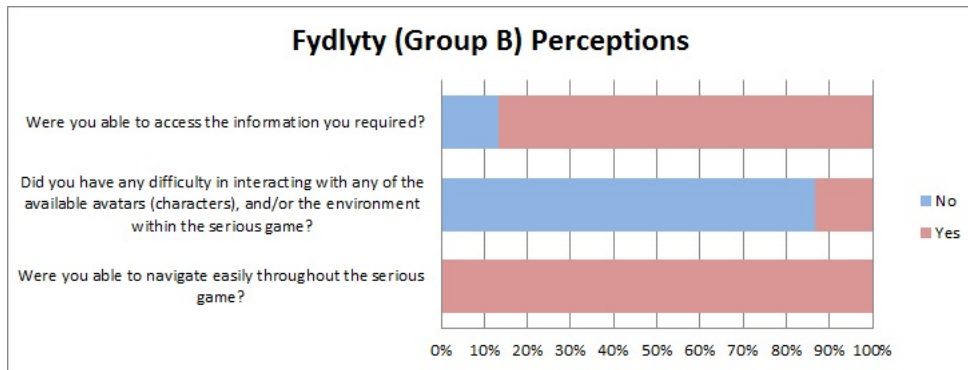
Figure 5.16: Group B Results: "User Perceptions".

5.3.3 Game Engagement Scores

The results for each user experience-based scores (i.e. (i) immersion, (ii) absorption, (iii) pressure, and (iv) flow), represent the average of the participants response. A graphical summary of the results is shown for each group below.

Group A Results for User Engagement

Average Group A (Scenario 1) scores for absorption and immersion have been combined to be presented together in Figure 5.17. Examining the results of immersion, it is evident that the majority felt immersed during game play (53%) while 40% were indecisive. However, on average the participant responses for the measure of absorption were "No", indicating there is definite room for improvement while designing the scenario.

With respect to flow, 60% participants thought that the game felt real, and 50% claimed that playing the game makes them calm. Furthermore, with respect to measuring presence (see Figure 5.19), a majority of participants (53%) suggested that they played the game longer than they meant to, signifying that the game was fun and entertaining. Also 53% and 47% were indecisive when asked "I lose track of time." and "My thoughts go fast." respectively.

Group B Results for User Engagement

In terms of Group B (Scenario 2), the average measure of immersion was 33%, whereas 47% of the participants felt indecisive (see Figure 5.20). The measure of absorption remained low for this group, where majority of the participants did not feel absorbed during game play.
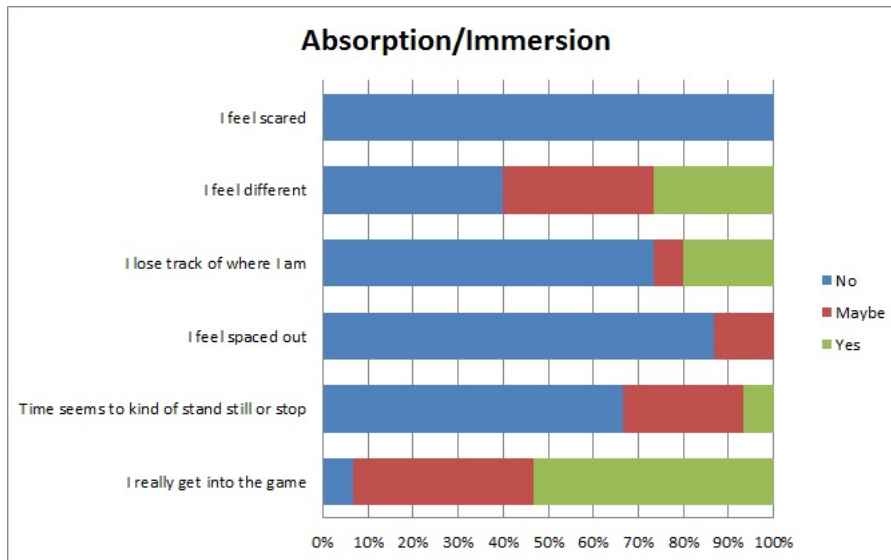
Figure 5.17: Group A Results: "Absorption/Immersion".
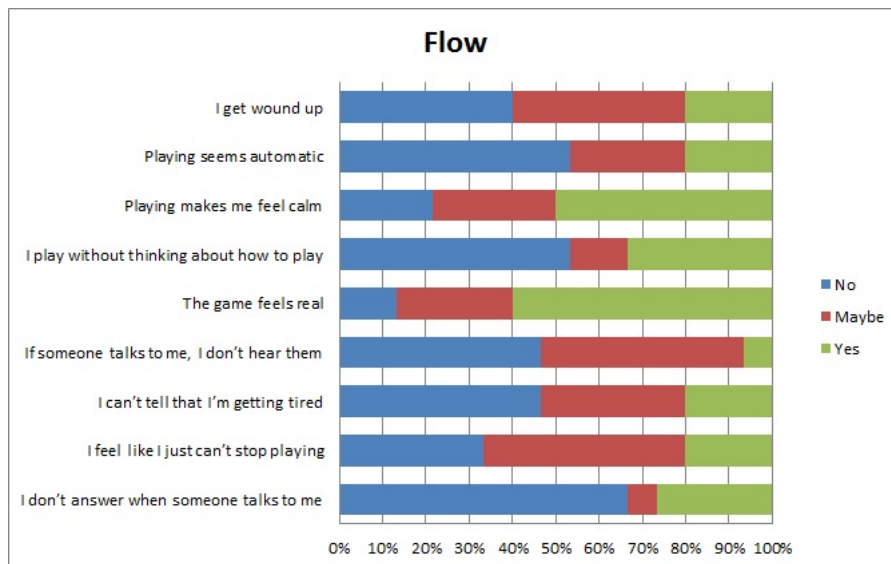
Figure 5.18: Group A Results: "Flow".

The averages for the measure of flow (see Figure 5.21) suggested that the majority of participants were indecisive if the game was real or not (53%), 33% participants thought that the game was real. 53% participants claimed that they play without thinking and 47% said that playing makes them feel calm.

When asked about their thoughts during game play (see Figure 5.22), the majority of participants (67%) believed that their thoughts go fast while playing the advanced fidelity version. However, a small portion of only 20% and 27% said that "I play longer than I meant to." and "I lose track of time." respectively.
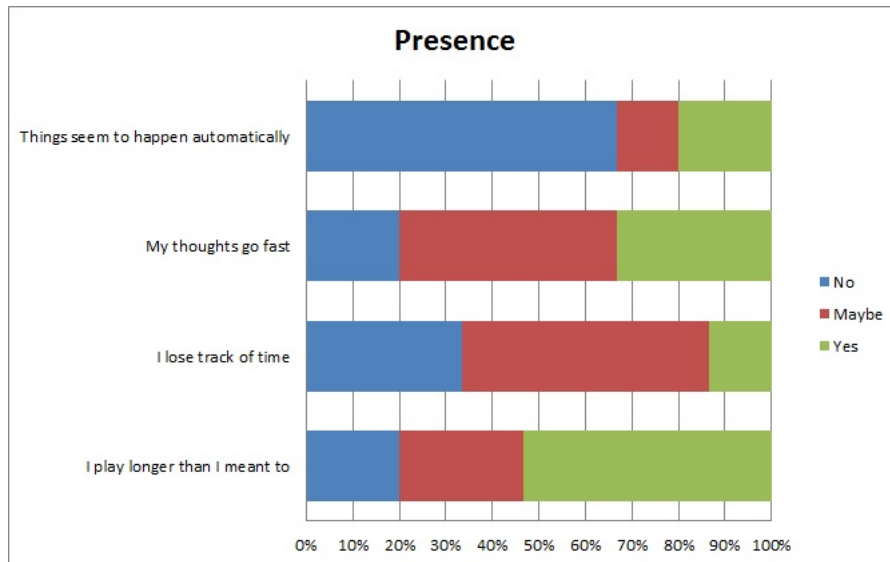
Figure 5.19: Group A Results: "Presence".
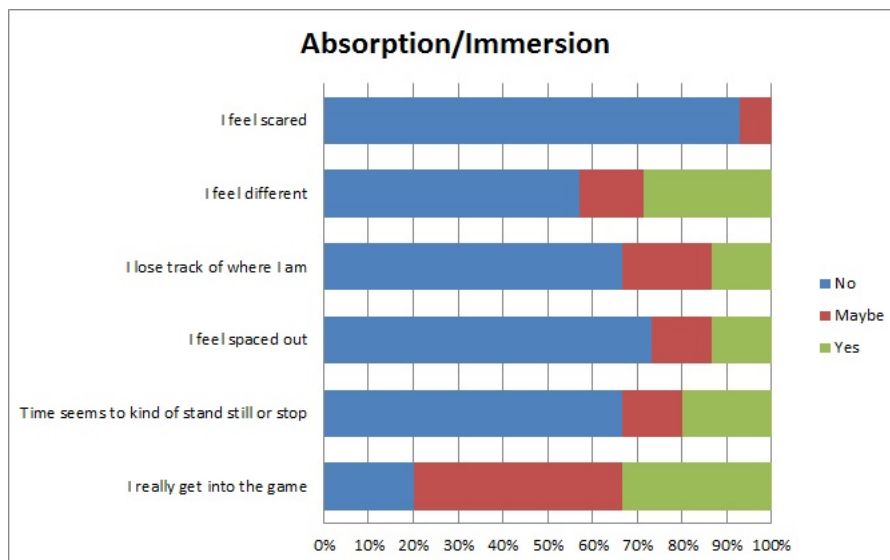
Figure 5.20: Group B Results: "Absorption/Immersion".

5.4 Discussion

This study examined the user interface and the game's engaging aspects. I developed a low-fidelity serious game that facilitates the dialogue between a game player (taking on the role of a medical professional) and a VC (Jade Wilson) who comes to the clinic to discuss her abrupt weight-loss. The participants were divided into two groups (15 participants per group) separated accordingly so that any bias could be minimized, in which each group was assigned a different version of the game (i.e. basic or advanced level of fidelity). This variation was based on the level of environmental fidelity provided (see Section 3.2.1). In this section the

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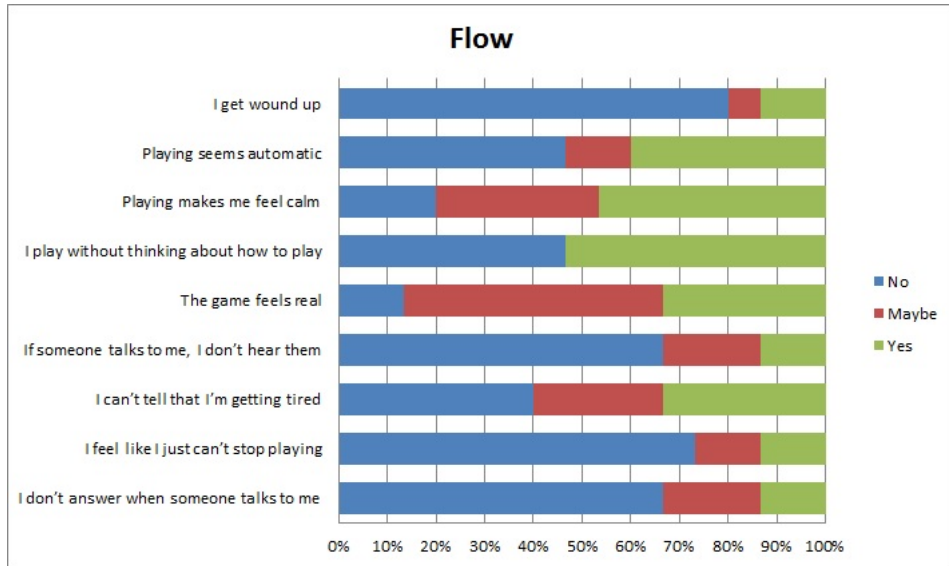
Figure 5.21: Group B Results: "Flow".
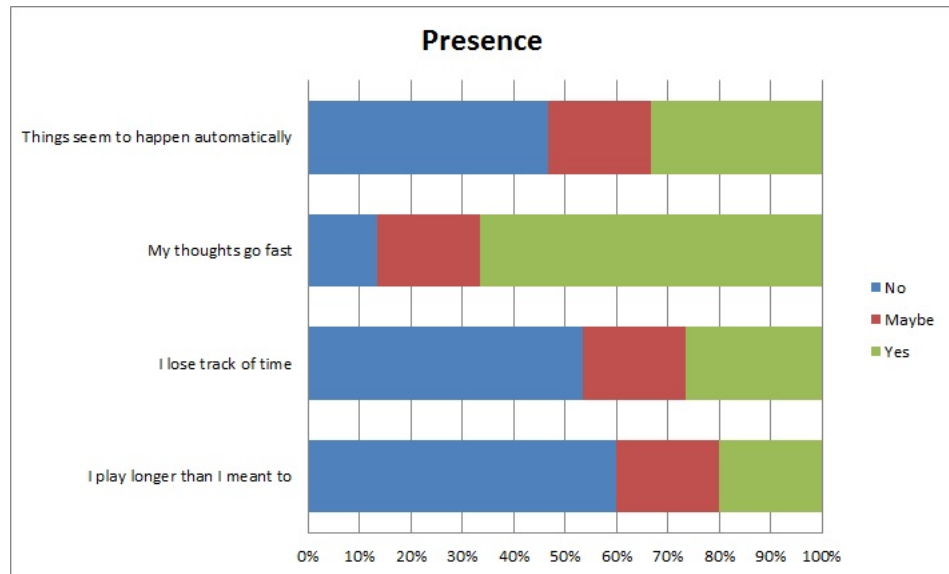
Figure 5.22: Group B Results: "Presence".

main results of the study and their implications based on the (i) user satisfaction, (ii) user engagement, and (iii) free-form comments provided by the participants are discussed.

5.4.1 User Satisfaction

Comparing average values across different questions of the QUIS-based scores, indicates that there was no significant difference in the user satisfaction for the two versions, except for graphics and sound. This outcome is highly expected, as other than the VCs, all other components remained identical in both versions of the

game. However, surprisingly Group A (low graphical fidelity), rated the graphics quality higher (5.7) than Group B (higher graphical fidelity) (3.8). Furthermore, both groups considered the interaction with the system very easy (approximately 7.5 each group) and a wonderful experience (Group A (6.6), Group B (6.1)) therefore justifying the purpose of developing a web-application, for users to operate on their own, from their personal space, and without receiving any professional assistance. Similarly, both groups did not have any trouble in learning to play the game. The average scores here are very similar and highlight the effective use of feedback provided at the end of each step (see Figures 5.7 and 5.13). The game was deployed on the in-house server at UOIT, which the participants accessed to play the scenario. No issue/problem was reported while accessing the server. The participants also endorsed the reliability (Group A (6.9), Group B (7.7)), and usability (Group A (7.1), Group B (7.2)) of the system.

5.4.2 User Experience

The measure of absorption was fairly similar in both versions of the game (see Figure 5.17 and 5.20). Both groups believed that they were not absorbed in the game environment, although many participants found the game to be fun which is evident from the scores in the measure of immersion. Even though participants in Group A were shown lower fidelity visual cues, with no audio, still the level of immersion was rated higher (53%) than Group B (33%). This can be understood by the study of Scerbo et al. [90], where they claim that higher fidelity is not always necessary and sometimes can impede learning. In another study, Hays and Michael's claim that high fidelity can also interfere with performance and disrupt learning [45]. One explanation with respect to Fydlyty is that audio and visual cues in the higher fidelity version were played only once for each response. The VCs emotion for each response was communicated through facial expressions, which might have not been perceived by the game player during one such instance. The pitch, intensity, and formant for audio cues also remained same for each emotion thus creating difficulty rather than helping the game player to determine the mood of the VC. Furthermore, participants in Group A (53%) reported that they play the game longer than Group B (20%). While providing informal feedback after the completion of the experiment, participants who played the game multiple times (eight participants), informed the experimenter that after their first attempt they were inquisitive to see what would happen in the game if they selected other options as well. One participant played the game until he/she obtained all of the correct options.

5.4.3 Free-form Comments

In the free-form comments section of the survey, majority of the participants described the serious game as fun, engaging, and a beneficial tool to enhance cultural competence skills (93%). Some of the notable responses are as following:

> "The experience was close to real life interaction with the patient. It helped me to appreciate my communication skills and the graphical response of the patient were like an instant feedback." (Participant 23, August 2015)

> "It helped me analyze my own behaviour towards patients." (Participant 27, August 2015)

Furthermore, I asked participants if there are things in the serious game which they would like to change. Some comments which provide feedbacks regarding the interface are as following:

> "I would have preferred real voice acting in the game, as opposed to the computer generated audio." (Participant 10, August 2015)

> "Better feedback. Feedback should be constructive. It should explain why the chosen selection was either the best or not. I feel that without the explanation of why an answer would be (or not) the most suited for the situation, the learning purpose of a serious game is hardly accomplished." (Participant 13, September 2015)

5.5 Conclusion

A study was conducted to compare the two versions of Fydlyty (i.e. lower and higher levels of environmental fidelity), and to obtain feedback regarding the user interface of the serious game. 30 participants comprising of health-care and computer science students were divided into two groups (15 participants per group), each of which played the game in one of the two levels of environmental fidelity: (i) basic (the VC did not exhibit any facial expressions or speech-based dialogue) or

(ii) advanced (the VC exhibited facial expressions and voice-based dialogue). To examine the user perceptions regarding the interface as well as determining which version of the game provided higher user satisfaction and engagement, data based on user: (i) demographics, (ii) satisfaction, and (iii) experience, was collected at the end of game play.

Comparing average values of the scores obtained from the study defied our earlier stated hypothesis, claiming that participants playing the lower level (environmental) fidelity cultural competence serious game in a higher level (environmental) fidelity (Group B) will feel more satisfied and engaged in the game play as compared to participants playing the game in a lower level of fidelity (Group A), where both these games are categorized as a low-fidelity design with a variation in the range of fidelity. Results from QUIS-based scores and the GEQ (see Section 5.3) provide evidence that changing only one component in the game (VC) can affect the players interaction and learning in the environment. Furthermore, this study can be meaningful when designing low-fidelity cultural-competence games such as Fydlyty. The results indicate that "high fidelity, high performance" is not always true in such a web-based low-fidelity environment, and the user engagement can be compromised if higher-fidelity audio and visual cues are used.

The free-form comments provided by the participants encouraged the use of such a serious game for medical-based cultural competence training. Health-care students mentioned that they could relate to the scenario, and the feedback provided helped them analyze their mistakes when dealing with patients. I use the feedback provided by the participants (formal and informal) to further improve the shortcomings of this study and run the next experiment which consists of health-care professionals, educators, and nursing students.

Chapter 6

Experiment Two: Engagement and Satisfaction of Health-care Professionals And Trainees in a Low-fidelity Design

The Fydlyty serious game was developed to facilitate health-care practitioners, educators, and professionals to learn and improve already existing cultural competence skills in a medical-based environment. For this purpose I conducted an experiment to obtain input regarding the usefulness of a low-fidelity cultural competence serious game, such as Fydlyty, to be used by health-care professionals and trainees. In this experiment I asked participants to play the version of the serious game which provided an advanced level of environmental fidelity (see Section 3.2.1) whilst recording their game play, after which their engagement and user satisfaction was quantified by using previously validated self-reporting tools. The results of this study bring us closer to developing a greater understanding of the user experience and satisfaction of professionals and trainees in a low-fidelity environment whilst playing a cultural competence serious game.

6.1   Participants

The participants were comprised of 14 volunteer health-care professionals (five) and students (nine) from the University of Ontario Institute of Technology (UOIT) and the University of Toronto (U of T). All participants who took part in the

experiment were females with the minimum, maximum, and average age of 18, 58, and 35 years respectively. Due to the lack of data for male participants, and to avoid any gender bias, all results are strictly relevant to female health-professionals and trainees only. Furthermore, I did not participate in the experiment and the experiment abided by the University of Ontario Institute of Technology Research Ethics Review process for experiments involving humans participants (UOIT REB #13-054).

6.2 Experimental Method

An experiment was conducted during the period ranging from September 29, 2015 - October 16, 2015. The experiment took place in a small faculty office (with dimensions of 12.2 m x 6.0 m x 2.5 m). Participants began the experiment by being seated in front of a laptop computer (Alienware 14) connected to a mouse, keyboard, and a 21" extended display (the game was displayed in full-screen mode). After being debriefed about the experiment, the participants were informed that their game play will be recorded anonymously and used to provide debriefing in a follow-up study. While recording the game play, only the computer screen displaying the rendering of the serious game was recorded using Camtasia, a powerful yet easy-to-use screen recording and video editing tool available 'off-the-shelf' [103]. As the tool had to record audio cues exhibited by the VC, therefore participants were not allowed to use headphones. To minimize the background noise, the room in which the experiment was being conducted was cleared of any other individuals so that only the participant and experimenter were in the room. The participants were also cautioned that during the process of recording the game play, any sound they made may disrupt the anonymity of the experiment. Furthermore, participants were asked to sign a consent form (see Appendix B.2) and then provided a brief explanation of how to proceed in the game. Once the participants were comfortably settled and understood the instructions provided, they were shown the scenario screen and asked to proceed by clicking on the record button at the bottom of the screen (see Figure C.9). The recording tool took three seconds to start after which the participants clicked on the link to the scenario on the screen to proceed. All the participants played the same scenario, using an anonymous user, on the Mozilla Firefox browser.

Once the participant completed the scenario, the recording was saved with an anonymous participant number, and they were asked if they wanted to play the game again. No restrictions were placed on the number of times a participant

could replay the game. If the participant requested to replay, the most recent iteration was selected for the next study. Only one participant asked to play the game again. The participant played it three times. In the end, the participants were asked to complete a brief questionnaire comprising of a subset of: (i) demographic, (ii) Questionnaire for User Interaction Satisfaction (QUIS), and (iii) Game Engagement Questionnaire (GEQ) based questions, as in Experiment One (see Section 5.2.1 - 5.2.3). Informal feedback received from participants in Experiment One suggested that the questionnaire was too long, and some questions could have been left out to reduce the time taken to complete it. The questionnaire was therefore revised for this experiment (see Appendix B.2).

6.3   Results

In this section the data collected by running the experiment is analyzed. The section has been divided as follows: (i) participants game experience, (ii) QUIS-based scores, and (iii) game engagement scores.

6.3.1   Participant Game Experience

Similar to Experiment One, participants were asked several questions regarding their prior video game experience. The majority of participants (71%) did not play video games, and those who did, spent an average time of less than 30 minutes playing video games each week. The most popular video game genres were strategy/simulation and adventure games (see Figure 6.1). Some participants also enjoyed playing puzzles and card games.

6.3.2   QUIS-based Scores

Figure 6.2 - 6.5 present a graphical summary of average values of the QUIS-based questions collected from participants in Experiment Two. The overall reaction of the participants towards the system was very encouraging. The minimum and maximum values in this category were: 4.8 and 7.3 respectively. To a great extent participants claimed that the interaction with the system was very easy (7.3), and a wonderful experience (6.1). 6.5 was the average score when asked if the interaction with the system was satisfying. However, participants felt that the interaction with the system was not very flexible (4.8). With respect to graphics and sound, to a high extent (7.1), participants believed that the amount of information displayed
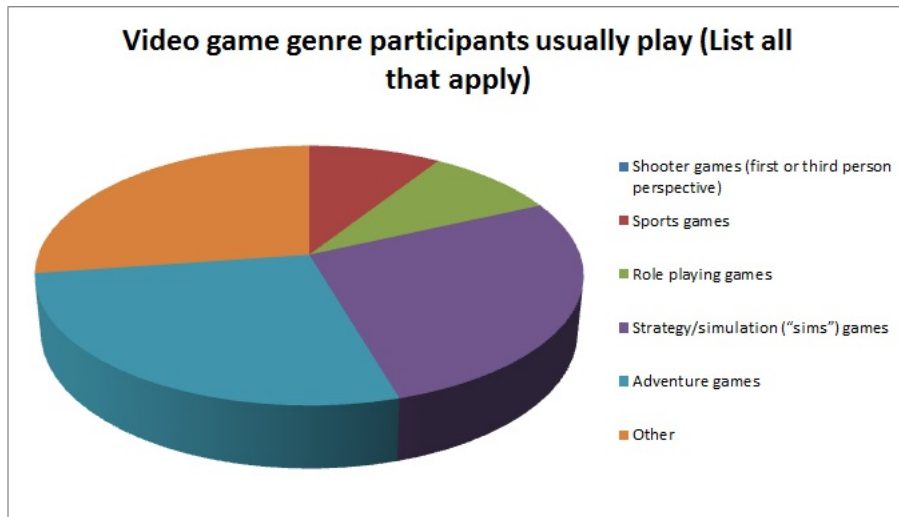
Figure 6.1: Genre of video games that participants usually play (list all that apply).

on the screen was adequate. They also felt that the information was logically placed on the screen (7.0).

With respect to the graphics and sound quality, the average values received were 5.3 and 4.7 respectively. The fidelity perceived was similar as well (4.8). Although these values are on the lower-side of the scale, it should be noted that the system in discussion is a low-fidelity design, and does not claim to provide high audio or visual fidelity using high-end computational resources.

The average values for the category "Learning to play the game" were highly ranked. The participants believed that operating the system was easy to learn (8.3), getting started was easy (7.6), commands were easy to remember (8.3), learning to use the system was fast (8.4), and the feedback obtained to complete the steps was clear (6.1).

Furthermore, the minimum and maximum average score for the systems capabilities was 7.2 and 8.6 respectively. Therefore, to a great extent the participants were satisfied with the speed of the system (7.4), response time (7.4), rate at which information was displayed (7.2), system reliability (7.6), operation dependability (7.9), and system dependability (8.6).

The percentages for the subset of open-ended questions, are graphically presented in Figures 6.6 - 6.7. The participants were asked to select one of the five possible answers on a 1-5 point Likert scale. 77% of the participants believed that the objectives of the serious game were presented clearly, and were easy to understand. When asked about the cues in the game, 57% said that they received cues in a
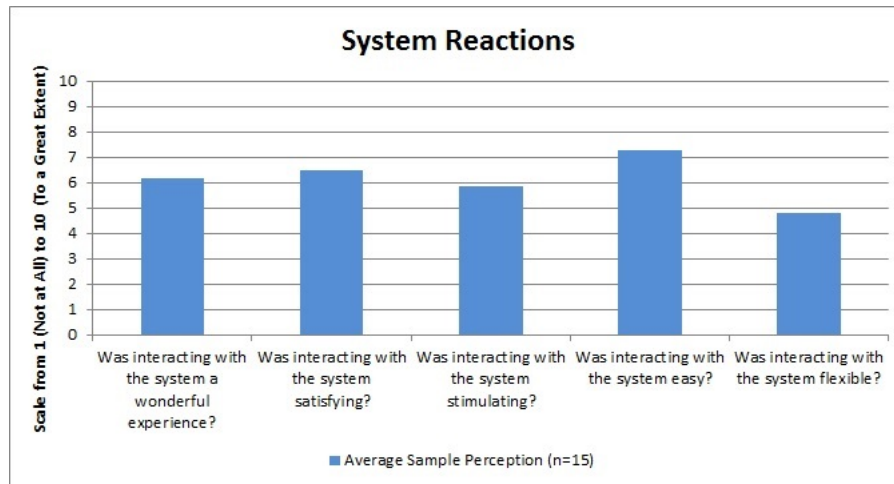
Figure 6.2: Experiment Two Results: "System Reactions".
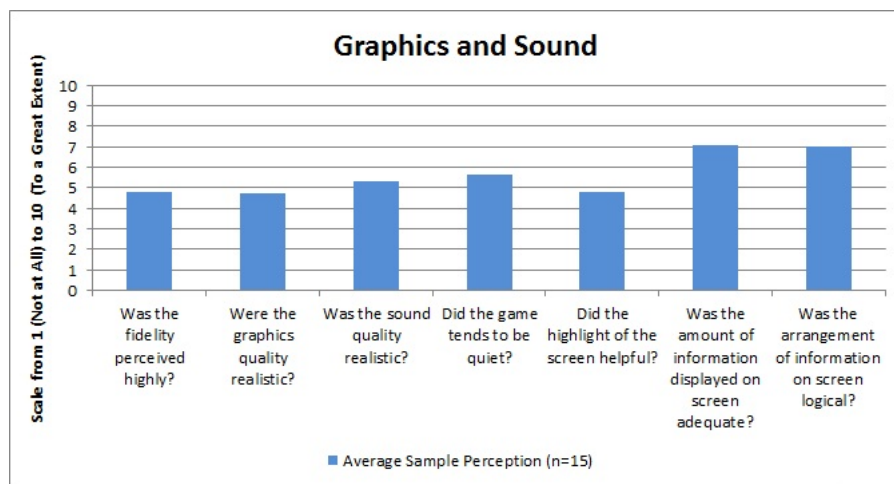
Figure 6.3: Experiment Two Results: "Graphics and Sound".

timely manner, 86% claimed that enough cues were provided to progress in the game, and 84% thought that cues were appropriate to promote understanding. Furthermore, the majority of the participants believed that the scenario resembled a real-life situation (78%), and that real-life factors were built into the serious game (76%). 63% agreed when asked if they clearly understood the purpose and objectives of the serious game. Approximately 39% agreed that the game provided enough opportunities to find out about one's progress. All of the participants believed that they did not have any difficulty in interacting with the VC presented in the game. In addition, all of the participants claimed to navigate through the game easily, and a majority of the participants (93%) were able to access the information they required.
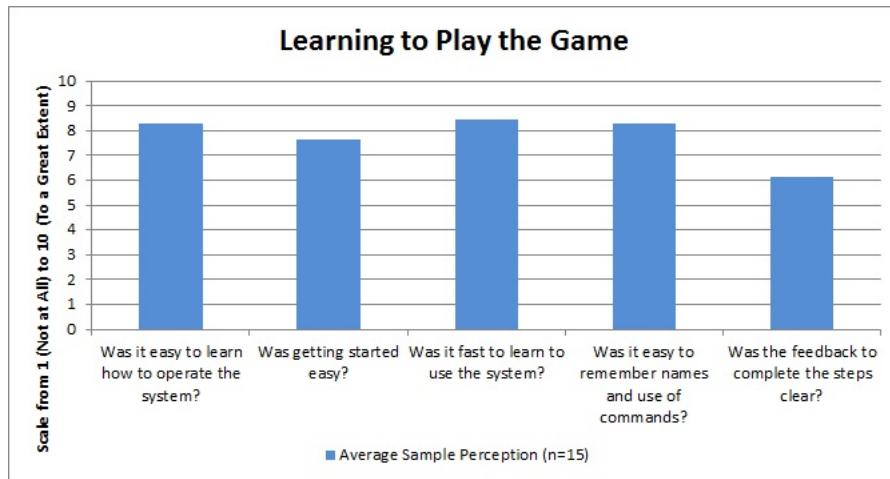
Figure 6.4: Experiment Two Results: "Learning to Play the Game".
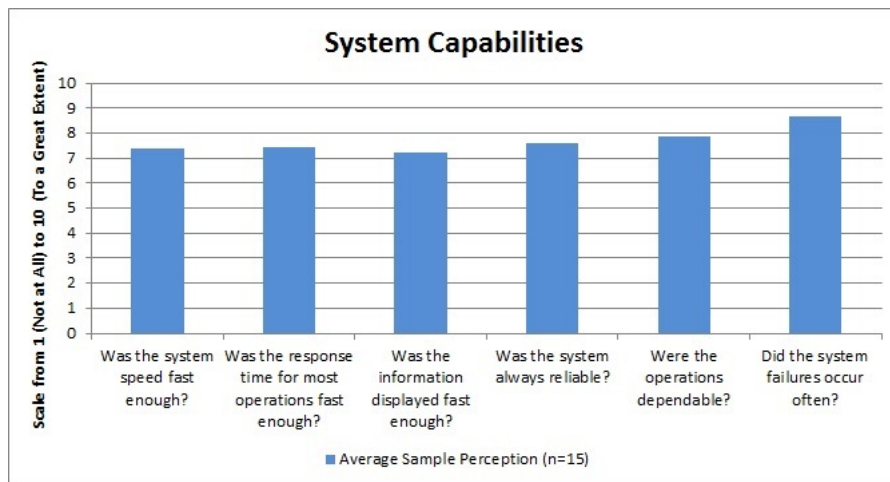
Figure 6.5: Experiment Two Results: "System Capabilities".

6.3.3 Game Engagement Scores

The average values for absorption and immersion are presented graphically in Figure 6.8. Examining the results for immersion, it is evident that a very small percentage of participants (21%) believed to be immersed into the game. However, 36% remained indecisive. Similarly, on average the participants response to the measure of absorption was "No". The majority of the participants did not feel scared (100%), different (92%), lost track of time (62%), spaced out (92%), or that time stopped while playing the game (86%). Lower absorption scores indicate the need of improving the user experience perhaps through the use of more advanced interactions and sounds.

With respect to flow (see Figure 6.9), 50% of the participants believed that playing seemed automatic, whereas, 43% were indecisive. A majority (93%) believed that
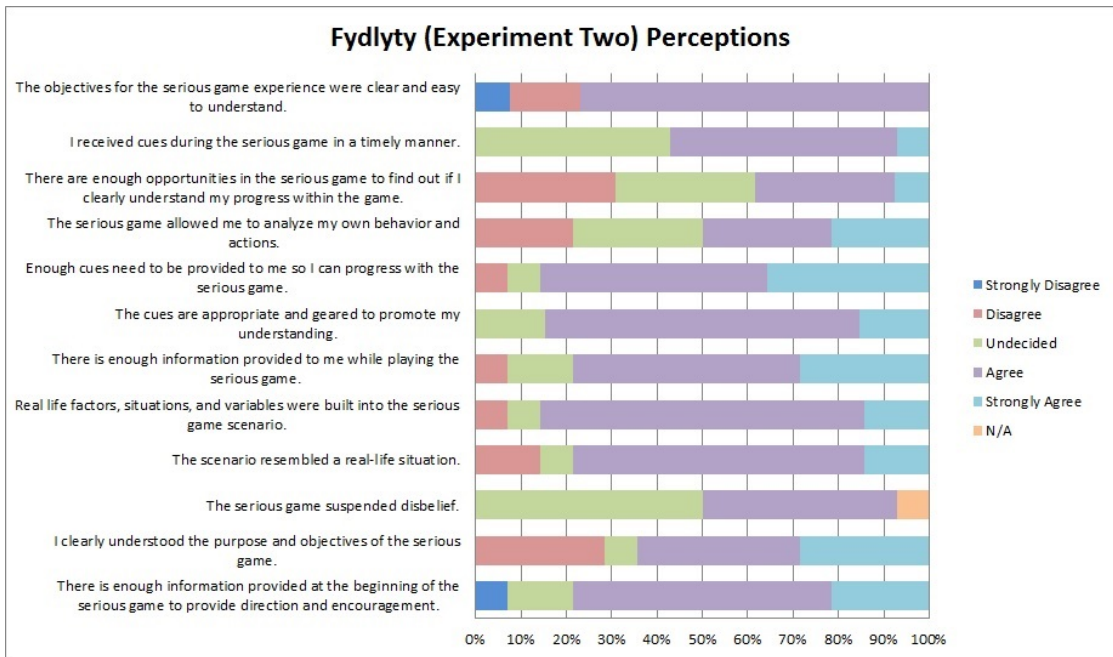
Figure 6.6: Experiment Two Results: "User Perceptions".
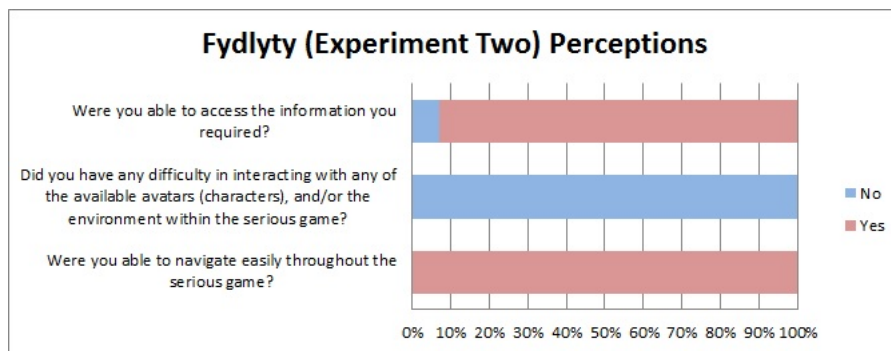
Figure 6.7: Experiment Two Results: "User Perceptions".

they did not get wound up while playing the game. When asked if the game felt real, 71% participants were indecisive and only 7% said "Yes". Furthermore, 43% claimed that they play without thinking about how to play the game (29% indecisive), and 29% believed that playing made them feel calm.

A majority of the participants (71%) believed that things seemed to happen automatically while playing the game (see Figure 6.10). 35% were indecisive when asked if their thoughts went quickly while playing. 21% said "Yes". A majority of 62% did not lose track of time, and 86% claimed that they did not play the game longer than they were meant to.
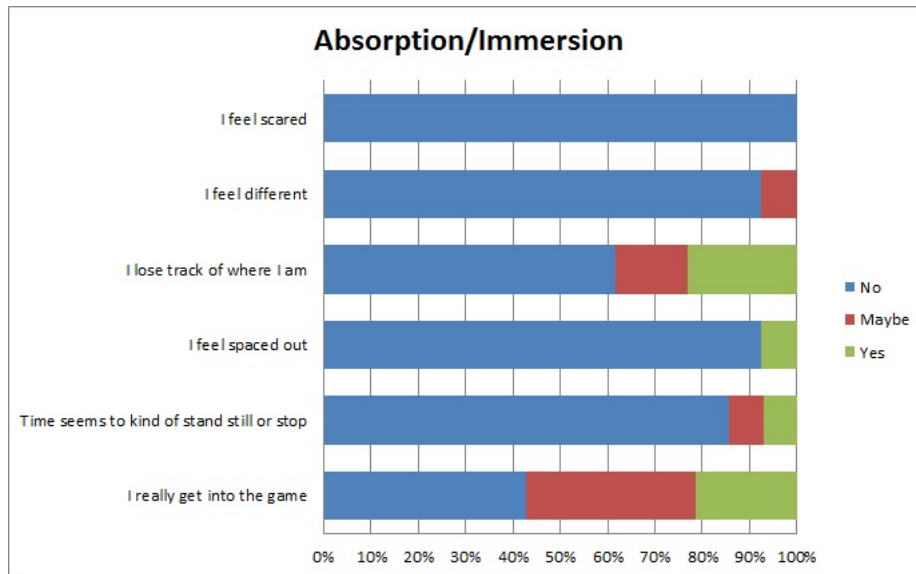
Figure 6.8: Experiment Two Results: "Absorption/Immersion".
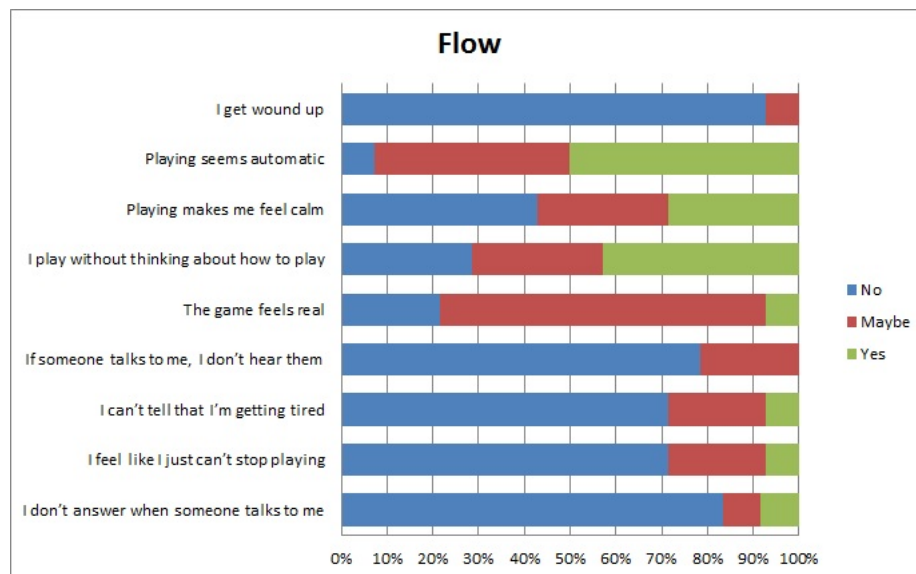
Figure 6.9: Experiment Two Results: "Flow".

6.4 Discussion

Experiment Two analyzes the user experience and satisfaction of health-professionals and trainees while playing a cultural competence serious game in a low audio and visual fidelity environment. 14 volunteer participants from Health Sciences programs were invited to play the Fydlyty serious game. Their game play was recorded for further research purpose, and once completed, they were asked to complete a questionnaire comprising of questions from: (i) demographics, (ii) QUIS-based, and (iii) GEQ. In this section, I discuss the main results of the experiment, and its

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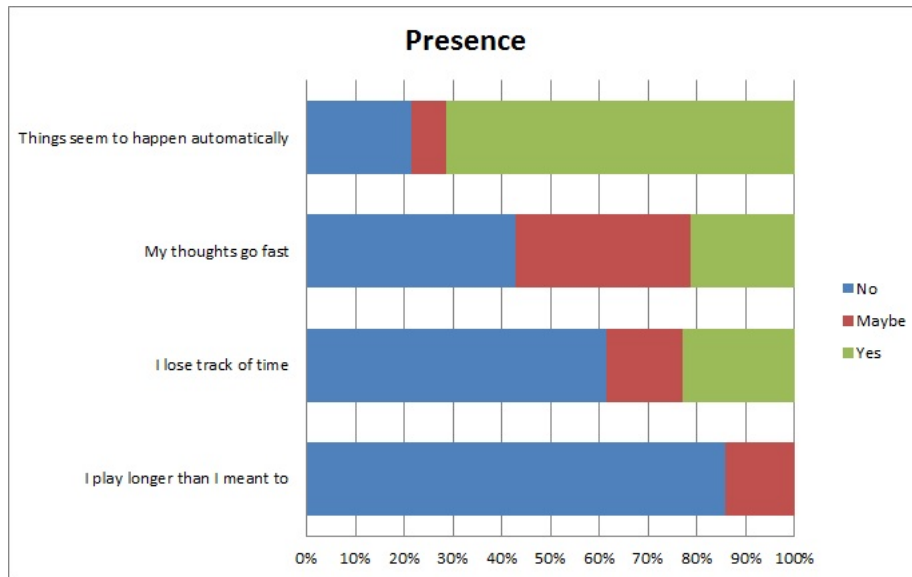
Figure 6.10: Experiment Two Results: "Presence".

implications based on: (i) user satisfaction, (ii) user experience, and (iii) free-form comments provided by the participants.

6.4.1 User Satisfaction

The user satisfaction was measured by means of receiving scores regarding four aspects of human-computer interaction, i.e. (i) system reactions, (ii) graphics and sound, (iii) learning to play the game, and (iv) system capabilities. The preliminary results received for the user satisfaction of health-professionals and trainees were very encouraging. The purpose of developing a web-based serious game was to benefit from the intrinsic advantages provided by the Web 2.0 platform e.g., (i) flexibility, (ii) creation and modification of collaborative content, and (iii) a responsive user interface, amongst others [73]. The QUIS-based results regarding the system capabilities and reaction signify the use of a web application. The participants believed that the interaction with the system was a wonderful experience (6.1), satisfying (6.5), easy to use (7.3), fast to respond (7.4), reliable (7.6), and dependable (7.9). Furthermore, to motivate users to play a game again and again, it is viable to provide enough opportunities to learn how to play the game. Gee describes the initial levels of a game as 'hidden tutorials', which are essential in setting up the users' cognitive skills for solving complex problems in the game ahead [40]. In Fydlyty, I provide initial steps in the scenario where the game player, taking on the role of a doctor, is provided information regarding the VC and then responds to something as simple as a salutation. During these introductory steps, the game player received ample opportunity to learn how to

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play the game, which reflects in the feedback provided by the participants. To a high extent the participants also agreed with the amount of information provided on the screen, and its arrangement (approximately 7.0 each). With respect to graphics and sound, the average sample perception was not highly rated (4.7 and 5.3 respectively). However, it should be reinforced that audio and visual cues were rendered in a low-fidelity environment without burdening any computational resources. Furthermore, the background and VC on the screen (see Figure 3.11) was a student designed model, precisely used for the purpose of this thesis, and to demonstrate the simplicity and usability of the scenario editor and dialogue authoring tool. Using professional expertise to design the avatars, might show improvement in the graphical score obtained. Moreover, humans use variation of pitch, intensity, and formant to highlight emotions through speech. The VC in Fydlyty has only one vocal expression. Algorithmically programming different variations of speech per emotion may yield higher results as well.

6.4.2 User Experience

The measure of absorption was very low for the health-professionals and trainees. A high majority believed that they did not feel scared (100%), different (92%), spaced out (92%), or lost track of where they were (62%). The reason for these results can be associated with two things: (i) the low-fidelity design, or (ii) a disconnect from the scenario provided in the experiment. The former cannot be relinquished without assessing the effect of using this tool to learn cultural competence skills in medical-based education. However, this is not within the scope of this thesis, but will be addressed in the future. With respect to content, as previously described, Fydlyty does not comprise of a single scenario. It is a tool to help educators and experts to develop various scenarios. Therefore, new and improved scenarios can be added to the system. Furthermore, absorption is interrelated with immersion and plays an important role in the participants immersion [9]. Even though the majority of participants did not feel immersed, the results for immersion have been distributed across the three categories (i.e. No = 43%, Maybe = 36%, and Yes = 21%). When asked if the game felt real, 71% of the participants were indecisive. This is very encouraging in respect to a low-fidelity design. Improvements in the current design, and adding a few components such as a story-line can refine the results. The majority of the participants (86%) believed that they did not play longer than they were required to. Adding game elements (e.g., multiple levels, leaderboards, or scoring elements) may improve the attention span of the game player captured by the game.

6.4.3 Free-form Comments

In the free-form section of the survey, the participants were asked what they best liked about the serious game. Some of the notable responses are as following:

> "It was quick yet effective. It got you involved and interacting due to the emotions it elicited." (Participant 03, September 2015)

> "How it related the medical portion of what I am studying." (Participant 12, October 2015)

> "Made you think of the implications of your actions more than just blindly acting." (Participant 14, October 2015)

Furthermore, the participants also highlighted the issue regarding the limited responses provided to the game player by the system. One participant while providing informal feedback after the experiment explained how she sometimes did not agree with any of the available responses, and wanted to type in her own response. Some comments are as following:

> "The response options were limited. The feedback (when I noticed it) didn't really provide a lot of information about why a response might be inappropriate. The patient responses were always the same, regardless of which option I chose." (Participant 01, September 2015)

> "Feeling forced to select response options that did not necessarily reflect how I would want to interact with the patient." (Participant 02, September 2015)

When I asked if the participants felt that the serious game would be useful for improving cultural competence skills, a majority of the participants (64%) believed that such a tool can be used effectively for cultural competence training.

> "Yes, if certain scenarios are expanded/developed. It would be a good space to teach (maybe evaluate) some of the soft skills." (Participant 03, September 2015)

"Yes as it will make people aware of how important their responses are perceived by other people, people particularly who do now share the same cultural." (Participant 07, October 2015)

"Yes. It required you to consider the most appropriate answer in regard to the situation and not to simply state the facts." (Participant 14, October 2015)

6.5 Conclusion

The experiment conducted assessed the user experience and satisfaction of health-professionals and trainees while playing the advanced level of the Fydlyty serious game. 14 participants took part in the study, where they were asked to play a scenario, taking on the role of a medical doctor. The game play for each participant was recorded. Once complete, the participant was asked to fill a short questionnaire which comprised of questions related to: (i) demographics, (ii) user satisfaction, and (iii) user engagement.

The average value of the scores obtained from the study confirms the earlier stated hypothesis, claiming that Fydlyty can be used as a cultural competence training tool for health professions education. The QUIS-based and GEQ scores discussed in the previous section, encourage the development of a low-fidelity tool and highlight the simplicity, accessibility, and reliability of using a web-based platform. Furthermore, with few improvements to the design, and adding new features may further enhance the user satisfaction and experience. In the future, when more scenarios are developed and available to the educators or experts, the usability of Fydlyty will be further appreciated. The free-form comments encouraged the use of the serious game in medical-based cultural competence training. Participants felt that the game was a quick and effective way to improve their already existing skills and can be used alongside their curriculum-based training.

Chapter 7

Experiment Three: Use of OPEN as a Tool for Debriefing

OPEN was originally designed to support health professions education and to provide health-care students and experts a unified platform to collaborate and communicate on. Since its development, OPEN has been used in multiple studies to assess the use of an Internet-based learning platform (IBL) to facilitate health-based education [18] [86]. In the experiment conducted by Welsher et al. [116], medical trainees performed a video-recorded simulated elliptical excision, which was later uploaded to OPEN. Participants were later invited to assess the performances of their peers using the checklist and global rating scale. Post- and retention-tests were followed immediately. Analysis indicated that learners significantly improved during the post-test, implying the successful use of video-based technologies in web-based learning. In this chapter, an experiment that was designed and conducted to develop an understanding of using OPEN as a tool for debriefing whilst using the serious game Fydlyty. This experiment is a continuation of Experiment Two (see Chapter 6), where I recorded the game play of each participant and informed them of providing feedback of their performance using an online educational networking (OPEN). The results will help me to understand if health-care professionals and trainees are receptive to the use of IBL in the form of an educational social network while learning cultural competence skills through the use of a serious game like Fydlyty. Furthermore, it will also highlight the use of OPEN as a tool for serious game-based debriefing.

7.1 Participants

The 14 volunteer health-care professionals (five) and students (nine) from Experiment Two were invited to participate in this experiment. Six participants did not respond to the email sent to them, hence leaving behind a total of eight participants. All participants who took part in the experiment were females with the minimum, maximum, and average age of 19, 54, and 34 years respectively. Due to the lack of male participants, and to avoid any gender bias, all results are strictly relevant to female game players only. Furthermore, I did not participate in the experiment and the experiment abided by the University of Ontario Institute of Technology Research Ethics Review process for experiments involving humans participants (UOIT REB #13-054).

7.2 Experimental Method

The benefits of using a web-based application is the direct access and around the clock availability it provides to the end-users. To ensure OPEN is viable to handle live traffic and can perform when real data is added onto the system, I deployed the web-site on to an in-house server at UOIT (see Section 4.2.3). In the study which ran from October 17, 2015 - November 09, 2015, the participants were encouraged to use their personal computers to access OPEN, and rate their peers game play.

Prior to the start of the experiment, I recorded myself playing Fydlyty so that the participants would rate the same video-recording without any bias, thinking they are rating one of their peers. The summary of the game play is provided in Appendix A.3.1. Furthermore, I designed a new course called 'Fydlyty' using the OPEN system (see Figure C.10). The quiz, 'P1 Debrief' was associated to this course (see Figure C.11).

Once the initial setup was completed, I registered each participant with an anonymous user profile in the system and enrolled them to the course 'Fydlyty'. Then the participants were sent out an email script which included: (i) information about OPEN, (ii) research domain, and (iii) user credentials (see Appendix A.3.2). Participants were also provided a step-by-step tutorial PDF document that outlined how to navigate to the quiz screen (see Appendix A.3.3).

After entering the URL `http://199.212.33.115:8003` in the browser, the landing page was displayed to the participants (see Figure 4.2). Entering the creden-

tials provided in the email took them to the profile page (see Figure 4.3). In the 'My Course' section, the new course 'Fydlyty' was displayed to the participants. Clicking on this displayed the course page (see Figure 4.5). The participants could access the quiz section for the course by agreeing to the consent form (see Figure C.12) for the experiment. After agreeing to provide consent to the experimenter, the participants were allowed to take the quiz which consisted of: (i) multiple choice questions (MCQ), (ii) Likert scale, and (iii) open-ended questions (see Appendix B.3.1). The first portion of the quiz i.e. MCQs, provide feedback for Experiment Two by encouraging peer evaluation. The remaining portion (Likert scale and open-ended questions), related to user satisfaction while operating OPEN. During the quiz, the participants were not allowed to leave the MCQ or Likert scale questions. Once completed, the quiz was removed from the list of quizzes presented to each participant.

7.3 Results

In this section, the data received for each attempted quiz is presented. The section is divided as follows: (i) debriefing for Experiment Two, and (ii) OPEN: user satisfaction.

7.3.1 Debriefing for Experiment Two

Figure 7.1 represents graphically, the responses received from the participants when asked to evaluate the game play of their peer. Each question in this category was a MCQ, with "Yes" or "No" as selectable options. It should be noted that all participants viewed the same game play recording however, they were not aware of this. Furthermore, questions regarding each step in the game i.e., (i) greeting the patient, (ii) breaking bad news, (iii) response to self-diagnosis, and (iv) ending the conversation, were presented.

62.5% of the participants believed that the game player greeted the virtual character (VC) correctly, 75% said that breaking bad news to the VC was done in a professional manner, 62.5% said that the game players response to the self-diagnosis by the patient was not adequate, and 75% of the participants agreed with the way the game player ended the conversation.
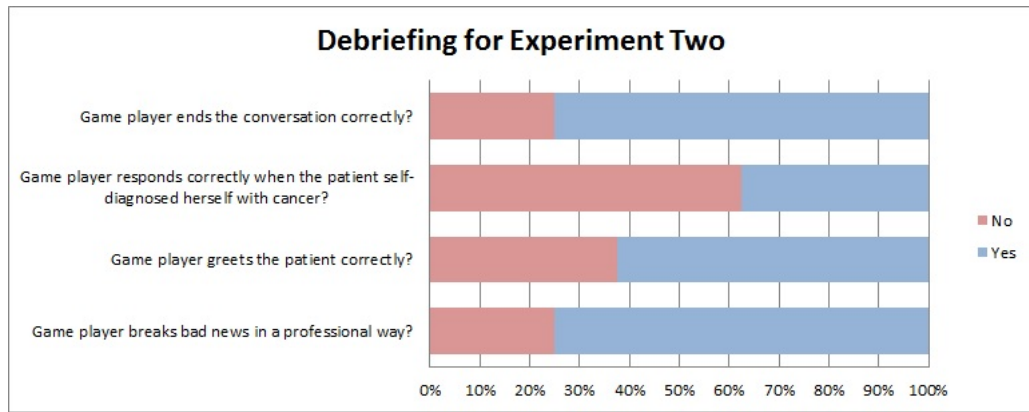
Figure 7.1: Experiment Three Results: "Debriefing for Experiment Two".
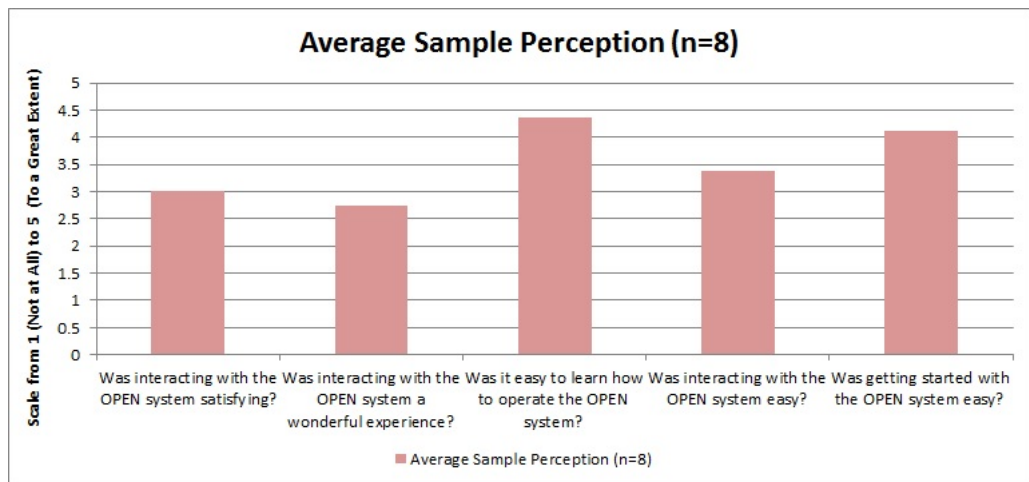
Figure 7.2: Experiment Three Results: "OPEN: User Satisfaction".

7.3.2 OPEN: User Satisfaction

In the remaining part of the quiz, questions with respect to the OPEN platform were asked to evaluate the user satisfaction for OPEN. Figure 7.2 presents a graphical representation of the average values of the participant responses received on a 1-5 point Likert scale. The highest and the lowest average values in this category are 2.8 and 4.4 respectively. On average, the participants believed that interacting with the OPEN system was easy (3.4), satisfying (3.0), and a wonderful experience (2.8). Furthermore, when asked if learning to operate the system was easy, 4.4 was the average response received. 4.1 was the score when asked if getting started with the system was an easy task.

In the free-form comments section, I asked the participants if they had any difficulty in using/interacting with the OPEN system, a majority of the participants (86%) believed they did not have any difficulty using the system. When asked if

there is any educational value in reviewing game play sessions, a majority of the participants agreed (75%). Some of the notable responses are as follows:

"Valuable to compare responses chosen to what you think is the most appropriate response." (Participant 02, October 2015)

"Yes. This is because you can see where mistakes have occurred and reflect on what would be the best solution." (Participant 07, October 2015)

Furthermore, all the participants believed that OPEN was useful to facilitate debriefing. Some of the notable responses are as follows:

"Yes, if used by a clinical teacher such that questions and alternative responses could be discussed in more detail." (Participant 01, October 2015)

"OPEN has a lot of potential to be used in parallel with other debriefing tools (could be used before the interaction takes place or after to allow for a more comprehensive understanding)." (Participant 03, October 2015)

"Yes, it is useful because you can experiment and see what mistakes you shouldn't make before you interact with a client." (Participant 07, October 2015)

One of the participant also provided additional comments to improve the user experience.

"Remember that most people will use phones or small screens such as laptops or tablets. The view of type must be large enough for a player to read or must be available in audio." (Participant 05, November 2015)

7.4 Discussion

In Experiment Three, I analyzed the use of OPEN as a tool to facilitate debriefing game play sessions, and measured the user satisfaction of the participants while using OPEN. Participants from Experiment Two were invited to anonymously rate the game play of their peers using the OPEN platform. Eight participants volunteered to take part in this experiment. A course was designed for the participants which contained different resources. Participants enrolled in the course were asked to attempt a quiz which was built around the game play from Experiment Two. In this section, I discuss the outcome of the results based on: (i) debriefing for the resulting game play of Experiment Two, and (ii) user satisfaction.

7.4.1 Debriefing for Experiment Two

The game play recording which the participants viewed during the quiz was a standard recording developed specifically for this experiment. The game play consisted of a variety of correct and incorrect choices, questions regarding which were asked in chronological order. The purpose here was to present the participants with a different version of an already played game to be viewed from a critical perspective. While rating the game play of another player, the participants learn about scenarios which might be different from theirs. Therefore using observational practices, OPEN provides experience to the participants to learn/improve their cultural competence skills.

7.4.2 User Satisfaction

The user satisfaction was measured by means of receiving scores regarding the reaction of the participants to the system and learning required to operate the system. The average values received from health-professionals and students regarding user satisfaction were very encouraging. On average, the majority of the participants believed getting started with using OPEN was straightforward (4.1), and learning to operate the system was very easy (4.4). An educational network such as OPEN has been developed to attract students, experts, and professionals amongst others from a wide variety of disciplines. In pursue of this, it is highly important to provide a platform which does not require a big learning curve to start, is easy to get used to, and works on multiple platforms. The lowest average value received in this category was when asked if interacting with OPEN was a wonderful experience (2.8). The reason of this low score might be associated with

the simplicity that the graphical user-interface imparts. Adding cues for new users to get started on the web site may help improve these results. Furthermore, as OPEN encourages the use of Internet-based learning, it may be useful to employ gamification elements to boost the use of a non-game product by making it enjoyable and engaging for the end-user [123]. Gamification refers to the "use of game design elements in non-game contexts." [29]. With respect to OPEN, some design elements that can be used include: (i) scoring elements, (ii) leaderboards, (iii) badges as rewards, and (iv) progress bars, amongst others.

7.5   Conclusion

Experiment Three assessed the user satisfaction of health-professionals and students while using the OPEN system as a tool for debriefing. Eight of the 14 participants from Experiment Two participated in this experiment. Each participant was asked to rate the game play session of their peers. In the process, feedback regarding the use of OPEN was also received.

The average values of the scores obtained from the study confirms the earlier stated hypothesis, claiming that OPEN can be used as a tool for debriefing game play sessions for health professions education. The scores discussed in the previous section encourage the use of an IBL such as OPEN, to facilitate debriefing and help professionals, trainees, and students to learn through observational practices. Using the platform, video recordings of novice level game players can be compared with expert level videos, so that reasoning can be formulated to improve the existing skill-set of novice level game players. Furthermore, using OPEN to immediately receive feedback regarding the task or skill does not necessarily require the presence of an expert [86]. The online community consisting of students and trainees, viewing pre-recorded videos and providing feedback, can help improve existing skill-sets. With the remodeled design, OPEN is not limited to facilitate health-based education only, but can be used to support learning in a wide variety of discipline.

Chapter 8

Discussion and Conclusion

Designers and developers of serious games and virtual simulations in general, typically strive for high-fidelity environments, particularly with respect to the visual (graphical) scene. However, despite the great computing hardware and computational advances we have experienced, real-time high fidelity rendering of complex environments (found in many serious games) across all modalities is still not feasible [51]. Furthermore, recent evidence suggests high fidelity simulation does not always lead to greater learning [75], and striving for high-fidelity can burden our computational resources (particularly when considering portable computing devices), and lead to increased development costs. Although when considering multi-modal virtual learning environments, many factors can influence graphical fidelity perception (e.g., sound), for the purpose of this work, I considered a variation in the audio and visual scene (e.g., environmental fidelity) and divided into separate designs. The results of this work form the basis of further, more extensive experiments that will examine the role of multi-modal interactions on visual fidelity perception.

Here Fydlyty, a low-fidelity, web-based serious game for medical-based cultural competence education was presented. Fydlyty allows for a wide variety of scenarios to be easily developed and/or edited using a simple scenario editor, ensuring it is practical across a wide variety of areas and applications. For the purpose of this thesis, a specific scenario where a virtual character (VC), Jade Wilson, was suffering from a medical ailment and thus visited her doctor was outlined. At this point the conversation between the VC and the player (taking on the role of the doctor) begins. Depending on the player's response, during the conversation the mood of the VC may change (e.g., become upset, or angry). The player's goal

in the game is to ensure they maintain a good relation with the patient, so that the patient will visit him/her again. At the end of each session, debriefing is also provided so that the trainee is informed about the mistakes they made and how they could be corrected. The system implies two different techniques to facilitate debriefing: (i) a summary of the game play at the end of each scenario, and (ii) using the Observational Practice and Educational Networking (OPEN) system.

The OPEN is an Internet-based learning (IBL) platform which was originally designed to promote health-based medical education [86]. Considering the utilization of such a research tool in numerous fields, I remodeled the design such that now OPEN can be used as a platform under which a community of learners (e.g., educators, students, amongst others), associated with any field, can collaborate and engage in learning sessions. Using OPEN, these learning sessions are built by subject matter experts, which later are accessed by students who have been granted access. Each session also contains different educational resources (i.e. PDFs, videos, forums, and quizzes) which assists learning in an online environment.

An initial study was conducted to determine whether playing the serious game Fydlyty under low graphical fidelity, and absence of audio cues was more engaging and satisfying than playing the same game with higher graphical fidelity and audio cues. From examining the results of the Questionnaire for User Interaction Satisfaction (QUIS) (tool used to assess the user's satisfaction) [76] and Game Evaluation Questionnaire (GEQ) (a questionnaire commonly used to determine the engagement of game players in a game [15]), it was determined that users did not find higher audio and visual fidelity in a low-fidelity environment as engaging or satisfying as compared to lower level of fidelity. Furthermore, it was also discovered that changing only a single component of the game (VC in this scenario), can affect the user experience and consequently the engagement and user satisfaction in the environment.

A second study that focused on the engagement and satisfaction of health-care professionals was conducted. In this study, the design that rendered higher audio and visual fidelity was displayed to the participants. The results of this study revealed that the web-based low-fidelity tool provided an easy to interact interface for professionals and students along with being highly accessible to them. Furthermore, it was also noted that health professionals, with little to no gaming background, felt comfortable while using the tool and did not face trouble while completing the scenario. The final study analyzed the use of the OPEN system as a tool to facilitate debriefing for game play sessions. Examining the results attained from

the course designed specifically to provide feedback to health-professionals and students, revealed that there is educational value in using the OPEN for reviewing game play sessions.

8.0.1 Contributions

The thesis describes the development of scenario editor and a dialogue authoring tool which can be used to construct various low-fidelity cultural competence serious games. The serious game allows various simulation parameters to be easily adjusted thus allowing us to methodically examine the effect of fidelity and multi-modal interactions on learning. Furthermore, the results obtained from the experiments that were conducted provide researchers a base to how low-fidelity serious games can be designed to increase the measure of engagement and user satisfaction. Moreover, the OPEN system provides educators and students a platform to build educational communities upon, that can be integrated into the traditional classroom learning. Using the OPEN, a global audience is provided a diverse educational content with widespread accessibility.

8.0.2 Future Work

Future work will examine the integration of Fydlyty into the medical curriculum and include a more thorough user-based study to better gauge the effectiveness of the serious game. Furthermore, future work will also involve using Fydlyty to examine what, if any effect low-fidelity visuals (graphics) have on learning. This will be accomplished through a pre- and post-testing study that will include three groups of participants: (i) control group which will not use Fydlyty but will receive all of the educational material using traditional methods, (ii) a group that will use the low graphical fidelity version of Fydlyty, and (iii) a group that will Fydlyty with higher graphical fidelity and audio cues.

Chapter 9

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Appendices

Appendix A

Experimental Material

A.1   Dialogue Script for Fydlyty

Dialogue Script for Fydlyty

Context:

This scenario involves an elderly woman meeting with her doctor to discuss her abrupt weight loss. The woman doesn't feel comfortable with her doctor. She doesn't like going to the doctor for a number of reasons:

1. She is nervous that she will not understand the doctor's medical vocabulary.
2. She is embarrassed for how little she has taken care of her health in the past.
3. Because of her lengthy and negative experiences at the hands of teachers and members of the clergy in residential school, she does not trust the mainstream health-care system or when there appears to be a power differential.
4. She does not want to feel judged, stereotyped or ignored.
5. She recognized the emphasis on disease and not the whole person, not to mention the life circumstances that may have shaped her overall health status.

Scene:

Mrs. Wilson walks into the doctor's office. The doctor is sitting at his desk that faces the wall. Mrs. Wilson sits on the chair nearby facing slightly away from the doctor.

Patient: Hello Doctor. Nice to see you today.

Doctor:

Normal	Upset	Angry
Hi Mrs. Wilson. How are you feeling today?	Hi Jade. How are you feeling today?	Come sit Jade.

Patient: A bit better.

Doctor:

Normal	Upset	Angry
That's good to hear. Are you still feeling nauseous?	Ok. What about the nausea?	Is that it?

Patient: I haven't felt sick to my stomach since you switched my medication.

Doctor:

Normal	Upset	Angry
Great. So your test results came in this morning.	The test results are out.	Your test results came in this morning. I think you have not been taking your medication properly.

Patient: It is about time. Is it good news or bad?

Doctor:

Normal	Upset	Angry
I guess it is a bit of both. Which do you want first?	It is not good. However, which do you want first?	What do you want to hear?

Patient: Please let me have the bad news first. I want to get over it.

Doctor:

Normal	Upset	Angry
Okay. It looks like you are going to need surgery to remove the tumour from your leg. After the operation you are going to have to stay off your feet for at least three weeks. That means no household chores.	We will operate you and put you off your legs for at least three weeks.	We will operate you and put you off your legs for at least three weeks. I hope your health insurance covers that.

Patient: I was afraid you were going to say that.

Doctor:

Normal	Upset	Angry
Now for the good news. The biopsy shows that the tumour is benign which means it is not cancerous. We are going to take it out anyway just to be on the safe side.	The biopsy shows that the tumour is benign. We are going to take it out anyway just to be on the safe side.	I am sure it is nothing serious, but we will take it out depending on your health plan.

Patient: Wow! that is a load off my mind. Thanks Doctor.

Doctor:

Normal	Upset	Angry
Do not get too excited yet. We still need to get to the bottom of all of this weight loss.	You look great with all the weight loss but still we need to be sure what caused it.	Some people would crave for such weight loss, but nonetheless we need to know what is causing it.

Patient: I have probably just been so worried about this stupid lump.

Doctor:

Normal	Upset	Angry
These things often are stress related. But we are still going to do a few blood tests just to rule a few things out.	Could be stress. I do not know to be honest, but will still run a few tests to check for a few things.	Please mind your language in my office. I will run a few blood tests just to rule a few things out.

Patient: Things like what Doctor? Ermm cancer?

Doctor:

Normal	Upset	Angry
Actually I am thinking more along the lines of a food allergy.	Haha no I would not go to that extent. Probably just food allergy.	Certainly not. Have you been diagnosing yourself using Google. Haha

Patient: Oh that should not be too bad. Well at least comparatively.

Doctor:

Normal	Upset	Angry
Yes Mrs. Wilson. You do not have to worry about anything.	Of course Jade. Do not worry.	Obviously better than cancer. What do you say?

Patient: Thanks Doctor. I will see you next week then?

Doctor:

Normal	Upset	Angry
Sure. Have a great day.	I might be out next week. Talk to Linda at the front desk.	Sure. Please pay Linda at the front desk.

A.2 Experiment One

A.2.1 Email Script for Participants

Hello xxxxx,

Thanks for participating in the study I talked to you earlier about. For my thesis I have developed a low-
`Serious games can be defined as regular games with an additional emphasis on learning a new skill, and
when I talk about fidelity I refer to *realism*. This serious game is intended for medical-based cultural
competence training particularly for medical students, practitioners, and professionals. The goal is for the
trainee (in this case YOU) to successfully complete a specific scenario (dialogue script), focusing directly
on the *mood* and the *cultural background* of the virtual patient (VP). Within the scope of this work, I am
also examining the use of low fidelity visuals (graphics) and their effect on learning.

I would like you to play a scenario and then fill out a questionnaire. The link to the questionnaire is
available at the end of the game. You can play the game as many times as you want to (at the end there is
a *replay* button). For this scenario you will require a **unity web plugin**
(https://dl.dropboxusercontent.com/u/105610217/UnityWebPlayer.exe) which can be installed easily
following the instructions in the instruction guide attached within this email. For consistency it is advised,
you use your personal computer and make sure you have speakers attached as audio will be played to you.
Also use **Firefox** as your web browser.

On average, the participants in the past have completed this exercise in 30-40 mins. I hope you would
have no problem during the course of this exercise, however so you can contact me via email or call me
directly at +1 (647) 409-7860.

Your credentials are
  username: **participantxx**
  password: **fydlyty**
  Scenario: **Scenario x**

Regards,

--
Zain Khan
BSc (Hons.), MSc Candidate
Faculty of Business and Information Technology
University of Ontario Institute of Technology (UOIT)

A.2.2 Instructional Guideline

Quick Guide to Start Playing Fydlyty

Step 1:

Open your browser (preferably Firefox or Internet Explorer) and enter http://www.fydlyty.com in the address bar.

Step 2:

Enter your username or password, provided to you in the email, in the box indicated in Fig 1.

FIG 1: LOGIN PAGE FOR TO ENTER YOUR CREDENTIALS.

Step 3a:

Once you have successfully logged in, you will see the main page. If you see the image indicated in the red box in Fig 2, skip to Step 4.
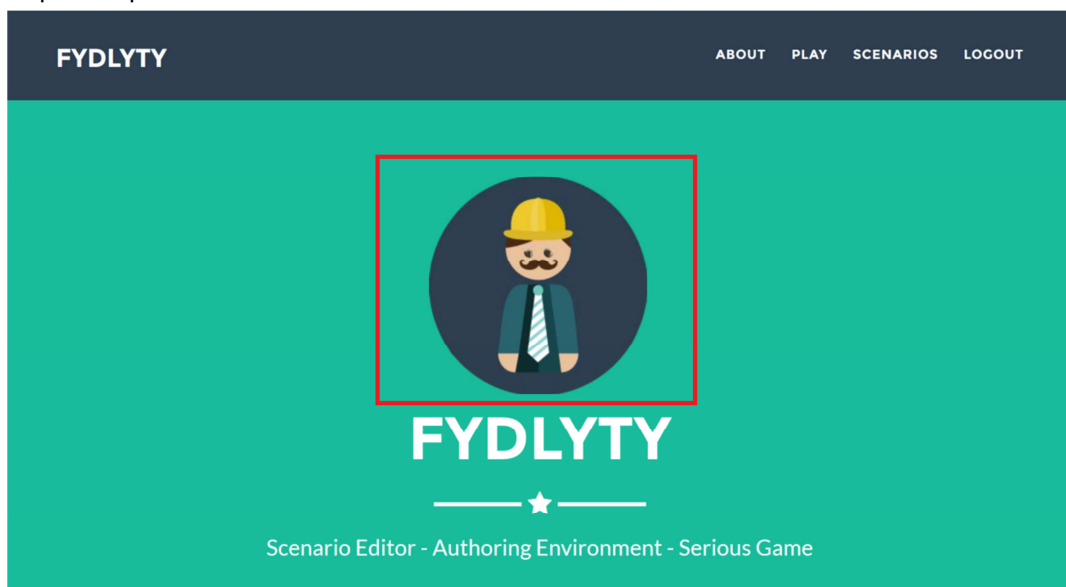
FIG 2: INDEX PAGE FOR FYDLYTY.

Step 3b:

Fydlyty requires the 'unity web player' to be installed on your system. If you do not have it installed click on the 'install now' button as indicated in the Fig 3A. This will open a new page. Click on the download button (Fig 3B) and install the plugin. Refresh the web site once when done and check Step 3a.
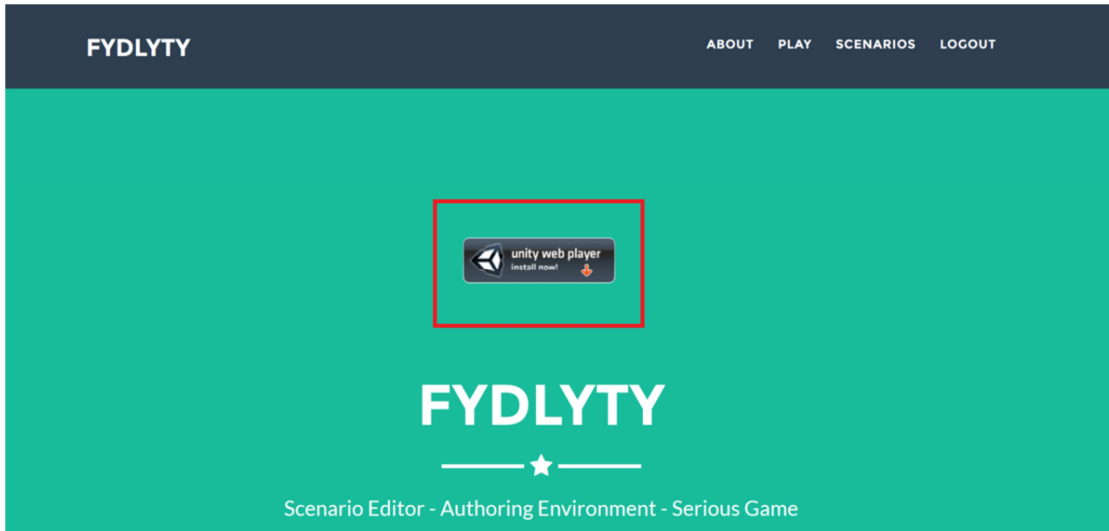
FIG 3A: IF THE UNITY PLUGIN IS MISSING THE AVATAR WILL NOT LOAD.
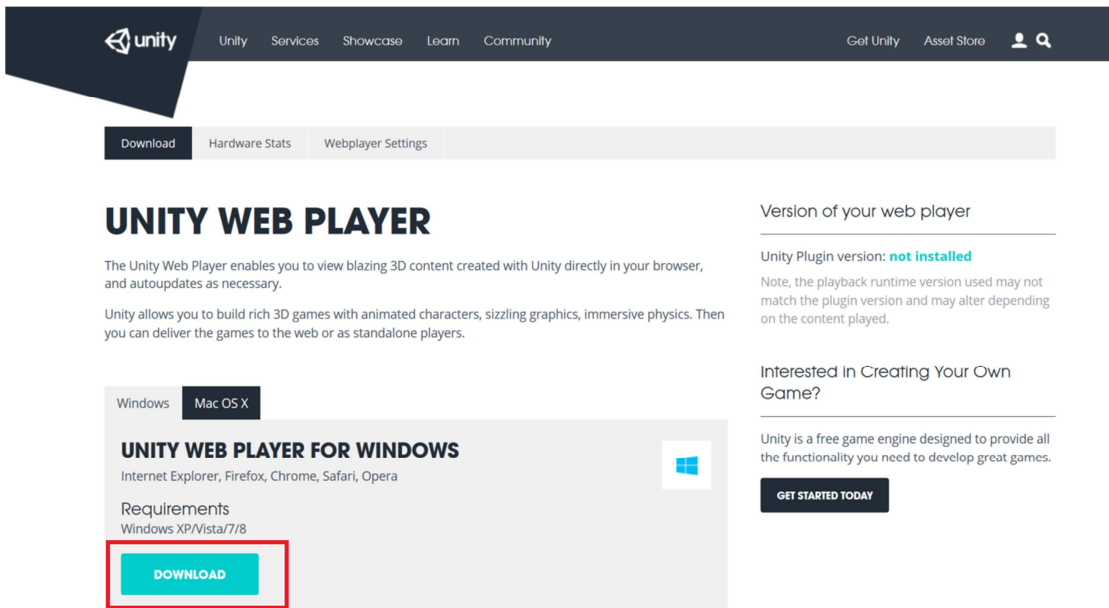
FIG 3B: THE UNITY WEB PLAYER CAN BE DOWNLOADED FROM THEIR OFFICIAL WEB SITE.

Step 4:

Click on the 'Play' button at the top right corner of your screen (Fig 4).
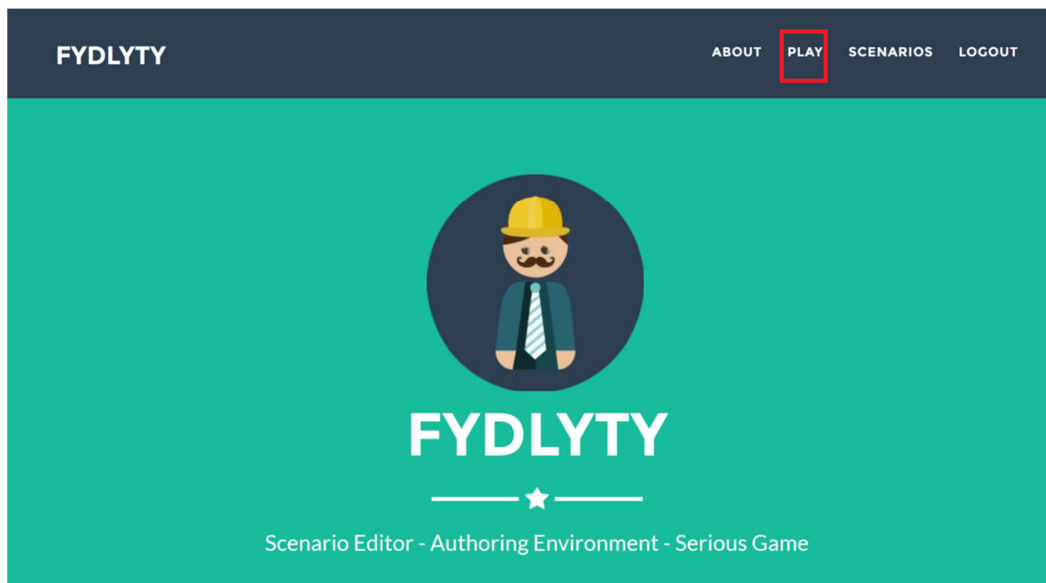
FIG 4: THE PLAY BUTTON AT THE TOP WILL TAKE YOU TO THE GAME PAGE.

Step 5:

The scenarios page shows the list of scenarios available to you (Fig 5). Click on the scenario prescribed to you in the email to start playing.

FIG 5: THE PAGE SHOWS THE LIST OF SCENARIOS AVAILABLE TO YOU.

A.3 Experiment Three

A.3.1 Game Play Summary

Game Play Summary

Scenario: Scenario 2

Script: Script for scenario Scenario 2

Game Type: Complex Scenario

User: anonymous

Time Lapse: 0

VC: Hello Doctor. Nice to see you today.

GP: Hi Mrs. Wilson. How are you feeling today?

GP: Hi Miss Wilson. How are you feeling today?

GP: Come sit Jade.

Selection: Hi Miss Wilson. How are you feeling today?

Character Mood: Mad

Time Lapse: 44

VC: A bit better.

GP: That is good to hear. Are you still feeling nauseous?

GP: Ok. What about the nausea?

GP: Is that it?

Selection: That is good to hear. Are you still feeling nauseous?

Character Mood: Normal

Time Lapse: 54

VC: I haven't felt sick to my stomach since you switched my medication.

GP: Great. So your test results came in this morning.

GP: The test results are out.

GP: Your test results came in this morning. I think you have not been taking your medication properly.

Selection: Your test results came in this morning. I think you have not been taking your medication properly.

Character Mood: Angry

Time Lapse: 68

VC: It is about time. Is it good news or bad?

GP: It is not good. However, which do you want first?

GP: What do you want to hear?

GP: I guess it is a bit of both. Which do you want first?

Selection: I guess it is a bit of both. Which do you want first?

Character Mood: Normal

Time Lapse: 83

VC: Please let me have the bad news first. I want to get over it.

GP: We will operate you and put you off your legs for at least three weeks.

GP: We will operate you and put you off your legs for at least three weeks. I hope your health insurance covers that.

GP: Okay. It looks like you are going to need surgery to remove the tumour from your leg. After the operation you are going to have to stay off your feet for at least three weeks. That means no household chores.

Selection: Okay. It looks like you are going to need surgery to remove the tumour from your leg. After the operation you are going to have to stay off your feet for at least three weeks. That means no household chores.

Character Mood: Normal

Time Lapse: 114

VC: I was afraid you were going to say that.

GP: Now for the good news. The biopsy shows that the tumour is benign which means it is not cancerous. We are going to take it out anyway just to be on the safe side.

GP: I am sure it is nothing serious, but we will take it out depending on your health plan.

GP: The biopsy shows that the tumour is benign. We are going to take it out anyway just to be on the safe side.

Selection: The biopsy shows that the tumour is benign. We are going to take it out anyway just to be on the safe side.

Character Mood: Mad

Time Lapse: 133

VC: Wow! that is a load off my mind. Thanks Doctor.

GP: You look great with all the weight loss but still we need to be sure what caused it.

GP: Do not get too excited yet. We still need to get to the bottom of all of this weight loss.

GP: Some people would crave for such weight loss, but nonetheless we need to know what is causing it.

Selection: Do not get too excited yet. We still need to get to the bottom of all of this weight loss.

Character Mood: Normal

Time Lapse: 149

VC: I have probably just been so worried about this stupid lump.

GP: These things often are stress related. But we are still going to do a few blood tests just to rule a few things out.

GP: Could be stress. I do not know to be honest, but will still run a few tests to check for a few things.

GP: Please mind your language in my office. I will run a few blood tests just to rule a few things out.

Selection: Could be stress. I do not know to be honest, but will still run a few tests to check for a few things.

Character Mood: Mad

Time Lapse: 170

VC: Things like what Doctor? Ermm cancer?

GP: Haha no I would not go to that extent. Probably just food allergy.

GP: Certainly not. Have you been diagnosing yourself using Google. Haha

GP: Actually I am thinking more along the lines of a food allergy.

Selection: Certainly not. Have you been diagnosing yourself using Google. Haha

Character Mood: Angry

Time Lapse: 188

VC: Oh that should not be too bad. Well at least comparatively.

GP: Yes Mrs. Wilson. You do not have to worry about anything.

GP: Of course Jade. Do not worry.

GP: Obviously better than cancer. What do you say?

Selection: Yes Mrs. Wilson. You do not have to worry about anything.

Character Mood: Normal

Time Lapse: 202

VC: Thanks Doctor. I will see you next week then?

GP: Sure. Have a great day.

GP: I might be out next week. Talk to Linda at the front desk.

GP: Sure. Please pay Linda at the front desk.

Selection: Sure. Have a great day.

Character Mood: Normal

A.3.2 Email Script for Participants

Hello xxxxx,

I hope this email finds you well. Thank you for participating in the Cultural Competence study some days ago. As discussed earlier, this is a continuation of the experiment you already participated in. Here we use a web-based learning platform called Observational Practice and Educational Networking (OPEN) to encourage a community of learners to access educational content and receive feedback. While doing so you will also rate the overall performance of the system.

In this experiment you have already been assigned a "course" called Fydlyty, that comprises of educational resources. One such resource is a "quiz". You have to take a quiz and rate the performance of your peers. This is a 5 - 10 minutes exercise. A quick guide is attached within this email to assist you to navigate in OPEN. Your credentials are as follows:

Web-site URL: http://199.212.33.115:8003
Username: participantxx
Password: participantxx

Thank you for your participation.

Regards,

Zain Khan
BSc (Hons.), MSc Candidate
Faculty of Business and Information Technology
University of Ontario Institute of Technology (UOIT)

A.3.3 Instructional Guideline

Quick Guide

Step 1: Open your browser and enter the URL http://199.212.33.115:8003 to see the main page (see Fig. 1). Enter the username and password provided to you in the email.

Step 2: Select the course 'Fydlyty' from the course section
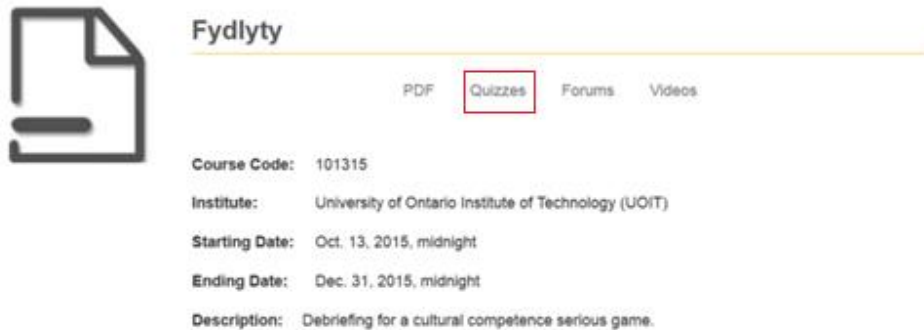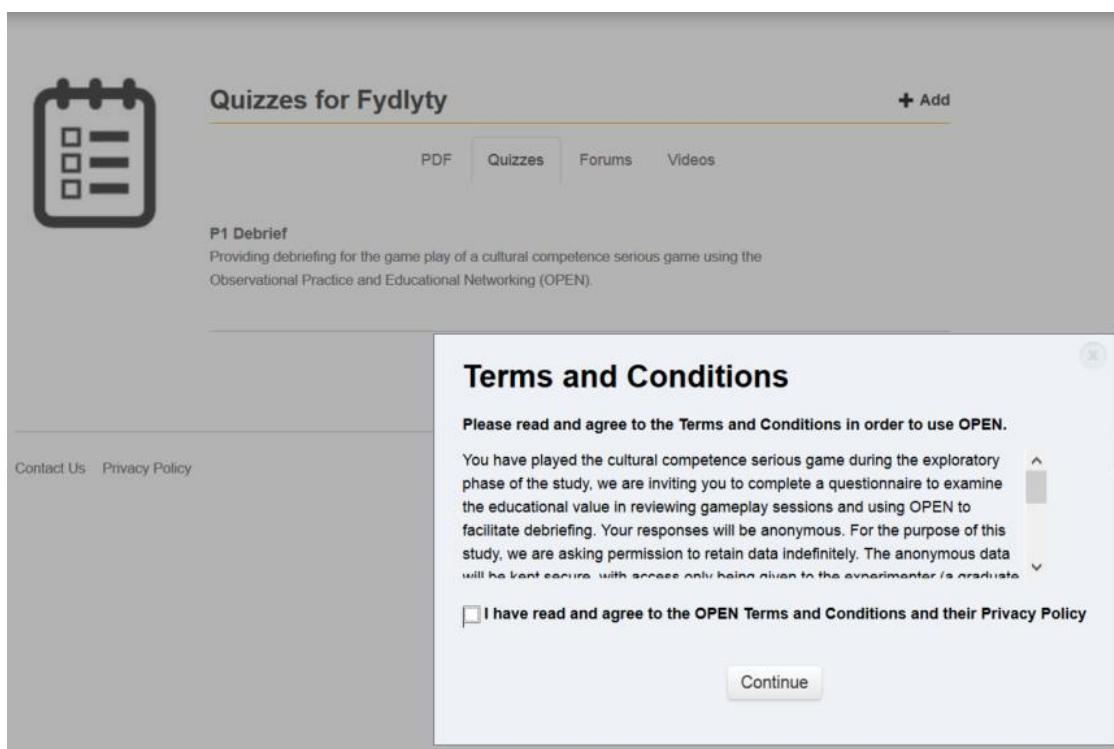
Step 3: Click on the 'Quizzes' tab.

Step 4: The consent form is shown in the dialogue box.

Step 5: Click 'P1 Debrief' to start the debriefing session.

Quizzes for Fydlyty

PDF   Quizzes   Forums   Videos

P1 Debrief
Providing debriefing for the game play of a cultural competence serious game using the Observational Practice and Educational Networking (OPEN).

Appendix B

Survey Material

B.1 Experiment One Survey

B.1.1 Questionnaire

Usability Testing of a Serious Game for Learning Cultural Competence in Medical-Based Education

Usability Survey

Introduction

Not too long ago the primary purpose of video games was to provide personal and social entertainment, but with the tremendous amount of scientific research conducted in using games for educational purposes, this trend has gradually changed. A subset of videos games called serious games have been re-appropriated for educational and training purposes. We have developed one such game for medical-based cultural competence training. By using this game we examine the opportunities to provide a dialogue authoring system and a scenario editor that can be used to learn and implement cultural competence skills through a web-based serious game. By leveraging the benefits of serious games (i.e. specific challenges or goals, the opportunity to provide instant feedback, and the ability to engage the learner within the learning process), we aim to enhance cultural competence-based education which is an important sector in medical education.

The cultural competence serious game is portable, adjustable, simple to use and was designed with the intention of being a tool for educators as well as medical students/practitioners. By mimicking a doctor-patient scenario in a clinical environment, the serious game offers the user a quick, rigorous, and safe environment to communicate with a virtual character from a different culture. In this specific study the game player is introduced to a pre-defined scenario which the player has to successfully complete. During the scenario, the virtual character can show different moods (neutral, mad, angry) which shall define the course of relationship between the virtual character and game player.

Now that you have played the cultural competence serious game during the exploratory phase of the study, we are inviting you to complete a questionnaire on your learning preferences and experiences. Your responses will be anonymous. For the purpose of this study, we are asking permission to retain data indefinitely. The anonymous data will be kept secure, with access only being given to the experimenter (a graduate student working under the supervision of Dr. Bill Kapralos) and the lead investigator (Dr. Bill Kapralos). Your participation in this survey is voluntary and you may withdraw from the experiment at any time (even after completing/submitting the survey) without any consequences. If you feel that you understand and agree to the above conditions of participation, please complete and submit the following questionnaire.

Consensus

○ I agree with the terms and conditions above and am over the age of 18

○ I disagree with the terms and conditions above or am below the age of 18

1. Background

Age: _____

Sex: Female   Male

Field of Study (if a student) or Profession: _____

Do you play video games?

Yes or NO

If Yes, on average, how many hours each week do you spend playing video games: _____

On which platform do you primarily play video games on?

      a. Console
      b. Computer
      c. Portable/hand-held video game players
      d. Mobile phone/device

What type of video game genres do you usually play (list all that apply)?

      a. Shooter games (first or third person perspective)
      b. Sports games
      c. Role playing games
      d. Strategy/simulation ("sims") games
      e. Adventure games
      f. Other: _____

2. Overall System Rating

Regarding the Use of the Cultural Competence Serious Game

Instructions: This questionnaire is a series of statements about your personal attitudes about the use of the cultural competence serious game you just had the opportunity to experiment/use. Each item represents a statement about your attitude toward your satisfaction with learning and self-confidence in obtaining the instruction you need. There are no right or wrong answers. You will probably agree with some of the statements and disagree with others. Please indicate your own personal feelings about each statement below by marking the numbers that best describes your attitude or beliefs. Please be truthful and describe your attitude as it really is, not what you would like for it to be. This survey is completely anonymous with the results being compiled as a group, not individually.

Q1. Overall Reactions to the System.

Please select the numbers which most appropriately reflect your impressions of using this computer system. Not Applicable = NA.

1. Terrible (1) to Wonderful (9)
2. Frustrating (1) to Satisfying (9)
3. Dull (1) to Stimulating (9)
4. Difficult (1) to Easy (9)
5. Rigid (1) to Flexible (9)

Q2. Graphics and Sounds.

Select the number which most appropriately reflects your impressions of using the serious game. Not Applicable = NA.

1. Graphics quality. Poor (1) to Very realistic (9)
2. Sound quality. Poor (1) to Very realistic (9)
3. The game tends to be. Noisy (1) to Quiet (9)
4. Computer generated sounds are. Annoying (1) to Pleasant (9)
5. Highlighting on the screen. Unhelpful (1) to Helpful (9)
6. Amount of information that can be displayed on screen. Inadequate (1) to Adequate (9)
7. Arrangement of information on screen. Illogical (1) to Logical (9)

Q3. Learning to Play the Game.

Select the number which most appropriately reflects your impressions of using the serious game. Not Applicable = NA.

1. Learning to operate the system. Difficult (1) to Easy (9)
2. Getting started. Difficult (1) to Easy (9)
3. Learning advanced features. Difficult (1) to Easy (9)
4. Time to learn to use the system, Slow (1) to Fast (9)
5. Exploration of features by trial and error. Discouraging (1) to Encouraging (9)
6. Exploration of features. Risky (1) to Safe (9)
7. Discovering new features. Difficult (1) to Easy (9)
8. Remembering names and use of commands. Difficult (1) to Easy (9)
9. Steps to complete a task follow a logical sequence. Never (1) to Always (9)
10. Feedback on the completion of the steps. Unclear (1) to Clear (9)
11. Remembering specific rules about entering commands. Difficult (1) to Easy (9)

Q4. System Capabilities.

Select the number which most appropriately reflects your impressions of using the serious game. Not Applicable = NA.

1. System speed. Too slow (1) to Fast enough (9)

2. Response time for most operations. Too slow (1) to Fast enough (9)
3. Rate information is displayed. Too slow (1) to Fast enough (9)
4. The system is reliable. Never (1) to Always (9)
5. Operations are. Undependable (1) to Dependable (9)
6. System failures occur. Frequently (1) to Seldom (9)
7. Correcting your mistakes. Difficult (1) to Easy (9)
8. Ability to undo operations. Inadequate (1) to Adequate (9)
9. Ease of operation depends on your level of experience. Never (1) to Always (9)

Q5. Objectives and Information

Choose one of: STRONGLY DISAGREE - DISAGREE - UNDECIDED - AGREE STRONGLY - AGREE - N/A

1. There is enough information provided at the beginning of the serious game to provide direction and encouragement.
2. I clearly understood the purpose and objectives of the serious game.

Q6. Fidelity and Realism

Choose one of: STRONGLY DISAGREE - DISAGREE - UNDECIDED - AGREE STRONGLY - AGREE - N/A

1. The serious game suspended disbelief.
2. The scenario resembled a real-life situation.
3. Real life factors, situations, and variables were built into the serious game scenario.

Q7. Complexity and Cues

Choose one of: STRONGLY DISAGREE - DISAGREE - UNDECIDED - AGREE STRONGLY - AGREE - N/A

1. There is enough information provided to me while playing the serious game.
2. The cues are appropriate and geared to promote my understanding.
3. Enough cues need to be provided to me so I can progress with the serious game.
4. The serious game allowed me to analyze my own behavior and actions.

Q8. Feedback

Choose one of: STRONGLY DISAGREE - DISAGREE - UNDECIDED - AGREE STRONGLY - AGREE - N/A

1. There are enough opportunities in the serious game to find out if I clearly understand my progress within the game.
2. I received cues during the serious game in a timely manner.
3. The objectives for the serious game experience were clear and easy to understand.

Q9. Usability of the Cultural Competence Serious Game

Were you able to navigate easily throughout the serious game?

○ Yes

○ No

Additional Comments?

Q10. Did you have any difficulty in interacting with any of the available avatars (characters), and/or the environment within the serious game?

○ Yes

○ No

Additional Comments?

Q11. Were you able to access the information you required?

○ **Yes**

○ **No**

Additional Comments

Q12. What did you like best about using the serious game?

Q13. What did you like least about using the serious game?

Q14. What are some of the things you like about the way the content is presented? Is it easy to read the information? Is the layout attractive and/or appealing?

Q15. What are some of the things you don't like about the way the content is presented?

Q16. Is there anything you would change regarding the way the content is presented?

Q17. Is there any additional content/instructions that you would like to see included?

Q18. Is there any other information/content that could be included in the serious game that you think would be valuable?

Q19. Have you ever used games, virtual simulations, or serious games for cultural competence education and training in the past?

○ Yes
○ No

If Yes, please briefly describe

Q20. Do you feel that this serious game will be useful for improving cultural competence skills? Please explain.

Q21. Please comment on any changes that could be made to this serious game to improve it.

Q22. Do you think that serious games such as this one are useful for cultural competence education?

○ Yes
○ No

Please explain

Q23. How would you integrate such a serious game into the medical curriculum?

Q24. What do you think are the major benefits to using serious games for improving cultural competence skills?

Q25. What do you think are some of the downfalls, limitations, and disadvantages to incorporating serious games into the medical curriculum?

Q26. Additional comments not captured in previous questions.

Game Engagement Questionnaire (GEQ)

The questions are Yes/No/Maybe answers

1 I lose track of time
2 Things seem to happen automatically
3 I feel different
4 I feel scared
5 The game feels real
6 If someone talks to me, I don't hear them
7 I get wound up
8 Time seems to kind of stand still or stop
9 I feel spaced out
10 I don't answer when someone talks to me
11 I can't tell that I'm getting tired
12 Playing seems automatic
13 My thoughts go fast
14 I lose track of where I am
15 I play without thinking about how to play
16 Playing makes me feel calm
17 I play longer than I meant to
18 I really get into the game
19 I feel like I just can't stop playing

Scoring:
No = 0
Maybe = 1
Yes = 2

Sum of all questions give you the GEQ score.

You have reached the end of the survey.

Thank you for participating in the survey.

B.2 Experiment Two Survey

B.2.1 Questionnaire

Usability Testing of a Serious Game for Learning Cultural Competence in Medical-Based Education

Usability Survey

Introduction

Not too long ago the primary purpose of video games was to provide personal and social entertainment, but with the tremendous amount of scientific research conducted in using games for educational purposes, this trend has gradually changed. A subset of videos games called serious games have been re-appropriated for educational and training purposes. We have developed one such game for medical-based cultural competence training. By using this game we examine the opportunities to provide a dialogue authoring system and a scenario editor that can be used to learn and implement cultural competence skills through a web-based serious game. By leveraging the benefits of serious games (i.e. specific challenges or goals, the opportunity to provide instant feedback, and the ability to engage the learner within the learning process), we aim to enhance cultural competence-based education which is an important sector in medical education.

The cultural competence serious game is portable, adjustable, simple to use and was designed with the intention of being a tool for educators as well as medical students/practitioners. By mimicking a doctor-patient scenario in a clinical environment, the serious game offers the user a quick, rigorous, and safe environment to communicate with a virtual character from a different culture. In this specific study the game player is introduced to a pre-defined scenario which the player has to successfully complete. During the scenario, the virtual character can show different moods (neutral, mad, angry) which shall define the course of relationship between the virtual character and game player.

Now that you have played the cultural competence serious game during the exploratory phase of the study, we are inviting you to complete a questionnaire on your learning preferences and experiences. Your responses will be anonymous. For the purpose of this study, we are asking permission to retain data indefinitely. The anonymous data will be kept secure, with access only being given to the experimenter (a graduate student working under the supervision of Dr. Bill Kapralos) and the lead investigator (Dr. Bill Kapralos). Your participation in this survey is voluntary and you may withdraw from the experiment at any time (even after completing/submitting the survey) without any consequences. If you feel that you understand and agree to the above conditions of participation, please complete and submit the following questionnaire.

Consensus

○ I agree with the terms and conditions above and am over the age of 18

○ I disagree with the terms and conditions above or am below the age of 18

1. Background

Age: _____

Sex: Female   Male

Field of Study (if a student) or Profession: _____

Do you play video games?

   Yes or NO

   If Yes, on average, how many hours each week do you spend playing video games: _____

On which platform do you primarily play video games on?

   a. Console
   b. Computer
   c. Portable/hand-held video game players
   d. Mobile phone/device

What type of video game genres do you usually play (list all that apply)?

   a. Shooter games (first or third person perspective)
   b. Sports games
   c. Role playing games
   d. Strategy/simulation ("sims") games
   e. Adventure games
   f. Other: _____

2. Overall System Rating

Regarding the Use of the Cultural Competence Serious Game

Instructions: This questionnaire is a series of statements about your personal attitudes about the use of the cultural competence serious game you just had the opportunity to experiment/use. Each item represents a statement about your attitude toward your satisfaction with learning and self-confidence in obtaining the instruction you need. There are no right or wrong answers. You will probably agree with some of the statements and disagree with others. Please indicate your own personal feelings about each statement below by marking the numbers that best describes your attitude or beliefs. Please be truthful and describe your attitude as it really is, not what you would like for it to be. This survey is completely anonymous with the results being compiled as a group, not individually.

Q1. Overall Reactions to the System.

Please select the numbers which most appropriately reflect your impressions of using this computer system. Not Applicable = NA.

1. Terrible (1) to Wonderful (9)
2. Frustrating (1) to Satisfying (9)
3. Dull (1) to Stimulating (9)
4. Difficult (1) to Easy (9)
5. Rigid (1) to Flexible (9)

Q2. Graphics and Sounds.

Select the number which most appropriately reflects your impressions of using the serious game. Not Applicable = NA.

1. Graphics quality. Poor (1) to Very realistic (9)
2. Sound quality. Poor (1) to Very realistic (9)
3. The game tends to be. Noisy (1) to Quiet (9)
4. Computer generated sounds are. Annoying (1) to Pleasant (9)
5. Amount of information that can be displayed on screen. Inadequate (1) to Adequate (9)
6. Arrangement of information on screen. Illogical (1) to Logical (9)

Q3. Learning to Play the Game.

Select the number which most appropriately reflects your impressions of using the serious game. Not Applicable = NA.

1. Learning to operate the system. Difficult (1) to Easy (9)
2. Getting started. Difficult (1) to Easy (9)
3. Time to learn to use the system, Slow (1) to Fast (9)
4. Remembering names and use of commands. Difficult (1) to Easy (9)
5. Feedback on the completion of the steps. Unclear (1) to Clear (9)

Q4. System Capabilities.
Select the number which most appropriately reflects your impressions of using the serious game. Not Applicable = NA.

1. System speed. Too slow (1) to Fast enough (9)
2. Response time for most operations. Too slow (1) to Fast enough (9)
3. The rate that information is displayed. Too slow (1) to Fast enough (9)
4. The system is reliable. Never (1) to Always (9)
5. Operations are. Undependable (1) to Dependable (9)
6. System failures occur. Frequently (1) to Seldom (9)

Q5. Objectives and Information

Choose one of: STRONGLY DISAGREE - DISAGREE - UNDECIDED - AGREE STRONGLY - AGREE - N/A

1. There is enough information provided at the beginning of the serious game to provide direction and encouragement.
2. I clearly understood the purpose and objectives of the serious game.

Q6. Fidelity and Realism

Choose one of: STRONGLY DISAGREE - DISAGREE - UNDECIDED - AGREE STRONGLY - AGREE - N/A

1. The serious game suspended disbelief.
2. The scenario resembled a real-life situation.
3. Real life factors, situations, and variables were built into the serious game scenario.
4. Rate the fidelity of the visuals (graphics). Lowest perceived fidelity (1) to Highest perceived fidelity (9)

Q7. Complexity and Cues

Choose one of: STRONGLY DISAGREE - DISAGREE - UNDECIDED - AGREE STRONGLY - AGREE - N/A

1. There is enough information provided to me while playing the serious game.
2. The cues are appropriate and geared to promote my understanding.
3. Enough cues need to be provided to me so I can progress with the serious game.
4. The serious game allowed me to analyze my own behavior and actions.

Q8. Feedback

Choose one of: STRONGLY DISAGREE - DISAGREE - UNDECIDED - AGREE STRONGLY - AGREE - N/A

1. There are enough opportunities in the serious game to find out if I clearly understand my progress within the game.
2. I received cues during the serious game in a timely manner.
3. The objectives for the serious game experience were clear and easy to understand.

Q9. Usability of the Cultural Competence Serious Game

Were you able to navigate easily throughout the serious game?
○ Yes
○ No

Additional Comments?

Q10. Did you have any difficulty in interacting with any of the available avatars (characters), and/or the environment within the serious game?

○ Yes
○ No

Additional Comments?

Q11. Were you able to access the information you required?

○ **Yes**
○ **No**

Additional Comments

Q12. What did you like best about using the serious game?

Q13. What did you like least about using the serious game?

Q14. Do you feel that this serious game will be useful for improving cultural competence skills? Please explain.

Q15. Please comment on any changes that could be made to this serious game to improve it.

Q16. Do you think that serious games such as this one are useful for cultural competence education?

○ Yes
○ No

Please explain

Q17. Additional comments not captured in previous questions.

Game Engagement Questionnaire (GEQ)

The questions are Yes/No/Maybe answers

1 I lose track of time
2 Things seem to happen automatically
3 I feel different
4 I feel scared
5 The game feels real
6 If someone talks to me, I don't hear them
7 I get wound up
8 Time seems to kind of stand still or stop
9 I feel spaced out
10 I don't answer when someone talks to me
11 I can't tell that I'm getting tired
12 Playing seems automatic
13 My thoughts go fast
14 I lose track of where I am
15 I play without thinking about how to play
16 Playing makes me feel calm
17 I play longer than I meant to
18 I really get into the game
19 I feel like I just can't stop playing

Scoring:
No = 0
Maybe = 1
Yes = 2

Sum of all questions give you the GEQ score.

You have reached the end of the survey.

Thank you for participating in the survey.

B.3 Experiment Three Survey

B.3.1 Questionnaire

Q1. Reaction to the Game Play.

Please select the option which most appropriately reflects your impressions of the game players understanding of the game.

1. Game player greets the patient correctly?
2. Game player breaks bad news in a professional way?
3. Game player responds correctly when the patient self-diagnosed herself with cancer?
4. Game player ends the conversation correctly?

Q2. Overall Reactions to the System.

Please select the numbers which most appropriately reflect your impressions of using the OPEN system.

1. Terrible (1) to Wonderful (5)
2. Frustrating (1) to Satisfying (5)
3. Difficult (1) to Easy (5)

Q3. Learning to Use OPEN.

Select the number which most appropriately reflects your impressions of learning to use OPEN.

1. Learning to operate the system. Difficult (1) to Easy (5)
2. Getting started. Difficult (1) to Easy (5)

Q4. Did you have any difficulty in using/interacting with OPEN?

Yes/No, comments (if any)

Q5. Do you think there is any educational value in reviewing gameplay sessions?

Yes/No, comments (if any)

Q6. Do you think OPEN is useful to facilitate debriefing?

Yes/No, comments (if any)

Q7. Additional comments not captured in previous questions.
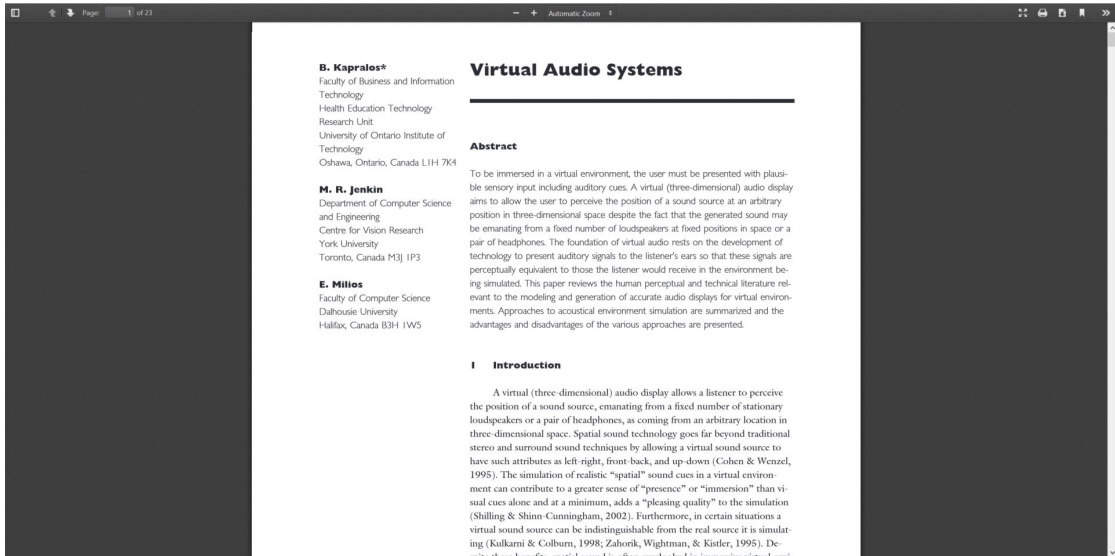
Appendix C

Additional Figures

Figure C.1: The PDF viewer displays the PDF file in the browser and can be used to print or download the resource.
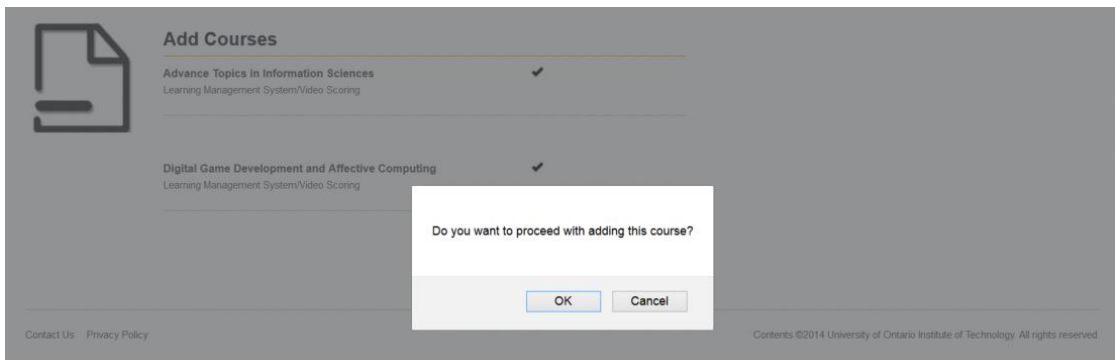

Figure C.2: For students to add a course to their list of courses, they click on the 'tick' next to the course name upon which the system asks them to confirm.
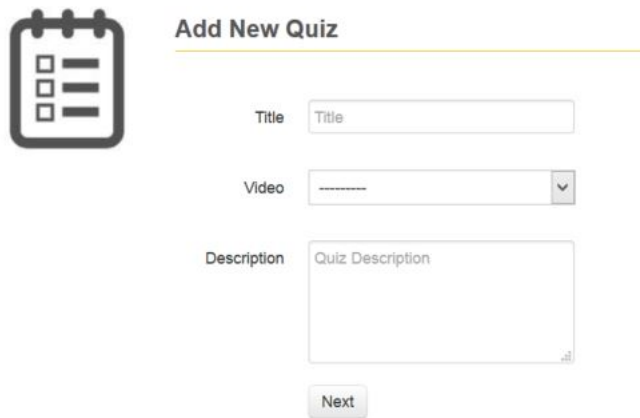

Figure C.3: Clicking on a video resource, plays the video in a new page.

Figure C.4: Form to add a new forum.

Figure C.5: The 'Add New Quiz' form takes some basic information for a quiz.

Figure C.6: The login page displayed for Fydlyty.

Figure C.7: Index page where the participant can familiarize him/herself with the environment.
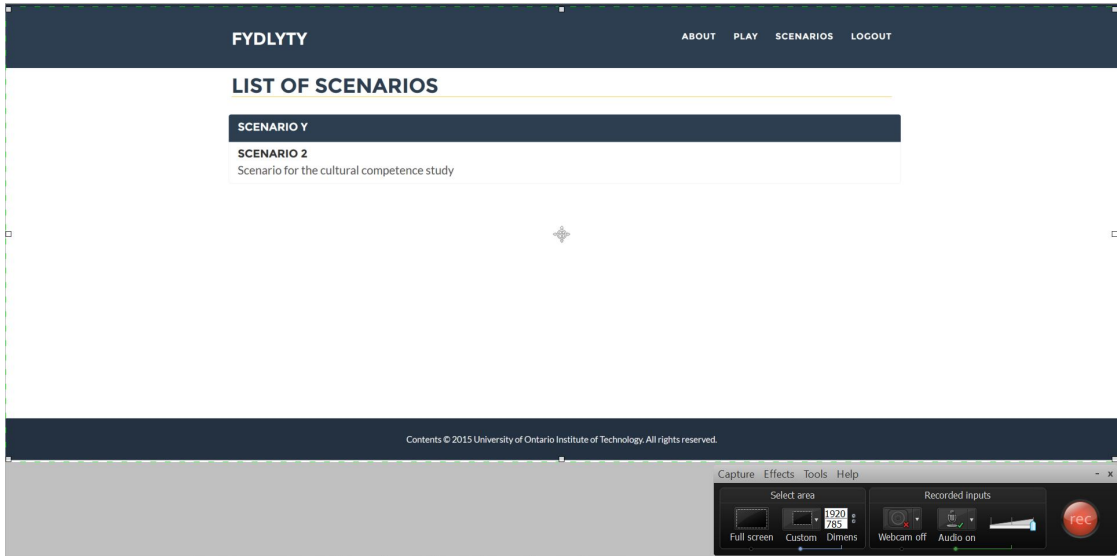

Figure C.8: The list of scenarios shown to the participant.

Figure C.9: Each participants game play is recorded using Camtasia [103]. Once ready, the participant is asked to click on the record button placed at the bottom of the screen, and then to choose the given scenario.

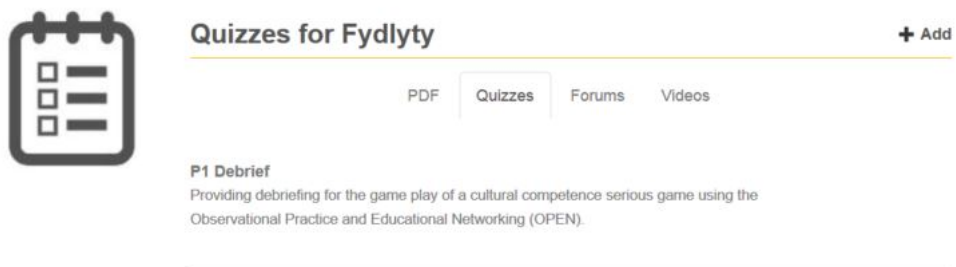Figure C.10: Experiment Three: The participants were enrolled to the new course 'Fydlyty'.

Figure C.11: Experiment Three: To rate the game play of their peers, a new quiz, 'P1 Debriefing' was designed.
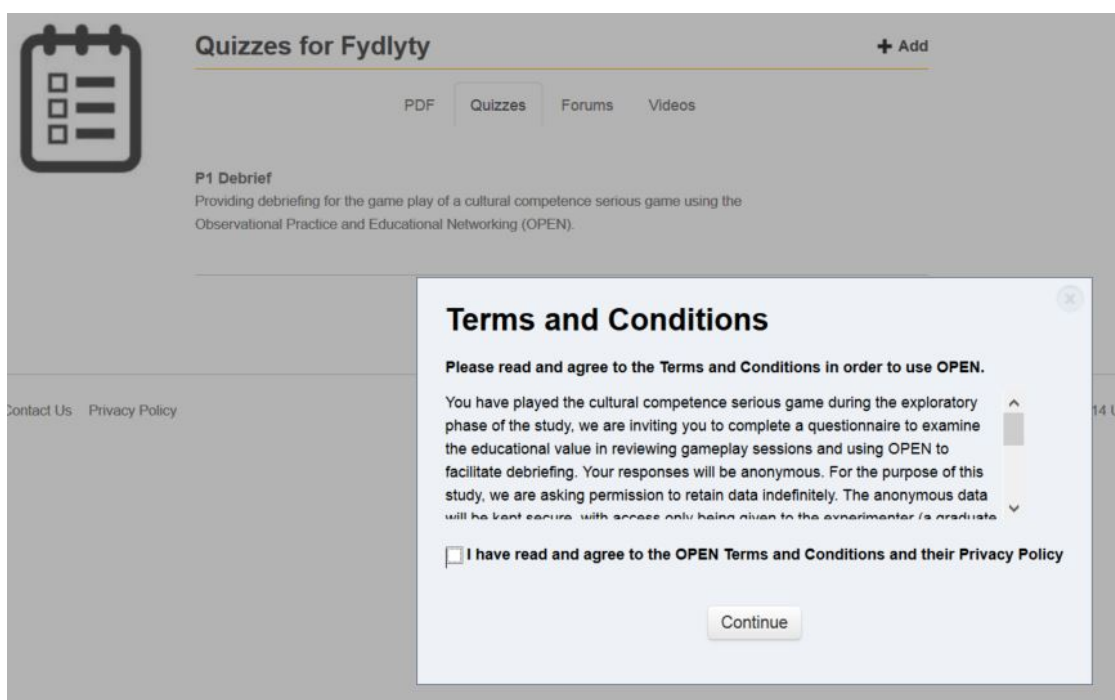
Figure C.12: Experiment Three: Consent form provided to the participants before the start of the experiment.