Using simulated digital role plays to teach healthcare ‘soft skills’

Stefan Schutt

Centre for Cultural Diversity and Wellbeing
Victoria University
Melbourne, Australia
Stefan.schutt@gmail.com

David Holloway

PhD Candidate

School of Nursing, Midwifery and Paramedicine
University of the Sunshine Coast
Sippy Downs, Australia
David.Holloway@research.usc.edu.au

Dale Linegar

Director

Oztron

Melbourne, Australia
dale@oztron.com

Daan Deman

Lead Developer

Oztron

Melbourne, Australia
daan@oztron.com

Abstract— Training deficits in ‘soft skills’ – personal or non-technical skills – have long been lamented by educators and employers despite longstanding evidence of their importance. Virtual environments, combined with online learning management and reporting platforms, offer potential for addressing this gap through affordable and scalable simulations. This paper aims to summarise virtual ‘soft skills’ work undertaken to date, and to explore practical issues encountered by development teams working in this area. The first section provides historical overviews of the ‘soft skills’ term and related digital training initiatives. This is followed by a case study of an interdisciplinary team of Australian software developers, researchers and educators who have built a series of virtual healthcare products. The case study reports on a number of challenges encountered by the team.

Keywords— virtual environments, soft skills, training, health, simulation, artificial intelligence

I. INTRODUCTION

This paper presents a case for technology-driven role plays and their potential for helping students in healthcare and other fields develop what are popularly known as ‘soft skills’. This term commonly denotes a range of personal or non-technical skills that allow people to respond more effectively to workplace situations, especially those involving interactions with others and/or a degree of personal judgement and sensitivity [1].

After outlining the history and use of the term ‘soft skills’, we present an overview of technology-

driven practice, followed by a case study of an interdisciplinary team and its development of a series of digital soft skills training products for the healthcare and medical industries. The case study will focus on practical knowledge gained that may potentially be of use to development teams.

Research tells us that soft skills both predict and produce future career and life success [2, 3]. However, the development of these skills are often overlooked, both during the training of future professionals and in the workplace itself, where achievement tests tend to miss the “personality traits, goals, motivations, and preferences” [2] that denote the acquisition of soft skills.

Acute shortfalls in soft skills development have long been noted by educators working in a range of professional areas such as engineering, law and information technology [7, 8]. Health and healthcare is no exception, with these shortfalls noted in the training of professionals including nurses [4] and medical practitioners [5, 6]. A range of strategies have been deployed to address this gap. Although there has been a recent growing focus on case-based, self-directed learning approaches [6], perhaps the most widely deployed strategy for teaching soft skills has been the use of role plays. Role play strategies generally involve students ‘acting out’ or assuming professional roles and scenarios, together

with fellow students, teachers and/or trained participants. [8]. Role plays have long been recognised as educationally effective [8], including within medical training regimes [9]. Here, the use of role plays has tended to involve either peer role plays or the hiring of ‘standardized patients’, or trained actors [10].

Although peer role plays are more cost-effective than standardized patients [10], peer role plays still result in significant resourcing overheads, especially in the need for teachers to coordinate role play activities during an era of increasing staff to student ratios in higher education [7, 10].

Educators have long looked to new technologies to improve the feasibility of role plays. In the early 2000s this included the use of video recording and playback [9] as well as online role plays [7]. The latter, with its possibilities for developing branching decision tree structures, was flagged as a promising medium for learning about complex scenarios that require the development of nuanced contextual awareness and responsiveness instead of a single ‘correct’ response [7].

Intervening years have seen the increasing accessibility of immersive simulated 3D platforms through the emergence of virtual world systems such as Second Life and OpenSim. Many educators looked to incorporate these technologies into their teaching practice after Second Life appeared in 2003, with virtual worlds gaining great popularity at first but lagging in uptake more recently [11]. This has been the result both of inherent usability limitations [12] and the development of a new generation of more flexible 3D technologies [13] such as the Unity3D platform used by the University of Southern California to build the ‘Virtual Patient’ health simulation role play product (<http://ict.usc.edu/prototypes/usc-standard-patient-hospital/>).

Additionally, concurrent advances in Artificial Intelligence and convergence of technologies – such as the ability to navigate 3D immersive spaces within web browsers – have led to new possibilities for the delivery of simulated role plays. These, however, have also come with associated drawbacks at the implementation stage. In this paper, we outline such drawbacks as encountered by an

interdisciplinary Australian team experienced in developing simulated role plays.

II. SOFT SKILLS: BACKGROUND AND CONTEXT

The term ‘soft skills’ has been used to describe everything from social skills to ‘self-efficacy, stress-coping, and motivation’ [14], but most working definitions focus on understanding and working with others. For example, three of the top six soft skills identified by the US Department of Labor are ‘communication’, ‘teamwork’ and ‘networking’ [1].

The origins of the term are in psychology. Thorndike’s human intelligence theory of 1920 proposed three facets of intelligence: Abstract, Mechanical and Social, or the ability to understand and manage others [17]. The term ‘social cognition’ was first used in 1944 and later became a sub-field of social psychology [18], expanding on the work of social psychologist Fritz Heider [34]. At the same time, the theory of Social and Emotional Learning emerged in educational research [19]. This in turn led to the development of Emotional Intelligence [20], which is commonly associated with soft skills, and which argues that personal character can be developed through the acquisition of new attributes. In recent years, educators in Australia and elsewhere have placed great emphasis on teaching and assessing ‘generic’ and ‘employability’ skills which encompass qualities such as ‘teamwork’ and ‘social competence’ [21].

As the term ‘soft skills’ has grown in popular use, it, along with its cousin ‘non-cognitive skills’ [16], has been critiqued for what some have seen as reductionist and even demeaning connotations: i.e. an artificial delineation between general and technical capabilities, labelling of vital qualities of resilience, agency, empathy and determination as ‘soft’ (and therefore implicitly inferior), and reduction of a holistic sense of personal agency and self-efficacy to the competitive acquisition of ‘skills’ for the employment marketplace [15].

In this paper we continue to use ‘soft skills’ as an umbrella term given that it is commonly understood in educational discourse as denoting a range of ‘non-technical’ skills, but with the aforementioned caveats in mind.

Soft Skills and Technology

The link between soft skills and technology use is longstanding. In the 1990s computer technology researchers identified the potential of technology to address soft skill gaps [22], the effect of shortfalls in ‘soft factors’ on software production timelines [23] and the increasing importance of ‘critical skills’ to Information Systems careers [24]. Awareness of the importance of soft skills, in IT education particularly, has heightened during recent years [25, 26, 27], with measurement of soft skills becoming an intensifying focus [28]. A recent keyword search of the Association for Computing Machinery (ACM) database for the term ‘soft skills’ revealed 582 matches for the 1990s, but (at the time of writing) 4470 matches for the 2010s to date.

Technology-based interventions in recent decades have directly tried to address the soft skills gap. In the 2000s these tended to be online training tools that allowed trainers to upload and link media files with hyperlinks [29], although some simulations were available for healthcare professionals [30]. Recent improvements in the sophistication and affordability of virtual reality, virtual worlds and other 3D tools have led to renewed interest in their use for healthcare education [31, 32], including for soft skills training and evaluation [14, 33].

III. LEARNING FROM SOFT SKILLS SIMULATION EXPERIENCE

In this section we present the case study of a series of role play-based healthcare simulations products built by an interdisciplinary Australian group of software developers, researchers and educators. The account provides an insight into the kinds of changes and challenges that can accompany the development of soft skills simulations for the health and healthcare industries.

The observations that follow are a distillation of a decade of applied industry experience, of trial and error in the field. They combine the collected reflections of designers, coders, project managers and educators associated with the group over time – as collected in field notes, interviews and communications - with data collected by the group’s software systems. It should be noted that the intention at this stage is not to present the results of an empirical study or studies, but rather to communicate on practical matters of implementation

that may be of use to others working in this area. As such, we make no claim to generalizability since project contexts differ considerably. Empirical work that deploys the group’s vPlay product is currently underway and we will report on the results in a subsequent publication (see Section IV for details).

From 2006 the group worked in the virtual world Second Life and its open source version Open Sim – platforms extensively used for educational role plays in the mid to late 2000s [11] – then moved to the Unity3D platform in 2009. The group’s first projects were health and safety role plays for building construction pre-apprentices, which culminated in the awarded project The Whitecard Game [35].

At the same time the group’s software developer began to build virtual role play products for medical and healthcare training clients. The first was a 2010 browser-viewable role play system for inter-professional learning between pharmacy and medical students at Monash University. It deployed the AIML (Artificial Intelligence Markup Language) engine created by Dr Richard S. Wallace of the ALICE A.I. Foundation to power browser-viewable automated patients. These ‘bots’ generated learned text responses to diagnostic questioning by medical and pharmaceutical sciences students, who then deployed their experiences to discuss and better understand the perspectives of the other group.

The team learned from this project that deploying Artificial Intelligence systems can generate increased project complexity. It found that simplified approaches may be justified in some circumstances, especially for smaller projects. In this aforementioned project the group found that the default AIML engine was capable of hosting a basic conversation, but was not able to mimic the specific reactions of a patient who knew (or had forgotten) their medical issues or the medications they were taking. As a result, the development team created a software system that allowed these responses to be programmed into the AIML engine. This included a ‘nested’ series of linked responses, so that medical and pharmaceutical sciences students could ask questions such as ‘Do you take medicine?’ followed by ‘What dosage?’

‘Training’ or programming the automated patient or ‘bot’ to recognise specific diagnostic questions

and statements by students proved to be resource intensive. This process involved;

1. live testing with students
2. capturing and sorting diagnostic questions and statements by students that were not recognised by the Artificial Intelligence engine powering the automated patient
3. reprogramming the Artificial Intelligence engine to recognise formerly unrecognised diagnostic questions and statements

In order to reprogram the system in the most effective manner, the development team prioritised the most commonly repeated student utterances, as follows:

Unrecognised diagnostic utterance	Student repetitions
Bye	43
Do you have diabetes?	32
Do you exercise?	30
How often?	30
Why?	30
Tell me more?	27
How is your diet?	26
Do you have high blood pressure?	20
Are you in pain?	20
Can you tell me more?	19
How is your diabetes?	19
Yes	19
How is your blood pressure?	19
Why do you feel anxious?	19
How is your arthritis?	18
Are you constipated?	18

The effect that this ‘training’ had on the automated patient can be seen in the chart below, which shows the relationship between the number of students testing the system and the responsiveness of the automated patient. This increase in responsiveness (from 75% to 84%) required 144 hours of work by the technical team alone. Much of this work also required consultation with a panel of experts to determine appropriate patient responses.

As 'training' continued, the returns on this work diminished over time, as also seen in the chart. At

first the team reprogrammed questions and statements uttered by many students, but as the project progressed the same amount of reprogramming time involved utterances by increasingly fewer students, resulting in less overall impact on the effectiveness of the automated patient to students.

Fig. 1. Number of student testers vs responses recognised by AI engine

Two related points on resourcing should also be mentioned here. Firstly, the aforementioned reprogramming time and energy focused on the responses of only one automated patient. An automated patient with a different set of responses would involve repeating much of the reprogramming work in order to achieve the same level of responsiveness. And secondly: the project found it difficult to source a sufficient number of medical students to test the software due to their restrictive schedule and curriculum. This also impacted on resourcing, due to additional project effort being expended to address this issue.

Simplifying the approach

The group’s next online role play platform, called vPlay, is now in its second iteration of development. Initially created to enhance the cultural understanding of medical practitioners working in Indigenous communities, vPlay is now being used by blood bank staff dealing with potential donors. It features an editable conversation tree that allows course administrators (teachers or instructional

designers) to prompt, record and score student responses to text-based interactions. The software also allows administrators to select both ‘reaction’ animations (which play immediately after a student has made a selection) and ‘idle’ animations, which reflect the mood of the client/patient. Reaction animations include ‘happy’, ‘sad’, ‘yes’, ‘no’, ‘angry’ and ‘confused’. Current idle animations include ‘disengaged’, ‘neutral’, and ‘engaged’.

Fig. 2. Figure 1. student interface: response options

Live feedback is displayed on programmable gauges that rate both the technical and soft skills as demonstrated by the student.

Fig. 3. Figure 2. results page: soft and hard skills scores

As described previously, the development team found that using Artificial Intelligence (AI) systems can have significant resourcing implications, both in terms of the programming and testing required and the need for the system to be adequately ‘trained’.

The vPlay team has instead opted for a simplified approach designed with principles of trainer editing/control and text-based interaction based on trainer-created conversation trees (rather than voice and AI). The first version of vPlay also requires limited character customisation but the forthcoming version, due for release in 2017, will involve trainers choosing responses from existing banks of avatar videos, with further avatar customisation optional.

IV. EMERGING RESEARCH USING VPLAY

The vPlay system is being currently used within a doctoral research project at the University of the Sunshine Coast, undertaken by PhD candidate David Holloway who is also a trained nurse and experienced virtual world operator. This study is investigating the efficacy of virtual environments to teach nursing students the safe administration of medications. Administering medications involves both procedural ‘hard’ skills (checking medication charts, calculating correct dosage and route amongst others) and, equally importantly, interpersonal ‘soft’ skills (discussing understanding of medications, informed consent). Combining vPlay’s analytics with pre and post participation surveys, the project will empirically examine both students’ competency and their perception of confidence in their safe administration of medications.

The pre-participation components establish the degree of perceived familiarity with 3D virtual environments. The post-participation survey assesses the impact of the use of the vPlay scenario on confidence in administering medications safely, as well as identifying the participants' perceptions on the scenario as a learning tool. The learning analytics embedded within the vPlay scenario itself will provide both the participant and researcher with detailed information on performance in relation to the key clinical and interpersonal steps required for safe administration of medications.

CONCLUSIONS

Virtual role plays have a constructive part to play in soft skills education at a time when innovative approaches are needed to address what researchers in a number of fields have identified as significant gaps in soft skills training. Given that resourcing issues loom large as a reason for such gaps,

affordability and scalability are important factors in, and potential obstacles to, the adoption of soft skills training approaches.

Due to the level of resourcing required to develop and deploy Artificial Intelligence based solutions, we propose that decision-tree based approaches - which are less resource-intensive to implement - offer one practical option until more affordable AI systems emerge.

REFERENCES

- [1] US Department of Labor, "Skills To Pay the Bills". Washington DC: US Department of Labor, Office of Disability Employment Policy, 2012.
- [2] J.J. Heckman and T. Kautz, "Hard evidence on soft skills". *Labour Economics* vol. 19, 4, 2012, pp. 451-464.
- [3] G.J. Duncan and R. Dunifon, "'Soft-Skills' and Long-Run Labor Market Success". In S. W. Polachek, K. Tatsiramos, Eds. *Research in Labor Economics*, vol. 35, 2012, pp. 313-339.
- [4] M. Kroning, "Fostering soft skills is a must for nurse leaders". *American Nurse Today*, vol. 10, 2, 2015, online.
- [5] A.M. Bergh, C.W. Van Staden, P.M. Joubert, C. Krüger, G.E. Pickworth, J.L. Roos, W.J. Schurink, R.R. Du Preez, S.V. Grey and B.G. Lindeque, "Medical students' perceptions of their development of 'soft skills' Part II: The development of 'soft skills' through 'guiding and growing'". *South African Family Practice*, vol. 48, 8, 2006, pp. 15-15d.
- [6] S. Gade and S. Chari, "Case-based learning in endocrine physiology: an approach toward self-directed learning and the development of soft skills in medical students". *Advances in Physiology Education*, vol. 37, 4, 2013, pp. 356-360.
- [7] H.R. Maier, "Meeting the challenges of engineering education via online roleplay simulations". *Australasian Journal Of Engineering Education*, vol. 13, 1, 2007, pp. 31-39.
- [8] K. Hegland, "Fun and Games in the First Year: Contracts by Roleplay". *Journal of Legal Education*, vol. 31, 1981, pp. 534-543.
- [9] S. Wearne, "Role play and medical education". *Australian Family Physician*, vol. 33, 10, 2004, pp. 858.
- [10] H.M. Bosse, M. Nickel, S. Huwendiek, J.H. Schultz and C. Nikendei, "Cost-effectiveness of peer role play and standardized patients in undergraduate communication training". *BMC Medical Education*, vol. 15, 2015, pp. 183.
- [11] S. Gregory, B. Gregory, T. Reiners, A. Fardinpour, M. Hillier, M.J.W. Lee, L. Jacka, D. Butler, D. Holloway, S. Grant, M. Hearn, K. Flintoff, J.J. Jegathesan, D. Ellis, M. McDonald, F. Stokes-Thompson, B. Gaukrodger, J. Zagami, C. Campbell, X. Wang, J.G. Salinas, S-K Loke, S. Scutter, C. Newman, N. Gu, S. Schutt, H. Farley, A. Bogdanovych, Y. Trescak, S. Simoff, C. Steel, P. Neuendorf, M. Bower, L. McKeown Orwin, T. Kerr, I. Warren, D. Wood, C. Miller, S. Mathews, D. Linegar, V. Knox, Y. Masters, R. Brown, G. Meredith, C. Atkins, A. Giovanangeli, K. Le Rossignol, A. Cram, E. Muir-Cochrane, A. Basu, M. Jacobson and I. Larson, I, "Virtual worlds in Australian and New Zealand higher education: Remembering the past, understanding the present and imagining the future". *Proceedings, Electric Dreams: 30th ascilite Conference, Sydney 2013*, pp. 312-324.
- [12] B. Dalgarno, S. Gregory V. Knox, T. Reiners, "Practising Teaching using Virtual Classroom Role Plays". *Australian Journal of Teacher Education*, vol. 41, 1, 2016, pp.126-154.
- [13] S. Gregory, B. Gregory, D. Wood, J. O'Connell, S. Grant, M. Hillier, D. Butler, Y. Masters, M. McDonald, S. Nikolic, D. Ellis, T. Kerr, S. De Freitas, H. Farley, S. Schutt, J. Sim, B. Gaukrodger, L. Jacka, J. Doyle, P. Blyth, D. Corder, T. Reiners, F. Stokes-Thompson, D. Linegar, M. Hearn, R. Cox, J.J. Jegathesan, S. Sukunesan, K. Flintoff and L. Irving, "New applications, new global audiences: Educators repurposing and reusing 3D virtual and immersive learning resources". *Proceedings, Ascilite 2015, Bentley Western Australia*
- [14] K. Maschuw, K. Schlosser, E. Kupietz, E.P. Slater, P. Weyers and I. Hassan, "Do Soft Skills Predict Surgical Performance?" *World Journal of Surgery*, vol. 35, 3, 2011, pp. 480-486.
- [15] A. Calkins, "It's Time to Trash the Terms 'Non-Cogs' and 'Soft Skills'". *Next Gen Learning Blog*, 2015, <http://nextgenlearning.org/blog/it%E2%80%99s-time-trash-terms-%E2%80%99Cnon-cogs%E2%80%99D-and-%E2%80%99Csoft-skills%E2%80%99D>
- [16] T. Vander Ark, "Non-cognitive Skills: Bad Name, Really Important", *Getting Smart*, 2015. <http://gettingsmart.com/2015/08/non-cognitive-skills-bad-name-really-important/>
- [17] J.F. Kihlstrom and N. Cantor, "Social Intelligence". In R.J. Sternberg, Ed, *Handbook of intelligence*. Cambridge: Cambridge University, 2000, pp. 359-379.
- [18] G.B. Moskowitz, "Social Cognition: Understanding Self and Others". New York: Guilford Publications, 2013.
- [19] M. Elias, "Promoting Social and Emotional Learning: Guidelines for Educators". Alexandria, VA: Association for Supervision & Curriculum Development, 1997.
- [20] D. Goleman, "Emotional Intelligence: Why It Can Matter More Than IQ". New York: Bantam Books, 1995.
- [21] K. Bowman, "Background paper for the AQF Council on generic skills". Canberra: Australian Qualifications Council, 2010.
- [22] W. Ives, "Soft skills in high tech computerizing the development of interpersonal skills". *Instruction Delivery*, vol. 4, 2, 1990, pp. 12-15.
- [23] C. Wohlin and M. Ahlgren, "Soft Factors and Their Impact on Time to Market". *Software Quality Journal*, vol. 4, 1995, pp. 189-205.
- [24] D. Lee, E. Trauth and D. Farwell, "Critical Skills and Knowledge Requirements of IS Professionals: A Joint 11 IBIMA Business Review Academic/Industry Investigation". *MIS Quarterly*, vol. 19, 3, 1995, pp. 313-340.
- [25] M. Stevens and R. Norman, "Industry expectations of soft skills in IT graduates: a regional survey". *Proceedings ASCW '16, ACM Press*, 2016, Article 13.
- [26] G. Zheng, C. Zhang and L. Lee, "Practicing and Evaluating Soft Skills in IT Capstone Projects". *Proceedings. SIGITE '15, ACM Press*, 2015, pp. 109-113
- [27] S. Purao and H. Suren, "Designing a multi-faceted metric to evaluate soft skills". *Proceedings SIGMIS-CPR '10, ACM Press*, 2010, pp. 88-91.
- [28] D. Beard, D. Schwieger and K. Surendran, "Integrating Soft Skills Assessment through University, College, and Programmatic Efforts at an AACSB Accredited Institution". *Journal of Information Systems Education*, vol. 19, 2, 2008, pp. 229-240.
- [29] C. Gaffney, D. Dagger and V. Wade, "A survey of soft skill simulation authoring tools". *Proceedings, HT'08, ACM Press*, 2008, pp. 181-186.
- [30] F. Mantovani, G. Castelnuovo, A. Gaggioli and G. Riva, "Virtual Reality Training for Health-Care Professionals". *CyberPsychology & Behavior*, vol. 6, 4, 2004, pp. 389-395.
- [31] N. Saxena, B.M. Kyaw, J. Vseteckova, P. Dev, P. Paul, K.T.K. Lim, A. Kononowicz, I. Masiello, L. Tudor Car, C.K. Nikolaou, N. Zary and J. Car, "Virtual reality environments for health professional education (Protocol)". *Cochrane DB of Systematic Reviews*, vol. 2, 2016, CD012090.
- [32] J. Falah, S. Khan, T. Alfalah, S.F.M. Alfalah, W. Chan, D.K. Harrison, V. Charissis, "Virtual Reality medical training system for anatomy education". *Proceedings Science & Information Conference*, 2014, pp. 752-758.
- [33] Abshier, P. *Feasibility Pilot Study: Training Soft Skills in Virtual Worlds. Games for Health* 1, 2 (2012), 174-176.
- [34] F. Heider, "Social perception and phenomenal causality". *Psychological Review*, vol. 51, 6, 1944, pp. 358-374.
- [35] M. O'Rourke, "Increasing engagement with vocational education and training: a case study of computer games-based safety training". Adelaide, Australia: NCVER, 2014