Adaptive Simulations for Communication Skills Training in Healthcare

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Abstract. Communication skills play a crucial role in everyday business and life, including but not limited to the healthcare sector. They are cognitively complex to learn and can span a wide range of educational settings. Teaching communication skills is also a complex task typically consisting of highly interactive, high fidelity and context sensitive environments such as actors playing "patients", videotaped interviews and conversations, and with the growing demand for eLearning solutions, e-simulations and e-games. Simulations provide the means to “learn by doing” in practical and safe environments. They support higher order cognitive skills such as application, analysis, synthesis and evaluation while providing structured environments to practice. However, there are a number of key challenges regarding simulations which must be addressed going forward to promote their widespread use, such as fidelity, cost, complexity, flexibility and maintenance. This paper explores the novel application of adaptive hypermedia principles to dialectic based simulations for teaching communications skills and briefly describes the design, development and initial evaluation of an Adaptive Simulator for Personalised Interactions in Realistic Environments (ASPIRE), which is being used as a training tool for communications skills in medicine at the University of Dublin, Trinity College.

1. Introduction

‘If you can’t communicate it doesn’t matter what you know’ Gardner, C 1982. Communication skills are central to successful human endeavour. They are the key skills of most professions but are especially important within the field of healthcare. Poor communication in healthcare results, not only in misdiagnosis, inefficiency and error but patient dissatisfaction, complaints and litigation.

Communication skills in medicine, once considered a minor subject, are now ranked a core clinical skill [1], requiring ongoing training, practice and feedback across the continuum of medical education. Given the widespread deficits in patient-doctor communication reported in academic research literature, large-scale consumer surveys and complaints to professional medical associations, an increased emphasis on teaching communication skills is essential [2][3]. The consequences of effective teaching strategies are far reaching since good patient-doctor communication has been shown to have positive influences on patient and physician satisfaction and the frequency of malpractice claims [4][5].

When doctors and other allied health professionals use communication skills effectively, patient’s problems are identified more accurately [6], patients are more satisfied with their care and better understand their problems, investigations and treatment options. They are also more likely to adhere to treatment and follow advice on behaviour change [1].

Traditional teaching methods have included lectures, tutorials and handouts which can help in gathering knowledge about communication skills, however putting this knowledge into practice requires high levels of cognitive engagement. Furthermore students typically observe senior health professionals at ward rounds or in clinics. They are then often expected to start at the ‘deep end’ by conducting interviews with real patients. Students have described this as a very anxiety provok-
ing experience continuing for varying periods of time, depending on the student, before they feel comfortable conducting patient interviews.

To improve on this approach trainers have used modelling whereby students are presented with demonstrations of the key skills in action either through audiotapes or videotapes of real consultations. Alternatively, an ‘interactive demonstration’ can be used with a facilitator conducting a consultation as he or she would in real life but using a simulated patient (actor/actress). The trainees can then practice their own skills with the simulated patients.

A further approach involves video-recording students conducting interviews with both simulated-patients and real patients with small group feedback. This has been shown to be a very effective approach to teaching communication skills [6]. However, this approach is extremely expensive, labour intensive and requires considerable resources each time for a large number of students. As a result, the teaching of these essential communication skills is being neglected.

An international consensus statement on communication teaching and assessment in medical education, which is relevant to both graduate and continuing medical education programmes, was published in 1999. This highlighted the need to have the teaching based on a broad view of communication in medicine, to be consistent, complementary and help students achieve patient-centred communication tasks. It also recommended that the teaching methods need to be evaluated [7]. The creation of interactive tools using videos and other electronic materials has been advocated as the logical progression in teaching both clinical and communication skills [8]. At this juncture, it is envisioned that the application of Adaptive Hypermedia principles to the interactivity of dialectic based simulations will herald a new era of user-centric, highly interactive, context rich, engaging and personalised eLearning experiences.

Adaptivity in eLearning or personalised eLearning offers an important alternative to the traditional ‘one size fits all’ [10] approach of online learning [11] [12] [13]. More specifically it offers the potential of uniquely addressing the specific learning goals [14], prior knowledge [15] and context of a learner [16] to improve their satisfaction and motivation, thus creating a more engaging experience. Personalised eLearning is seen as a key element for next generation eLearning systems [17] [18].

The core goal of personalised eLearning is to support eLearning content, activities and collaboration, adapted to the specific needs and influenced by specific preferences of the learner and built on sound pedagogic strategies [19] [20]. In an eLearning experience, for example, personalisation could involve the selection of the most appropriate learning resources based on the learner’s preferred learning style (more pragmatic learners could receive more examples or more interactive content) or the selection of the most appropriate subject concepts based on the learner’s prior knowledge of the specific subject area or the selection of the most appropriate learning paths. In achieving this goal, personalised eLearning can offer many tangible benefits to the entire educational process such as teacher and learner empowerment [21] [22], educational community collaboration and tailored eLearning delivered “just in time” and “just for you”.

This paper explores the challenges of adaptive simulation design, the design and development of an Adaptive Simulator for Personalised Interactions in Realistic Environments (ASPIRE) and the initial evaluation results of using ASPIRE as a tool for teaching communications skills in healthcare at the University of Dublin, Trinity College.

2. Challenges

A number of key challenges for adaptive dialogue-based simulations must be addressed going forward. These include;

**Fidelity:** Fidelity is a measure of the accuracy with which a computer system can reproduce something modelled from the real world. It is a key aspect of simulation that directly affects many other factors such as content, interactions and presentation. There has been much research into how fidelity and learning are related. The general thought being that high fidelity produced high learning and transfer. But this was realized not to be the entire truth; their relationship was indeed significantly more complex.

Over the years many different results have shown how the two (fidelity and learning) were related; Miller [23] who predicted a normal ogive curve for similarity and transfer; Robinson [24]
who predicted a U-shaped curve. These many differing results led to the hypothesis that the relationship between fidelity and learning is non-linear; that this relationship depends on a number of other variables such as the competence level of the student, which is illustrated in Figure 1 [25].

Examine Figure 1 we can see that in simple terms there are three different levels of student; novice, experienced and expert. For each level the amount of learning gained with respect to the fidelity of the simulation is different. While the expert student will excel when fidelity is high, the novice student’s learning experience suffers. This is typically due to the fact that the novice is overwhelmed and distracted by the realism of the simulation. As you start to layer the different variables on top of such a hypothesis, such as roles, context, etc. you begin to realize the inefficiveness of trying to create a single static simulation for all user’s under all circumstances.

**Flow:** Flow, although can be in some way affected by fidelity, involves the sequencing and the semantic paths of the simulation. With dialogue-based (dialectic) simulations this includes the logical structuring of the dialogue, the sub-dialogues and the dialogue elements and how they are linked together to form a consistent and effective learning experience for the user of the simulation. However, different flows may be required for different users based on such things as role in the simulation (doctor, nurse, patient, etc.), competence level (first med, trainees, consultants, etc.) and user context (time constraints, environmental constraints, etc.). These issues are very difficult to address in static simulations and often their solution leads to one-off simulation designs.

**Adaptivity:** Adaptivity can introduce a dynamic layer of user scaffolding whereby the simulations become personalised and individualised. The potential benefits of bringing adaptivity into simulations are immense. However, there are a number of interesting challenges to be addressed involving selection and sequencing. One of the most crucial challenges involves the process of adapting or personalising a simulation while maintaining the correct levels of fidelity while also maintaining a consistent and semantically appropriate flow. Another key challenge involves the representation and realization of the adaptive mechanisms. This challenge is two fold. The first involves the representation and association of adaptivity at design-time; i.e. when the simulation is being designed and developed, how do we promote best practice in the application of adaptivity. The second involves the presentation of the adaptivity mechanisms and the control metrics within the simulation itself, i.e. how does the adaptivity effect the presentation and the navigation of the simulation and how do you give ownership over the ability to adapt to the user of the simulator (user-centric adaptivity).

3. **Design and Development**

A number of design decisions have been made in order to address the challenges as detailed in the previous section. Firstly, an initial online simulator was designed, developed and extensively evaluated. This first simulator called VISIoN (Virtual Interviews for Students Interacting online)
was focused on teaching good interview techniques for psychiatry students and professionals. This provided a platform for testing and evaluating a series of decisions such as the complex processes involved with creating the knowledge models for the simulations and the control metrics as presented in the simulator. During this phase of development 4 ‘virtual’ interviews were created to address the various learning objectives and skills essential to the task of effective communication in psychiatric care. For each interview we would initially decide the general context and area of the scenario. A variety of skills and objectives i.e. the learning outcomes had to be addressed within each scenario. For example each scenario would look at how to greet and orientate the patient, how to gather information about the presenting problem while maintaining rapport and how to use a wide variety of question styles, facilitation techniques and empathic statements etc. A list of other more specific learning objectives needed to be addressed within individual scenarios. For example, when interviewing the manic patient it was important to maintain some form of control over the direction the interview was going by gently interrupting and using directive comments. The benefit of creating virtual interviews meant that we could also script alternative dialogues which enabled the students to see what might happen if they used the wrong interview techniques. Within the safety of using the simulator they experienced the patient becoming increasingly angry, frustrated and walking out of the interview. They learnt how to deal with such stressful events which of course can often happen in the real life situation. The users interact with and control the simulator by choosing paths within a series of dialogues and sub-dialogues pertinent to the current scenario. They can dynamically follow dialogue paths to completion or they can choose to change their line of questioning which brings them to different places within the dialogue. For each question the interviewer asks, there is an appropriate video clip associated with it that provides the interviewee with the patient’s response. The simulator provides feedback on the semantics of that specific piece of dialogue, i.e. the type of question asked (closed, open, etc.), the type of clinical information which can be gleaned from the patient’s response (family problems at home, not sleeping well at night, etc.) and a written transcript of the dialogue. At this point the simulator also provides a range of support materials for the interviewer such as a detailed glossary of psychiatric terms and links to detailed learning material by experts in the field, e.g. tips from consultant psychiatrists on best practice interviewing techniques. The interviewer’s competencies are then tested at the end of the simulation through the completion of a quiz with appropriate feedback on their performance. The key to this approach to learning is that the learner interacts with and engages the patient rather than being a passive recipient of information.

This approach was highly rated by the students and, as later identified during the preliminary evaluations; all of the users of the simulations described an increase in confidence. It allowed those users to practice their interviewing techniques repeatedly in the safety of a simulated environment, thus reducing overall anxiety. However, the issue of fidelity versus learning as detailed in the previous section had still not been addressed. In addressing this variance, the need for adaptivity was highlighted.

Applying adaptivity in simulations meant that the design of an Adaptive Simulator must be based on the principles of good design from the fields of Adaptive Hypermedia and Adaptive Web Based systems and the Semantic Web. This involved the “separation of concerns” [26]; where each component of an intelligent system be defined and modelled separately; and the abstraction of adaptivity mechanisms [20]; where adaptivity is not defined at the atomic level, i.e. explicitly applied to pieces of content, but at the strategic and more abstract level, i.e. describing adaptive strategies. This means that the adaptive simulator is designed in such a way that not only is the simulator itself completely reusable but so too are the knowledge models that it operates on.
As illustrated in figure 2 above, the adaptive simulator is a service which operates across a collection of knowledge models to produce personalised simulations for the end user. These knowledge models consist of: dialogue models describing the dialogues, sub-dialogues, dialogue elements and how they relate to each other within a scenario; the resource models which describe the types of learning resources available for the simulation; the pedagogic models which describe the educational principles behind the simulation; and the adaptivity models which describe the types of adaptivity and personalisation that the simulation supports.

The simulation designer, through the suite of simulation design tools, can now focus their efforts on best practise in the design of their simulations and not on the technologies and techniques for realising the simulations.

This adaptive simulator has been designed and developed as part of an Enterprise Ireland commercialisation initiative. It is currently being evaluated at the University of Dublin, Trinity College as a training tool for communications skill in healthcare. The following section details the initial findings from these evaluations and the strategy for further evaluation.

4. Initial Evaluation

It is important to note that at this initial stage we were looking at how to evaluate the effectiveness of this tool for teaching communication skills in the area of psychiatry. Research has shown that students self ratings are higher when not given communication skills training, students are more confident but less competent. So with less effective communication skills training, such as non-interactively watching a video of an interview, we would expect the students to be over confident and not so competent. We would hope that being able to interactively interview a virtual patient would decrease the students’ confidence but make them more competent heading into the real life situation.

The initial prototype simulator, VISION (Virtual Interviews for Students Interacting Online), contained a single interactive interview with a depressed patient. To evaluate the effectiveness of the simulation at this early stage we conducted a randomised controlled trial on Trinity College Dublin medical students completing their two month psychiatric rotation over a two year period (October ’04 to March ’06). The students were randomly divided into 2 groups. We compared the demographics of both groups and were confident that the randomisation was effective. One group (interactive) were exposed to the interactive simulator of the depressed patient interview, the other
group (non interactive) watched the video of the virtual interview but were not able to interact. Both groups had access to the additional web-based teaching resources.

Questionnaires at baseline and at the end of their rotation looked at the students’ experience of using the tools as well as their self-reported assessment of confidence and competence conducting psychiatric interviews.

We have preliminary results; comparisons made using independent t-tests. 189 Students consented to participate in the RCT. Of these 152 (80%) completed all of the questionnaires. The mean time students used the simulator was 1 hour 43 minutes (ranging from 10 minutes to 10.5 hours). All students who used the simulator reported higher confidence and competence levels at the end of their rotations. Although there was no significant difference between the interactive and non-interactive groups on their self-reported assessments of confidence and competence, there was a definite trend towards the control group being more confident and the interactive group were less confident. This is in accordance with previous research in this area. 82 students (54%) thought that the simulation was realistic and felt they were ‘virtually interviewing a patient. Initially only 30 (20%) felt that web based resources were useful compared to 115 (76%) who were more inclined to use the internet for learning after using the simulator.

Obviously there are limitations to this evaluation in that the groups were only exposed to one interview. Also self assessment of students’ own communication skills is often unreliable with students over estimating their skills. To address this we have conducted objective assessment of the students’ performance by analysing video recorded interviews using validated scales and hope to have more robust evaluation of whether the tool is effective in teaching communication skills.

It is important to note that at this early stage we did not objectively assess the usability of the tool however focus group discussions provided many useful comments from the students which enabled us to update this prototype version incorporating their suggestions.

To continue this evaluation into the domain of adaptive simulations we have established the following strategy going forward. The adaptive simulator will be trialled along side the non-adaptive simulator with a group of 20 medical trainees. The evaluation will address issues such as the levels of fidelity experienced by the users in relation to flow (navigation) and resources engaged (presentation). The evaluation will also look at the impact of adaptivity on the simulations and the user’s conceived control and ownership of the simulations. This is a crucial point in supporting the need for user-centric and engaging environments when teaching higher order cognitive skills.

5. Conclusions

Good communications skills are a global requirement in the majority of professions, especially so in the area of healthcare. Traditional teaching methods, as described earlier in this paper, typically fail to address the complexities involved with teaching such engaging skills in an economical, efficient and effective manner. The more advanced teaching approaches to communication skills provide highly successful but highly restrictive and costly solutions, such as actors playing patients or video analysis of student patient interviews. The use of simulation as a training tool is a novel approach to teaching these types of skills. However, it too has a set of challenges to be addressed in order to be successful. Simulations provide a more efficient approach to teaching communications skills than traditional teaching methods, however, users at various levels feel disenfranchised due to a number of reasons such as fidelity and flow, as previously described.

Adaptive Simulations are seen as a key enabler to creating realistic and personalised learning experiences for individuals to gain and retain higher order competencies in communications skills in safe and friendly environments.

References


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