2009; 31: 764–769 MEDICAL TEACHER

Training staff to create simple interactive virtual patients: the impact on a medical and healthcare institution

JONATHAN ROUND, EMILY CONRADI & TERRY POULTON
St George's University of London (SGUL), UK

Abstract

Background: Virtual patients (VPs) are excellent teaching tools for developing clinical decision-making skills and improving clinical competency, but are believed to be very expensive and time consuming to make.

Aim: The aim of this study was to establish whether it was possible to design a workshop for VP creation, which would enable teaching staff to create interactive, immersive VPs quickly, and with limited technical support.

Methods: The Centre for Medical and Healthcare Education at St George's University of London's (SGUL) medical school developed an ergonomic and generic 'model' for VP creation, simple enough for clinicians and educators to use, yet flexible enough to simulate real decisions through non-linear pathways. One-day workshops were set up to support the development of VPs by medical and healthcare educators.

Results: VP creation workshops have been successfully trialled, attracting a large number of clinicians and educators from a range of medicine and healthcare courses. Feedback from participants was very positive. Educators, organised into small groups, were unable to complete VPs within the workshop, but many groups completed a VP after the workshop. Interest was highest in mental health.

Discussion: The workshops catalysed a change in the awareness of the value of VPs, with staff directly integrating VPs into the curriculum.

Introduction

The training of medical and healthcare professionals has traditionally been based on substantial direct student–patient contact. Good doctors need to be able to apply reasoning skills gained from exposure to a variety of cases in order to develop diagnostic and therapeutic accuracy, so as to take proper care of their patients.

Advances in clinical care are reducing patient time spent in hospitals (European Commission 2002). This means that the availability of patients for engagement in teaching activities is diminishing even as the numbers of students are growing, with a 38.1% increase between 2002 and 2007 in the UK (Higher Education Statistics Agency 2009). Clinician time available for teaching has been significantly reduced (Aldridge & Fitzpatrick 2008). Furthermore, due to the increased specialisation of most university hospitals, students are increasingly encountering patients with complex problems and a narrow scope of illness.

One response to these challenges has been the development of simulated or virtual patient (VP) encounters employing a range of technologies and software to replicate common or important patient presentations (Ellaway 2007). VPs can provide students with a reliable, safe and repeatable environment in which to rehearse and practise diagnostic skills and develop clinical reasoning. In particular, VPs have demonstrated their use in healthcare teaching, learning and assessment (Issenberg et al. 1999) and throughout a wide range of designs for learning (Ellaway et al. 2006). Typically VPs offer task repetition, the ability to investigate alternative courses of action, the ability to make mistakes without real world repercussions, more exposure to patient scenarios, learning at a time, place, and pace convenient to the learner and formative or summative

Practice points

- Virtual patients (VPs) are excellent teaching tools for teaching clinical medicine, developing decision-making and improving clinical competency.
- VPs are believed to be very expensive and time consuming to make.
- An ergonomic 'model' for VP creation has been developed at St George's, simple enough for clinicians and educators to use, flexible enough to simulate real clinical decisions through non-linear pathways.
- VP creation workshops have been successfully trialled and evaluated, largely attended by clinicians and healthcare teachers.
- The next step is to evaluate the various uses of the generated VPs, such as an online interactive replacement for cases in problem-based learning.

Correspondence: Jonathan Round, Centre for Medical and Healthcare Education, Hunter Wing, Level 4, Cranmer Terrace, Tooting, London SW17 ORD, UK. Tel: 020 8725 2203; fax: 020 8725 0806; email: jround@sgul.ac.uk

ISSN 0142–159X print/ISSN 1466–187X online/09/080764–6 © 2009 Informa Healthcare Ltd.
DOI: 10.1080/01421590903127677

assessment with consistent feedback (de Jong 1991; Bergin & Fors 2003; Scalese et al. 2008).

The problems that limit virtual patient development

Whilst VPs are a useful component of healthcare education, they are not a cheap alternative. In a recent survey in the USA it was noted that half of the VPs constructed had cost between US$10–50,000, and some over US$100,000 (Huang et al. 2007). Not surprisingly, few medical schools are currently producing them.

Furthermore, the range of VPs produced is very limited and many of the VPs written are essentially automated and enhanced versions of 'paper cases', such as those used in problem-based learning (PBL). These cases can only proceed in a single direction, and so prevent users from tracking down 'wrong paths' by immediate correction. This inflexibility limits the development of clinical reasoning, and is both unrealistic and unengaging. In real life there are often several ways to tackle a problem, but such multiple route scenarios can be very time consuming to model.

Development of low cost, multiple route virtual patients

An authoring model was developed at St George's medical school to produce multi-route, engaging VPs at low cost. Cases constructed in this way were more reflective of real situations and choices, and provided excellent tools to practice reasoning and decision-making skills. Each case required 8–10 h of a specialist's time to create, along with simple development support (Round 2007).

Although there were no courses at the medical school which were using (or even considering) VPs at that stage, interest in the model led to workshops designed to teach staff how to write VPs. The challenge of this project was to establish whether simple one-day workshops could be provided which would attract teaching staff to create VPs in a relatively short time and with limited technical support.

The progress and problems encountered in the introduction of these workshops are detailed in this article. The VP creative process, the performance of the workshops and the outcomes of the exercise are discussed.

Methods

St George's e-Learning Unit set up workshops to explore an ergonomic method for VP creation which could provide a unique opportunity for disseminating VP design and development throughout the institution.

The workshops were free one-day events open to all staff within the Medical and Healthcare Faculties at SGUL. They were advertised through emails and internal dissemination events and ran every couple of months over the course of a year, for 10–15 participants at a time. Five workshops were run in total. Workshops began with an overview of VPs, the possibilities they bring to education, demos of existing VPs, followed by an overview of the creation process itself. This was followed by a 4 h practical session to complete the workshop (see the Process model for an outline of these activities).

The workshop was run by a paediatric clinician and aided by two learning technologists. All the tutors were familiar with the VP authoring model and the authoring technology. The learning technologists took the VP maps produced in the workshops and created the online VPs from them.

Process model

The VP authoring model adopted at St George's allows options for decision-making, but uses 'key nodes' (or 'critical nodes') – gateways between the main stages of the case – to keep the number of these options sufficiently limited (Figure 1). Key nodes are essential stages through which the scenario must pass, and restrict the expanding number of choices by creating a bottleneck for each main phase of the case. This simple technique makes it possible to create VPs quickly (in up to 20 h), and therefore at realistic cost (varying between an estimated £200 and £800) in terms of subject specialists' time.

Working in speciality-based small groups of 2–4, workshop participants brainstormed possible scenarios, outlined key nodes and the steps between them to make an ideal pathway (dark shaded boxes in Figure 1). They then expanded the patient 'map' to incorporate other decisions and pathways the user might consider taking, along with potential consequences.

These patient maps were initially drawn using whiteboards. Once the outline map is in place, the accompanying narrative is added. This map and accompanying narrative could then be transformed into an online VP using the software tools outlined below.

Software

The process of VP creation was based on collaboration between practitioners and technologists. The case narrative needed to be rich in clinical detail, making it essential for practitioners to be at the heart of the authoring process. However, practitioners did not need to be highly skilled in software creation and development, as their clinical experience was combined with a learning technologist's skills in converting a VP map into a usable resource.

VP maps were first drawn on a whiteboard, then a learning technologist copied the map into the visual understanding environment (VUE – developed by the University of Tufts, Figure 2). VUE is an information management application that provides an interactive, concept mapping interface, allowing a case to be quickly drawn as a VP map.

VUE files were then transferred into OpenLabyrinth, an educational pathway authoring and delivery system, which has an easy to use, code-free interface (Figure 3). VUE and OpenLabyrinth are designed as complementary tools. Each node in a VUE patient map generates a page in the case and each arrow becomes a hyperlink. Any accompanying media, e.g. sound or video clips can then be incorporated. Finished cases are played within OpenLabyrinth, displaying the VP as a series of web pages that can be accessed online.

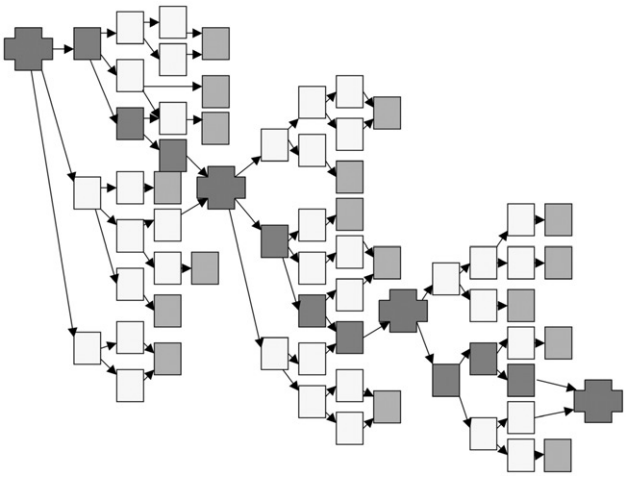

Figure 1. An empty patient map: key nodes are the cross shaped boxes, and dark shaded boxes an 'ideal' pathway. The empty boxes are for alternative choices, some of which (as in real life) allow progression. Light shaded boxes contain advise and redirect back to an earlier node.

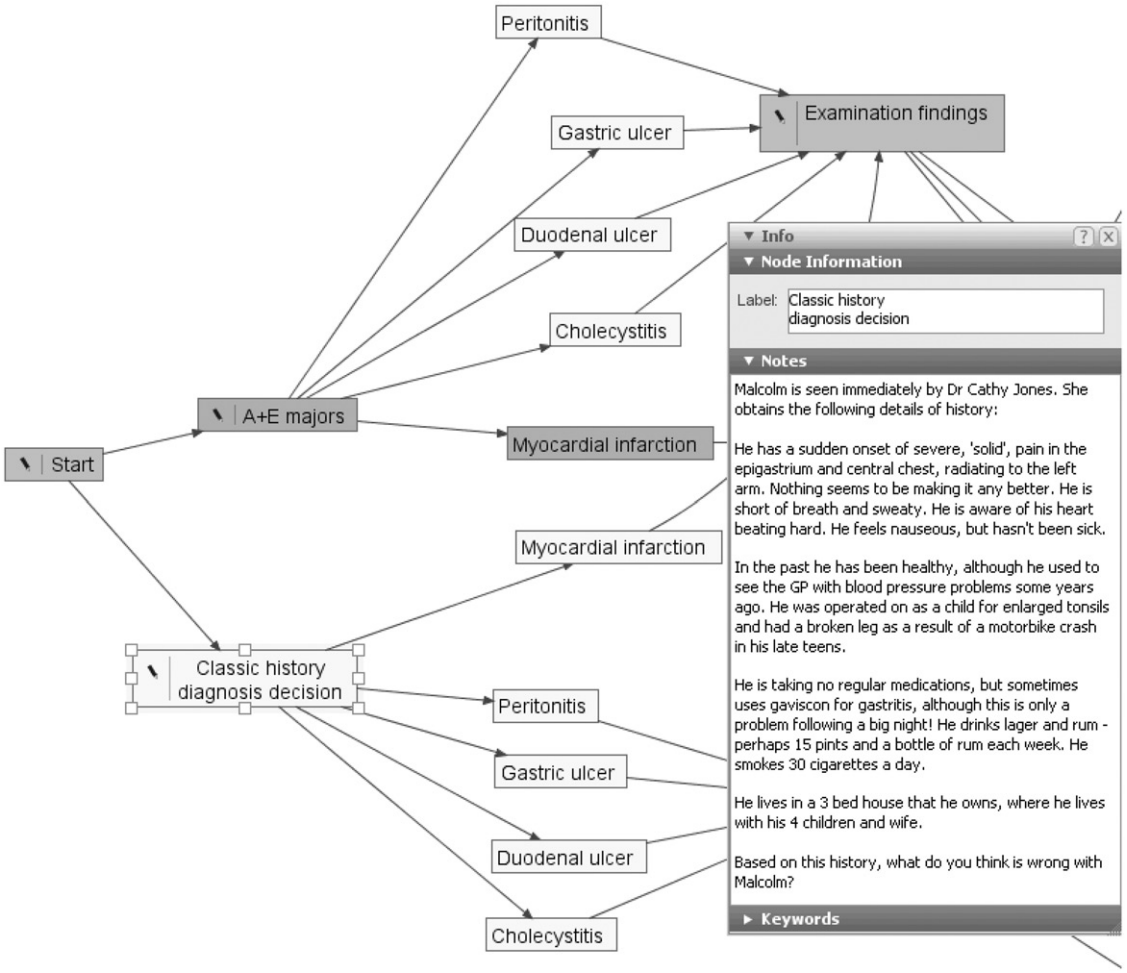

Figure 2. Patient map drawn using VUE, showing accompanying page narrative within a floating panel.

Data collection

The intention was to evaluate factors, such as the feasibility and productivity of the workshops, the attendees' responses to the value of VPs as a teaching tool, the quality of VPs produced and the institutional take-up. Evaluation of the workshop was obtained via feedback questionnaires distributed at the end of the event, and 1 year after the first workshop.

As the VP authoring model disseminated through the workshops is a non-linear design, the range and richness of a case is in part dictated by the degree of branching – i.e. the number of choices a student could take at various steps in

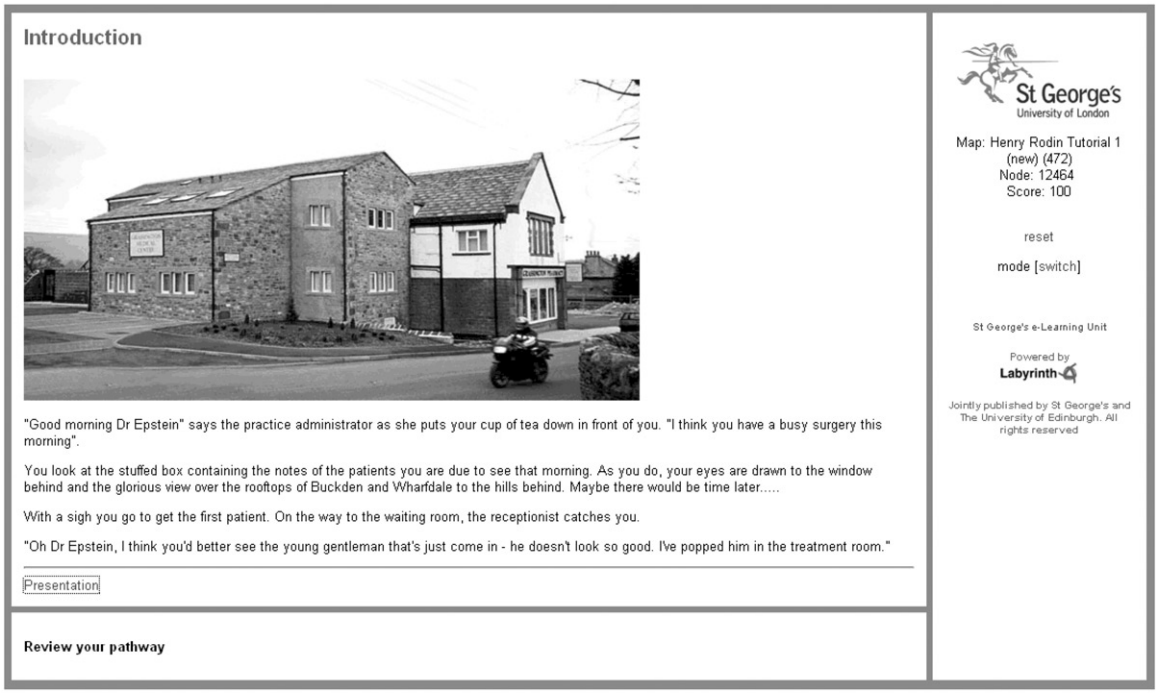

Figure 3. A VP case being played in OpenLabyrinth.

the case. This was analysed by measuring the ratio of links (representing the choices) to nodes (representing each page – or consequence – in the scenario) within a completed case. Ideally each point within a case should have at least three choices (links) for the students to select from. To make the case immersive and detailed, there should be a sufficiently high number of different consequences (nodes) for the student to select from. Although setting a 'standard' for the density and linearity of a case was difficult, a rough guideline was set up using the ratio of links to nodes in an exemplar case, and workshop VPs were measured against this guideline.

Results

Analysis of participants

The workshops were advertised to all faculty staff within the University, but the Medical teaching staff was the intended target. However 43% of attendees were from the faculty of healthcare and social sciences which includes nurses, radiographers, physiotherapists and other healthcare practitioners and teachers. Only 48% of attendees were from the medical faculty. This contrasted with a large-scale evaluation and comparison of VP creation and use across the USA (Huang et al. 2007) which had noted that interest in VPs was largely confined to medicine.

Participants were from a wide range of Medical and Healthcare roles, including representatives from most healthcare specialities, e.g. physiotherapy, midwifery, nursing, radiography and paramedic sciences; a range of basic and clinical sciences such as physiology, immunology, cellular pathology and a wide range of clinical specialities, namely, primary care, obstetrics and gynaecology, dermatology, gastroenterology and anaesthesia. Only two areas had more than three representatives, mental health with 12 attendees (20% of all attendees), followed by primary care with seven (12%). Nine per cent of our attendees were from administrative departments, and not directly involved in teaching. Almost invariably these participants left after lunch before the practical sessions began.

Interest in the workshops was surprisingly high, with a total of 58 participants, 50 of whom stayed on to complete the practical phase of the workshop. This represented between 20% and 25% of the teaching workforce. In general, the attendees who stayed for the practical sessions were hands-on teachers delivering modules, and only two possessed official roles in curriculum development. This contrasts sharply with the more normal level of interest in workshops for other e-resources at the medical school, such as the virtual learning environment, which is normally less than 5%.

VP creation

The attendees were divided into groups of 2–5 for the purposes of creating VPs. Of the 20 groups, half were made up of a single course or subject e.g. mental health sciences, and half had mixed subject backgrounds.

Though it was possible to shape a VP within the 4 h time frame for practical work within the workshop, this proved insufficient time to complete the patient narrative. Nine groups were able to complete their VP after the workshop. Significantly, seven of these nine shared a subject area or were closely involved in the same course. Only one attendee of a VP workshop has written a VP subsequently without further structured support, but others managed with support.

Participant feedback and evaluation

Forty four out of the fifty participants who attended the entire workshop also filled in a written questionnaire (88%). Thirty four out of forty four (77%) said the workshop was highly relevant to them, and thirty (68%) responded positively when asked whether they intended to continue creating VPs in the future. Qualitative feedback from participants indicated that they found the sessions valuable, ('very useful'; 'workshop format is good as I was able to realise more clearly the practical implications and difficulties with experts on hand . . .'; 'gave me skills and ideas') and that they thought they would be able to use the VP approach in their courses ('I would like to use VP cases for final year teaching as well as postgraduate training'; 'very useful for my module').

Analysis of VPs

A breakdown analysis of the density and linearity of the finished cases is shown in Table 1. The exemplar case used is Sarah Jane Pritchard, created by the VP tutor.

All the cases created in the workshops were less 'branched' than the exemplar case, and shorter. Only three cases had as many or more nodes as the exemplar case.

The subject areas of the completed VPs represented a range of disciplines.

Follow up survey

A year on from the first workshop, a short online survey was distributed to those who had taken part. Seventeen out of fifty (34%) participants responded. Five participants (29%) indicated they had made a VP since the workshop and six (35%) were in the process of making one. Sixteen respondents (94%) were still interested in creating VP resources, and thirteen (76%) planned to use VPs in their teaching. Twelve out of fifteen (80%) felt they needed technical support. Nine (53%) needed colleagues to help with the case writing, five (29%) felt more workshops were needed and another four (24%) wanted a community of practitioners with whom they could exchange cases and ideas.

Table 1. Breakdown of VPs created as a result of the workshops.

Virtual patient	Subject area	Total nodes	Node : link ratio
Sarah Jane Pritchard	Paediatrics, infection (exemplar)	50	1 : 4
Average workshop VP		38	1 : 1.6
George Harrison	Psychiatry, depression	27	1 : 1.5
Mr Jones	GP, dementia	57	1 : 1.6
Emily Smith	Nursing, eczema	20	1 : 1.3
Mrs Brown	Midwifery, wound infection	32	1 : 1.7
Jim Brown	Paramedics	27	1 : 2
James	Cardiology	20	1 : 1.6
Desmond	Mental health, schizophrenia	26	1 : 1.2
Chris James	Nursing, diabetes	76	1 : 1.9
Mr Cairns	Addiction	58	1 : 1.4

Outcomes

Within 6 months of the final workshop, the university successfully trialled the replacement of PBL paper cases with interactive VPs in the undergraduate medical curriculum. A year later, in an implementation co-funded by the Joint Information Systems Committee (JISC), the PBL curriculum for the undergraduate medical students was transformed by introducing an entire year of VP-based clinical PBL, starting in Autumn 2009.

Discussion

The workshops described here were used in a very different manner to the way in which learning tools would normally be embedded in a curriculum. Normally, staff might be offered training in a tool or learning resource which was being embedded, and uptake of the workshop would generally be poor. In the case of VPs, motivation might be expected to be even lower, since these workshops were offering a tool which was neither being used, nor were there any plans for its use. In that context, the number of attendees represented a very high proportion of the SGUL teaching staff (20–25%). In contrast, attendance at case writing workshops for traditional PBL, the nearest parallel, is very low, even though it attracts teaching recognition.

The distribution of interest in VPs amongst medical and healthcare specialties may be explained by specific needs arising from the differing dynamics of these specialties. In this study, workshops were led by a paediatrician, and the highest attendance was from mental health. This has striking similarities with a recent study of VP creation across the USA, in which paediatrics emerged as the most common specialty, followed by internal medicine then mental health/psychiatry (Huang et al. 2007). Similarly in the EU-funded eVIP programme, the largest project worldwide in VP development, paediatrics is also the most common speciality, followed by internal medicine (eViP 2007). Internal medicine is not a specific division in the UK, but if it was, then the subjects it covers would also place that division in second place in our own study.

The reasons for the dominance of these three areas may be quite practical. Paediatrics is an area where decisions need to be made quickly, and risks cannot be afforded; risk-free decision-making rehearsal is a particularly useful learning resource. Internal medicine covers a wide variety of conditions and diseases and VPs can increase exposure to a greater variety of diseases. The maturation of a mental health case is often quite protracted, and VPs allow the process of decision-making to be accelerated for more practical learning. Four of the nine completed cases were within the mental health discipline, reflecting the high proportion of mental health attendees.

Based on feedback, it was evident that teachers attended the workshops because they had a genuine commitment to embed VPs in their curricula when the opportunity arose; in short, the teachers had recognised value in the medium and the process by which it could be realised.

If assessed immediately after the workshop series had ended, the lack of impact of the workshops (measured for

instance by the number of VPs developed) would have identified the project as a failure. However, with such a large proportion of the workforce involved, the workshops had catalysed an institutional change in the awareness of the value of VPs. This led to a trial of VPs as replacement for a paper PBL cases. Staff had identified an obvious synergy between major nodes in VPs, and the multiple tutorial structure of PBL systems. Indeed there are many similarities (problems to be understood, the narrative) as well as differences (the multiple routes within a VP for instance). With minimal adaptation of the model, multiple pathway VPs were developed to use in a PBL course.

Subsequently, the University took the decision to implement VPs at the core of the undergraduate curriculum, the first time that VPs have completely replaced an existing resource within the curriculum.

Conclusions

This study has demonstrated that, with a little support, teachers are capable of creating VPs that are simple and inexpensive in comparison with the commonly advocated cost of VP development (for example, the costs described in Huang et al. 2007). Using what is intended to be a simple educational model, with methods to limit the total number of choices, it is possible to create cases that are realistic both in terms of scenario and in terms of development. Currently the number of freely available VPs in medical education is low with most VPs retained by those who have created the authoring systems. With the advance of easier models for VP design, shared practice and pooling of resources within the e-Learning community, the number of VPs available for teaching will rise, and they can become central elements in curriculum design. The role of the workshops was as important in developing understanding of what VPs are and how they can be used as it was in terms of generating VP cases.

It is anticipated that the VP development model outlined here can be adapted to create decision-making scenarios for a number of different educational applications. These resources have the potential to be used in a variety of settings, including developing and assessing reasoning, decision-making skills and augmenting basic knowledge.

The workshops described here have promoted the embedding and evaluation of VPs, not just as supplementary learning tools, but as direct replacement for the linear paper models of PBL, and as tools for formative assessment, bringing greater interactivity and clinical decision-making to the currently linear models of case-based learning.

Declaration of interest: The authors report no conflicts of interest. The authors alone are responsible for the content and writing of the article.

Notes on contributors

JONATHAN ROUND is a Consultant Paediatrician and Senior Lecturer who runs the Child Health component of the Graduate Entry Programme at SGUL. His area of specialisation is Paediatric Intensive Care. His research area is intensive care in oncology patients. Jonathan works with the eLearning unit in the development of virtual patients and their rational use.

EMILY CONRADI is the Manager for e-Learning Innovation at SGUL. Emily has been involved in the development of internal virtual patients, trialling and evaluating their use in formative assessment, PBL and their applicability for a virtual world platform.

TERRY POULTON is the Head of the eLearning Unit at the Department of Medical Education at SGUL and responsible for both the delivery of e-Learning and all R&D. Terry has been responsible for development of the scenario based 'learning week' for the MBBS medical curriculum and the case-based learning Paramedic Foundation degree at SGUL.

References

Aldridge J, Fitzpatrick S. (2008) Clinical academic staffing levels in UK medical schools – report for the Medical Schools Council. Available from: http://www.chms.ac.uk/documents/ClinicalAcademicStaffSurvey2008-Medicine.pdf

Bergin R, Fors U. 2003. Interactive simulation of patients – an advanced tool for student-activated learning in medicine & healthcare. Comput Educ 40(4):361–376.

Ellaway R, Candler C, Greene P, Smothers V. 2006. An architectural model for MedBiquitous virtual patients. Baltimore, MD: MedBiquitous [Accessed on 20 April 2009]. Available from: www.medbiq.org/working_groups/virtual_patient/MVP_WhitePaper_11Sep2006.pdf

Ellaway R. 2007. Discipline based designs for learning: the example of professional and vocational education. In: Beetham H, Sharpe R, editors. Design for learning: rethinking pedagogy for the digital age. London: Routledge. pp 153–165.

European Commission. 2002. Heath statistics – key data on health 2002 – data 1970–2001. (Belgium, European Commission Publications) pp 306–310.

eViP. 2007. Electronic virtual patients programme. (Accessed 20 April 2009). Available from: http://www.virtualpatients.eu/

Higher Education Statistics Agency. 2009. [Accessed 22 April 2009]. Available from: http://www.hesa.ac.uk/

Huang G, Reynolds R, Candler C. 2007. Virtual patient simulation at US and Canadian medical schools. Acad Med 82(9):446–451.

Issenberg SB, McGaghie WC, Hart IR, Mayer JW, Felner JM, Petrusa ER, Waugh RA, Brown DD, Safford RR, Gessner IH, Gordon DL, Ewy GA. 1999. Simulation technology for health care professional skills training and assessment. JAMA 282(9):861–866.

de Jong T. 1991. Learning and instruction with computer simulations. Educ Comput 6:217–229.

Round J (2007) Creating your own virtual patients. The Higher Education Academy: Medicine Dentistry and Veterinary Medicine. 1(13): 20–22.

Scalese RJ, Obeso VT, Issenberg SB. 2008. Simulation technology for skills training and competency assessment in medical education. J Gen Intern Med 23(Suppl 1):46–49.