An investigation into sonography student experiences of simulation teaching and learning in the acquisition of clinical skills

Abstract

Introduction: Technological developments are impacting on many aspects of life, including education. One particular area of technology where there is growing interest within HEIs offering healthcare training, is the use of simulators. The literature shows diverging views on the role of simulated learning in healthcare and further evaluation is needed to explore the quality of learning opportunities that are offered, and their effectiveness in the preparation of students for clinical practice.
Research method: A qualitative study was undertaken, using interviews to explore the experiences of a group of sonography students after interacting with an ultrasound simulator.
Findings: Simulation was positively evaluated by students in this study. The findings confirm that simulated learning enables students to be interactive learners rather than being passive recipients of knowledge. Simulated learning provides learning opportunities in a risk free environment, which reduces stress for the student and potential harm to patients. Confidence levels were increased, thereby improving future clinical scanning experiences for both the student and their patients. Suggestions were made for the more effective integration of simulated learning into the curriculum.
Conclusion: Continued research into simulation, teaching and learning practices needs to occur if we are to ensure maximum advantage of the simulation experience.

Introduction

There has been a rapid development of technology over the past few years, which has had a dramatic effect on many aspects of society. Associated with this, are increasing pressures to integrate technology to enhance learning, both in higher education and the NHS (1*)*. The challenge for higher education institutions (HEIs) has been to develop new approaches to teaching, learning and assessment, and to incorporate technology to further improve the student experience.

In addition to these pressures, the current challenging economic climate in which the health and education sectors are operating is resulting in a continual search for more efficient and cost-effective methods of delivering healthcare education (2, 3) .Universities have experienced severe reductions in budgets and as a consequence they are looking for more efficient methods of running programmes (4). This puts additional emphasis on the need for more creative methods of education delivery, learning opportunities and assessment. The further integration of technology into educational programmes for healthcare workers is now generally viewed as a positive solution, by enabling more cost-effective methods of delivering learning, (5, 6, 7).

One particular area of technology where there is growing interest within HEIs offering healthcare training, is the use of simulators. Simulation learning takes many forms and can include a spectrum of equipment, from simple reproduction of body parts through to the complex human interactions portrayed by sophisticated simulators (8). The aviation industry first used simulation as a training method over 80 years ago (9) and this approach to training and education is now evident within a number of different industries and disciplines.

Simulation in Healthcare Education

The use of simulation in healthcare education has developed dramatically over the past decade. Simulators enable students to acquire essential skills through trial and error, in a safe, non-threatening environment closely representing reality (10). This allows students to develop skills whilst applying theoretical knowledge in a controlled setting away from the patient (11) and prepares students for real clinical scenarios.

Education practices have traditionally been teacher centred (12). Simulation however, is considered to be more learner centred as students are required to become more active in the learning process. Rather than memorising information and regurgitating facts, they need to access knowledge and apply the learning in context (13). With the educator acting as a facilitator of learning, the student needs to demonstrate greater levels of self-motivation and direction (13), thereby promoting understanding and application of the cognitive and psychomotor skills required for future professional working (14, 15).

Whilst it is generally recognised that simulation learning cannot replace clinical experience, concerns have been raised regarding widespread integration of technology-based education tools in healthcare education. Although several authors suggest that there is some validity in teaching psychomotor skills in a designated simulated clinical skills laboratory, other sources have questioned the value in terms of student experience (16, 17, 18, 19). The drift towards technology rather than philosophically-based pedagogy is an area of concern for many (20, 21), and a particular criticism of simulated learning is that it may only reproduce procedural training rather than any depth of learning (22). These concerns suggest that further investigation is needed to assess the effectiveness of patient simulation in achieving clinical learning objectives and competence. Simply including simulation learning within a curriculum is not sufficient, and a greater number of simulations may not necessarily result in superior learning (23).

The literature shows diverging views on the role of simulated learning in healthcare. Educators sense that simulation is a powerful student learning strategy, but the absence of an evidence base may locate simulation peripherally and limit its role in many fields (8). Further evaluation of simulated learning opportunities across healthcare education is needed to explore the quality of learning opportunities that are offered, and their effectiveness in the preparation of students for clinical practice.

Ultrasound simulator learning

It was in this context that in December 2012 the University of the West of England (UWE), Bristol, purchased a Medaphor ScanTrainer with the purpose of integrating its use into the teaching sessions on the postgraduate Ultrasound programme. The Medaphor system utilises a haptic device to replicate sensations of transvaginal and transabdominal real-life scanning applications. This was introduced into the programme for students beginning their modules in 2013, in order to enhance the student experience, and was used for teaching, learning and formative assessments on the Obstetric and Gynaecology modules.

Students studying on the Gynaecology Ultrasound module were initially shown how to use the system and given log-in passwords. They were asked to complete learning and assessment modules on the simulator as part of their course, and were invited to book as many sessions as they felt they needed on the simulator, working either singly or in pairs.

The dearth of investigation into the impact of simulators on healthcare education, and ultrasound training in particular, led to a decision to investigate student experiences of interacting with the ScanTrainer at the end of their Gynaecology module in August of 2013. The aim of the investigation was to explore how the simulator can be used to enhance learning in order to fully explore its future potential to support students.

Research Method

A qualitative approach was used, incorporating interviews with students who had interacted with the scanning simulator. All students were invited to participate at the end of their module via an information sheet. Consent was obtained from twelve students who were willing to share their experiences. The interviews were semi-structured, supported by a framework which acted as a guide for an informal conversation between researcher and participant, and also guided the analysis. Gomm (24) calls this ‘qualitative interviewing’ and claims that it is an

effective method of obtaining reliable views and information. Institutional ethical approval was obtained from the UWE Ethics Committee (July 2013).

Findings

During the research, although discussions and responses were wide-ranging, several common themes began to emerge. A thematic analysis approach was taken in order to understand the findings, by manually assigning codes to each of the topics as they were identified. The comments from students that arose from the interviews, were reviewed by the project lead by defining subject content of the data, and then coded according to their content (25). As the codes were accumulated, they were then sorted into themes. Unlike quantitative coding, where preconceived codes are used, qualitative coding involves creating the codes as the data is studied, and this process was applied to the interview data (26). This resulted in a transfer of the descriptive data summarising the responses, into a more interpretative approach to help understand the data.

All the points raised by individuals were identified as fitting into one of four themes. These were: opportunities to build confidence in a non-threatening environment; the enjoyment of simulation as a learning strategy; how simulation supports the implementation of theory into practice; suggestions for improving the simulator experience. The comments have been synthesised and outlined below:

<u>Opportunities to build confidence in a non-threatening environment</u>

Students found it useful to be able to practise techniques in the classroom setting before working with a real patient, particularly when performing challenging procedures such as a transvaginal scan. In addition, others appreciated the value of repetition of tasks at their own pace. This was demonstrated by comments such as:

'it was good because I could use it on my own and keep repeating things without anyone thinking I was stupid'

'I hadn't done a TV scan on a patient so it was much better to have my first practice go on a model before doing the real thing'

'I like to go back over things several times when I'm learning something new, so this gave me the chance to repeat things as many times as I needed'

'I wish I'd had the chance to use it (the simulator) before I scanned my first TV patient because although it's not completely life-like, I felt much more comfortable with the technique after I'd used the simulator'

'It's difficult when you first start scanning patients trying to remember to do everything, and I liked the fact on the simulator that I could concentrate on the scan images and how I was moving the transducer, without having to think about talking to the patient or worrying about whether I was hurting them'

<u>The enjoyment of simulation as a learning strategy</u>

One outcome was how much students enjoyed interacting with the simulator:

'I was a bit concerned at first, not knowing how to use the system but soon found that it was quite straightforward, so I booked a second session because it became like a test of skill or a computer game'

'scanning the pathology cases was much better than just reading it in a textbook because you had to work your way through the step by step assessment'

'once I got used to how to use it, I found I enjoyed the session'.

'although we'd covered topics in the lectures first, I found I liked the hands-on learning better because I was actually doing something and it all made much more sense'

<u>How simulation supports the implementation of theory into practice</u>

The simulator provided opportunities for individual learning styles to be taken into consideration; some realised they learnt best by doing a task rather than listening to it being explained. Students commented that the simulator was a useful method of trying out practically what they had learnt in a lecture:

'it was good having the lectures first because then I had the chance to practise things that I was a bit hazy about from the lecture'

'I learn best when I do something myself so it was good having the chance to try things we'd been told in the lecture but which I wasn't really clear about'

'I found I remembered things I learnt on the simulator more than being told about them'

'I was able to scan a lot more cases of pathology than I would normally see in practice'

‘I was struggling with understanding 2D anatomy and orientation in clinical practice but the diagrams and instructions as you move the simulator transducer made it suddenly click with me’
‘I’d done a few TV scans in my department but never really understood the orientation until I did the session on the simulator’.

Suggestions for improving the simulator experience

As the simulator was newly introduced into the course, students were asked for any ideas they had for improving student learning experiences. Various ideas for technical enhancements were suggested, including providing a cine-loop function and easier to use gain controls. Requests were made for case studies of technically challenging examinations, such as postmenopausal ovaries or large patients. The main criticism of the simulator was that, in order to pass the formative assessments, the system required defined precise criteria to be achieved which often appeared unrealistic. This resulted in the students occasionally becoming frustrated when having to repeat areas in an attempt to pass, without understanding why. In addition suggestions were made regarding improving access of the simulator for students by establishing a more efficient booking system.
‘I found it annoying that I failed a session just because I did one trivial thing not exactly as the simulator wanted. I thought this was unfair and quite demotivating’
‘it would have been useful for someone experienced, such as the lecturer, to be available to answer some of the questions that I had about the feedback the simulator was giving me’
‘the chair and the table weren’t at the right height I would be working at in practice’
‘I would have used it more but it was difficult booking a time when it was available and when I was free to use it’.

Discussion

Simulation provides a controlled learning environment where the learner can engage in activities reflecting real life conditions without exposing patients to risk (13, 27)). In this study, students found the opportunity to practise scanning without having to worry about potential patient discomfort, particularly advantageous. Most felt they needed to have used the simulator more extensively before interacting with real patients. Furthermore, it became apparent that in the early stages of their module, students appreciated opportunities to master basic psychomotor skills without having to simultaneously consider activities such as appropriate patient communication skills. This helped to reduce stress during the learning process, which is a known barrier to learning. The primary aim of simulated learning should be to prepare the student for practice in the real clinical setting, in a context where time and repeat practice can be manipulated to meet the needs of the student. The learning can be halted providing opportunities to reflect on the experience. Current literature suggests that there is some validity in teaching psychomotor skills in a designated simulated clinical skills centre, whilst other sources still question its value in terms of experience (14,21). The results from this study however, demonstrated clear advantages for the students when developing technical scanning skills.

Simulation enables repetition and instant feedback, and several students valued the opportunity to repeat activities a number of times until they felt confident. Enabling the student repetition opportunities whilst guided by on-screen feedback, may increase confidence, an important feature of successful learning (10). However, comments were noted regarding the need for a facilitator to be available, particularly in the early stages of interaction with the simulator, to provide required feedback and guidance. Some students also indicated a need for a post-simulator discussion, either as a class, or one-to-one with a lecturer/facilitator. This would enable opportunities to clarify and further reinforce learning points. It is recognised that one of the strengths of simulation is that it can afford a more measured approach to training than expected in real patient interactions, because the educator and student can manage the simulation to meet individual learning needs, by interspersing activity to offer feedback and discuss theory (28). Although the Medaphor simulator used in this study provided on-screen advice and feedback, the additional need for a facilitator was apparent in the responses from the students.

It is unlikely that, during their training, ultrasound students will encounter the range of pathology and different scenarios they will be expected to cope with once qualified.

Ultrasound simulators offer a more consistent approach to learning by providing all students with access to a greater number of clinical scenarios in a concentrated period of time. Students commented that whilst images may be available in textbooks or on-line, the opportunity to engage dynamically with these images using the simulator, provides a superior learning opportunity. This helps to prepare students for clinical situations that they may not otherwise encounter during training, thereby providing a response to the challenge of ensuring consistent learning for all students in clinical practice (13)

There are often perceived or real contradictions between the theory and practice of clinical situations. When students listen to lectures in a classroom, they may find it difficult to relate the theory to the clinical practice environment, and this was apparent in several of the sonography student comments within this study. Students described how the sessions on the ultrasound simulator helped to make sense of what they learnt in lectures, before transferring this to the real clinical world. This concurs with results from other studies (15, 29) which found simulation education was superior in terms of knowledge acquisition compared with using traditional lecture as the sole method of teaching. Students all have their own preferred individual learning styles, and the simulator provided opportunities for these to be taken into consideration. Simulation experiences provide an opportunity for learning where students can be supported to consider the integration of theory into practice, without the distractions that inevitably occur in a clinical department (8). The general consensus amongst the participants however, was that simulated learning should be used as an adjunct to classroom learning rather than a replacement.

The flexibility of simulation learning was raised as a positive aspect by several students. The ability to book sessions at their own convenience, plus the opportunity to revisit areas of the learning on several occasions, were particularly useful features. Students who lived a distance from the University, however, would have preferred access to equipment nearer their workplace to enable greater opportunities for interaction.

The suggestions from the students for improving the simulator experience provided useful insights into how simulated learning can be enhanced. Changes to the system for students booking time with the simulator need further consideration to ensure this is less problematic. Ideas for refinements to the technical aspects of the simulator have been forwarded to the manufacturers, and this has resulted in formation of a users' group, so that teaching staff can work with software engineers to enhance the system. Potentially this will provide an excellent forum for the simulator to evolve in response to user feedback.

Simulation can provide more focused and deeper learning experiences (30) and should be regarded as learning techniques, not just advanced technologies (31), but perhaps more importantly, the aim is to improve patient safety whilst helping to achieve fitness to practice (32). Simulated learning has created an increasingly attractive alternative education strategy in many settings, and one that may enhance clinical competence (33, 34). However, the available literature indicates there is a lack of empirical research determining the efficacy and effectiveness of simulation and in particular, whether learning gained through simulation can be transferred to clinical practice (35). Direct information about actual learning is difficult to obtain because it requires a demonstrated or observed change in the participant's behaviour and/or skills. One particular aspect of ultrasound simulation that needs to be explored is whether the knowledge and skills acquired through simulation are transferred as competence and proficiency in clinical practice. It is therefore intended to monitor the sonography students' achievements over the coming year and compare them with previous cohorts.

Conclusion

Simulation was positively evaluated by the majority of the students in this study. The findings confirm that simulated learning enables students to be interactive learners rather than being passive recipients of knowledge. Confidence levels were increased when students used the simulator to improve their technical scanning abilities and image recognition skills, thereby improving future clinical scanning experiences for both the student and their patients. Simulated learning provides learning opportunities in a risk free environment, thereby reducing stress for the student and potential harm to patients. In order to further enhance the

role of simulated learning, discussions are underway to introduce refinements into the simulator software, and the role of the lecturer as facilitator in the process will be reviewed to maximise the learning experience.

The role of simulators within healthcare education has become increasingly important and more sophisticated over the past few years. However, with the contradictions existing in the literature over the role of simulators in education, further exploration is required. The aim of this study was to investigate the experiences of a small group of students interacting with an ultrasound simulator. The findings provide an insight into many of the advantages, together with ideas for improvement for the integration of this facility. The general consensus amongst the participants was that the introduction of the simulator was innovative and will lead to enhancements in the learning processes. Continued research into simulation, teaching and learning practices needs to occur if we are to ensure maximum advantage of the simulation experience.

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