The role of ultrasound simulators in education: an investigation into sonography student experiences and clinical mentor perceptions

Vivien Gibbs

Faculty of Health and Applied Sciences, University of the West of England, Bristol, UK
Corresponding author: Vivien Gibbs. Email: vivien.gibbs@uwe.ac.uk

Abstract

Simulation as an effective pedagogy is gaining momentum at all levels of health care education. Limited research has been undertaken on the role of simulated learning in health care and further evaluation is needed to explore the quality of learning opportunities offered, and their effectiveness in the preparation of students for clinical practice. This study was undertaken to explore ways of integrating simulation-based learning into sonography training to enhance clinical preparation. A qualitative study was undertaken, using interviews to investigate the experiences of a group of sonography students after interacting with an ultrasound simulator. The perceptions of their clinical mentors on the effectiveness of this equipment to support the education and development of sonographers were also explored. The findings confirm that ultrasound simulators provide learning opportunities in an unpressurised environment, which reduces stress for the student and potential harm to patients. Busy clinical departments acknowledge the advantages of opportunities for students to acquire basic psychomotor skills in a classroom setting, thereby avoiding the inevitable reduction in patient throughput which results from clinical training. The limitations of simulation equipment to support the development of the full range of clinical skills required by sonographers were highlighted and suggestions made for more effective integration of simulation into the teaching and learning process. Ultrasound simulators have a role in sonography education, but continued research needs to be undertaken in order to develop appropriate strategies to support students, educators and mentors to effectively integrate this methodology.

Keywords: Sonography, ultrasound, simulation, training, learning, education

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Introduction

Simulation is recognised as an innovative pedagogic approach that has gained much popularity in health care education in recent years. Simulation-based learning takes many forms and spans a range of sophistication from simple reproduction of body parts through to the complex human interactions portrayed by high-fidelity simulators.¹ The aviation industry first used simulation as a training method over 80 years ago when, in 1929, Ed Link developed a simulator to train pilots.² This approach to training and education is now not unique to the aviation industry and is evident within many individual industries and disciplines.

Advances in technology have led to dramatic improvements in the sophistication and realism of simulators, and the role of simulation in health care education has developed rapidly over the past decade. It is a learning strategy requiring the learner to actively engage with the learning

process, whilst the educator acts as a facilitator of learning.³ Students are able to use simulation to acquire essential skills through trial and error in a safe, non-threatening environment closely representing reality.⁴ All forms of simulation allow students to develop skills whilst applying theoretical knowledge in a controlled setting away from the patient⁵ and prepare students for real clinical situations.

Ultrasound simulators have evolved over recent years due to technological developments, and now offer students a realistic clinical learning experience. The student can often interact with the equipment using an interface in the form of an ultrasound transducer, whilst observing a computer-generated display with in-built virtual examinations, which mimic the view obtained during a scanning procedure. Haptic technology is able to recreate sensations of real-life scanning and enable the development of psychomotor skills.⁶ A range of cases of pathology can be made available, creating varying degrees of difficulty for the learner.

Background

A number of factors are impacting on the drive to incorporate simulation into health care education. Government initiatives associated with service efficiency and patient-centred care frequently highlight the need for the health care practitioner to be equipped with the appropriate knowledge and skills to partake in the delivery of a high-quality service. In 2008, the Chief Medical Officer highlighted the potential for simulation-based education to reform the way clinical training is provided,⁷ citing examples of success in other industries. Many health care training programmes now include simulation equipment as part of the learning process; however, there is little guidance available on how best this can be utilised. In 2011, the NHS developed a *Framework for Technology Enhanced Learning* which set out the aim for the use of technology across health and social care within the United Kingdom.⁸ This was centred around six key principles stating that technology should: be patient centred and service driven; be educationally coherent; deliver value for money; be innovative and evidence-based; deliver high-quality educational outcomes; and ensure equity of access and equity of provision. Whilst these principles provide general guidance for simulation, more specific strategies are required to ensure appropriate integration of this technology.

Given the need to ensure health care practitioners are equipped with appropriate knowledge and skills, training should resonate with the mapping of core attributes that ensure effective patient services are being delivered. Experiential learning, where students are actively engaged in the learning process, is generally recognised as offering the most effective learning environment.⁹ However, it is often difficult to achieve the requisite clinical tuition when departments are under pressure for a rapid throughput of patients to control the ever-increasing waiting lists. Busy clinical departments struggle to allow students sufficient supervised clinical practice time. Patients are often reluctant to tolerate inexperienced operators, and the associated extended examination times, particularly where this may involve uncomfortable or invasive procedures. Simulation offers the potential to overcome the challenges associated with shortages of quality clinical placement experiences for students.^{9,10}

In addition to these pressures, in the current climate of global austerity, Higher Education Institutions (HEIs) are being challenged to identify more efficient and cost-effective methods of delivering education.¹¹ Universities have experienced severe reductions in budgets and this puts additional emphasis on the need for more creative methods of education and assessment. There is a need to offer innovative and flexible training programmes that provide students with the necessary skills and opportunities to excel within their selected specialities.^{12,13} The further integration of technology such as simulators, into educational programmes for health care workers, offers a potential solution by enabling more cost-effective methods of delivering learning.

Most simulators, however, have limitations and complete replication of the clinical scenario cannot be achieved.

Whilst it is generally recognised that simulation-based learning cannot replace clinical experience, concerns have been raised regarding widespread integration of technology-based education tools in health care education and the drift towards technology rather than philosophically-based pedagogy is an area of particular concern for many.^{14,15} The available literature indicates that there is a lack of empirical research determining the efficacy and effectiveness of simulation,¹⁶ and in particular, whether the knowledge and skills acquired through simulation are transferred as competence and proficiency in clinical practice. Prion suggests that direct information about actual learning is difficult to obtain because it requires a demonstrated or observed change in the participant's behaviour.¹⁶ This suggests that simply including simulation-based learning within a curriculum is not sufficient, and further evaluation of simulated learning across health care education is needed to explore the quality of learning opportunities that are offered and their effectiveness in the preparation of students for clinical practice.¹⁷ Whilst the use of simulators is not new to health care education, care needs to be taken to ensure that a learning pedagogy appropriate to the required outcomes of the programme is introduced. Failure to do this has the potential to lead to student dissatisfaction, the introduction of irrelevant information and ultimately a lack of student engagement.

This project was undertaken as part of a process to help establish a pedagogic base for ultrasound simulation, in order to support the acquisition and development of the range of complex clinical skills required by student sonographers. This will help to facilitate the development of educational resources that can impact positively into learning and teaching within ultrasound training.

Research method

Following on from an earlier small project in 2013,¹⁸ in September 2014 a larger study was undertaken to explore the experiences of a group of sonography students after interacting with a Medaphor ScanTrainer ultrasound simulator. The perceptions of their clinical mentors on the effectiveness of this technology to support the education and development of student sonographers were also explored in this study.

A qualitative approach was used, incorporating interviews with students who had interacted with the scanning simulator. All students on their first year of study on the Diagnostic Ultrasound programme were invited to participate at the end of their clinical module via an information sheet. These students were undertaking a range of clinical practice modules incorporating both transabdominal and transvaginal approaches to scanning. Consent was obtained from 25 students (this represented 47% of the cohort) who were willing to share their experiences. The interviews were conducted by a single member of the programme team. Each interview was semi-structured, supported by a framework which acted as a guide for an informal conversation between researcher and participant, and also guided the analysis. This method of qualitative interviewing is recognised as an effective method of obtaining reliable views and

information from participants.¹⁹ In addition, 16 clinical mentors were invited to participate in semi-structured telephone interviews to explore their perceptions on the effectiveness of the simulation-based learning in preparing their students for scanning patients in the real clinical environment. Fourteen mentors participated in the project and were each contacted individually. Institutional ethical approval was obtained for the study from the University of the West of England Ethics Committee in July 2014.

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. The broad range of comments from students and mentors 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. As the codes were accumulated, they were then sorted into three themes. 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 finally identified as fitting into one of three themes. These were: *Advantages of simulation; Limitations of simulation; Suggestions for improvement.*

The comments have been synthesised and outlined in Table 1.

Table 1 Comments from students and mentors arising from the interviews

Advantages of simulation

Students and mentors were generally positive about their experiences of interacting with the simulator, and comments were made such as:

Students

- *It was useful on the simulator to be able to concentrate on scanning and looking at the images in relation to how I was moving the transducer, without having to think about talking to the patient at the same time.*
- *I get quite nervous when I'm trying to learn something new because I've always been a bit slow compared with other people, so I liked being able to practise on my own at my own pace.*
- *I could use the simulator on my own and keep repeating things as many times as I liked without anyone thinking I was being too slow.*
- *It's so busy scanning in the department and there's the constant pressure of getting on to the next patient. With the simulator, it was more relaxed and I had time to think about what was happening as I moved the transducer and what the images were showing.*
- *It was really helpful for learning anatomy and understanding how the 2D images relate to 3D anatomy.*
- *It was like having a tutor sitting next to me to answer questions, because I could get feedback and find correct answers from the simulator at any time while I was scanning.*
- *I felt it was much better for my first trans-vaginal (TV) patient because I'd been able to practise first on the simulator model.*
- *I found it (using the simulator) more useful at the beginning of my scanning because, although it wasn't completely life-like, it did prepare me for when I had to scan my first real patient on my own.*
- *I found that I really understood the orientation of the transducer and the scan planes after using the simulator. In fact, I was even able to explain the TV scanning coronal plane to my mentor which she'd never thought about before!*
- *I don't get to see much pathology in my clinical department so it was really useful to be able to choose a case on the simulator which showed me the appearances of different pathologies.*
- *I found it was really good to practise manipulating the simulator transducer and it gave me time to understand what happened to the image as I moved into a different position. I felt much more confident about this when I got back into work to scan a real patient.*
- *Listening to a lecture on scanning doesn't always make sense unless you've already started scanning, but the simulator seemed to help me understand things because I had to practise the technique as the instructions and explanations were given.*
- *I found it really helpful to be able to read information on the screen and then put it into practice when the simulator asked us to demonstrate various structures. The guidance given was a great help and when I wasn't sure what I was looking at I could select colour coding to outline various structures.*
- *It was helpful being able to work through the whole package of different organs on the simulator because then I felt I'd covered everything to the same level as everyone else on the course. I always worry that there are some 'black holes' in my knowledge which no-one has remembered to tell me about, so I found the simulator reassuring*

Mentors

- *My student this year used the simulator for TV scanning before we scanned a real patient and she did seem much more confident in her approach to the patient compared with students in the past who I've worked with on their first TV patient.*
- *I had the chance to use the simulator myself and even though I've been scanning for many years, I still found it a useful exercise to work through the various components. It made me stop and think about why I was doing things and what I was actually seeing on the images.*
- *I found that after she worked on the simulator, my student has taught me a few things about orientation which I'd never really thought about before!*
- *This year my student has grasped the anatomy and relationship of organs very quickly – not sure if she's just spent more time learning this than my previous students or whether it was the simulator that helped.*
- *I spent less time this year teaching my student the basics of performing a scan. She'd managed to book time on the simulator before she scanned patients in the department, and this was a noticeable advantage*
- *My student was struggling at the beginning of her clinical training, so I arranged for her to spend time on the simulator and this seemed to be the turning point for her, because after that I noticed that her hand-eye co-ordination had improved and she was much more confident.*

Limitations of simulation

Students and mentors were able to highlight several areas where they perceived the simulator to have limitations, such as:

Students

- *Although it was useful at the beginning of my scanning to get me started with learning anatomy and relationships of organs, later on I didn't really find it was like scanning a real patient.*

(continued)

Table 1 Continued

- *It made my arm ache because the chair and the bench weren't at the correct height, so I had to keep stopping for a rest.*
- *There were so many people in our year and we had trouble booking time on the system.*
- *When I was trying to pass the assessments on the simulator, it wanted everything done too precisely and you can fail a session just for really minor things.*
- *We were all worried when we heard we would be using the simulator in our viva, so we spent time practising on the simulator again near the end of the course, just to make sure we would be able to demonstrate things in the viva, even though we didn't really feel we were getting benefit from using the simulator at that stage in our learning.*
- *The formative assessments take too long to work through and we were told we had to get at least 75% right in all modules to pass.*
- *Although the simulator did react when I used too much pressure on the TV scan, it wasn't the same as having to think about the patient and communicate with them.*

Mentors

- *My student wasn't able to book time on the simulator on the days when she was already at the University and, because she lives at such a distance, this meant we had to give her additional time off work to travel to attend on days when it was available.*
- *Although the simulator seemed to be useful at the beginning of the course in helping with orientation and anatomy, my student didn't seem to be gaining much benefit later on, because the feedback from her was that there was limited pathology to scan in her module.*
- *It seems my two students were reluctant to use the simulator at the beginning of their course because they knew they had to pass assessments on it. This meant they waited until they were fairly confident at scanning and left it too late to be of real benefit to us in the clinical department, because we still had to spend time teaching them the basics of scanning.*
- *I think it's a really useful tool but it can't replace other aspects of teaching (such as lectures, discussions and clinical scanning). It's another piece in the jig-saw really when trying to train a student to be competent, but still a very powerful tool.*
- *The simulator can never be the same as scanning a real patient so has its limitations when using it for training or assessing.*

Suggestions for improvement

Several suggestions were made on how the use of the simulator could be improved during the training and how the simulator itself could be improved:

Students

- *More cases of pathology to scan on the simulator would be helpful.*
- *More challenging patients to scan to make it more realistic (e.g. large BMI; postmenopausal ovaries).*
- *More feedback from the simulator 'patient', such as if I was pressing too hard on the abdomen.*
- *I think we should have the chance to use the simulator before scanning real patients, especially the first TV patient, because I would have felt much more confident with the technique.*
- *The formative assessments could allow more latitude of positioning to avoid failing for minor inaccuracies.*
- *Ergonomics could be improved by being able to move the bench and the chair up and down.*
- *It would help if we didn't need to pass all the formative assessments and it could perhaps be limited to a smaller number.*
- *Increase the availability of the simulator so that all students can get enough time.*
- *It would be useful if we could have booked on the simulator before we even began the course so that we could practise scanning before dealing with real patients.*

Mentors

- *Opportunities for report writing and being able to check the report with a suggested version would be useful. Our students are expected to report on all their scans and this is often the area they find most challenging.*
- *It would be useful to arrange sessions for students to use the simulator before they've begun scanning in the department, or perhaps even earlier, using it as part of the selection process for students to identify those with good hand-eye co-ordination.*
- *It would perhaps be useful to arrange for the mentor to have a session with the student when they first use the simulator to enable them to observe any weaknesses, ask questions and be able to offer guidance in an environment where the patient isn't overhearing the conversation.*
- *I feel the students should have a compulsory requirement to use the simulator at the beginning of their course, because it would save us so much time in clinical practice if they used the simulator first to master the basics.*
- *It seemed to be useful to include the simulator in the viva, but perhaps the students need to be reassured beforehand that they aren't being tested on their skills with the simulator but rather, about real-life scanning. My student seemed to find this the most stressful aspect of her assessments.*

Discussion

Although it is recognised that simulation-based learning cannot replace clinical experience,¹⁷ the findings from this study indicate that simulators do have an important role in the training of sonographers. Several students commented on the pressures placed on them when trying to master scanning techniques in a busy clinical environment. Trying to get protected one-to-one quality tuition time with a mentor is always challenging when rapid throughput of patients is often the chief objective of a department. In addition, if patients are delayed whilst waiting for scans they are often not receptive to agreeing to be scanned by a student. Students commented that they particularly benefited from time spent on the simulator where they could

repeat tasks without the clinical pressures arising when working in a busy department. Simulation offers the potential to overcome challenges associated with shortages of quality clinical placements for students. Time spent working with a simulator in a classroom can help alleviate the pressures on students, mentors and patients. In their study of nursing students, Baillie and Curzo²⁰ concluded that replacing some clinical hours with simulation was undoubtedly advantageous for students as an alternative to busy clinical environments.

To become an effective sonographer demands expertise in several areas, and a holistic approach to practice requires these to be integrated. Bloom's taxonomy of learning objectives is widely used within health care education and its three categories of knowledge, skills and attitudes are

frequently quoted.²¹ *Knowledge* is gained by assimilation of information. *Skills* require the development of psychomotor competencies and require regular practise complemented by expert feedback. *Attitudes* relate to how knowledge and skills are combined in the care of patients, and include areas such as clinical decision-making and professional behaviour. Arguably, whilst ultrasound simulators may be helpful in the acquisition of knowledge and psychomotor skills, opportunities for integrating the formulation of attitudes into this method of learning are currently limited, and remain the preserve of the clinical departments.

One criticism of simulated learning is that it may only reproduce procedural training²² and therefore not include all the skills required by a competent practitioner. This is supported by comments in this study from sonography mentors regarding the lack of patient interaction, clinical decision-making and report-writing skills involved in using current simulation equipment. This is an area that could potentially be developed further by the manufacturers, or by the course tutors, by interfacing report-writing skills and patient communication skills with the simulated scans and case studies.

Another criticism that was made on several occasions by both students and mentors in this study was that the simulator did not provide a complete replication of reality. McKenna et al.²³ in their study, concluded that simulation offers educational opportunities to support the development of competent students, but the potential for further use is limited by lack of realism in available simulation models. As the technology improves, so does the potential for more complex and realistic simulation. However, such authentic replication cannot always be achieved and should not be aimed for at the expense of the development of student confidence and competence.²⁴ The primary aim 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.²⁵ Rather than spending resources on advanced simulation technologies that mimic real life, it is more important to develop systems which put the student at the centre of the learning experience to enable them to have time for reflective learning in a non-pressurised environment.²³ Those developing simulation equipment need to work closely with clinical practitioners and educationalists to ensure that the field will not be dominated by technology, but rather driven by needs of the students. Neary,²⁴ in her research, supports this claim that skill laboratories can facilitate the development of 'real practice' in clinical placements without trying to replace it. She observes that the emphasis rather needs to move away from focusing on the technology and towards a more integrated learning framework where knowledge can be acquired alongside technical skills and not in isolation from them. Work on 'situated learning' emphasises the potential for simulation to enhance clinical practice²⁵ rather than trying to replace it, otherwise there is a danger that skills learnt in the simulator environment and skills applied in real-life clinical practice may exist separately.

Comments from some students demonstrated that they were under the misapprehension that use of the simulator

in their final viva assessment meant they would be tested on their use of the simulator, whereas what they were actually tested on was their knowledge of clinical scanning, using the simulator merely to demonstrate specific aspects. This resulted in some students spending time on the simulator towards the end of their training period, simply to familiarise themselves with the simulator; this was time which they perceived as not beneficial to their clinical scanning. This will need to be made more explicit to future cohorts to provide greater clarification. Another area that received criticism from students was the perceived onerous requirement to successfully complete at least 75% simulator formative assessments. This requirement was introduced to ensure appropriate levels of engagement by all students and for the tutors to track which areas a student may be struggling with. However, this may need to be reviewed for future cohorts to ensure students' interactions are beneficial, rather than perceived as merely additional tasks to complete.

Many positive responses were received from students and mentors about the advantages of using the simulator to gain an understanding of orientation and improve hand-eye co-ordination. This is an area where many students struggle to master the skills required of a competent sonographer. Skill acquisition occurs at different rates in individuals, and simulators allow students to work at their own speed and perform repetitions as many times as required without being observed.²⁶ The incremental approach, around which the simulator is structured, allows the students to work at a pace to suit the individual. Some students find the technical aspects of scanning a particular problem to overcome and may decide to abandon their training without a sympathetic department, where they can be given the additional time needed to become proficient.²⁷ Tutors, whilst working with these students on the simulator, have observed the benefits for students when they are able to engage with the simulator in a classroom setting. Comments from mentors also noted observable improvements in students' psychomotor skills after time spent interacting with the simulator. The opportunity to halt the learning in order to reflect on the experience is advantageous for students, particularly as the clinical setting offers limited opportunities for this. Enabling the student opportunities to repeat the simulation activities, guided by feedback, undoubtedly increases confidence, which is important as low levels of confidence are recognised as a barrier to learning.²⁸

Several comments from students in this study indicated that the simulator helped to reinforce theoretical concepts relating to ultrasound, which were difficult to assimilate in the classroom. The simulator enabled the blending of theory with practical contextualised application, which served to ensure the learning had more impact. Much of the literature reinforces this observation that simulation can provide more focused and deeper learning experiences.²⁹

The development of simulators has made standardised training possible, and students commented that they found it useful to have a package they could work through, knowing that everyone else was learning the same information. Students are often concerned that there may be areas of

their learning which have not been covered during their often unstructured training period, leading to unknown holes in their knowledge. This is always a potential problem when students rely on a number of different individuals in clinical practice and educational institutions to teach them, and there is often not one person guiding them systematically through the learning process. The requirement for all students to work through the same training package on the simulator provides a certain amount of reassurance that they have all covered the same areas and reduced the possibility of 'unknown unknowns' in their knowledge. Students particularly appreciated the opportunity to scan a number of different pathologies on the simulator that may not have been encountered during their clinical training period. Ectopic pregnancies or unusual pelvic masses could be scanned, for example, giving the students the opportunity to visualise and identify these images. 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.³⁰ However, several students commented that there needed to be more case studies available to enable interaction with an even greater range of pathologies.

Some students did not manage to engage with the simulator until after they had already spent time in clinical practice mastering the basic skills of scanning. In some cases, this was due to clinical departments being reluctant to let their students spend time out of the clinical department; in others, the students viewed the simulator as another hurdle to master in their learning process, rather than a facility which would enhance their clinical practice learning. There was a tendency for these students to wait until much later in their course to use the simulator and to then interact with the simulator just to fulfil the requirements stated by the tutors, without retaining an awareness of how this would enhance their clinical practice. Students and their clinical departments need to be encouraged to realise the benefits of time spent using the simulator in the early stages of their training. This would help to ensure they book time on the simulator at the beginning of their training and realise that, rather than being an additional burden during their training, it is more beneficial for students if used early in the training period. This is an area where maybe tutors need to be more insistent with students to ensure they do book time on the simulator, as often it is not until the end of their training periods that students realise the benefits that could have been obtained.

The suggestions from the participants for improving the ways in which the simulator experience can be enhanced, provided useful insights. Several students and mentors commented on the logistical problems associated with booking time on the simulator when competing with numerous other students also requiring access. This was a particular problem for students travelling from further afield when trying to organise their simulator sessions to coincide with lecture days at the university, in order to reduce travel time. Whilst every effort was made to give these students priority, it was not always logistically

possible to accommodate all requests. This is unfortunate, as most students would have appreciated the ability to book usage of the simulator at more convenient times, and is a problem that will need reviewing to avoid ongoing issues.

In addition, ergonomic aspects of using the simulator need to be addressed. With some students spending a whole day working on the simulator, height adjustable stools and benches are needed to avoid the development of musculoskeletal disorders. Ideas for technical developments for the simulator have been forwarded to the manufacturers.

As in the previous study undertaken in 2013,¹⁸ this project confirmed that students in the early stages of their training found the opportunity to practise scanning, without having to consider potential patient discomfort, particularly advantageous. Students reported that being able to separate tasks was beneficial so that, for example, they could concentrate on scanning technique and locating anatomical structures, without having to simultaneously consider activities such as communicating with the patient. Most felt that on reflection, they needed to have used the simulator more extensively before interacting with real patients.

Comments from many of the experienced clinical mentors in this study suggested that student performance was enhanced by interacting with the simulator. The speed of acquisition of skills appeared to be increased, and this was of particular benefit to busy departments and training staff. Those mentors whose students had spent time on the simulator prior to scanning patients noted a marked improvement in their initial performance with patients, compared with experiences with previous students who had not been given the opportunity.

Simulation has the capacity to offer sonography students opportunities to practise skills in a controlled, safe environment,³¹ and to improve patient safety whilst helping to achieve fitness to practise.^{32,33} The primary aim of simulated learning should be to prepare the student for practice in the real clinical setting and there is therefore a need to understand to what extent the learning can be transferred to practice settings. Whilst further research is needed to assess the effectiveness of ultrasound simulation in achieving clinical learning objectives and competence, this study demonstrated several useful insights from students and their mentors in determining some of the benefits and limitations of this learning technique. Simulation provides an opportunity for learning where students can be supported to consider the integration of theory into practice, without the pressures that inevitably occur in a clinical department. Additionally, simulation can potentially offer a range of opportunities not always available in clinical practice. Limitations of this study include potential interviewer bias; however, acknowledging this at the beginning of the study enabled this to be kept to a minimum by the interviewer.¹⁹ The results from this study demonstrated that there does appear to be validity in teaching psychomotor skills using a designated simulator, in a context where time and repeat practise can be manipulated to meet the needs of

the student, but there are questions as to its value in terms of the overall clinical experience.

Conclusion

Simulation as an effective pedagogy is gaining momentum at all levels of health care education. The literature, however, shows diverging views on the role of simulation-based learning in health care, and further evaluation is needed to explore the quality of learning opportunities offered and their effectiveness in the preparation of students for clinical practice. This study was undertaken to explore ways of effectively integrating simulation into sonography training to enhance clinical preparation.

Simulation was positively evaluated by the majority of the students and mentors in this study. The findings confirm that ultrasound simulators provide positive 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. Busy clinical departments acknowledge the advantages of opportunities for students to acquire basic psychomotor skills in a classroom setting, thereby avoiding the inevitable reduction in patient throughput which results from clinical practice training. The limitations of simulation equipment to support the development of the full range of clinical skills required by sonographers were highlighted and suggestions made for more effective integration of simulation into the teaching and learning process. Simulation should therefore remain as one component in a larger picture of education and there is a need to ensure effective integration of technology with clinical practice, and professionalism. The primary aim of incorporating simulation into sonography education should always be to improve patient safety whilst helping to achieve fitness to practise.

Ultrasound simulators have the potential to enhance and transform sonography education. However, continued research needs to be undertaken in order to develop appropriate strategies to support students, educators and mentors in order to effectively integrate this methodology and maximise the advantages of the simulation experience.

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