



Student perspective on using a virtual radiography simulation



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ABSTRACT

Aim: Virtual radiography allows students to practice a range of radiographic techniques in a safe learning environment. The aim of this pilot study was to introduce Projection VR™, a software simulation, into the academic environment and harvest user feedback about the application.

Methods: Purposefully designed worksheets were developed to support the implementation of Projection VR™ into the laboratory component of an undergraduate diagnostic radiography course. Following completion of the course, all enrolled students (N = 86) were invited to complete an online survey to ascertain student perceptions on technical issues and educational value of the software. Descriptive and inferential statistics were applied.

Results: Responses were received from 84 students (response rate 98%). The student cohort had a range of confidence levels in their computer technology ability, with significant relationships observed for gender ($p = 0.025$) and age group ($p = 0.016$). Few students (19) had previously used simulation software. Overall students were positive regarding ease of use (83%) and ability to control the equipment as needed (89%). Primary benefits of using the simulation included allowing students to repeat activities until satisfied with the results (95%) and being able to quickly see images and understand if changes needed to be made (94%). Students reported the simulation positively developed their technical (78%), image evaluation (85%), problem solving (85%) and self-evaluation (88%) abilities.

Conclusion: Student feedback indicates that virtual radiography simulation has a valuable role to play developing technical and cognitive skills. Future work will extend the implementation of this software across multiple courses.

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Introduction

Clinical education is a core component of medical radiations university programmes (Diagnostic Radiography, Nuclear Medicine, Radiation Therapy) with simulation recognised as an important educational tool for preparing students for clinical practice.^{1–4} Virtual simulation software has been used successfully within these programmes to support communication skill development,⁴ interdisciplinary learning,⁵ and skill development,^{6–9} as well as workflow training⁹ within radiation therapy. Whilst virtual simulation has been successfully embedded within radiation therapy programmes to support pre-clinical technical skill development in Australia⁹ and internationally,^{6–8} the utilisation of virtual simulation within diagnostic radiography to support technical skill development, does not appear to have been widely adopted.⁴ This

paper outlines a pilot study in which a virtual radiography simulation was introduced, as an educational tool, into an Australian undergraduate radiography programme to support pre-clinical technical skill development.

Multiple approaches are adopted to supporting pre-clinical technical skill development in radiography programmes. Thoir et al.⁴ identified that Australian universities utilised x-ray imaging systems together with simulated patient positioning (student and actor) and the use of anthropomorphic phantoms to develop student patient positioning and communication skills. In addition, to support the development of image evaluation skills, Australian universities include image analysis of anthropomorphic phantom and de-identified patient images. As radiography involves the use of ionising radiation, student use of radiographic equipment is tightly controlled in laboratories at universities and clinical placements. This limits student ability to understand, practice and learn fundamental components of radiography principles and practice.

Mason¹⁰ asserts the two primary stressors of radiography students during clinical placement are 'fear of making a mistake I

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repeat' and 'feeling unprepared/inexperienced'. Virtual simulation, where radiographic images are generated without the use of ionising radiation, allows students to develop their understanding and practise their skills, in a safe pre-clinical learning environment. Within radiation therapy programmes, the introduction of virtual simulations, such as VERT™, an immersive 3D LINAC simulator, has successfully allowed students to practice technical skills and has led to increased student confidence^{6,8,9} and students better prepared for clinical placement.⁹ Students appreciated the safe learning environment that VERT™ provided, allowing them to develop their skills without endangering a "patient",^{6,8,9} the ability to make and learn from their mistakes,⁶ and undertaking procedures with less 'time pressure' than occurs in clinical practice.^{6,9} A computer-based virtual radiography simulation may also assist pre-clinical skill development for diagnostic radiography students.

Virtual simulation for radiography is a recent adjunct to radiography education and as such there is little published research regarding its implementation as a pre-clinical skill development tool. Thoir et al.⁴ reported that in the United Kingdom, a virtual radiography simulation system, Virtual Radiography™ (Shaderware, UK), was in use. The academic interviewed for the Thoir report, indicated that student feedback was positive and that this simulation supported acceleration of student skill level which better prepared them for clinical placement. A literature search did not identify any peer-reviewed published empirical studies evaluating Virtual Radiography™ as an educational tool. However, two papers published on the Shaderware company web site,^{11,12} by authors associated with developing Virtual Radiography™, demonstrate that the use of Projection VR™ (a simulation programme within Virtual Radiography™ suite), prepared pre-clinical students, equally as well as traditional hands on laboratory sessions with x-ray equipment, to set up an x-ray room with a specified FFD, reduced the time taken to set up x-ray equipment, and to identify (name) parts of the x-ray imaging system. In addition to developing technical skills, virtual radiography simulation was also perceived by students to enhance their knowledge and understanding. The use of virtual simulation would appear to support pre-clinical development of technical skills and knowledge in a safe learning environment for radiography programmes. However, due to the paucity of research evaluating Virtual Radiography™, there is a need for an independent evaluation of this simulation as an educational tool.

Whilst simulation software offers learning advantages, the introduction of new simulation software can be associated with technical difficulties that diminish learning opportunities.^{5,13} For instance, James et al.⁵ investigated the use of second life to develop communication skills and interdisciplinary knowledge amongst university students and concluded "we were not prepared for the degree of technology problems that beleaguered this study" (p. 33). In addition, the use of computers is also associated with gender and age differences. For example, males report higher levels of self-belief in their computing abilities and competency than females.^{14,15} Digital natives, those born with access to computers and the Internet, have higher confidence in their computer abilities than those born earlier.¹⁶ This means that when introducing a new computer-based educational technology, student cohort difference as well as technological issues may impact on its implementation and hence its educational value.

This paper outlines a pilot study in which Projection VR™ simulation software was introduced as an educational tool into the laboratory component of a 2nd year course within an Australian undergraduate radiography programme, along with an evaluation of technological issues, and the impact, as perceived by students, on their confidence and skill development.

Methodology

Materials and methods

Within the course (first semester, 2015) students were scheduled to attend two, two hour lectures each week, providing the theoretical framework for radiographic imaging of given body areas chest, thorax, and abdomen (revision from first year and extension), pelvis, hip and femur, shoulder girdle and humerus, and spine. Each student was also scheduled to undertake a laboratory session each week with activities focussed on the body area covered in lecture. Each laboratory session consisted of several rotations. These rotations allow students to practice positioning on fellow students, who represent walk in patients (two rotations), x-ray a phantom to generate an image that they critically evaluate (one rotation), and simulate radiography under a trauma or mobile scenario (one rotation). These rotations occur with students receiving feedback, from a registered medical radiation practitioner, on their procedural steps setting up and manipulating x-ray equipment as well as patient positioning and patient care. In addition, during these rotations, images of the body area are viewed and discussed. For this study, Projection VR™ (version 5) was added as an additional (fifth) rotation to the laboratory session. Each rotation was a small group of 5–6 students.

Projection VR™ is a computer-based radiography simulation. At the time of the study, the minimum computer requirements for installing Virtual Radiography™ version 5, included Windows 8 or 7 (64 or 32 bit) with a graphics processor of at least DirectX9 and Shader Model 2.0 hardware support and a minimum 128 megabytes dedicated video RAM. It was noted by the supplier that these minimum requirements would not allow optimal performance. The supplier recommended support for Shader Model 3.0 or 4.0 and 512 megabytes or more of dedicated video RAM. The simulation was installed into a standard university computer laboratory operating Windows 7 with specifications that exceeded stated minimum requirements. Due to unexpected delay in installing the software onto the university laboratory computers, for the first two laboratories students undertook the Projection VR™ rotation using the software installed onto 4 laptop computers. The use of an external mouse allowed for easier and full control of movement of the x-ray tube within the virtual x-ray room. In laboratories 1 and 2, where students used laptop computers, they used the simulation individually or in pairs. In the remaining laboratories, when Projection VR™ was able to be used on the laboratory computers, students used the simulation individually.

A series of new simulation worksheet activities using Projection VR™ were developed for each laboratory. This was a necessary step for a number of reasons. Firstly, the academic had no previous experience using Projection VR™ software. As such, both the academic and students would benefit from detailed worksheets to support the introduction of the simulation into the laboratory. There was no pre-session training on using the technology for students. The detailed worksheets allowed students to learn the technology as they undertook laboratory sessions. Secondly, the workbooks available from the Shaderware, UK web site did not provide laboratory exercises that were contextually relevant to the laboratories, which each week focussed around a different body area. Thirdly, limitations in the software system meant that not all projections that are able to be generated were considered, by the academic, to be a useful learning tool. For example, the lateral chest radiograph produces an image that was considered, by the academic, to yield little value and was not included as a worksheet exercise (Fig. 1). In contrast, many body area projections were judged by the academic to be useful learning tools and included in the weekly worksheets. For example, having first produced an

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