Design and validation of a tutor-led computer simulated environment for diagnostic radiography education

Abstract:

Efforts to provide student radiographers support in skills acquisition have relied on extended clinical placement or time in a clinical skills lab at university. Clinical placements are hard to come by, and clinical skills labs are expensive to procure and staff. Both options perpetuate risks associated with ionizing radiation. Simulation may be an alternative, as computer simulation can multiply and make portable cumbersome or expensive physical resources while reducing risk. The initial aim of this work was to survey the low cost computer simulation field in healthcare to ascertain what role it may play in future radiography training.

The review suggested that screen based simulation for diagnostic radiography could be achieved using published techniques of simulated radiographic image creation. Subsequently, computer graphics programming techniques were combined with specialist radiographic knowledge to produce a bespoke simulated x-ray photon transport equation. This was combined with a virtual radiographic world consisting of a voxel based service user analogue, a model of the x-ray source and receptor.

An iterative approach to simulation design was adopted, following previously published frameworks. Initial trials proved the concept and stakeholder focus groups, task analysis and usability surveys informed the interface design process during three iterations. The simulator and the skills lab teaching and learning activities were designed by ‘constructive alignment’ principles using the pre-existing intended learning outcomes and assessment tasks. Student evaluation, effectiveness and costs of the two comparable curricula were captured, analysed and presented.

Projection geometry was chosen as a validation parameter for the transport equation due to its importance in diagnostic radiography. The digitally reconstructed radiographs generated by the equation were compared with real radiographs of the same anthropomorphic skull phantom. The measured distance comparisons showed agreement within the accepted margins of error for cephalometric assessment and qualitative photometric assessment provided good face validity.

Radiography student volunteers participated in a randomized control trial examining the effectiveness of the emergent simulator training on real world radiographic tasks. Skills lab and simulation lab curricula were compared. Training was over a five-week period. Real world radiographic ability was assessed in the clinical skills lab before training and immediately after training. A multi-modal assessment comprised of radiographic vocabulary recall, source image distance estimation error, collimation size estimation error, and task completion time. All measurements

improved after training in both groups. Radiographic vocabulary recall improved faster in the simulator group (n=30, p=0.018).

The results indicate that screen based simulation can form part of an effective curriculum for radiographic skills acquisition and is more cost effective.

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