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Comparison of student radiographers' performance in a real x-ray room after training with a screen based computer simulator

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Abstract

Background: The objective of this study was to investigate if a commercially available computer simulation of radiographic practice (ProjectionVR™) could improve student performance in a real x-ray room.
Methods: A prospective blinded randomised controlled trial was conducted over five weeks comparing individual work in a tutor-facilitated screen-based computer simulated radiographic environment with tutor-supported group-work in a radiography skills lab.
Results: The results indicated that the screen based computer simulator improved median distance estimation error from 24% to 14%, and reduced median task completion time from 40 to 32 seconds. Similar performance improvements were found for the skills lab group. Simulation participants scored 90% on a radiographic vocabulary test vs 70% for the skills lab group, which was a significantly better performance.
Conclusion: Our results support the use of screen based computer simulation as an aid to radiography skills training.
Trial Registration: ISRCTN81149048

Keywords: Student Radiographers, Simulation, Skills-lab, Task Completion Time, Error, Skills Transfer

Introduction

Simulation has gradually become accepted in healthcare skills training. An increasing number of professions are participating in the design and implementation of simulation curricula, particularly for 'high stakes' procedures. The goal is to allow training away from the clinical placement in a dedicated supervised HEI setting. A trainee can then become familiar with a procedure and develop skills required before touching a real patient for the first time.

Diagnostic radiography utilises ionising radiation, which is inherently dangerous; thus student training has always required very strict supervision. The use of simulation therefore opens up the possibilities of training in a more experiential fashion.

Among the types of simulation available for teaching procedural skills are physical anthropomorphic phantoms irradiated by real x-rays (physical simulation), and screen based computer simulations. ProjectionVR™ (Shaderware, UK) is a commercially available screen based diagnostic radiography computer simulator. It attempts to simulate individual basic skills such as positioning the patient, directing the central ray, collimation, placing receptor and side markers and use of Bucky tray.

Benefits hinge upon simulation being able to deliver real world performance improvement in clinical practice. To test this, accurate measures of what is loosely called 'radiographic performance' must be available. This study used a composite score comprising source image distance estimation, collimation accuracy, task completion time and vocabulary recall. We tested the ability of ProjectionVR™ to improve 'radiographic performance' so measured, in a real x-ray room for a group of novices.

Materials and Methods

Sixty-nine diagnostic radiography students with no previous exposure to the radiographic environment were assessed in a real x-ray room on the novel 'radiographic performance' measure. This involved moving the ceiling suspended x-ray tube gantry from a park position to a point 180cm away from the vertical Bucky, then opening the collimation to cover a 35 x 43cm rectangular area on the surface of the Bucky and centred to it. This task was timed and recorded. Students were also asked to name various items of equipment visible.

The subjects were then randomized into two groups. The SIM group received four weeks of tutor facilitated time on ProjectionVR™ comprising of eleven 45 minute sessions (individual). The SKILL group received four weeks of tutor facilitated group work (6-7 in a group) with real radiography equipment. This comprised of six 90 minute sessions.

Both groups engaged in radiography procedure training in their respective environments. At the completion of the four weeks both groups were retested on the same 'radiographic performance' task. The results of the pre and post tests were analysed using the Statistical Package for Social Sciences (SPSS v16; IBM, 2010). Wilcoxon Signed-Ranks Tests for two repeated measures analysis compared pre-with post-test sub scores for each group. ANCOVA analysis of log transformed mean change in sub scores was presented to compare the groups. A value of $p<0.05$ was taken as significant.

Results

Table 1 shows the results obtained for each group expressed as the median change for each sub test

Table 1. Results of pre post test in 'radiographic performance' for simulation

Median Measures	Pre (*n*=30)	Post (*n*=30)	Wilcoxon Signed Ranks Test
SID % Error	23.75	13.75	$p = 0.017$
Time (sec)	40.00	32.00	$p = 0.006$
Vocabulary %	0.00	4.50	$p < 0.001$
CA % Error	37.65	27.61	$p = 0.230$

Table 2 compares the results expressed as the median change in sub scores between the pre-test (r1) and the post test (r2)

Table 2. Results of change (r2-r1) in sub scores between pre-test (r2) and post-test (r2)

Measure	SIM (n=30)	SKILL (n=30)	ANCOVA
SID % Error	13.75	8.33	$p = 0.168$
Time (sec)	32.00	34.00	$p = 0.739$
Vocabulary %	4.50	3.50	$p = 0.018$
CA % Error	27.61	21.76	$p = 0.848$

Discussion

The findings are as expected in all but collimation accuracy; many previous studies have shown that courses or various training techniques lead to desired improvement in task performance. However, this is also a novel finding for screen based computer simulation in diagnostic radiography. The other important factor was that the ProjectionVR™ experience was only 15% of the cost of physical simulation.

The largest limitation of this work is the use of a previously unvalidated test score; the Vocabulary element of which suffered from ceiling effects. Collimation accuracy did not show an improvement at 5% significance for either training type. Setting collimation to an exact area specified verbally is perhaps invalid.

Conclusion

Individual screen based computer simulation experience provoked radiography performance improvements on skill, confidence and knowledge based assessments in novice student radiographers. It is an economical alternative to group work in a physical x-ray room, or a suitable adjunct to it.