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Competency Based Assessment Using a Virtual Environment for Radiotherapy

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Abstract

Virtual reality in the form of VERT (Virtual Environment for Radiotherapy) has been used for radiography training since 2007. The system is a back projection system that allows the user to work within a 3D radiotherapy treatment room interacting with the room via a machine hand pendant which allows full control of the unit as in real life. With the demands within the profession and Higher Education both constantly changing we have to constantly re-evaluate our teaching and assessments in order to give the students the best learning experience whilst measuring their competencies against set professional criteria. Method: The study was a mixed methods design consisting of a randomized crossover study of 52 subjects undertaking the Radiotherapy programme at City University who were asked to undertake a simulated electron setup on both VERT and a phantom in a radiotherapy treatment unit. This was followed by focus group interviews to consider the student's perspective of using VERT in this way. Subjects also completed an immersive tendencies questionnaire and presence questionnaires. Results: The results presented are from an interim analysis based on their first setup. Results indicate significantly better performance on the real treatment unit (5.23) compared to VERT (3.62) $p < 0.001$. The focus groups also reported that they felt VERT was not suitable as a measure of competency, but felt it could be used very effectively as a training tool for setups if the final assessment was on the treatment unit.

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Keywords: competency; mixed methods; radiotherapy; simulation

1. Introduction

Virtual reality in the form of the VERT (Virtual Environment for Radiotherapy) has been used for educational training since 2007. The VERT system produces a stereoscopic immersive 3D image back projected onto a large screen within a bespoke viewing space. The systems requires the use of stereoscopic viewing goggles in

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order to visualize the image in 3D and effectively put the user into a radiotherapy treatment room that they can navigate around and have realistic control of the equipment using an actual treatment controller, see Fig 1.

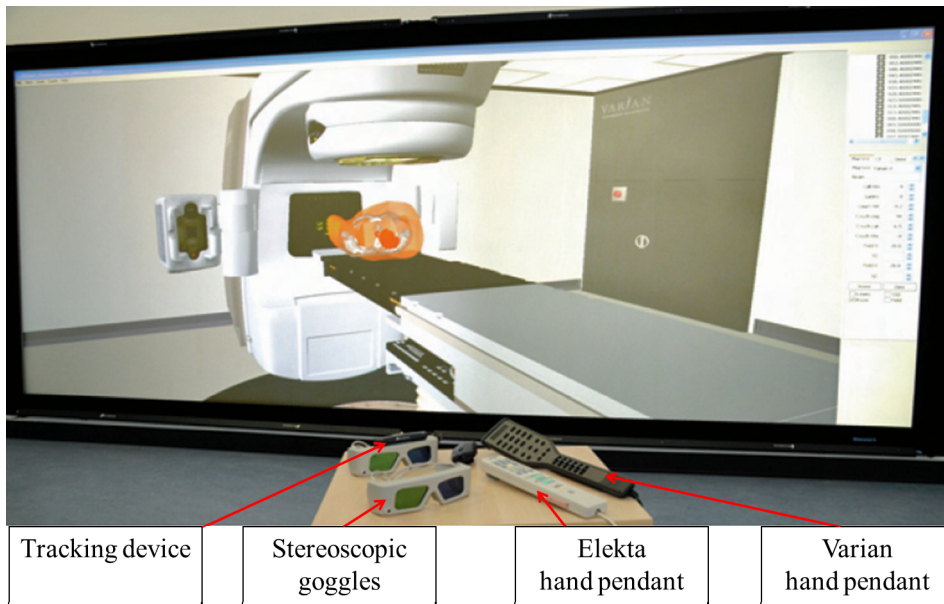


Fig. 1. The VERT system

Although virtual environments including VERT are currently being used mainly as training tools their use is increasingly being considered as a method of assessing performance [1, 2]. In the United States the Medical Licensing Examination already utilises simulations as part of the assessment prior to qualification [3]. It is this aspect of the VERT system that is being considered in this study that aims to compare the outcomes of identical simulated electron setups on VERT and a treatment unit. It also considers student views about the use of VERT as a measure of competency.

2. Materials and Methodology

This was a single center, randomized, cross-over study of subjects undertaking an electron treatment set up. Electron setups were selected as the focus of the study as they require good 3D visualization and are a type of setup that is encountered infrequently in the department so finding suitable patients to assess students on is a problem. 52 students undertook the study. Each simulation (LINAC and VERT) had identical start points and identical setups. An assessor was also present who timed the setups and noted if the patient was endangered during the procedure. On completion of the setup they then recorded the final details of the setup.

3. Results

Analysis of unpaired data from the users first setup indicated significantly better performance for the simulation using the real treatment unit compared to the virtual unit students scoring on average 5.23 compared to 3.62 on VERT, $U=46.5$, $p<0.0001$. Further analysis was done using the paired crossover data on the binary outcome of the electron setup, i.e. success or failure. The analysis followed the procedure detailed in Toutenburg and

Shalabh [4] who recommend the use of the McNemar's test for an analysis of binomial data if the period effect can be ignored. Analysis of the outcome of the data in terms of success or failure of the setup indicates that the two simulated setups are performed differently by the students, the test indicating a difference of 35.56% (CI 18.16-39.89), $p=0.0001$. The test was then repeated for all outcomes that were included in the overall outcome, the results of which can be seen in Table 1 The results appear to indicate that the major differences between the setups was the setting of the treatment distance, obtaining a good fit of the light beam to the setup marks in both the superior/inferior direction and the medial/lateral direction. All scores were better for the treatment unit simulation than for the virtual simulation.

Table. 1. (a) McNemar test results

	Difference	95% CI	Significance
Rotation fit	22.22%	3.10 - 32.68	0.0213
Superior/Inferior fit	42.22%	27.32 - 42.22	<0.0001
Medial/Lateral fit	37.78%	23.04 - 37.78	<0.0001
Machine hit the patient	4.44%	-10.56 - 16.82	0.7539
Treatment distance	47.78%	16.78 - 48.27	0.0005
<5% Dose Variation	13.33%	-6.16 - 27.72	0.2101

Feedback from the focus groups tallied with the quantitative findings, students preferred the treatment room based simulation to the VERT system. Issues that were raised related to lack of immersion, lack of reality no tactile feedback from the simulation, limited viewing angle and the poor fit of the glasses. These were all cited as reasons why they felt that the VERT system could not be used to measure competence. The student's, however were positive about using VERT as a training tool stating that it would help them prepare for the assessment, allowed them to make mistakes and work in an unhurried environment, even if it couldn't be used as an assessment.

4. Conclusion

From the interim analysis carried out it is clear that the VERT system is not as favorable to the students as an assessment tool as an identical simulation on an actual treatment unit. As both arms of the study were simulations we can't say which of the method represents how the student would perform in real life, what we can say however is that the students perform significantly better on the treatment machine simulation compared to the VERT simulation.

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