University of South Australia

International audit of Virtual Environment for Radiotherapy Training usage

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Title:
International Audit of VERT Academic Practice

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Abstract:

Introduction

The Virtual Environment for Radiotherapy Training (VERT) is a high fidelity simulation hardware and software resource that replicates the expensive and high pressure clinical environment of a radiotherapy treatment machine. The simulation allows students to gain confidence with clinical techniques in a safe and unpressured academic environment prior to clinical placement. The aim of this study was to establish the current and future role of VERT and explore the potential for collaborative resource development and research.

Methods

An anonymous online survey was made available to all users of the software internationally. A mixture of fixed and open response questions gathered usage data and user feedback.

Results

The study had a 90% response rate. Most participants (78.5%) used the resource 1 day per week or less; around 8000 hours worldwide. It was clear that most participants used the simulation resource to help student to either gain understanding of concepts and techniques or to gain practice with techniques and practical skills. There was good support for collaborative resource development and sharing and the development of an international community of practice.

Conclusions

This audit demonstrated high levels of engagement and enthusiasm for collaborative resource development and ongoing research among the radiotherapy simulation community. Adoption of an international Academic Community of Practice for collaborative simulation resource deployment and support may be of significant value and is worthy of further discussion and consideration

International Audit of VERT Academic Practice

Introduction

Successful radiotherapy depends on the accurate delivery of radiation to target anatomical structures with millimetre precision. The spatial relationship between different organs as well as the geometric positioning of the equipment, the patient and the radiation dose distribution requires therapeutic radiographers to not only use the equipment competently but also have a sound understanding of 3D geometry. Training in radiotherapy combines academic teaching with placement in clinical departments; these are typically pressured environments with high patient throughput and a low tolerance for error. As with medical education in many other professions[1-7], a range of simulation resources have been enthusiastically adopted to facilitate training away from the clinical area. The Virtual Environment for Radiotherapy Training (VERT) is a high fidelity simulation hardware and software resource that places the user in a 3D immersive virtual radiotherapy bunker using clinical anonymous patient data. VERT was introduced in 2007[8-9] and is currently installed in academic[10] and clinical departments[11] across the world. VERT provides opportunities for pre-clinical skills acquisition[12], technique learning[13,14], physics and dosimetry teaching[15-17], plan evaluation[18] and visualisation of anatomy. The resource provides a useful array of tools to help close the gap between theory and practice. In particular, the use of clinical control systems within the platform allows students to gain confidence with clinical techniques without interfering with the daily workflow. Students are able to learn from mistakes without harming patients and enter the clinical workplace with some technical skills, allowing them to focus more on patient care and communication than the controls of the equipment. A specific module of VERT (known as PEARL) has been developed for use in patient education[19-21] where it can help to prepare patients for what is an unfamiliar and potentially daunting environment.

Recent presentations and discussion at VERT users group and research meetings have indicated that there is a wide variety of resource development and implementation internationally. New users, however, are commonly finding that initial resource development is time-consuming and that opportunities for collaboration are restricted. The evidence base underpinning VERT pedagogy is still small and suffers from low cohort numbers and disparate outcome measures. A more collaborative approach to resource development and underpinning evaluation may enable VERT to be used more productively and lead to an evidence-based approach to ongoing development.

The aim of this study was to collect data and user feedback in order to establish the current and future role of VERT in radiotherapy education and in a range of health professions. This data will help to define best practice guidelines as well as inform development of the VERT user group's strategy regarding curriculum and resource development and research.

Methods and Materials

Data collection

A short, 18 item, survey tool was developed that comprised a mixture of multiple option and short-answer open questions. The survey comprised 3 sections that gathered data on the software and hardware used in the VERT facility, current usage of VERT and suggestions for future practice and resource development. Ethical approval for the project was granted by the University of Liverpool Research Ethics Committee. A link to the survey was distributed to 52 Higher Education Institutions worldwide in February 2016. A reminder to complete the survey was distributed 1 month later. Global VERT users were identified using Vertual Ltds customer database. Additional input from Vertual Ltd on the design and content of the survey was not utilised in order to minimise potential bias. The survey was deployed by the University of South Australia via SurveyMonkeyTM to enable anonymous online completion.

Analysis

Quantitative data was collated and analysed using the descriptive tools within Survey Monkey™. Responses to the open short-answer questions were subjected to qualitative analysis using a conceptual approach. This identified key themes that were sorted under the following categories: VERT use, pedagogical practice, resource development, collaborative approaches/research and barriers/challenges. Qualitative data was triangulated against the quantitative findings.

Results

Demographics and VERT use:

There was a 90% response rate (47 out of 52) and compliance was generally high, although some questions (such as use of specific physics and patient information "PEARL" modules) were omitted, limiting the value of the data. Responses to 11 of the additional short answer "clarification" questions provided a total of 105 comments for analysis. Most users were using the latest version of the software with only 2 having failed to upgrade in the last 2 years. Participants were asked to identify barriers to use of VERT; the most common of these were related to the availability and location of the facility as well as technical support. Overall 32% of responses (32%) indicated that there was a perception in their institution that VERT was not useful. It was not clear from where this perception had arisen, although one respondent did comment that lack of use had resulted in low staff confidence when using it. Another suggested that VERT was being seen as the answer to everything which was problematic and students would be no worse off without it, they would just be taught differently.

Stereoscopic function was used by 69% of users, although only 43% used the position tracking function. VERT was most commonly used with pre-registration and prospective students as seen in Figure 1 but was also used with post-registration students, students on other courses and visitors. When asked to estimate total annual hours of use, most participants (78.5%) reported using 1 day per week or less for a typical 30 week academic year. A rough total estimate across the participants was 8000 hours annually worldwide.

Pedagogical practice

Most VERT activities (93%) were conducted in small group seminars or as individual /paired work. In centres indicating the use of more than one licence, these were utilised on laptops or desktop personal computers primarily for teaching preparation using the virtual presenter function, educational and promotional events and to support the delivery of VERT based teaching in clinical sites without permanent VERT facilities using a mix of 2-D and 3-D modalities. A wide range of activities were supported well by VERT as seen in Table 1. It was clear that most participants used VERT to help students to either gain understanding of concepts and techniques or to gain practice with techniques and practical skills. The system was also commonly used to teach understanding of anatomy. Less commonly used but popular activities included: plan evaluation, learning and practice of physics and quality assurance, as well as supporting provision of multi-disciplinary teaching and staff continuing professional development (CPD). Additional benefit was perceived by users in relation to student assessment, research, enhancing retention and as an additional placement as seen in Table 2, although it was not clear to what extent this had been implemented.

Future collaborative resource development

Participants were asked about the level of support for collaborative resource development and sharing at institutional level and it was encouraging to see 64% of responses in favour of this. Concerns relating to intellectual property rights were highlighted by 12% but overall there seemed to be support for taking this forward. One of the resource areas identified as having potential for collaboration was the development of additional patient data sets with a variety of body sizes, supported by additional workbooks for both students and staff continuous professional development activities. This may be beneficial for those users without access to a treatment planning software or permission to use clinical datasets. Additionally, there was a substantial recurring theme in free text responses of users being open to collaboration or an on-line community of practice. Table 3 summarises these responses.

Future collaborative research

One of the key themes for collaborative research identified the need to determine the impact that VERT has on learning and assessment using both formative and summative methods linked to the need for supporting evidence of both a quantitative and a qualitative nature. Other respondents expressed a need to determine VERT's role in peer assisted learning, the impact for final year radiotherapy and other healthcare students and, in patient education, the role in supporting patient decision making. Its value in supporting the development of 3-D understanding of geometry was also identified as an area for further study together with its possible contribution to reducing the amount of time required for clinical placement. Those who identified themselves as new users reported that they would be interested in collaboration and would welcome support from other more experienced users and researchers in getting started:

> "*I am going to start using it for patient education soon and will wish to evaluate it so would be interested in collaborating with others using it this way"*

> *"We are planning to use VERT for research; maybe it's good to have any idea how to start?*

Discussion

Implications for VERT pedagogy

Given the strong support for collaborative development and research it may be sensible to consider a consistent approach to VERT pedagogy that provides VERT users with a basis on which to develop and share approaches that reflect best practice and work in local contexts. Nisbet and Matthews[13] highlighted the value of a generic workbook with clear alignment with Bloom's taxonomy of learning for supporting VERT seminars and practical sessions. This survey has shown that radiotherapy concepts and techniques are commonly taught using VERT and a collaborative approach to developing and sharing resources may not only help support new users but also extend the potential datasets available for comparative evaluation of the impact of the VERT resources.

Barriers and Challenges

The barriers and challenges encountered by users fell into four main categories. The first was the issue concerning the availability of staff time although it was not clear whether this related to the development of resources or the time available to actually engage with the platform and the ability to engage new staff. The second related to the use of VERT in its 3-D mode with comments relating to students finding the 3-D glasses cumbersome and therefore being reluctant to use them. There was also a perception that aspects of the software were out of date especially in relation to image guided radiotherapy functions. However no further explanation was offered and therefore it is not clear if this comment relates to older versions of the software. The final theme related to the financial constraints that some users encounter and how this impacts on their ability to introduce new tools particularly in the field of patient information. Although some of these issues can be addressed by the manufacturers, it is interesting to see that many of the challenges are associated with logistical and financial issues. In these cases collaborative resource development and sharing may decrease the impact of time and financial constraints and help support wider use of simulation.

Academic Community of Practice

A collaborative model has already been tested by a consortium of Australian Universities in 2011. This grew from a federally funded agreement that resulted in the establishment of the VERT academic community of practice (VACoP) amongst the six Universities that offered entry-level radiation therapy programs at that time. Wenger defines[22] a community of practice as a group of individuals who share their interests with a specific topic, gaining greater knowledge of and expertise through interacting regularly. Members of the VACoP collaborated to develop and share VERT teaching resources that were then embedded in programs nationally to improve the effectiveness of existing practices.[23] This two and a half year project saw the creation of multiple pedagogically based clinically relevant training resources accessed by all universities through shared cloud based

technology. Radiation Oncology stakeholder groups; radiation oncologists, medical physicists and radiation therapists were briefed on VERT and the systems' capabilities to encourage wider use of VERT in training or patient information. All developed resources have the branding of VACoP on title slides and documentation so that appropriate acknowledgement is visible in use. Radiotherapy students are thus made aware of the national approach to their training.

The high response rate of this survey suggests that VERT users are a particularly engaged academic community internationally. Based on this, the enthusiastic support for collaborative resource sharing in the VERT community demonstrated through this survey and the successful introduction of a Community of Practice in Australia, it is suggested that the establishment of a wider Academic Community of Practice be considered. It would, however, be interesting to see whether a model similar to that adopted in Australia can be adopted internationally in the absence of project "seed funding". In terms of wider health education, this would seem to be a useful model for increasing use of health simulation resources and further collaboration with other disciplines should prove to be valuable.

Limitations of study

The study had a high response rate but it was not clear from the data which individuals had completed the survey tool; ideally this would have been the institutional VERT lead. A limitation of this study was that respondents were asked to make rough estimations of usage. While this is less accurate than a prospective timing measurement it should provide a reasonable approximation. There is also likely to be a slight respondent bias as individuals in a VERT role are likely to perceive VERT in a favourable light. It was encouraging to see some negative comments included in the feedback; this may indicate a less biased response than anticipated. The support of the VERT manufacturers in facilitating contact with users may have influenced response and potentially introduced recruitment bias; however the high response rate suggests that this impact is minimal. Participants were advised that manufacturer input did not extend to survey tool construction, deployment or data analysis

phases; this combined with the anonymity of response should have further ameliorated introduction of manufacturer bias.

Future Development

Several respondents offered suggestions for new tools related to problem solving activities, for example, how changes in various parameters including focus to skin distance and gantry angle effect dose distribution, improved image matching functions and the development of the virtual presenter facility to include the addition of text. From an anatomical perspective, the development of an anatomical atlas to include lymph nodes was also suggested. In addition to these themes, the value of combining VERT with other technology enhanced learning platforms was also identified as a research need. Ongoing collaborative evaluation from users will continue to provide suggestions for ongoing development and ensure that software development matches user requirements. This survey has demonstrated the support for collaboration between users and involvement of a wider user community of practice with simulation software manufacturers may ensure that development continues to match user expectations.

Conclusions

The results of this audit indicate that VERT is used for around 8000 hours annually (less than 1 day per week in most centres) mainly to support small group teaching of radiotherapy concepts and provide practice of techniques. Advanced technical features are not used fully with many users and there are resource issues impacting on users' ability to use the software to its full capability. Despite this, the simulation package is perceived as valuable for radiotherapy education across a wide range of topics and learning activities.

This audit has also demonstrated good levels of engagement and enthusiasm for collaborative resource development and ongoing research among the radiotherapy simulation community. Adoption of an international Academic Community of Practice for collaborative simulation resource deployment and support may be of value and is worthy of further discussion and consideration..

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Table 1: Activities supported by VERT

Activity	Used at all	(Commonly)	(Sometimes)
Understanding of fundamental RT concepts	43	29	14
Understanding of RT techniques	43	31	12
Development of practical/psychomotor skills	39	22	17
Practicing RT techniques	38	23	15
Understanding of anatomy	36	25	11
Evaluation of plans	35	10	25
Understanding of physics, dosimetry and QA	29	11	18
Practicing dosimetry and QA	25	5	20
Multi-disciplinary teaching	28	8	20
CPD course provision	22	2	20
Recruitment and selection	23	12	11
Formative assessment of students	24	11	13
Summative assessment of students	16	7	9
Research projects	22	4	18

Table 2: Perceived value of VERT

Activity	Beneficial	(Very)	(Some)
Understanding of radiotherapy techniques	39	31	8
Understanding of fundamental radiotherapy concepts	38	26	12
Understanding of anatomy	37	21	16
Practicing radiotherapy techniques	37	20	17
Development of practical/psychomotor skills	36	20	16
Preparing students for clinical placement	34	23	11
Evaluation of plans	30	9	23
Recruitment and selection	24	14	10
Understanding of physics, dosimetry and QA	24	9	15
Multi-disciplinary teaching	23	14	9
Formative assessment of students	22	11	11
Practicing dosimetry and QA	21	7	14
As a means of enhancing student retention	20	10	10
CPD course provision	18	8	10
Summative assessment of students	18	8	10
Providing a resource for research	16	8	8
As an additional clinical placement	16	3	13

Table 3: Comments relating to collaborative working

"How can we help each other to promote the system?"
"I think this (Community of Practice) would help us engage in the use of VERT"
"Good idea if institutes are willing to share data…sharing of patient data may be an issue"
"Suggest setting up a VERT users online community (i.e. Facebook) to allow educators to share VERT uses"
"Train the trainers - we have a small group of enthusiastic people, but it is difficult to engage new teachers to use the system as an integrated part of education"
"I am going to start using it for patient education soon and will wish to evaluate it so would be interested in collaborating with others using it this way"
"We are planning to use VERT for research; maybe it's good to have any idea how to start?"

Figure Legend:

Figure 1: Frequency of use with different groups