

EXPERIENCE EXCHANGE

Blended learning continuing education using virtual animated characters: A novel radiation therapy course for nurses

Joanne Crawford ^{*1}, Liat Brudnoy², Tracy Soong³, Thomas Graham³

¹Department of Nursing, Faculty of Applied Health Sciences at Brock University, St. Catharines, Ontario, Canada

²Deloitte, National Assurance and Advisory Learning, Toronto, Ontario, Canada

³de Souza Institute, Toronto, Ontario, Canada

Received: August 13, 2015

Accepted: September 9, 2015

Online Published: October 27, 2015

DOI: 10.5430/jnep.v6n1p124

URL: <http://dx.doi.org/10.5430/jnep.v6n1p124>

ABSTRACT

Introduction: A blended radiation therapy course was developed to meet continuing education needs of nurses working with patients diagnosed with cancer in diverse health care settings. The purpose of this paper is to describe the design, development, and evaluation of an innovative blended radiation therapy course including eLearning modules using virtual animated character guides, an independent self-managed project, and a one-day face-to-face symposium.

Methods: A pre/post-test group design was employed using standardized program evaluation measures. Participant data included self-reported confidence in knowledge of radiation therapy. Additional evaluation included assessment of the virtual animated character guides, and open-ended feedback of the overall course and areas of improvement.

Results: A total of 51 participants enrolled in two separate iterations of the course with a 71% response rate. In Group A (n = 17) statistically significant improvements were identified at post-test in self-perceived confidence levels in knowledge for 11 of 12 radiation therapy domains ($p < .05$). In Group B (n = 19), statistically significant improvements in self-perceived confidence levels in knowledge were identified in all domains ($p < .05$).

Discussion/Conclusions: The course provided a learning environment that drew on a variety of technologies and delivery methods. The improved confidence levels in knowledge may enhance individual nurses' ability to address the needs of patients undergoing radiation therapy. Interactivities, virtual animated character guides, discussion forums, the project assignment, and the symposium were activities perceived to be conducive to learning. Further evaluation may elucidate if confidence level in knowledge gained from the course was assimilated into practice and improved information and education needs of patients.

Key Words: Nurses, Radiation therapy, Cancer care, Continuing education, eLearning, Virtual animated characters

1. INTRODUCTION

Radiation therapy is an important modality used in cancer treatment. Nearly 60% of patients diagnosed with cancer will require radiation as part of their treatment plan.^[1] As technology continues to evolve in radiation oncology, the number of patients diagnosed with cancer requiring radia-

tion therapy is likely to increase. Interdisciplinary teams work collaboratively to provide care to patients undergoing radiation therapy. The teams include radiation oncologists, physicists, dosimetrists, radiation therapists, and oncology nurses.^[2,3] While technical aspects of radiation therapy are managed by most of the team, the oncology nurse plays a

*Correspondence: Joanne Crawford; Email: joanne.crawford@brocku.ca; Address: Department of Nursing, Faculty of Applied Health Sciences at Brock University, St. Catharines, Ontario, Canada.

role in promoting continuity of care from initial consultation, throughout treatment and in follow up.^[3,4] The nurse's role in radiation therapy encompasses comprehensive health assessment, nursing intervention, patient and family education, counselling, and supportive care.^[3,5,6] In one report, patient education was reportedly the main role function of oncology nurses working in radiation oncology, followed by supportive care needs (*i.e.*, psychosocial, emotional or practical).^[2]

Nurses working in radiation oncology require enhanced knowledge of radiation therapy including: (1) principles of radiation therapy (*i.e.*, mechanisms of action, indications for use, delivery methods, and treatment machines); (2) concurrent treatment protocols; and (3) symptom management.^[3,7] Likewise, nurses caring for patients being treated for cancer in other areas of practice require some level of knowledge of side-effects of radiation therapy not only for management but also to meet information and education needs.^[8] While patients undergoing radiation therapy require information and support, often they report unmet needs.

In one longitudinal study, over 50% of women diagnosed with breast cancer who had undergone radiation therapy reported "partially met" or "unmet" needs related to receiving information about adverse effects of radiation to the lung and heart, as well as the follow-up plan at two time points (time 2, after treatment planning; time 3, first week of treatment).^[9] For 20% of women, information received on treatment planning, radiation field area, and side effects were either partially or not met at time 2 and 3.^[9] Similarly, patients with prostate and breast cancer shared expectations related to quality care during radiation therapy and identified several needs such as additional information about radiation therapy, sequence of treatment, and potential side-effects.^[10] In addition, participants felt that an individualized patient-centered approach was important, and they preferred contact information post treatment if problems arose, for example, with a nurse specialist who had expertise in radiation therapy.^[10] The gaps associated with meeting the needs of patients undergoing radiation therapy are important, and there is certainly room for improvement in management and information.

The unmet needs of patients receiving cancer treatment may also relate to health professionals' lack of knowledge or opportunities for professional development. For example, radiation therapists, dieticians, nurses, and psychosocial staff described learning needs associated with symptom management, treatment of anxiety, and assessment of psychological needs.^[11] With the increase in cancer incidence globally,^[12] and the advances in technology and complexity of treatment protocols using radiation therapy, nurses will also require

continuing education to keep up with current best practices.^[5] Of course, this will have to be on their own time, which may pose challenges related to competing work demands, personal responsibilities, as well as other individual personal factors.^[13] This may also be compounded by the fact that continuing education may not be available, yet, access to resources and learning opportunities are important.^[3] Web-based continuing education ameliorates some challenges by facilitating access to learning that is flexible, convenient, and aims to meet professional nurses' learning needs.

The Oncology Nursing Society (ONS),^[14] an accredited organization by the American Nurses Credentialing Center's Commission on Accreditation, offers an international web-based continuing education course for nurses, the Radiation Oncology Certificate Program. However, there is a lack of formal radiation therapy courses for nurses in Canada. Consequently, to meet the learning needs of nurses who care for patients diagnosed with cancer, a virtual center of learning that supported excellence in oncology nursing facilitated the development of a radiation therapy course. The course used a blended learning model and featured CodeBaby®, a software application used to create virtual animated characters.^[15] Additional course components included an independent self-managed project, and an in-person symposium. The purpose of this paper is to describe the design, development, and evaluation of a novel blended learning course on radiation therapy for nurses in Canada.

2. METHODS

2.1 Curriculum development

Evidence-based literature, cancer care practice guidelines and websites, radiation therapy textbooks, and practice standards and competencies were main sources used to develop course content. The syllabus provided a course description and structure, learning objectives (see Table 1), course expectations, and learning methods. The course was advertised on the virtual center of learning's website, and disseminated via e-blasts (electronic news by mass email) and newsletters to a pre-established list of oncology practitioners, and partner organizations. Participants who enrolled in the course were first required to complete an orientation to Moodle®, the Institute's Learning Management System.^[16] The course was made up of three components: (1) four eLearning modules incorporating virtual animated character guides; (2) an individual self-managed project assignment; and (3) a one-day symposium for knowledge transfer and dissemination of participant projects. Evaluation of the course was also completed to assess learning but also to make improvements to the course.

2.2 eLearning modules

Four eLearning modules covering key topic areas were developed for web-based learning (see Table 2). Adult learning principles were used as a foundation to develop the structure and activities for the course.^[17] Module content was segmented into chunks of text and presented in formats appealing to different learning styles to keep participants engaged with the material. For example, audio, video, descriptive images, interactive games, and textual information were balanced throughout the course. Participants were involved in

learning that was autonomous, self-directed, and provided flexibility to complete modules within a one week timeframe. Anticipated time required to complete each module was approximately 20-30 minutes; however, as modules were open at all times, participants were at liberty to repeat parts of a module or use it as a resource for practice or their project. A number of key features were incorporated into each eLearning module: virtual animated character guides to deliver detailed content, interactivities, required readings, and discussion forums.

Table 1. Learning objectives and domains evaluated

<p>By the end of this course, you will be able to have increased confidence to:</p> <ol style="list-style-type: none"> 1) Describe principles of radiation therapy 2) Define radiobiology and list effects on the cell 3) Discuss the purpose and rationale for the use of radiation therapy 4) Describe the mechanisms of ionizing radiation, dose, fractionation, and administration 5) List the common radiation treatment modalities 6) Describe treatment planning, scheduling, and identify key interdisciplinary staff roles 7) Describe radiation safety principles 8) Define radiosensitizers, radioprotectors, and chemotherapeutic agents 9) Recognize the most common disease site and concurrent protocols using radiation therapy as one of the main modalities 10) Describe the most common side effects, and disease site specific side effects of radiation therapy 11) Recognize the different interventions for prevention, and management of side effects 12) Explain the nurse's role in assessment, patient education, and symptom management

2.2.1 Virtual animated character guides

The creation of virtual animated characters (ACs) was an innovation integrated into each module. CodeBaby[®] was used to develop simulated real life characters using 3-dimensional animations embedded within web-based education modules.^[15] Virtual animated characters are technologically derived animated agents that create unique social context within immersive environments to disseminate content and knowledge.^[18] The rationale for incorporating this new technology into the course was to facilitate delivery of large text based information and to provide an engaging platform for participants. The virtual ACs have the ability to take on humanistic mannerisms that include automated lip movement and physical gestures that sync with recorded audio components. Simulated conversations between virtual ACs may be used to enrich course content and engage learners.^[18,19] Incorporating virtual ACs into eLearning can improve learner motivation and foster deeper processing of information.^[18,19] While reporting the integration and evaluation of virtual ACs has been undertaken with diverse health professional disciplines,^[20,21] there is limited literature focused on an innovative blended learning course using virtual AC guides in continuing education for nurses.

Two virtual ACs served as our instructional guides – a female

expert radiation oncology nurse and a novice male student nurse. The virtual ACs provided a consistent presence to guide learners through more challenging course content.^[18] For example, content developed for radiation therapy treatment planning was quite lengthy and difficult to adapt to an eLearning platform. Consequently, a dialogue between virtual ACs enabled the description of each phase of radiation therapy treatment planning. The discussion between the two virtual ACs occurred concurrently while an embedded image of a flat screen TV illustrated video clips of a real patient going through the process of radiation treatment planning with the radiation oncologist, physicist, and radiation therapist (see Figure 1). A script was created for the virtual ACs and recorded individually using Articulate[®] software.^[22] For the final product, audio data was used to match lip movement and other humanistic gestures to each character. In essence, the characters took on the personalities of the individual playing each role (the educator leading the course, and a team member) adding another dimension of personality to the virtual ACs.

2.2.2 Inter-activities

A variety of interactive elements were created for each module using Raptivity[®], a multi-media program.^[23] Animations, quizzes, and games were examples of interactive fea-

tures imbedded into the eLearning modules. Interactivities were incorporated to engage learners with content, and also test comprehension or application of concepts. Often, these interactivities complemented dialogue between the virtual ACs on some aspect of radiation therapy, assessment, or treatment. For example, an animation was created to enhance understanding of biochemistry and the effects of radiation therapy on cancer cells. While this animation was being presented in a separate dialogue box, the two virtual ACs discussed associated concepts. Another interactive element involved an animation to review the layers of the skin and function to then understand the significance of the most common radiation side effect, a skin reaction. Participants were engaged in navigating through the layers of the skin, and

then later observed a subsequent dialogue between the virtual ACs, who proceeded to discuss the assessment of a radiation therapy related skin reaction.

2.2.3 Readings

Required readings were assigned for each module. The main textbook by Watkins and colleagues^[7] was available electronically from a virtual library to all participants as part of the course. The purpose of assigned readings was to complement eLearning modules, foster critical thinking, and integrate learning into current practice. Readings added approximately two to three hours of time to weekly workload. Additional resources were provided in the form of handouts and website links to supplemental treatment or management related information and resources.

Table 2. eLearning modules

eLearning: Module Topics	
<p>1. Introduction to Radiation Therapy</p> <ul style="list-style-type: none"> • The Energy Spectrum (non-ionizing and ionizing radiation) • Typical Forms of Ionizing Radiation • The Discovery of Radiation Therapy • Radiation Therapy Use in Canada • Radiation in Cancer Treatment • Radiobiology • Side Effects and Time to Appearance • Characteristics that Influence the Radio-sensitivity of the Cell 	<p>2. Radiation Administration and Treatment Modalities</p> <ul style="list-style-type: none"> • Photon Absorption in Human Tissue Radiation Absorption and Measurement • Radiation-induced Tissue Injury • Fractionation • Administration • External Radiation Treatment • Internal Radiation Treatment • Treatment Procedures Review • Treatment Planning and Simulation • Treatment Planning Presentation • Interdisciplinary Team Members
<p>3. Combination Therapies using Radiation</p> <ul style="list-style-type: none"> • Radiation Safety Principles • The Use of Personal Protective Gear • Radiation Safety Principles Review • Chemical Modifiers • Administration of Combined Modalities • Brief Overview of Drug Classes • Radiosensitizing Agents • Concurrent Combined Modality Therapy • Acute and Late Toxicities of Combined Modalities • Combined Therapies Review Exercise 	<p>4. Radiation treatment side effects, prevention, and management</p> <ul style="list-style-type: none"> • Anatomy of the Skin • Radiation Effects on the Skin • Different Radiation Treatments: Effects on Skin • Skin Assessment Criteria • Long Term Effects • Skin Effects Review Exercise • Introduction to Fatigue • Psychosocial Factors • Radiation-related Fatigue • Cancer-related Fatigue: Assessment • Distress and Coping • Screening for Distress • Edmonton Symptom Assessment System (ESAS) • Canadian Problem Checklist • Disease Site Specific Side Effects • Nursing Role during Radiation Therapy

2.2.4 Discussion forums

Collaborative discussion forums were integrated within each module to foster active participation and dialogue between participants (see Table 3). The use of weekly discussion forums were particularly important to the learning process for participants to: (1) respond to questions specific to weekly module content and readings; (2) respond to weekly inde-

pendent project planning activities; and (3) provide a weekly open forum to share practice experiences, interventions, and challenges. The instructor, who had certification in oncology nursing, was accessible to participants via the eLearning platform and email. General announcements and weekly course updates were posted on the news forum.



Figure 1. Virtual animated character guides

Table 3. Discussion collaboration forums

Week	Discussion Forum Questions
Week 1 Module	1. Describe your exposure to patients who are undergoing radiation therapy in your practice setting. Provide some information about the type of patients and whether you work in an in-patient setting, ambulatory cancer center, community hospital, or home care. 2. Describe what you are hoping to learn from taking this course? Be sure to also read and respond to the answers of your fellow learners.
Week 2 Module	Please respond to the following questions and interact with your fellow learners. 1. Reflect on a treatment modality that you have had experience with or one that is new to you and you would like to understand more about. 2. How will gaining a deeper understanding of this modality help you in your practice?
Week 3 Module	Please respond to the following questions and read and respond to the answers of your fellow learners. 1. Provide some challenges that you have encountered or might encounter in your practice in adhering to ALARA as it pertains to time, distance and shielding. 2. Provide an example from your practice of a side effect from concurrent chemotherapy and radiation therapy treatment (chemotherapy agent, disease site, and stage). How has this been managed?
Week 4 Module	Please respond to the following questions and read and respond to the answers of your fellow learners. 1. Which side effect of radiation treatment do you see most often in your practice? What are the specific disease sites and stage? 2. What role do you play and at what instance along the cancer journey do you provide patient education for patients undergoing radiation therapy (pre-treatment, during treatment, post treatment)? What areas do you think that you could improve upon?

2.3 Individual self-managed project

The individual project used a stage based approach to assist participants to plan, develop and organize a presentation

for the face-to-face symposium. The main objectives of the project were (1) to enhance learning of a specific disease site and radiation treatment modality; and (2) to develop research

and presentation skills. Weekly resources were posted to support participants through each phase of the project development process (see Table 4). While the project required more independent time to complete, it was an integral part

of learning in the course given the breadth and depth of treatment protocols for specific cancer disease sites and diverse radiation treatment modalities.

Table 4. Project development process

Individual Project Activity for Knowledge Transfer on Symposium Day	
<p>Week 1. Project Step One: Selecting a Topic</p> <ul style="list-style-type: none"> • Topic relevant to practice and meets learning need • List of topics provided (participants, selected their top three choices) 	<p>Week 2. Project Step Two: Selecting a Format</p> <ul style="list-style-type: none"> • Oral presentation or poster presentation • Pamphlet or patient education development • Peer feedback at symposium with evaluation criteria • List of resources for content and presentation style choice
<p>Week 3. Project Step Three: Project Outline</p> <p>A draft outline to be submitted for instructor feedback to include:</p> <ul style="list-style-type: none"> • Background • Radiation side effects • Evidence-based interventions for symptom management • Implications for nursing • Key lessons learned 	<p>Week 4. Project Step Four: Abstracts</p> <p>Create an abstract and include:</p> <ul style="list-style-type: none"> • Background • Radiation side effects • Evidence-based interventions for symptom management • Implications for nursing • Key lessons learned

At the start of the course, a topic list was provided. Participants were asked to select a topic of interest related to their practice or one that addressed a learning gap. A list of learning resources was provided; however, participants were required to search for additional literature on the virtual library. As participants progressed, they selected a presentation format, were provided with a presentation outline, received feedback on abstracts, and were also given a copy of the peer evaluation criteria. Two additional weeks were allotted to work on projects after eLearning modules were completed. Participants were encouraged to ask for assistance as needed throughout the course and during preparations prior to the symposium.

2.4 Face-to-face symposium

The main goal of the symposium was to foster knowledge transfer of project work. A pre-planned schedule of presentations was developed to organize the full day symposium, and emailed to participants prior to the day. Participants had 15 minutes to present their project to peers with a five minute question period. Participants delivered their presentation in a non-threatening and safe learning environment, and received written peer feedback. Peer feedback forms were collected and placed in each participant's envelope and given to each participant at the end of the day. We encouraged participants to review the feedback and make modifications to their presentation if needed. The rationale was that we wanted participants to extend this learning beyond the course. Therefore, we further encouraged them to present their radiation therapy projects to interdisciplinary staff at their places of employment, and to submit an abstract to a local, provincial or national cancer care nursing conference.

2.5 Evaluation

The evaluation was based on two sequential sessions of the course that took place November 2011 and May 2012. As this course was newly developed and used new technology, we wanted to evaluate data from two groups to not only have a larger pool of participants but also to compare group changes, impressions of the virtual ACs, and participant feedback to make modifications to improve the course. The main objectives of the evaluation were: (1) to examine if there was an increase in participant confidence levels in knowledge pertaining to radiation therapy at post course from baseline; (2) to obtain participant assessment of the new technology, the virtual AC guides; and (3) to elicit participant feedback of the overall course, and areas of improvement. A pre/post group design was used to evaluate confidence levels in knowledge of 12 learning objectives. The questionnaires were adapted from previously developed standardized measures, and reviewed by research team members, and the lead educator for content validity.

Participant baseline characteristics included both groups of participants. Paired-sample *t* test was used to examine a change in confidence of radiation therapy knowledge post course from baseline. Significance level was set at $p < .05$. The 12 domains (see Table 1) were ranked using a Likert scale: 1, not confident at all; 2, not very confident; 3, somewhat confident; and 4, very confident. Participants were also asked to respond to eight measurement items using a five point Likert scale that assessed if the newly created virtual ACs facilitated individual uptake of learning (see Table 5). Open ended questions at post-course were used to obtain participant feedback of the course overall and suggested areas of improvement.

Table 5. Virtual animated characters measurement items

Likert scale: 1. <i>strongly disagree</i> ; 2. <i>disagree</i> ; 3. <i>neutral</i> ; 4. <i>agree</i> ; and 5. <i>strongly agree</i>	
1)	The ACs seemed real and made me feel connected, which enhanced learning of radiation oncology
2)	The ACs were clear and easy to understand
3)	The ACs focused my attention on the material and topic at hand
4)	The ACs drew attention to important points and made the content more lively and engaging
5)	The ACs summarized information ensuring that the basic concepts were understood
6)	The ACs were an innovative learning tool for introducing new concepts and/or reinforcing learned content
7)	The ACs simulated an interactive face to face style of teaching that increase content engagement and retention
8)	Overall, this teaching style was an effective way to learn

3. RESULTS

A total of 51 nurses enrolled in two sessions of the radiation therapy course: Group A (n = 29), Group B (n = 22) (see Table 6). Thirty six participants completed both pre/post questionnaires for a response rate of 71%. All participants were female. Sixty-seven percent of participants were over the age of 40 years. Approximately 65% of participants primarily cared for oncology patients and just over 80% were frontline staff working in direct patient care delivery. Over half (53%) of participants indicated they had “some” or “a lot” of experience in radiation oncology. In Group A (n = 17), statistically significant improvements were identified at post-test (from baseline) in self-perceived confidence levels in knowledge for 11 radiation therapy domains ($p < .05$) except one domain, “the nurses role related to assessment, patient education, and symptom management” ($p = .055$). In Group B (n = 19), statistically significant improvements were identified at post-test for all radiation therapy domains ($p < .05$) (see Table 7).

3.1 Measures assessing virtual ACs

Overall, virtual AC ratings of the eight measurement items were similar: Group A scores ranged from 4.4 to 4.6 out of 5; and Group B scores ranged from 4 to 4.5 out of 5 (see Table 5). These scores represent that the virtual ACs were an acceptable method to facilitate learning for the participants in the two sessions of the course. The open ended feedback provided by participants of the virtual ACs were overall very positive (81%, 42/50 written responses). Participants stated that they were: simple and easy to use, realistic, interesting, engaging, a good way to break up content, reinforced learning material, and an excellent teaching and learning tool. This is an important finding given that 65% of participants reported no prior exposure to virtual ACs in past continuing education learning environments. Fewer participants (20%, 8/50 written responses) wrote comments that were unfavorable towards the virtual ACs, for example, two participants found them irritating/annoying, two preferred a

live facilitator, and one preferred to read text.

3.2 Overall course feedback

Participants provided positive open-ended feedback on the course overall, commenting on the flexibility and accessibility of learning online, the interactivity of eLearning modules, and the resources provided. Discussion forums were an aspect of the course that participants highly favored. Sharing experiences, client situations and additional contextual issues of practice were important aspects of learning. Participants were able to connect with and learn from others through reading posted responses, sharing of information and through interaction during the full day face-to-face symposium. The project assignment was also valued by most participants as they gained skills in project development by working through each phase, developing a presentation, and presenting to peers on symposium day, and later to peers at their places of employment.

One suggested area of improvement included a longer timeframe to help manage workload, unit readings, and project preparation. Participants who enjoyed the interactivities requested more to be added to the eLearning modules. Additionally, participants suggested process and technological improvements including more guidance with abstract and presentation components, and increasing virtual library holdings as some articles were not readily available and nurses had to access them elsewhere. Participants also recommended the development of a mock simulation to understand the patient journey from the initial radiation therapy consultation to the completion of treatment. As well, the interactivities and dialogue segments with virtual ACs within Moodle[®] posed a number of technological challenges for some participants. Individual computer system capabilities were issues identified. Slow upload of interactivities was one issue. Another issue reported by one participant was that the audio for a segment with the virtual ACs was not adequate to properly hear dialogue despite efforts to help troubleshoot technological concerns.

Table 6. Participant characteristics

Course Sessions	n	(%)	Gender	n	(%)
Group A: November 2011	29	56.9	Female	51	100
Group B: May 2012	22	43.1	Male	0	
Total					
Age in years	n	(%)	Completed Education	n	(%)
<29	11	21.6	Registered Practical Nurse	2	3.9
30-39	6	11.8	RN (diploma)	21	41.2
40-49	17	33.3	RN (degree)	23	45.1
50-59	15	29.4	Masters	4	7.8
60+	2	3.9	Other	1	2.0
Total	51	100	Total	51	100
Primary Functional Area	n	(%)	Experience with Radiation therapy patients	n	(%)
Direct patient care	41	80.4	No experience	5	9.8
Patient education	1	2.0	Minimal experience (6 months- 2 years)	19	37.3
Nursing education	5	9.8	Some experience (2-5 years)	13	25.5
Other	4	7.8	A lot of experience (more than 5 years)	14	27.5
Total	51	100			
Clinical Setting*	n	(%)	Experience with virtual characters	n	(%)
Cancer center, ambulatory	28	54.9	Yes	18	35.3
Cancer center, inpatient	15	29.4	No	33	64.7
Diagnostic assessment unit	1	2.0			
General hospital, ambulatory	4	7.8			
General hospital, inpatient	10	19.6			
Primary care/Family Health Team	1	2.0			
Community agency	4	7.8			
Home care or Long Term Care	6	11.8			
Hospice Palliative Care	6	11.8			
University/College	4	7.8			
Clinical setting [other]	2	3.9			

* Totals for clinical settings do not add to 100% as participants selected more than one option

Table 7. Descriptive statistics: Pre vs. post confidence levels

Pre-Post Design	Course Time	Mean	Std. Deviation	N
Base-total	November 2011	28.31	9.37	16
	May 2012	34.26	7.82	19
	Total	31.54	8.95	35
Post-total	November 2011	45.06	2.23	16
	May 2012	45.26	2.53	19
	Total	45.17	2.37	35

4. DISCUSSION

A novel blended learning course enhanced confidence in knowledge of radiation therapy domains among nurses caring for patients diagnosed with cancer. For the last domain of the nurse's role in assessment, education and symptom management, Group A had no change in scores. Given that the nurse's role in radiation therapy is diverse including the complexity of emerging evidence-based treatment protocols,^[3] this was interesting. Perhaps, Group A nurses' confidence levels in knowledge of their role did not differ because these attributes were perceived to be general competency requirements in oncology or general nursing practice. Nonetheless, the improved confidence in knowledge was important

to support continuing education. The course was flexible, and self-paced within a planned timeframe to accommodate work scheduling, and drew on a variety of learning strategies to meet individual learning needs, similar to findings of eLearning education reported in other studies.^[13,24-26] These insights reinforce the feasibility of providing blended learning continuing education to nurses from diverse backgrounds working with patients undergoing cancer treatment. Oncology nurses have reported that online access to continuing education is a good vehicle for learning.^[27]

The necessity to partake in continuing education is important as is online access for nurses as it not only meets professional

requirement to practice safely, but also meets a recognized need to assist patients or answer their questions.^[27] Despite the fact that nurses may report high levels of knowledge in a particular area of practice, such as attending to the emotional aspects of cancer, nurses continue to be very interested in learning opportunities as demonstrated in a large study assessing educational needs and preferred methods among oncology nurses.^[27] Equally important, is the need for nurses to maintain competence, particularly when care is being provided to patients who may have/or are in the process of undergoing radiation therapy.^[28,29] For nurses who aspire to achieve more advanced specialization in oncology nursing, continuing education is as valuable as the years of experience in oncology to be certified.^[29] This type of qualification is highly regarded and recognized nationally in Canada. In fact, our radiation therapy course was used to not only gain knowledge for practice but also for credit towards a certification from the institute, as well as continuing education hours for eligibility to write the oncology certification exam. Similar certification designations also exist for oncology nurses in other countries, such as the Oncology Certified Nurse (OCN) available to nurses in the US, or internationally.^[30] Online learning will continue to grow in popularity as it presents a feasible and accessible option for more nurses in practice.^[27]

Overall, the majority of participants viewed the virtual ACs positively, while a few participants did not particularly like them. This may reflect that many nurses were more comfortable or open to newer technologies. Nurses with greater comfort with using computers and technology perceived greater confidence and reported positive feedback related to online learning.^[13,31] Barriers to online learning may include lack of computer skills or access, or time to complete all required coursework.^[32] Possibly, for some participants, the disagreeable aspects of the virtual ACs reflected generational differences in learning styles given that some preferred to read text or have a live facilitator rather than listen to content delivered by virtual ACs. Preference for lecture format has been reported elsewhere.^[33] However, the majority of participants were over 40 years of age, and for some who had never taken an eLearning course, they were very enthusiastic about the new technology (virtual ACs), and interactivities. In developing blended learning courses, educators should acknowledge that some nurses still prefer live facilitation. Perhaps, to meet the needs of different nurse learners, an alternative option may be to record short presentations developed by live facilitators and imbed them into the eLearning modules.

The collaborative discussion forums facilitated learning and asynchronous peer interaction within a learning community. Nurses with diverse experience and many years in oncology

practice provided valuable advice and feedback to those with less experience. The majority of participants stated that they valued the interaction on the discussion forums. Similar findings have been reported elsewhere among nurses and other health care professionals working in cancer care, such as social workers, psychological and spiritual care staff, and medicine.^[20,34,35] Discussion forms simulate conversations that would normally occur in person. Therefore, educators should attempt to integrate activities that foster active discussion when developing online courses.

Multi-media applications and virtual ACs dialogue posed challenges for some participants. This is consistent with findings reported elsewhere related to virtual technology^[21] and other online courses where internet or computer access were common issues with uploading content from eLearning.^[31] These findings are useful to nurse educators who would like to develop online learning as the reality of technological issues will likely persist given that participants will have different systems, and varied internet access depending on their geographical location. Strategies to deal with some of these issues includes providing trouble-shooting instructions at the outset of a course, or providing alternative access such as scripts for virtual ACs dialogue for slow uploads.

Limitations and future evaluation

The evaluation was limited to pre/post-test confidence levels in knowledge gained on radiation therapy from two sessions of the blended learning course. Given that radiation therapy is a specialty in oncology practice, participant numbers were lower than with other eLearning courses despite the participation of nurses working in other non-oncology settings. One limitation of the evaluation was that there was no cohort group for comparison; however, this was not feasible for the virtual center of learning. The main purpose of the virtual center of learning was to provide continuing education to support nurses to learn about radiation therapy, assess confidence levels and the newly developed virtual AC guides, and make improvements based on participant feedback. While content was focused on aspects of knowledge that aimed to increase participants' ability to meet patient needs, we were unable to establish if they integrated the learning within their practice settings because there was no follow-up. Therefore, we were not able to assess if these confidence levels increased patient satisfaction with having their needs met. However, it is acknowledged that among health care professionals, nurses play an important role in meeting the information needs of patients.^[36] Perhaps, their increased confidence in understanding radiation therapy can make inroads to improving the provision of information rather than direct a patient to another health care provider. Nevertheless,

nurses are responsible for basing their nursing care on best practices to maintain competence, and continuing education presents a mechanism to fulfill this responsibility. Future evaluation might be best carried out by evaluating patient related outcomes of those cared for by nurses engaged in continuing education, such as this radiation therapy course.

5. CONCLUSION

The increasing use of radiation therapy in cancer care will require nurses to be knowledgeable and up-to-date on radiation therapy and treatment protocols in order to meet the needs of patients in cancer care. A novel blended learning model of continuing education for radiation therapy provided an opportunity to enhance knowledge for those who took the course. The benefits of eLearning for nurses included the convenience and flexibility to complete the course at their own pace presenting a feasible alternative to incorporate with work schedules. Positive assessment related to the virtual AC guides was of value in assessing the acceptability of this new technology for future development of eLearning courses for nurses who work with patients diagnosed with cancer. Discussion forms are also of significant value for interactive sharing of experiences and learning. During

course development, strategies need to be in place to deal with different technological issues before they occur. In our program, difficulties uploading multi-media inter-activities and audio quality of virtual ACs dialogue were experienced by some participants. To deal with these issues, we provided individualized support, troubleshooting strategies, and alternative resources for audio issues such as printed transcripts of virtual ACs dialogue. Future evaluation could extend knowledge of the outcomes of this blended learning course by examining whether nurses' confidence in knowledge translated into practice, and improved the information and education needs of patients diagnosed with cancer.

ACKNOWLEDGEMENTS

The Radiation therapy course is offered by the deSouza Institute, a virtual center of learning promoting excellence in cancer care. We would like to acknowledge and thank nurses and other health care providers who have and continue to participate in the course.

CONFLICTS OF INTEREST DISCLOSURE

The authors declare that there is no conflict of interest statement.

REFERENCES

- [1] Ruppert R. Radiation therapy 101: What you need to know to help cancer patients understand their treatment and cope with side effects. *American Nurse Today*. 2011; 6(1). Available from: <http://www.americannursetoday.com/article.aspx?id=7400>
- [2] Moore-Higgs GJ, Watkins-Bruner D, Balmer L, *et al*. The role of the licensed nursing personnel in radiation oncology part A: Results of a descriptive study. *Oncology Nursing Forum*. 2003a; 30(1): 51-58. <http://dx.doi.org/10.1188/03.ONF.51-58>
- [3] Gosselin-Acomb TK. Role of the radiation oncology nurse. *Seminars in Oncology Nursing*. 2006; 22(4): 198-202. <http://dx.doi.org/10.1016/j.soncn.2006.07.001>
- [4] Bruner DW. Report on the radiation oncology nursing sub-committee of the American College of Radiology Task Force on Standards Development. *Oncology*. 1990; 4(8): 80-81. PMID:2145014
- [5] Moore-Higgs GJ, Watkins-Bruner D, Balmer L, *et al*. The role of the licensed nursing personnel in radiation oncology part B: Integrating the ambulatory care nursing conceptual framework. *Oncology Nursing Forum*. 2003b; 30(1): 59-64. PMID:12515984
- [6] Quinn A. Expanding the role of the oncology nurse. *Biomedical Imaging and Intervention Journal*. 2008; 4(3): e34. <http://dx.doi.org/10.2349/bijj.4.3.e34>
- [7] Watkins BD, Haas ML, Gosselin-Acomb TK. *Manual for radiation oncology nursing practice and education (3rd Ed.)*. Oncology Nursing Society: Pittsburgh, PA. 2011.
- [8] Poirier P. Nursing-led management of side effects of radiation: Evidence-based recommendations for practice. *Nursing: Research and Reviews*. 2013; 3: 47-57. <http://dx.doi.org/10.2147/NRR.S34112>
- [9] Halkett GKB, Kristjanson LJ, Lobb E, *et al*. Information needs and preferences of women as they proceed through radiotherapy for breast cancer. *Patient Education and Counseling*. 2012; 86: 396-404. <http://dx.doi.org/10.1016/j.pec.2011.05.010>
- [10] Nijman JL, Sizma H, van Triest B, *et al*. The quality of radiation care: The results of focus group interviews and concept mapping to explore the patient's perspective. *Radiotherapy and Oncology*. 2012; 102: 154-160. <http://dx.doi.org/10.1016/j.radonc.2011.08.005>
- [11] Rennie H, Mackenzie G. The psychosocial oncology learning assessment: A province-wide survey of cancer care providers learning needs. *Journal of Cancer Education*. 2010; 25: 206-210. <http://dx.doi.org/10.1007/s13187-010-0112-z>
- [12] Jemal A, Bray F, Center MM, *et al*. Global cancer statistics. *CA: A Cancer Journal for Clinicians*. 2011; 61(2): 69-91. <http://dx.doi.org/10.3322/caac.20107>
- [13] Karaman S. Nurses' perceptions of online continuing education. *BMC Medical Education*. 2011; 11: 86. PMID:22013974 <http://dx.doi.org/10.1186/1472-6920-11-86>
- [14] Oncology Nursing Society. ONS/ONCC Radiation Therapy Certificate Course. 2015. Available from: <https://www.ons.org/content/onsoncc-radiation-therapy-certificate-course>
- [15] Codebaby®. Engage your customers when it matters most. 2015. Available from: <http://codebaby.com/>
- [16] Moodle. Community driven, globally supported. 2015. Available from: <https://moodle.org/about/>
- [17] Knowles MS. *The modern practice of adult education: From pedagogy to andragogy*. Cambridge, NY: Cambridge Adult Education. 1980.

- [18] Reeves B. The benefits of interactive online characters. Center for the study of language and information, Stanford University. 2004. Available from: http://www.sitepal.com/pdf/casestudy/Stanford_University_avatar_case_study.pdf
- [19] Wood A, McPhee C. Establishing a virtual learning environment: A nursing experience. *Journal of Continuing Education in Nursing*. 2011; 42(11): 510-415. PMID:21780735 <http://dx.doi.org/10.3928/00220124-20110715-01>
- [20] Schmidt B, Stewart S. Implementing the virtual reality learning environment: Second Life. *Nurse Educator*. 2009; 34(4): 152-155. PMID:19574850 <http://dx.doi.org/10.1097/NNE.0b013e3181aabb8>
- [21] Wiecha J, Heyden R, Sternthal E, *et al.* Learning in a virtual world: Experience with using Second Life for Medical Education. *Journal of Medical Internet Research*. 2010; 12(1): e1. <http://dx.doi.org/10.2196/jmir.1337>
- [22] Articulate®. Meet storyline 2. 2015. Available from: <https://www.articulate.com/>
- [23] Raptivity®. Rapid interactivity for effective learning. 2015. Available from: <http://www.raptivity.com/>
- [24] Diaz LA, Entonado FB. Are the functions of teachers in e-Learning and face-to-face learning environments really different. *Educational Technology & Society*. 2009; 12 (4): 331-343. Available from: <http://www.ifets.info>
- [25] Glogowska M, Young P, Lockyer L, *et al.* How blended is blended learning: Students perceptions of issues around integration of online and face-to-face learning in a continuing professional development health care context. *Nurse Education Today*. 2011; 31: 887-891. <http://dx.doi.org/10.1016/j.nedt.2011.02.003>
- [26] Heidari F, Galvin K. The role of open learning in nurse education. Does it have a place? *Nurse Education Today*. 2002; 22: 617-623. [http://dx.doi.org/10.1016/S0260-6917\(02\)00133-8](http://dx.doi.org/10.1016/S0260-6917(02)00133-8)
- [27] Klemp JR, Frazier LM, Glennon C, *et al.* Improving cancer survivorship care: oncology nurses' educational needs and preferred methods of learning. *Journal of Cancer Education*. 2011; 26: 234-242. <http://dx.doi.org/10.1007/s13187-011-0193-3>
- [28] College of Nurses. Professional standards. 2003. Available from: <http://www.cno.org/learn-about-standards-guidelines/standards-and-guidelines/>
- [29] Canadian Nurses Association. Available from Canadian Nurses Association. *Oncology Nursing*. 2015. Available from: <http://nurseone.ca/en/certification/what-is-certification/competencies-per-specialty-area/oncology-nursing>
- [30] Oncology Nursing Certification Corporation. Certifications. *Oncology Certified Nurse*. 2015. Available from: <http://www.oncc.org/certifications/oncology-certified-nurse-ocn>
- [31] Smart KL, Cappel JJ. Students' perceptions of online learning: A comparative study. *Journal of Information Technology Education*. 2006; 5: 201-219. Available from: <http://informingscience.org/jite/documents/Vol15/v5p201-219Smart54.pdf>
- [32] Gerkin KL, Taylor TH, Weatherby FM. The perception of learning and satisfaction of nurses in the online environment. *Journal for Nurses in Staff Development*. 2009; 25(1): E8-E12. <http://dx.doi.org/10.1097/NND.0b013e318194b6a4>
- [33] Pilcher JW, Bedford L. Willingness and preferences of nurses related to learning with technology. *Journal of Staff Development*. 2011; 27(3): E10-E16. <http://dx.doi.org/10.1097/NND.0b013e318217b447>
- [34] Atack, L, Rankin J. A descriptive study of registered nurses' experiences with web-based learning. *Journal of Advanced Nursing*. 2002; 40(4): 457-465. <http://dx.doi.org/10.1046/j.1365-2648.2002.02394.x/pdf>
- [35] McLeod DL, Curran J, White M. Interprofessional psychosocial oncology education: Nurse outcomes of the IPODE project. *Psycho-Oncology*. 2011; 5: 109-115. <http://dx.doi.org/10.1007/s11839-011-0318-2>
- [36] Finney Rutten LJ, Arora NK, Bakos AD, *et al.* Information needs and sources of information among cancer patients: A systematic review of research (1980-2003). *Patient Education and Counseling*. 2005; 57: 250-261. <http://dx.doi.org/10.1016/j.pec.2004.06.006>