ORIGINAL ARTICLE

ANZJSurg.com

Improving the impact of didactic resident training with online spaced education

David E. Gyorki,* Tim Shaw,† James Nicholson,† Caroline Baker,‡ Meron Pitcher,§ Anita Skandarajah,¶**†† Eva Segelov‡‡§§ and G. Bruce Mann¶**††

*Department of Cancer Surgery, Peter MacCallum Cancer Centre, East Melbourne, Victoria, Australia
†The University of Sydney, Sydney, New South Wales, Australia
‡Austin Health, Heidelberg, Victoria, Australia
§Western Hospital, Sunshine, Victoria, Australia
¶Department of Surgery, The Royal Melbourne Hospital, Parkville, Victoria, Australia
**The Breast Service, Royal Women's Hospital, Parkville, Victoria, Australia
††The University of Melbourne, Parkville, Victoria, Australia
‡‡St Vincent's Hospital, Sydney, New South Wales, Australia and
§§University of New South Wales, Sydney, New South Wales, Australia

Key words
continuing medical education, online learning, spaced education, surgery.

Correspondence
Professor G. Bruce Mann, Royal Melbourne and Royal Women's Hospital, Parkville, Vic. 3052, Australia.
Email: bruce.mann@mh.org.au

D. E. Gyorki MBBS, MD; **T. Shaw** PhD; **J. Nicholson** Btech; **C. Baker** MBBS; **M. Pitcher** MBBS; **A. Skandarajah** MBBS, MD; **E. Segelov** MBBS, PhD; **G. B. Mann** MBBS, PhD.

This paper was presented at the Royal Australasian College of Surgeons Annual Scientific Meeting Congress, Kuala Lumpur, 8 May 2012.

Accepted for publication 7 March 2013.

doi: 10.1111/ans.12166

Abstract

Background: Educational programmes are frequently developed to improve the knowledge of medical trainees. The impact of a programme may be limited if there is no follow-up to reinforce the message. Online Spaced Education (SE) has been developed to address this limitation. This study was performed to assess whether an SE programme would improve the impact of a didactic seminar.

Method: A randomized trial of an online SE programme occurred as part of the 2010 Clinical Oncology Society of Australia Breast Cancer Trainee Workshop. Consenting participants were randomized to undertake SE or not and were then invited to undertake a 22-question knowledge test. A questionnaire was administered relating to the perceived value of the SE programme. Participants consisted largely of surgical and medical oncology trainees.

Results: Two hundred people attended the workshop and 97 consented to randomization. Thirty-eight of 49 randomized to the SE group commenced the SE course. Seventy-one percent of participants answered each question at least once and 55% of participants completed the entire programme. Fifty-nine participants completed the post-test. The SE participants performed significantly better than the control group ($P < 0.05$). The questionnaire was completed by 26 of the SE group. Ninety-two percent strongly agreed or agreed that SE would improve their practice and 96% agreed that SE effectively reinforced key aspects of workshop.

Conclusion: This study demonstrates the utility of SE to increase knowledge retention following a face-to-face workshop. The programme was very well received by the participants and may be an appropriate reinforcing methodology for other similar seminars.

Introduction

Residency training involves a combination of hands-on mentored teaching interspersed with discrete didactic events such as lectures and seminars. Increasingly, these activities are being included in the core curriculum for many training programmes and considerable time is being invested by faculty in their construction and delivery. Despite this, multiple studies over decades have only demonstrated a modest impact on knowledge and behaviour from attending didactic programmes.[1–6]

A number of recent studies indicate that blended programmes that combine face-to-face activities with online learning activities can be more effective than either intervention alone.[7–10] This raises the possibility that the impact of traditional didactic programmes for

medical trainees can be enhanced through the addition of adjunct online programmes.

Spaced Education (SE) is a novel form of online learning that has been demonstrated to increase knowledge retention and impact on behaviour.[11–13] In addition, SE has been demonstrated to enhance the impact of face-to-face continuing medical education programmes developed for primary care clinicians in the United States.[12,13] SE involves participants receiving short multiple-choice questions and feedback via e-mail in a repeating pattern over a number of weeks. The methodology is based on the spacing and testing effects. The *spacing effect* refers to the finding that educational encounters that are repeated over time increase the acquisition and retention of knowledge.[14] The *testing effect* refers to the finding that the process of testing does not only measure knowledge, but alters the learning process itself to improve knowledge retention.[15,16] Each *spaced education item* consists of an evaluative component (a clinically relevant multiple-choice question) and an educational component (the correct answer and a brief explanation of the answer). Participants submit an answer, receive immediate feedback about the rationale for the correct answer as well as a summary of the performance of their peers. The item is repeated over intervals of time ranging from 1 to 12 weeks. An adaptive algorithm tailors the length of the spacing intervals and number of repetitions of the content for each learner based on his or her performance. Each question must be answered correctly twice to be retired. In a randomized trial, this adaptive algorithm was found to increase learning efficiency by more than 35%.[17]

The primary aim of this study was to assess whether an SE programme could improve the impact on resident knowledge of a discrete didactic seminar on the multidisciplinary management of breast cancer. The secondary aim was to assess the acceptability of this form of teaching to residents.

Methods

Participants

Participants in the Clinical Oncology Society of Australia weekend seminar, titled 'Everything you need to know about breast cancer', were invited to participate in the study. Participation in both the weekend seminar and the study was voluntary, with attendees having to opt in to the programme. There was a modest cost involved to attend the seminar, but no added cost to participate in the study. Attendance and participation was open to residents in general surgery, medical oncology and radiation oncology from Australia and New Zealand.

Development of spaced education items

A multidisciplinary team of clinicians with expertise in the management of breast cancer and educators devised a bank of 34 case scenarios, each with associated multiple-choice questions. Questions were related to all aspects of breast cancer therapy including surgery, chemotherapy, endocrine therapy, radiation oncology, supportive care and cancer genetics. The multiple-choice questions included multiple potential correct answers in order to minimize the chance of answering the question correctly by chance. Each question also included short, focussed feedback and links to further references. Development of the question bank took one face-to-face meeting to define key learning points and an additional 3–4 h of time from each of the four senior faculties to produce questions supported by an educational developer. Question writing was led by a senior surgical registrar.

Study design and organization

The study design is demonstrated in Figure 1. Participants were randomized to either the SE group or a control group (using the Research Randomizer software, version 3.0, http://www.randomizer.org). The SE group received three case scenarios by email every 2 days. Immediate feedback was given after an answer was submitted. If a question was answered correctly, it would be repeated after a 20-day interval and if answered incorrectly, after an 8-day interval. When a question was answered correctly on two successive occasions, the question became retired. The course was completed after 80% of questions were retired. The emailing of participants was fully automated using publically available online software (http://www.app.qstream.com). All participants in the control group received the bank of SE questions after completing the post-test so none was disadvantaged.

Post-test

Three months following commencement of the SE programme, participants completed an online post-test developed by the multidisciplinary team. The post-test consisted of 22 questions. Thirteen questions were matched to questions covering a similar topic in the SE question bank and nine questions were unmatched, covering an aspect of the seminar that was not covered in the SE programme.

Completion survey

All participants were asked to complete a feedback survey following the post-test to assess the acceptability and perceived benefit of the

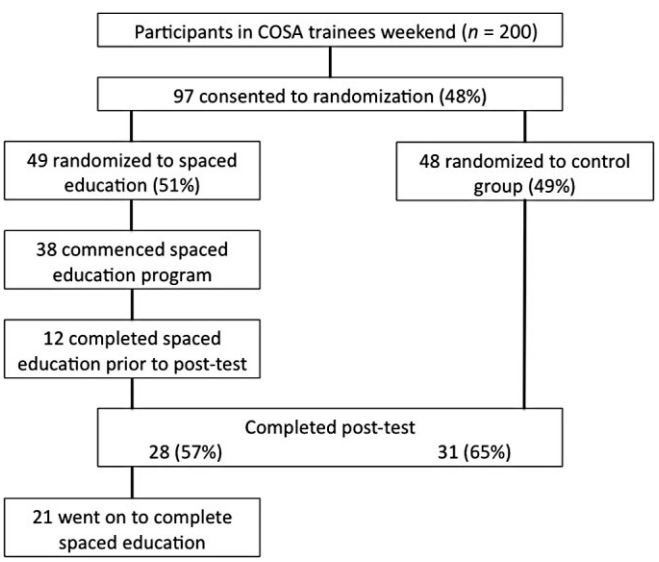

Fig. 1. Consolidated Standards of Reporting Trials flow chart of randomized controlled trial. COSA, Clinical Oncology Society of Australia.

Table 1 Survey response at completion of study using a 5-point Lkert scale

Survey Questions	Mean score (/5)
I believe the Spaced Education course will improve how I practice with regard to breast cancer treatment.	4.1
The Spaced Education course was effective as a method to learn or reinforce key aspects of breast cancer treatment.	4.3
The Spaced Education course was effective as a method to reinforce key aspects of the two-day Clinical Oncology Society of Australia Breast Cancer Workshop in November 2010.	4.3
I found the Spaced Education course engaging and enjoyable.	4.3
I would be happy to undertake other health-related programmes if offered in the Spaced Education format.	4.3

Table 2 Demographic details for participants in Spaced Education (SE) programme

	Spaced Education	%	Control	%
Fellow	4	8	0	0
Registrar	40	82	41	86
Junior resident	3	6	4	8
Other	2	4	3	6
Total	49	100	48	100

programme (Table 1). Statements were answered using a 5-point Likert scale ranging from strongly agree to strongly disagree.

Statistical analysis

Statistical analysis was performed using Microsoft Excel version 12.2.9 (Microsoft Corp., Redmond, WA, USA). One-tailed *t*-test was used to compare the results for the two study groups and subsequent post-hoc subgroup analysis. A *P* value threshold of 0.05 was used for determining significance.

Results

A total of 97 residents consented to participate in the study out of 200 participants in the weekend seminar. Forty-nine were randomized to the SE group and 48 to the control group.

The level of training of participants is shown in Table 2. Randomization was effective and the groups were well matched. The large majority of residents were at senior resident level, and therefore, in an accredited training programme.

Of the 49 residents randomized to the SE group, 38 (76%) actually started the programme. Of these, 21 (43%) completed the SE programme (retired 80% of questions). Twelve (24%) had completed the programme prior to undertaking the post-test. The remaining nine completed the SE questions after having participated in the post-test. Seventy-one percent of participants saw each question at least once prior to completing the post-test.

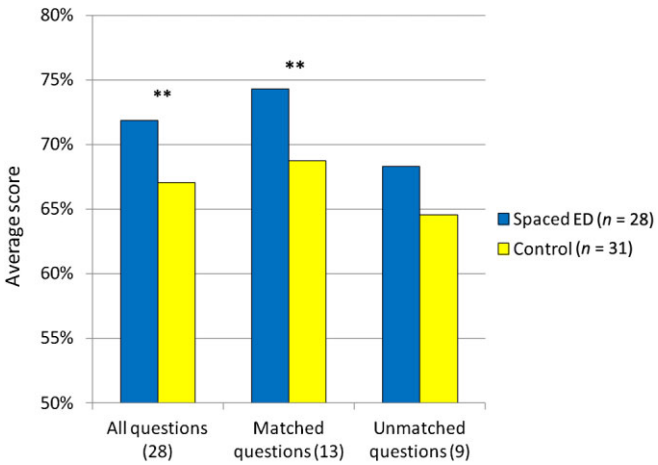

Fig. 2. Post-test results for matched and unmatched questions. (** indicates $P < 0.05$).

Fifty-nine trainees (61%) completed the post-test. A greater proportion of the control group completed the post-test compared with the SE group (65 versus 57%).

The residents randomized to the SE group had a significantly higher post-test score than the control group (72 versus 67%, $P = 0.03$) (Fig. 2). This difference applied only to the questions that were 'matched' to the SE programme (74 versus 69%, $P = 0.02$) and not to the unmatched questions (68 versus 65%, $P = 0.14$). The highest scores (76%) were seen in the subgroup of participants who had completed all questions but were not significantly better than the remainder of the SE group ($P = 0.3$).

The completion survey showed that the SE programme was very well accepted by the residents (Table 1), with 93–100% of participants agreeing or strongly agreeing with all questions. The mean score was 4.3/5 for questions relating to acceptability and enjoyment and the same score was given for residents' desire to undertake other programmes using the SE format.

Discussion

This study demonstrates that participation in an SE programme can reinforce the knowledge acquired by medical residents following a face-to-face didactic seminar. The results also indicate that SE was perceived by residents as an effective and enjoyable learning methodology that was likely to impact on their practice.

Although SE completion rates are relatively low, with only 55.3% completing the course, our results are in line with completion rates of other comparable publications.[8,12,13,18] The studies with the highest completion rates are those which are specifically goal directed.[11,19] In the study by Kerfoot *et al.*, urology residents were randomized to SE in preparation for Urology In-Service examination. They observed completion rates of 74%.[19] The majority of participants in the current study were not specifically preparing for an examination related to the contents of the seminar. The authors hypothesize that the presence of a specific incentive may encourage higher rates of completion of SE courses.

A participation incentive may have also led to a higher enrolment rate; the authors were somewhat surprised that only 48% of partici-

pants in the seminar enrolled in the SE course. This is despite trainees paying and giving of their free time to attend the seminar. A further 22% of trainees randomized to the SE arm did not start the course. The reason for this low commencement rate is unclear. Trainees in residency programmes are a time-poor group and prioritize their obligations accordingly, for many participating in an SE programme may not be a high priority. Alternatively, the study itself may have been a disincentive, as the participants were not provided with evidence that the course would be beneficial. This low commencement and completion rate are important considerations when planning further such programmes.

The results of this study are in line with other studies that demonstrate that SE improves knowledge retention. While the quantum of improvement is less than that of some other previous SE publications,[19] this may be due to fact that this study followed an existing face-to-face programme and that the subject area covered was extremely broad and covered multiple specialities. Given that participation in this study was voluntary, an intention to treat analysis was not able to be performed; however, such an evaluation may have demonstrated a reduced benefit of the programme.

The results support the growing body of evidence that blended online and face-to-face education has a greater impact on learning than either intervention alone.[8] The authors were unable to find other studies that specifically describe the use of online programmes to enhance the impact of face-to-face postgraduate medical education, but this study supports the finding that SE can improve the impact of didactic education delivered to primary care clinicians.[12,13]

Strengths of this study include the significant number of residents and their randomization. Limitations of this study include the fact that residents did not complete a pre-test to assess their baseline knowledge. This may have provided more insight into the specific improvement associated with SE. Further research is needed to investigate the impact of adjunct online programmes on clinicians' behaviour, to improve completion rates and to assess the impact of SE on the retention of knowledge over time.

This is one of only a small number of studies that demonstrates SE to be a well-accepted methodology to enhance vocational medical training. Given the effort required to produce and run such a face-to-face training programme, consideration should be given to integrating SE into the delivery of future training seminars to achieve maximal impact.

References

1. FitzGerald JD, Wenger NS. Didactic teaching conferences for IM residents: who attends, and is attendance related to medical certifying examination scores? *Acad. Med.* 2003; **78**: 84–9.
2. Pollak R, Baker RJ. The acquisition of factual knowledge and the role of the didactic conference in a surgical residency program. *Am. Surg.* 1988; **54**: 531–4.
3. Winter RO, Picciano A, Birnberg B *et al*. Resident knowledge acquisition during a block conference series. *Fam. Med.* 2007; **39**: 498–503.
4. Cacamese SM, Eubank KJ, Hebert RS, Wright SM. Conference attendance and performance on the in-training examination in internal medicine. *Med. Teach.* 2004; **26**: 640–4.
5. Davis D, O'Brien MA, Freemantle N, Wolf FM, Mazmanian P, Taylor-Vaisey A. Impact of formal continuing medical education: do conferences, workshops, rounds, and other traditional continuing education activities change physician behavior or health care outcomes? *JAMA* 1999; **282**: 867–74.
6. Forsetlund L, Bjorndal A, Rashidian A *et al*. Continuing education meetings and workshops: effects on professional practice and health care outcomes. *Cochrane Database Syst. Rev.* 2009; (2): CD003030.
7. Kerfoot BP, Fu Y, Baker H, Connelly D, Ritchey ML, Genega EM. Online spaced education generates transfer and improves long-term retention of diagnostic skills: a randomized controlled trial. *J. Am. Coll. Surg.* 2010; **211**: 331–7 e1.
8. Means B, Toyama Y, Murphy R, Bakia M, Jones K. *Evaluation of Evidence-Based Practices in Online Learning: A Meta-Analysis and Review of Online Learning Studies*. In: US Department of Education OoP, Evaluation and Policy Development (ed.). Washington DC: US Dept of Education, 2009.
9. Kerfoot BP, Lawler EV, Sokolovskaya G, Gagnon D, Conlin PR. Durable improvements in prostate cancer screening from online spaced education a randomized controlled trial. *Am. J. Prev. Med.* 2010; **39**: 472–8.
10. Matzie KA, Kerfoot BP, Hafler JP, Breen EM. Spaced education improves the feedback that surgical residents give to medical students: a randomized trial. *Am. J. Surg.* 2009; **197**: 252–7.
11. Kerfoot BP, Kearney MC, Connelly D, Ritchey ML. Interactive spaced education to assess and improve knowledge of clinical practice guidelines: a randomized controlled trial. *Ann. Surg.* 2009; **249**: 744–9.
12. Long A, Kerfoot BP, Chopra S, Shaw T. Online spaced education to supplement live courses. *Med. Educ.* 2010; **44**: 519–20.
13. Shaw T, Long A, Chopra S, Kerfoot BP. Impact on clinical behavior of face-to-face continuing medical education blended with online spaced education: a randomized controlled trial. *J. Contin. Educ. Health Prof.* 2011; **31**: 103–8.
14. Pashler H, Rohrer D, Cepeda NJ, Carpenter SK. Enhancing learning and retarding forgetting: choices and consequences. *Psychon. Bull. Rev.* 2007; **14**: 187–93.
15. Karpicke JD, Roediger HL 3rd. The critical importance of retrieval for learning. *Science* 2008; **319**: 966–8.
16. Larsen DP, Butler AC, Roediger HL 3rd. Test-enhanced learning in medical education. *Med. Educ.* 2008; **42**: 959–66.
17. Kerfoot BP. Adaptive spaced education improves learning efficiency: a randomized controlled trial. *J. Urol.* 2010; **183**: 678–81.
18. Kerfoot BP. Learning benefits of on-line spaced education persist for 2 years. *J. Urol.* 2009; **181**: 2671–3.
19. Kerfoot BP, Baker HE, Koch MO, Connelly D, Joseph DB, Ritchey ML. Randomized, controlled trial of spaced education to urology residents in the United States and Canada. *J. Urol.* 2007; **177**: 1481–7.