Health Education in Practice: Journal of Research for Professional Learning

Vol. 1 | No. 1 | 2018

Citation: Shaw T, Janssen A, Barnet S, Nicholson J, Avery J, Henenka N and Phillips J (2018) The CASE methodology: A guide to developing clinically authentic case-based scenarios for online learning programs targeting evidence-based practice. *Health Education in Practice: Journal for Professional Learning* 1(1): 18–31

Research & Evaluation article (double blind peer-review)

The CASE methodology: A guide to developing clinically authentic case-based scenarios for online learning programs targeting evidence-based practice

Tim Shaw[1], Anna Janssen[1], Stewart Barnet[1], James Nicholson[2], Jennifer Avery[1], Nicole Henenka[3] and Jane Phillips[3]

Abstract

Introduction: Online learning has become an increasingly common means of delivering healthcare professional education. Case-based scenarios are the foundation of many continuing professional development (CPD) activities. No framework currently exists to ensure the development of quality, evidence-based cases, despite the weighted importance case-based scenarios have on improving participant learning. The aim of this project was to develop a systematic framework for generating evidence-based case-based scenarios for learning. ***Methodology****: A literature review was conducted to determine whether case development frameworks or resources currently existed: few were found. The authors then engaged in a framework development process, integrating their own previous experiences and lessons learnt in developing case-based scenarios, together with adult learning theory and evidence from the literature.* ***Results****: A framework that entailed a systematic approach to developing evidence-based case scenarios was developed, called the CASE methodology. This framework ensures a* ***C****ollaborative approach to developing* ***A****uthentic and* ***S****uccinct case scenarios that are founded on the* ***E****mbedding best available evidence.* ***Conclusion****: The CASE framework is a concise approach to developing quality case studies that are grounded on evidence. The CASE methodology could easily be applied to CPD development in many contexts to improve the overall consistency and quality of case scenarios for learning.*

Keywords: educational design, online learning, health education.

1 RISe, The University of Sydney

2 Learning and Teaching Centre, Australian Catholic University

3 Faculty of Health, University of Technology, Sydney (UTS)

Corresponding author: Ms Anna Janssen, Level 2, Charles Perkins Centre D17. The University of Sydney NSW 2006. anna.janssen@sydney.edu.au

INTRODUCTION

The need to improve the uptake of evidence into routine practice is well recognized. Despite regular development and updating of numerous clinical guidelines over the last 15 years, translating the best available evidence into practice remains challenging (Nutley et al. 2003). A wide variety of approaches have been taken to address this challenge, including interventions that target policy issues, organizational factors and healthcare professionals themselves (Browman et al. 2003; Grol & Grimshaw 2003; Sandars & Heller 2006).

Online learning is increasingly being used to deliver educational programs to healthcare professionals to improve quality of care. However, to date, there is little evidence regarding how to structure online learning to have the most impact on clinician behaviour. There is even less evidence demonstrating which methodologies have the highest impact on patient outcomes (Curran & Fleet 2005). Furthermore, there is sparse literature on how to incorporate cognitive learning theory that may be synergistic with health education into online learning for the health sector. Incorporating cognitive learning theory around processes such as chunking, which describes the way learners take fragments of information and combine them to create a valuable and cohesive whole (Gobet et al. 2001), and short- to long-term memory transfer, may have value when designing online health education.

In spite of the lack of literature on methodologically sound approaches to designing online health education, there is evidence that the use of case-based scenarios in continuing professional development (CPD) can effectively promote authentic learning experiences relevant to clinical practice (Ryan et al. 2007; Shaw et al. 2011; Janssen et al. 2016). Case-based scenarios – questions framed around scenarios that occur in clinical practice – are widely used in both formative and summative assessments, and a number of high-impact online learning programs rely solely on the use of targeted case scenarios to deliver educational content (Kerfoot & Brotschi 2009). However, to be effective, the development of these online scenarios must be purposeful, and sets of cases need to be structured in a way that ensures adequate coverage of a topic area and alignment with evidence-based practice (Shaw et al. 2015). Despite the central role of case-based scenarios in online learning, the literature reveals that there are few methodologies or resources available to support the systematic development of quality, effective case-based scenarios for online health education (Manns & Darrah 2012).

The aim of this paper is to describe the CASE methodology for developing online case-based scenarios that are concise, clinically authentic, reflect best evidence-based clinical practice and have the capacity to target key clinical decision-making or practice points. The CASE methodology has been used across a wide spectrum of health education and professional development.

METHODOLOGY

REAL-WORLD EDUCATIONAL DESIGN EXPERIENCE

The CASE methodology draws on over two decades of experience by the authors in developing cases for online education programs targeted at a wide variety of health professionals, including physicians (Jiwa et al. 2014), oncologists (Robinson et al. 2017) and nurses (Phillips et al. 2014), The CASE methodology is applicable to the development of case-based learning scenarios that are designed to capture the attention of busy practicing clinicians. The aims of the methodology are to directly impact clinical practice and to concurrently improve patient outcomes whilst aligning with evidence-based care. In particular, the authors have used the methodology in the development of case scenarios using the Qstream learning tool.

Qstream is an online learning platform developed at Harvard in the mid 2000s. The Qstream platform has been demonstrated to improve learner knowledge in a range of contexts (Kerfoot & Brotschi 2009; Shaw et al. 2012). Furthermore, the platform has been demonstrated to change clinician behaviours and to maintain those changes over time (Bruckel et al. 2016; Robinson et al. 2017). The Qstream platform is a system for delivering short case-based questions to learners online. The platform emails participants a small bundle of questions at spaced intervals, and repeats the delivery of the questions until participants have answered each question correctly a set number of times. The platform is informed by two core psychological principles: the testing effect and the spacing effect. The testing effect refers to the finding that testing has the capacity both to assess learners and also to improve retention of the knowledge being tested (Agarwal et al. 2008). The spacing effect refers to a learning principal that exposure to educational content that is repeated over time has the capacity to facilitate long-term knowledge retention (Vlach & Sandhofer 2012).

CONCEPTUAL FRAMEWORK

The use of case scenarios in online CPD activities conforms to adult learning principles. Key principles of adult learning include ensuring that the content in training material aligns with the real-world experiences of learners, and that learning experiences are situated and authentic (Reeves et al. 2002; Cercone 2008). Authentic learning experiences should have real-world relevance and provide opportunities for collaboration and reflection (Reeves et al. 2002). Furthermore, the use of case scenarios aligns with contemporary instructional design theory, which suggests that educational design should be authentic, creative and innovative (Hokanson & Miller 2009).

Instructional design theory has demonstrated that the medium in which a course is delivered needs to be chosen to suit the learner (Wong et al. 2010). In the case of online learning, it is important to balance the technical attributes of the medium with the needs of the learners, to enable meaningful interactions (Wong et al. 2010). The scenarios developed for case-based online learning must be clearly structured, with concise tasks that allow learners to promptly see the relevance of the online learning (Cercone 2008).

This aligns with adult learning theory, which suggests that offering such structure and support fosters self-reliance and self-directed learning (Cercone 2008).

A distinct learning process arises when online case-based learning integrates group discussion and interaction, which promotes sociality, thought sharing and, at times, discourse (Heckman & Annabi 2005). One framework describes learning as incorporating social processes, response processes, and reasoning processes (Aviv et al. 2003). In the social process, participant comments may have social value and be unrelated to the formal content, or, contrarily, may have no social value and be strictly focused on the formal content. In the response process, participants may have no response at all, may respond to other learners, or may respond to the instructor. In the reasoning process, participants undergo many sub-levels of learning, including making inferences, deductions, judgments, and seeking clarification. All of these processes instil varying degrees of learning that utilize self-reflection and sharing of individual experiences, thus aligning with adult learning principles.

Regardless of whether group discussion is integrated into online case-based CPD, the overarching concepts of adult learning theory imply that learners need authentic learning experiences, self-involvement, and reflection. Implementation of this conceptual framework promotes the ability of learners to apply their learning in practice (Shaw et al. 2015).

THE CASE METHODOLOGY

The CASE methodology is based on four key principles:

- Collaborative approaches to development
- Authentic clinical scenarios
- Succinct clinical scenarios, and
- Embedding the best available evidence.

These principles can be considered as a matrix, within which a series of key actions should be considered. (See Table 1.)

Table 1: key actions to be considered when designing to incorporate principles of the CASE Methodology

Principle:	Collaborative	Authentic	Succinct	Evidence-based
Description	Use a multidisciplinary approach that includes multiple professions, experts, end users and health consumers	Develop cases that are authentic to the end user to engage interest and enhance learning	Develop cases that cover key points as concisely as possible	Ground case development in best available evidence
Actions	Form a multidisciplinary development team and use a structured and consensus-based approach to case development	Use real cases where possible and include end users in case development	Use a rigorous development and editorial process	Review available guidelines and other sources of evidence prior to commencing case development

The CASE methodology has been developed over a number of years during which time it has been applied to the development of clinically focused cases on a variety of online learning platforms. The authors have used the methodology effectively across a broad range of online training initiatives to guide the development of concise and focused educational content. Through multiple applications of the CASE methodology, it has been demonstrated that the process streamlines the development of content for the platform and results in the creation of clear and contextually relevant case scenarios that are well received by participating clinicians (Phillips et al. 2014; Janssen et al. 2016).

The CASE methodology is not meant to be prescriptive, but rather provides a structured approach that can easily be adapted to meet the individual needs of each program's development.

APPLYING THE CASE METHODOLOGY

The methodology includes the following suggested sequence of steps to be used in approaching case development. See Table 2 for an overview.

Table 2: Steps in the CASE methodology

1. Assemble the team

Identify core team members, including an editor and project officer, to manage the process and conduct reviews.

Form a multidisciplinary development team that includes:

- representatives from multiple disciplines (ideally drawing from an actual clinical care team)
- content matter experts (if not covered above)
- health consumer(s)
- clinicians in the target group.

2. Establish the evidence base

Conduct a literature review and gap analysis.

3. Run a structured development process

(a) Develop an information pack that includes evidence summary, gap analysis, case examples and templates.

(b) Conduct a 3–4 hour orientation and priority setting workshop, at the conclusion of which you will have:

- discussed literature and gap analysis to determine key behaviours most likely to impact on outcomes
- identified 10–15 key take-home messages
- canvassed likely case scenarios that will allow exploration of key take-home messages
- familiarized the development team with the format to be used for the case scenarios
- assigned case writing tasks to team members based on area of expertise and enthusiasm.

(c) Case writers prepare cases and share with the editor, subsequently the draft set of cases is shared with the overall group via email for comment.

(d) Pilot the cases with a cohort of participants.

(e) Final meeting or teleconference confirms selected case scenarios and implements any necessary changes post pilot phase.

4. Evaluate the end product

Evaluate case study effectiveness and review learner feedback.

STEP 1: ASSEMBLE THE TEAM

The effort required to develop quality case scenarios for CPD programs is often underestimated.

To ensure that a systematic and robust approach to case development is taken, it is necessary to undertake an adequate review of the literature and evidence-base prior to case development. To oversee this process, the authors suggest that, at a minimum, a project officer is assigned to manage the overall development process for the cases, perform a literature review and conduct data analysis. The

authors have frequently appointed an individual who is close to the target audience to this role, such as a medical student who has had previous clinical experience in nursing or other health disciplines. Ideally, the project officer will work on multiple programs and will assist in the development and editing of cases by content experts. The second key appointment is an overall editor who has substantial content-matter expertise. The editor will appoint the multidisciplinary team, liaise with content-matter experts, oversee the development and review processes, and ultimately approve cases for use.

Several elements of the CASE methodology make it a unique tool for developing case-based educational resources. One of the central aspects of this methodology is the focus on a collaborative and multidisciplinary approach throughout the content-development process. It has been established in the literature that a multidisciplinary approach is beneficial in a range of situations, due to the ability to draw on a wide variety of views and experiences (Fraser and Matthews 2007). The use of multiple authors and disciplines facilitates discussion around complex clinical issues to ensure the development of clinically relevant cases. When forming the multidisciplinary team, it is important to include members not in the target audience (e.g., include nurses in programs being developed for doctors and vice versa). It is also important to include participants that are close in terms of years of practice to the target audience (e.g., using advanced trainees when developing programs for new graduate doctors). This helps to ensure that case scenarios are authentic to the end user and that any associated formative assessment is set at the appropriate depth. Where possible, healthcare consumers should also be involved in the development process to provide patient and carer viewpoints. Depending on the context of the course, it is important to consider including non-clinical team members drawn from the organization, such as risk managers if developing cases in safety and quality for example.

In the process of developing authentic case scenarios, an unanticipated but well-received consequence of engaging a multidisciplinary team in case development has been the creation of a safe and constructive space for the multiple healthcare professionals and consumers to discuss the clinical scenario under consideration. As an example, during the development of a program on reducing pain in palliative care and oncology, the multidisciplinary development team of nurses and doctors from a single clinical unit spent a number of weeks longer than anticipated developing the program. It was clear during the discussion that the case-development process was one of the few opportunities these professionals had had to discuss key challenges that they experience in their team-based care delivery.

STEP 2: ESTABLISH THE EVIDENCE BASE

It is surprising how many case scenarios used in CPD programs are not developed against an evidence base. An evidence base helps to ensure that any set of scenarios that are developed covers the content area and reflects best available practice. Having this evidence available to the development team is especially important during the initiation workshop and to guide initial case selection.

The evidence base to cover varies, but could include practice guidelines, patterns of care studies, and available local data. Ideally, an evidence base will also include consideration of where there are gaps in knowledge and practice to inform the targeted development of cases. The degree of effort expended in reviewing evidence will depend on the area under consideration and available budget and resources. If resources are limited, even a simple review of key guidelines and evidence can have a significant impact on the cases developed.

In instances where there is a lack of evidence, it can be useful to spend time canvassing the potential end users of a program for key issues they would like addressed. For example, in a program developed to address key issues in safety and quality for interns at Massachusetts General Hospital and Brigham and Women's Hospital, interviews were held with interns from the previous year regarding which safety and quality issues had had the most impact on their practice (Shaw et al. 2012). This step revealed a significant number of on-the-ground scenarios that were used to develop an authentic set of case scenarios set at the right level for the participants. It was of note that the leadership team had not previously identified a number of these issues and tended to focus on higher level issues that were not encountered regularly by the participants (Shaw et al. 2012).

STEP 3: RUN A STRUCTURED DEVELOPMENT PROCESS

Once a multidisciplinary team has been established, it is important to run a structured development process.

(A) COMPILE INFORMATION

To facilitate the development of scenarios, it is important to compile an information pack for the multidisciplinary team prior to their first meeting. This should include the following:

- contact details for the team members
- a summary of the evidence base, key publications and guidelines, as appropriate
- exemplar cases
- an example of how cases will be used in the educational program
- ideally, links to an example live online site.

(B) THE INITIATION WORKSHOP(S)

It is recommended that a 3–4 hour initiation meeting is held with the multidisciplinary team. The authors' experience suggests that this is best done face to face, but teleconferencing or video conferencing can also be used. Being able to see the other members of the development team at an initial meeting can help to ensure that all members share a common understanding of the process of program development and are included in the team as it moves forward. In the authors' experience, not holding this initial meeting delays the development of the program development and reduces its quality significantly.

During the meeting, the team will be led by the editor to achieve the following key objectives:

- discuss the evidence base and gap analysis to determine key behaviours that are most likely to have an impact on improving outcomes
- identify 10–15 key take-home messages
- discuss the structure of feedback to be included with the case scenarios
- canvas likely case scenarios that will allow exploration of key take-home messages
- familiarize the development team with the format to be used for the case scenarios
- assign case writing tasks to team members, based on area of expertise and enthusiasm for the topic area.

Discussing the evidence base and identifying the specific problem the course will address may be a lengthy or a short process, depending on the program area. In the development of a nursing program designed to improve pain management in the palliative care setting (as mentioned earlier), discussion of the evidence base and potential gaps in knowledge occurred over a series of meetings attended by the development team, including palliative care nurses and medical staff. In this instance, the issue at hand was improving patient self-reported pain scores, and it was not immediately clear what key behaviour or systems change was required. Following a very productive discussion, it was agreed that effective pain assessment was the key issue and a program of ten cases focused on this aspect of care was developed. The cases developed in this program were subsequently used in a program demonstrated to improve clinician knowledge and to reduce self-reported pain scores (Phillips et al. 2014).

This example contrasts with a program developed for primary-care clinicians on the diagnosis and referral of lung cancer patients, where the evidence base was covered in a 30-minute conversation with the multidisciplinary team, as a succinct resource had been recently developed by Cancer Australia covering the evidence and practice gaps surrounding this issue.

In almost all the programs developed by the authors, this step has proved productive and has produced unexpected results, in even the most evidence-based areas of clinical practice, in terms of where the gaps are in clinical behaviours and how these relate to patient outcomes.

In addition to the use of collaboration, the CASE methodology emphasizes the importance of the take-home message (THM) in developing online CPD programs. We have found this to be a particularly useful concept in CPD, where the time for course delivery is often limited and it is vital that a program is focused around the key learning objectives. The use of key THMs also generates a concisely defined focus on the key behaviour or patient outcomes that the program should target. THMs capture the core message from each scenario that learners should take away from the program. Collectively,

the THMs encase the core learning objectives of the program. It has been the experience of the authors that an average CPD activity of 4–6 hours should not exceed 10–15 THMs. It has also been the experience of the authors that each case should only deal with one or two key THMs to keep the program learning manageable from the participant's point of view. The authors have found that content experts invariably struggle with refining their content down to a manageable volume for inclusion in a course. If a reductive process is not applied then it is easy to end up with overly complex cases and text-heavy content.

Defining the THMs first, before case development, has been found to be a good way of informing a tighter and more focused case writing process. If one starts with case development *without* focusing first on THMs, one can quickly lose sight of the overall program objectives.

Almost all case scenarios used in online learning will be associated with a learning object, such as a multiple-choice question or free-text question, that provides an opportunity for providing feedback to participants once they have interacted with the case. The authors have found in their work that the impact of the learning experience is related to the structure and quality of the feedback. Through review of the literature and trial and error, we have found that the following points are important to consider when developing feedback.

In general, we have found it most important to keep feedback to no more than a small number of paragraphs, each of which is only a handful of sentences long. We generally break the feedback into four sections:

- *Take home message.* To reinforce the THM we commence feedback with a simple two or three-line paragraph that reiterates this take-home message.
- *What actually happened.* Where it is possible to use real-life case scenarios, it is very powerful to follow the THM with a section that describes the ultimate outcome for the clinician and/or patient in the case. For example, in the case mentioned earlier around developing case scenarios for medical interns in the USA, highlighting in the feedback the consequences for the interns and their patients who had been involved in the original scenario was found to enhance learning retention (Shaw et al. 2012). Where it is not practical to use real-life scenarios, then one can instead provide feedback on what the likely consequence of the scenario would have been on the patient and the clinician.
- *How are we performing?* The authors often include links to relevant organizational or national performance data relevant to the case. In safety and quality programs this may, for instance, include rates of falls in the hospital or adverse drug interactions. Once again, this directs the attention of the participant by contextually relating the case to their immediate practice. The authors are currently researching the impact of including audit and feedback data in scenario feedback, given the effectiveness of audit and feedback in other clinical contexts.
- *Links and resources.* Feedback on a case will usually conclude with a links to a small number of references, and ideally to local policies and procedures.

(C) COMMENCING DEVELOPMENT OF CASE SCENARIOS

During the initial meeting, it has been our experience that most participants will join more actively in the discussion around certain THMs than others. It is useful for the editor to note this participation, and then to allocate case development along these lines of interest. Ideally, to avoid too much variation in style, no more than two or three authors will develop a case in a set of 10–15.

In providing advice to authors on how to build cases, we provide exemplars and, ideally, access to case scenarios in-situ in other similar learning programs. During the meeting we emphasize the following points in case development:

- Where possible, draw on real scenarios that will be relevant and in the appropriate scope for the target audience.
- Keep cases short (no more than six or seven lines).
- Focus cases to address no more than one or two points.
- Use a writing style and language that participants will relate to – for example avoid overly formal language.
- Ideally, use a strong image alongside the case.
- Give the patient and any clinicians involved in the case credible pseudonyms.
- If developing multiple questions with the case, focus around one or two areas to explore and avoid the use of too many answer options in a multiple true/false question type (ideally no more than four options in any given question).

(D) CASE DEVELOPMENT AND REVIEW

We recommend that authors prepare draft cases that they first share with the content-matter expert. The content matter expert can then provide advice on consistency and content coverage. Ideally, authors will be given no more than two weeks to complete this step.

Once the editor has a complete, or near complete, set of cases, then these can be shared with the entire group to review overall coverage of the content area. It has been the authors' experience that this can be done effectively via email exchange rather than teleconference.

(E) PILOT TEST CASES

It is vital that the cases are pilot tested with a cohort of participants representative of the target audience, as this always results in significant modification of the cases regardless of the authorship team. Ideally, cases will be pilot tested using the same delivery platform that will ultimately be used.

(F) FINAL TELECONFERENCE

The authors have found it useful to arrange a final teleconference once all cases have been reviewed. This allows for sign-off from the group, which can be important in some courses, as well as time for the resolution of any final issues that may have arisen.

STEP 4: EVALUATE THE END PRODUCT

If possible, any new program is best released on a smaller cohort of participants, as there will inevitably be issues even following the pilot testing phase. As with any program roll-out, an evaluation plan should be developed to ensure adequate qualitative and quantitative feedback is gathered on the effectiveness of the case scenarios. Any feedback that is received should be extensively reviewed and used to modify and improve cases.

CONCLUSION

Continuing professional development in healthcare is being transformed with an ever-increasing reliance on online learning to deliver education. It is of concern that, in healthcare, increasing use is being made of click-through slide-set based online learning with an exit, fact-based knowledge quiz, to deliver mandated education.

The use of case scenarios to deliver contextually relevant online learning is an approach that aligns well with adult learning principles (Reeves et al. 2002; Cercone 2008). That being said, it has been the experience of the authors that case-based scenario development in many online learning programs does not follow a structured process and often little attempt is made to align case scenarios with key THMs and learning objectives. The CASE methodology provides a framework to support a structured, multidisciplinary, evidence-based and patient-centered approach to case development for use in online learning programs. Use of the CASE methodology has also resulted in unexpected benefits, such as providing an opportunity for multidisciplinary care teams to discuss key aspects of their practice in the 'safe' context of educational development.

The CASE methodology has been used successfully by the authors to develop a number of online learning programs that have had an effective impact on participant knowledge and behaviour (Shaw et al. 2012; Phillips et al. 2014; Robinson et al. 2017). The authors are currently researching aspects of extending the CASE methodology, such as how best to deliver audit and feedback data as part of online learning and how to link program evaluation with improvement in patient care and outcomes. From its use to date, the CASE methodology has successfully provided a concise, thorough and structured approach to designing what is an integral part of many online CPD programs. The CASE methodology should be considered for future use in case development as it ensures a well-constructed, thorough and structured approach to what is a commonly used educational strategy for health professionals.

Conflicts of interest

The authors declared no potential conflicts of interest with respect to the research, authorship and/or publication of this article.

Funding

This research received no specific grant from any funding agency in the public, commercial or not-for-profit sectors.

References

Agarwal PK, Karpicke JD, Kang SH, Roediger HL & McDermott KB (2008) Examining the testing effect with open-and closed-book tests. *Applied Cognitive Psychology* 22: 861–876.

Aviv R, Erlich Z, Ravid G & Geva A (2003) Network analysis of knowledge construction in asynchronous learning networks. *Journal of Asynchronous Learning Networks* 7: 1–23.

Browman GP, Snider A & Ellis P (2003) Negotiating for change. The healthcare manager as catalyst for evidence-based practice: changing the healthcare environment and sharing experience. *HealthcarePapers* 3: 10–22.

Bruckel J, Carballo V, Kalibatas O, Soule M, Wynne KE, Ryan MP & Shaw T (2016) Use of spaced education to deliver a curriculum in quality, safety and value for postgraduate medical trainees: trainee satisfaction and knowledge. *Postgraduate Medical Journal* 92:137–144.

Cercone K (2008) Characteristics of adult learners with implications for online learning design. *AACE Journal* 16: 137–159.

Curran VR & Fleet L (2005) A review of evaluation outcomes of web-based continuing medical education. *Medical Education* 39: 561–567.

Fraser S & Matthews S (2007) The Critical Practitioner in Social Work and Health Care. London: Sage.

Gobet F, Lane PC, Croker S, Cheng PC, Jones G, Oliver I & Pine JM (2001) Chunking mechanisms in human learning. *Trends in Cognitive Sciences* 5: 236–243.

Grol R & Grimshaw J (2003) From best evidence to best practice: effective implementation of change in patients' care. *The Lancet* 362: 1225–1230.

Heckman R & Annabi H (2005) A content analytic comparison of learning processes in online and face-to-face case study discussions. *Journal of Computer-Mediated Communication* 10. DOI: https://doi.org/10.1111/j.1083-6101.2005.tb00244.x

Hokanson B & Miller C (2009) Role-based design: A contemporary framework for innovation and creativity in instructional design. *Educational Technology* 49: 21–28.

Janssen A, Shaw T, Bradbury L, Moujaber T, Nørrelykke AM, Zerillo JA, Lacasce A, Robinson T, Starr A & Harnett P (2016) A mixed methods approach to developing and evaluating oncology trainee education around minimization of adverse events and improved patient quality and safety. *BMC Medical Education* 16: 91.

Jiwa M, Halkett G, Meng X, Pillai V, Berg M & Shaw T (2014) Supporting patients treated for prostate cancer: a video vignette study with an email-based educational program in general practice. *Journal of Medical Internet Research* 16.

Kerfoot BP & Brotschi E (2009) Online spaced education to teach urology to medical students: a multi-institutional randomized trial. *The American Journal of Surgery* 197: 89–95.

Manns PJ & Darrah J (2012) A structured process to develop scenarios for use in evaluation of an evidence-based approach in clinical decision making. *Advances in Medical Education and Practice* 3: 113.

Nutley S, Walter I & Davies HT (2003) From knowing to doing: a framework for understanding the evidence-into-practice agenda. *Evaluation* 9: 125–148.

Phillips JL, Heneka N, Hickman L, Lam L & Shaw T (2014) Impact of a novel online learning module on specialist palliative care nurses' pain assessment competencies and patients' reports of pain: results from a quasi-experimental pilot study. *Palliative Medicine* 28: 521–529.

Reeves TC, Herrington J & Oliver R (2002) Authentic activities and online learning. *In: HERDSA 2002 Quality Conversations*, Perth, Western Australia, 7–10 July 2002, pp. 562–567.

Robinson T, Janssen A, Kirk J, Defazio A, Goodwin A, Tucker K & Shaw T (2017) New approaches to continuing medical education: a QStream (spaced education) program for research translation in ovarian cancer. *Journal of Cancer Education* 32: 476–482.

Ryan G, Lyon P, Kumar K, Bell J, Barnet S & Shaw T (2007) Online CME: an effective alternative to face-to-face delivery. *Medical Teacher* 29: e251–e257.

Sandars J & Heller R (2006) Improving the implementation of evidence-based practice: a knowledge management perspective. *Journal of Evaluation in Clinical Practice* 12: 341–346.

Shaw T, Barnet S, Mcgregor D & Avery J (2015) Using the Knowledge, Process, Practice (KPP) model for driving the design and development of online postgraduate medical education. *Medical Teacher* 37: 53–58.

Shaw T, Long A, Chopra S & Kerfoot BP (2011) Impact on clinical behavior of face-to-face continuing medical education blended with online spaced education: A randomized controlled trial. *Journal of Continuing Education in the Health Professions* 31: 103–108.

Shaw TJ, Pernar LI, Peyre SE, Helfrick JF, Vogelgesang KR, Graydon-Baker E, Chretien Y, Brown EJ, Nicholson JC & Heit JJ (2012) Impact of online education on intern behaviour around joint commission national patient safety goals: a randomised trial. *BMJ Quality & Safety* 21: 819–825.

Vlach HA & Sandhofer CM (2012) Distributing learning over time: The spacing effect in children's acquisition and generalization of science concepts. *Child Development* 83: 1137–1144.

Wong G, Greenhalgh T & Pawson R (2010) Internet-based medical education: a realist review of what works, for whom and in what circumstances. *BMC Medical Education* 10: 12.