New approaches: Embedding on-line interactive scenarios as core course components for international biosecurity practitioner training

Terry Mark Stewart
Centre for Teaching and Learning (Manawatu)
Massey University

Joanna S. McKenzie
EpiCentre, Institute of Veterinary, Animal and Biomedical Sciences
Massey University

Willem D. Vink
EpiCentre, Institute of Veterinary, Animal and Biomedical Sciences
Massey University

Interactive scenarios were used in an on-line international Masters degree programme for veterinary and public health professionals launched in 2010. For two courses in the programme, students were required to play the role of a senior advisor, analyzing data, determine the cause of an unfolding disease outbreak and critiquing recommendations. The scenario was presented in six episodes. Each episode was designed to be completed in one sitting and these also contained the history of previous episodes. On-line forums were used for group activities which included a vote on the diagnosis. Students were also required to give a critique of the diagnosis and solution proposed in the scenario. A student survey rated the use of the scenario-based approach highly with motivation and engagement being the most obvious benefits. This paper illustrates how an interactive scenario can deliver student outcomes when be embedded at the very core of a course.

Keywords: interactive scenarios, case-based learning, scenario-based learning, course design, SBL interactive, biosecurity training, epidemics, health professional training, authentic learning

Introduction

Learners need to see relevance in the tasks they are set. There is general agreement in educational circles that student engagement is enhanced and better learning is accomplished where groups of learners are immersed in authentic, real-world problems (Barnes, Christensen & Hansen, 1994, p. 1-6; Herrington, Reeves & Oliver, 2010, p. 216; Jonassen, Peck & Wilson, 1999, p. 229). One way to facilitate this in an on-line setting is to use interactive scenarios or cases, where students are required to explore, investigate and analyze an unfolding situation (or crisis!). However, it is also recognized that benefits from any "active learning" approach are not automatic, and it is important that such activities are designed carefully, and embedded (and scaffolded) correctly in the context of the course as a whole (Hmelo-Silver, Duncan & Chinn, 2007; Kirschner, Sweller & Clark, 2006). Failure to do this can confuse the student and undermine the learning objectives.

The following case study reports on the design, implementation and evaluation of two sequential courses which had an interactive scenario (or case) at their core. It illustrates how these scenarios, properly embedded and supported as a core component of the course, can interest and motivate students. Furthermore, they can also be used as an engaging platform to facilitate other activities important to the learning outcomes, such as collaboration (groupwork) and report writing.

Background

Recent years have seen a number of human diseases emerge which have their origins in animal populations. Some examples include the SARS virus, HPAU and N1N1 influenza. Furthermore, these global threats often arise in developing countries where limited capacity exists to deal with them.   Sophisticated interdisciplinary training is required in disease surveillance, investigation and control, along with institution and policy building. In 2010 Massey University launched a "One Health" for Asia program to strengthen the response to outbreaks of major human and animal infection diseases in three sub-regions of Asia (South Asia, Central Asia and East Asia). Part of this program provides Masters level training of public health doctors and veterinarians. Of the eight papers offered in the two-year Masters programs, seven are taught entirely on-line whilst the eighth is a

combination of on-line and regional face-to-face training. The first four courses provide a foundation in epidemiology and are common to both degrees. The remaining four courses address specialised topics related to human or animal health. Each of the eight courses is delivered over a six-week period with a study load of about 20 hours per week, using the Moodle Learning Management System. Intensive student support is provided online, with tutors overseeing groups of students at a ratio of approximately 1:8.

It was decided to use an interactive scenario as a core component in two of the four compulsory courses titled 'Epidemiological Techniques for Disease Investigation' and 'Principles of Disease Control and Management'. The overall purpose of these two courses was to give students the skills to prepare an outbreak investigation plan, manage an epidemiological investigation, develop hypotheses regarding risk factors, recommend control measures and evaluate their success, and communicate the outcomes to different stakeholder groups. Such outcomes fitted well with a scenario or case-based approach. Also, teaching an almost fully on-line Masterate program of eight courses to working professionals in developing countries is a daunting challenge. Notwithstanding potential technology issues, there is a mix of languages, cultures and pre-knowledge. Consequently, it was important to develop lessons that incorporated activities and examples that had current relevance and that engaged and motivated the students.

The outbreak scenario

Description

The scenario was based on an actual disease that emerged in South East Asia during the 1990s, killing both humans and animals. In essence, very early reports of an unfamiliar disease in animals were not investigated thoroughly and were not identified by authorities as being unusual. The early stages of the ensuing outbreak showed a pattern similar to a commonly occurring endemic disease, although some epidemiological evidence did not support this hypothesis. Intensive control measures were implemented, but these failed to contain the disease which spread to become a major epidemic. This example was chosen as it contained the ideal ingredients for an authentic online learning scenario that would address the learning outcomes. These included knowing how to deal with complex epidemiological problems involving humans and animals, compounded by socio-cultural and socio-economic aspects.

Development

Two people were involved in the creation of the interactive scenario. One was the subject expert responsible for developing the activity; the other was the e-learning instructional designer whose main role was to author the scenario. Both were working from different geographical locations.

The scenario was initially "mapped out" using storyboarding techniques at face to face meetings. After the structure of the scenario was agreed on, development of content was facilitated using a scenario schema. The schema was a Microsoft Word document which initially was a template. Specifically it just contained headings laid out sequentially representing specific information and activities students would be exposed to as they progressed through the scenario. Text was often included under these headings which elaborated on the content the scenario authors wanted to put there.

The schema was split into segments. Work on the content then progressed section by section. Each section was initially filled with draft content by the subject expert then provided to the instructional designer by email for comment. The document would then be passed back. It was a collaborative process, and each section of the schema would often pass through several iterations before being finalized. Once it was deemed ready, the content was cut and pasted from the schema to the scenario authoring and delivery tool. The tool of choice was Scenario-Based Learning Interactive (SBLi) (Unversity of Queensland, 2012) an e-learning software package designed for presenting storyboarded scenarios. SBLi gave a structured interface to the scenario, allowing students to always see where they were in the timeline of the case. Furthermore, it facilitated an interactive learning process by integrating narrative, activities, and reference material into one environment.

While the scenario was modelled on the actual sequence of events that unfolded during the outbreak, fictional place names and dates were used to reduce the opportunity for students to identify the cause of the outbreak through Internet searches, and increase the probability that they developed their own hypotheses based on their interpretation of the data with which they were provided.

Pilot

Once developed, a draft scenario was piloted using a group of campus-based Master of Veterinary Science students with similar backgrounds to the students in the 'One Health' Masters degrees. The students were observed as they worked through the scenario, their progress was timed and their experiences recorded. The developers questioned the students on coherence of the interface, ease of navigation and whether the tasks and their purposes were clear.

Some important modifications were made as a consequence of this trial. One major modification was to break the large and complex scenario into a series of separate installments or 'episodes', each of which could be completed in two to four hours. This served to maintain the students' interest in the scenario. It also enabled tighter integration of the scenario into the course, by interspersing the episodes with relevant teaching material and resources in the Moodle environment using a combination of formats including web pages, discussion forums and activities, primarily to facilitate group discussion (Figure 1). Each successive SBLi episode contained all the content of the prior episodes for student review, but excluded the tasks or questions contained in these as they added scaffolding (hence extra work) which was no longer required.

Another finding from the pilot was the necessity of familiarising the students with the SBLi interface and its functionality. Navigation in SBLi was not always intuitive to those familiar with standard web browsers, and certain conventions were used such as color-coding text boxes to represent hints, tasks and navigation instructions. An introductory SBLi training scenario was developed which introduced the interface and conventions used. This introductory "training" episode was worked through prior to commencing with the scenario, to reduce the extraneous cognitive load which would come at the expense of learning (Van Merrienboer, Kirschner & Kester, 2003).

Delivery

In the Moodle course page of the 'Epidemiological Techniques for Disease Investigation' course, each episode of the scenario was prefaced by a static webpage that presented teaching material related to the relevant stage of a disease outbreak investigation (Figure 1). Clicking on the scenario icon launched the scenario in a new browser window.

Working through the scenario
Students were introduced to the crisis in the first episode of the scenario (Figure 2). They subsequently worked through the scenario step by step, as participants or actors in the story. Narrative was written in the second person to enhance engagement. At almost all stages of the scenario, students were required to complete a task to reinforce the learning. This could take the form of selecting options from tick-boxes, developing definitions or conducting analyses as the data became available. Feedback was provided to each question.

Students sequentially worked through the activities which gradually appeared from left to right across the top of the screen. Each activity would include a series of action links which would appear from top to bottom in the left-hand window. As with the activities, these links would not become visible until students had completed the work under the previous one. Resources could also be included from within the scenario. For example, clicking the link in the main page shown in Figure 3 brought up a Microsoft Excel spreadsheet with data that students subsequently used as they were guided through descriptive analyses of the data.

Students worked through the first five episodes of the scenario individually, gathering data about the outbreak, conducting descriptive analyses and interpreting disease spread patterns. Having completed the five episodes, the students were challenged to interpret their findings and develop a hypothesis regarding the cause of the outbreak. Also they were required to summarise their thoughts on the most likely factors causing the disease together with the supporting evidence.
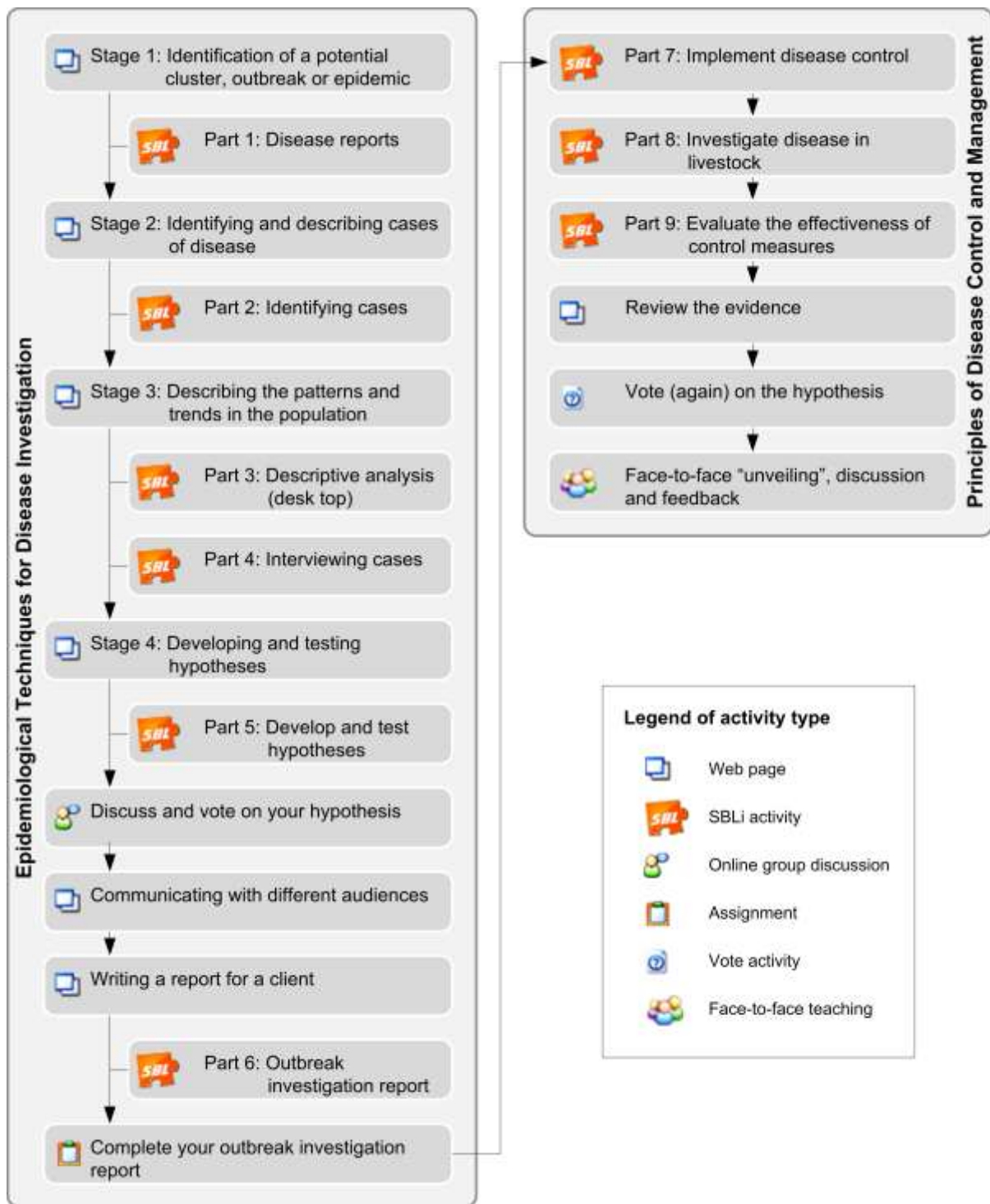
Figure 1. Flowchart showing the staging of the scenario across the two sequential Moodle courses, including the different activity types.

Figure 2. Introducing the scenario in SBLi

Group work
Subsequently, the scenario moved into small group activities for which students were placed into 11 groups of 6 to 7 students, comprising an equal mix of doctors and veterinarians from different countries. The members of the groups were asked to discuss their hypotheses and supporting evidence, and produce a group report. All students were then asked to peer review the other groups' reports and finally to vote on their hypothesis regarding the cause of the outbreak. This task was designed to mimic a situation of an investigation team discussing the results of their investigation and coming to a consensus with respect to their conclusions and recommendations. All discussion amongst group members was via separate group forums within Moodle.

Assessable output: An outbreak report
The final episode in the 'Epidemiological Techniques for Disease Investigation' course provided context and content for the development of skills in communicating the findings of an outbreak investigation to a key decision maker such as the Minister of Health. The students were required to submit an individual outbreak report, which was to clearly communicate a conclusion regarding the cause of the outbreak, support this with appropriate epidemiological evidence, and recommend further investigation and / or control measures.

Carry through to subsequent courses
To assess the effectiveness of the implemented control measures, three additional episodes were integrated into the subsequent course 'Principles of Disease Control and Management' (Figure 1). The emphasis of these episodes was placed more strongly on the affected livestock populations. The final episode presented new evidence showing the consequences of the incorrect diagnosis and inappropriate control measures that resulted in spread of the disease to a new area and development of a major epidemic. The students were given the opportunity to re-evaluate their initial diagnosis in light of this new evidence, and vote again on the group hypotheses developed previously.
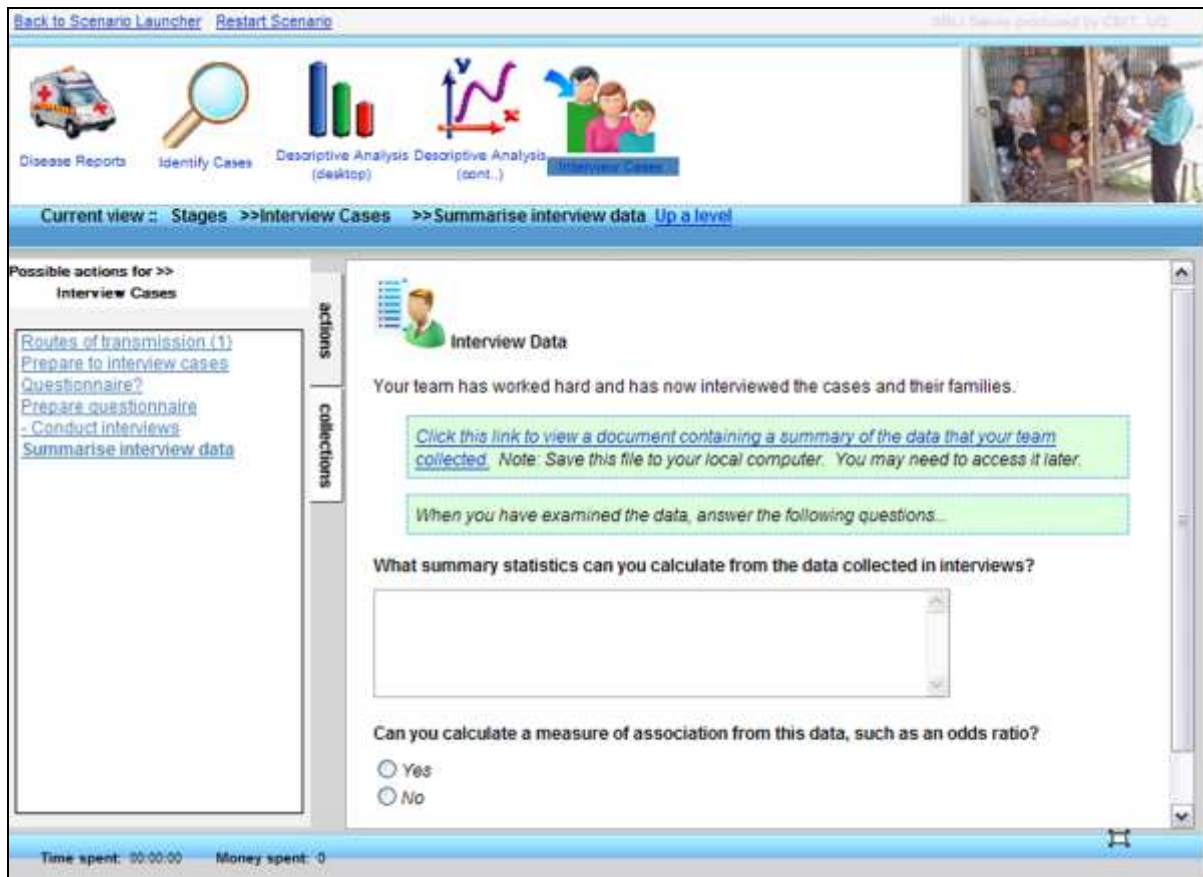
Figure 3. Scenario content screen showing link to data resources and questions

Face to face work

This course incorporated an intensive two-week face-to-face training component. During this workshop, the students were shown a documentary which provided footage of the outbreak, and disclosed its cause. This brought the scenario to life and showed the impact of the outbreak on peoples' lives and livelihoods. It also discussed the mistakes made during the investigation and diagnosis of the cause. It presented the likely involvement of wildlife as the source of infection, bringing the scenario into the full context of the 'One Health' programme.

Later in the face-to-face workshop, the scenario was used during a session on effective management of the media during an outbreak crisis. Student pairs comprising a doctor and a veterinarian were interviewed and asked to prepare a joint press release for the Ministry of Health and the Ministry of Agriculture, providing information about the disease, how people could protect themselves and how spread could be prevented.
In a later course ('Public Policy in the context of Disease Management'), the scenario was revisited and used as a case study to discuss and identify behavioural changes that would assist early detection of a new disease.

Results

In an evaluation questionnaire of the 'Epidemiological Techniques for Disease Investigation' course, students were asked to evaluate the following four aspects of the learning approach used:

1. Embedding the problem-based learning (SBLi scenarios) with the course material (web pages)
2. Using the SBLi interface, and quality of the scenarios
3. Preparing the investigation report
4. Discussing the hypothesis

A total of 46 out of 67 (69%) students completed the course evaluation questionnaire. The majority of respondents found the four aspects of the scenario to be either very effective or quite effective (Figure 4).
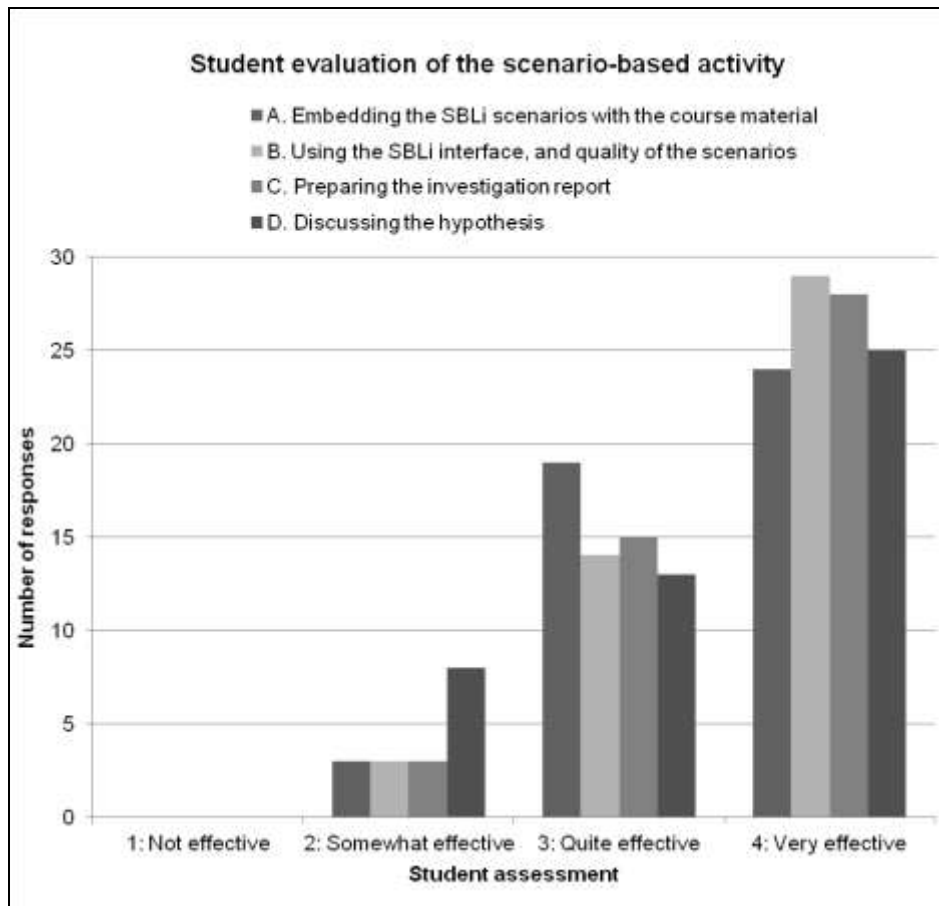
Figure 4. Chart showing student evaluation of the scenario and SBLi. Students were asked for their opinion on the effectiveness of the scenario and SBLi related to presentation of content and facilitation of activities (n=46)

Students were also asked open questions about what they enjoyed most about the course and what they enjoyed least. As these were free-form questions, the results were parsed and categorised into a series of identifiable aspects. Many respondents agglomerated several aspects into one response. Twenty-five respondents (56%) explicitly considered the most enjoyable aspects of the course to be related to the scenario and related activities (Table 1).

Table 1. Responses from the evaluation questionnaire to the open question, 'What did you like most about the course? '. 46/67 (69%) students completed this question. The 25 responses that refer specifically to the interactive scenario are presented in bold font.

Q. What did you like most about the course?	Number
SBLi scenario	**16**
SBLi scenario and group work	**6**
Group work	9
Capacity development and the concept note	4
Logical framework analysis	1
SBLi scenario and report writing	**3**
"Activities"	3
Almost all	2
Report writing	1
"We were forced to work"	1
Total responses	**46**

Some reported that almost everything was enjoyable. However, three students cited the scenario-based lessons

as being the worst aspects of the course! Four others mentioned that there should be more scenario based lessons in future courses.

Discussion

While it is not possible to quantify how much the interactive scenario contributed to learning per sé, it was clear that a majority of students enjoyed this aspect of the course. This is reflected in 54% of the course evaluation respondents ranking the scenario and its activities as the most enjoyable aspect of the course (Table 1), indicating a high level of satisfaction with this approach to teaching. Motivation and engagement are both important elements for learning (McMillan, 2010, p. 1-13) and it is clear the scenario provided both. This is typified by one student's comment in the feedback which said "[The SBLi scenario]…was really practical, inspiring and interesting! ". The following comments indicate that some students enjoyed the novel teaching method and found it stimulated them to think about the problem: "The scenario was interesting as well as confusing, helping to think more to probe the situation" and, "This is the first time I have encountered scenario based learning and found it very useful as an effective learning tool".

Given students were unfamiliar with SBLi, a walk-through scenario to get the students used to the SBLi interface before the real lesson also proved to be worthwhile. This is reflected in the following student comment: "I was so scared to open SBLi. But once opened - nothing to fear". Navigation through an interactive learning environment can be cognitively challenging and students benefit from prior exposure to it and the conventions used (Liang & Sedig, 2009).

Presenting this large scenario in sequential workable units (i.e. episodes) was decided upon after running the pilot. This change proved to be extremely valuable. It facilitated tight linking of the teaching material in Moodle with relevant episodes of the authentic activity-based scenario in SBLi. Students could complete these episodes at one sitting which assisted focus.

Using a mix of resources and activities in Moodle also contributed to variation. Rolling out the scenario episodes over time meant that students were all more or less at the same place within the scenario, which assisted the tutors in providing support. However, having split the episodes, it was important that students had the ability to revisit earlier parts of the scenario; this was not straightforward, as much of the episode content (when first visited) was bound up in the feedback to questions (some rhetorical) which students needed to answer. The solution to this problem was to preface each scenario episode with a history of those before it, but with the content explicit, which could be revised or skipped depending on the inclination of the student.

Integrating both the scenario narrative and related exercises within SBLi, rather than splitting these between SBLi and Moodle, minimised the "split attention effect", which can arise where students jump between systems to obtain information and to conduct activities using this information. This has been shown to have a detrimental effect on learning by adding extraneous cognitive load (Van Merrienboer & Sweller, 2005). The use of narrative in the scenario, rather than just presenting plain facts, was designed to immerse the student as a participant or actor in the story where events unfolded over time. Hazel (2008, p. 199-213) discusses the importance of narrative in interactive learning environments, where it can build both coherence and context.

It should be mentioned, however, that developing this narrative was quite time-consuming. The story had to have integrity and credibility. It had to "feel" real. The cause of the outbreak was a puzzle and clues to the solution lay scattered throughout the timeline. The skills to produce such work are more akin to storytelling or film and these requirements need to be factored into any design budget using this learning design.

The use of a scenario schema was extremely beneficial to facilitate communication between the subject expert and instructional designer as they crafted content before it was entered into SBLi. Furthermore the schema holds the whole scenario content as a flat file in an easy accessible format. This is valuable in case the scenario (or parts of the scenario) are reused in a different authoring/delivery package . Using scenario schemas is now a standard practice at Massey University for developing SBLi scenarios with a team.   (Stewart, 2011; Stewart, Brown & Weatherstone, 2009).

There was considerable value in linking the outbreak investigation scenario with group work, report writing activities and communicating with the media. It reinforces the value of incorporating and embedding interactive scenarios into the core of the course in an integrated way, rather than using them as simply an add-on where their value may not be fully exploited (Gossman, Stewart, Jaspers & Chapman, 2007)

Integrating the scenario into the face-to-face course following the on-line activities provided a very effective way of concluding the scenario on a dramatic note. Students were intrigued to find out from the documentary if they had correctly identified the cause of the outbreak. Furthermore, the documentary brought the scenario to life, showing the impact that the outbreak had on people's lives and livelihoods and discussing some of the controversial issues associated with the management of the outbreak. This provided an excellent segue to wrapping up the scenario with a general discussion of the key issues relating to 'One Health' investigation and management of diseases affecting animals and people and to early detection of emerging diseases.

Conclusion

We believe the integration of the unfolding disease outbreak scenario into the courses described above reflects "Learning for the Future" and adheres to Meyers and Nulty's five curriculum design principles (Meyers & Nulty, 2009). They argue that in order to maximise the quality of student learning outcomes, courses should provide students with teaching and learning materials, tasks and experiences which:

1. are authentic, real-world and relevant;
2. are constructive, sequential and interlinked;
3. require students to use and engage with progressively higher order cognitive processes;
4. are all aligned with each other and the desired learning outcomes; and
5. provide challenge, interest and motivation to learn.

The combination of an on-line scenario-based approach with group work, report writing activities, face-to-face discussion and role play was effective in presenting an immersive learning experience. While most students were unfamiliar with this teaching model (and some were initially apprehensive), the levels of participation and enthusiasm were high. As with any course, there is room for improvement but the student feedback and positive evaluation reflected a high level of satisfaction. The scenario grounded the learning in context and facilitated group work, embodying what Reeves, Herrington & Oliver (2002) defined as "authentic activities".

Acknowledgements

References

Barnes, L.B., Christensen, C.R., & Hansen, A.J. (1994). *Teaching and the case method: Text, cases, and readings*. Boston, MA: Harvard Business School Press

Gossman, P., Stewart, T. M., Jaspers, M., & Chapman, B. (2007). Integrating web-delivered problem-based learning scenarios to the curriculum. *Active Learning in Higher Education, 8*(2), 139-153.

Hazel, P. (2008). Towards a narrative pedagogy for interactive learning environments. *Interactive Learning Environments 16*, 199-213. https://doi.org/10.1080/10494820802113947

Herrington, J., Reeves, T.C., & Oliver, R. (2010). *A guide to authentic e-learning*. London and New York: Routledge. https://doi.org/10.4324/9780203864265

Hmelo-Silver, C.E., Duncan, R.G., & Chinn, C.A. (2007). Scaffolding and Achievement in Problem-Based and Inquiry Learning: A Response to Kirschner, Sweller, and Clark (2006). *Educational Psychologist, 42*(2), 99-107. https://doi.org/10.1080/00461520701263368

Jonassen, D., Peck, K., & Wilson, B. (1999). *Learning with technology: A constructivist perspective*. Upper Saddle River, NJ: Prentice Hall.

Kirschner, P.A., Sweller, J., & Clark, R.E. (2006). Why Minimal Guidance During Instruction Does Not Work: An Analysis of the Failure of Constructivist, Discovery, Problem-Based, Experiential, and Inquiry-Based Teaching. *Educational Psychologist, 41*(2), 75-86. https://doi.org/10.1207/s15326985ep4102_1

Liang, H.N., & Sedig, K. (2009). Characterizing navigation in interactive learning environments. *Interactive Learning Environments 17*, 53-75. https://doi.org/10.1080/10494820701610605

McMillan, W.J. (2010). 'Your thrust is to understand' - how academically successful students learn. *Teaching in Higher Education, 15*(1), 1-13. https://doi.org/10.1080/13562510903488105

Morse, S.S. (2004). Factors and determinants of disease emergence. *Scientific and Technical Review of the Office International des Epizooties*, 23, 443-451. https://doi.org/10.20506/rst.23.2.1494

Meyers , N.M., & Nulty, D.D. (2009). How to use (five) curriculum design principles to align authentic learning environments, assessment, student's approaches to thinking and learning outcomes. *Assessment & Evaluation in Higher Education, 34*(5), 565-577.

Reeves, T.C., Herrington, J., & Oliver, R. (2002). Authentic activities and online learning. In A. Goody, J. Herrington & M. Northcote (Eds.), *Quality conversations: Research and development in higher education.* (p. 562-567). Jamison, ACT, Australia: HERDSA

Stewart, T.M., Brown, M.E., & Weatherstone, A. (2009). Interactive Scenario Design: The Value of Flowcharts and Schemas in Developing Scenario-Based Lessons for Online and Flexible Learning Contexts. *Journal of Distance Learning, 13*(1), 71-79.

Stewart, T. M. (2012). Supporting the Design of Interactive Scenarios in a University Environment. Techniques, Issues and Constraints. In D. Holt, S. Segrave, & J. L. Cybulski (Eds.), *Professional Education Using E-Simulations* (pp. 316-335). Hershey PA: IGI Global Press.

University of Queensland. (2012), *SBL Interactive (SBLi).* Retrieved from http://www.sblinteractive.com

Van Merrienboer, J.J.G, Kirschner, P.A., & Kester L. (2003). Taking the load off a learner's mind: Instructional design for complex lLearning. *Educational Psychologist, 38*(1), 5-13.

Van Merrienboer, J.J.G., & Sweller, J. (2005). Cognitive load theory and complex learning: Recent developments and future directions. *Educational Psychology Review, 17*,147-177. https://doi.org/10.1007/s10648-005-3951-0

Author contact details:

Terry Mark Stewart, t.stewart@massey.ac.nz

Please cite as: Stewart, T.M., McKenzie, J.S. and Vink, W.D. (2012). New approaches: Embedding on-line interactive scenarios as core course components for international biosecurity practitioner training. In M. Brown, M. Hartnett & T. Stewart (Eds.), Future challenges, sustainable futures. Proceedings ascilite Wellington 2012. (pp.885-894).

---

https://doi.org/10.14742/apubs.2012.1545