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Interactive Scenario Design: The Value of Flowcharts and Schemas in Developing Scenario-based Lessons for Online and Flexible Learning Contexts

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Introduction

Distance education has been a central part of Massey University's focus since the first courses were offered in 1960. Since then, the design of distance learning has moved from an 'art' (often left to teachers' own devices), to a sophisticated craft and applied science involving institutional assistance and training. Would-be distance course conveners now attend professional workshops on how to develop extramural courses. These workshops are based on contemporary principles of learning design, and the training is often followed up by one-to-one consultancies and checks during the preparation phase itself.

Because the process was becoming increasingly complex, it was felt the existing training and staff support on distance education course design would be enhanced by an interactive problem-based scenario. This would be used as a visually engaging and valuable teaching tool, allowing the learning consultant to 'walk' workshop participants through it in a tutorial session, promoting discussion on questions posed by the scenario. However, the scenario would also be designed to be used as a stand-alone flexible learning exercise which novice distance course designers could explore in their own time. Furthermore, in the spirit of open access, it would be made available to other New Zealand distance providers to adapt and amend for their own training.

The use of interactive problem-based scenarios in educational contexts is founded on the premise that students learn better by active engagement (that is, by doing things), and then reflecting on what was done—rather than simply listening (Bruner, 1973; Jonassen, Howland, Moore, & Marra, 2003; Schön, 1991). Scenarios of this nature illustrate problems in context, and can aid in understanding the subject material and the motivation to learn it (Hmelo-Silver, 2004; Mykytyn, Pearson, Souren, & Mykytyn, 2008; Schank, Fano, Bell, & Jona 1993; Tait, Tait, Thornton, & Edwards, 2008).

One lesson from the above literature is that manifestation of the problem-based scenario paradigm in an e-learning context is often supported by an illustrated narrative or story, which the student must follow by clicking through the 'scenes'. At various stages of the scenario the student is required to provide input. In this sense, interactive scenarios are ideally suited to supporting the concept of personalised learning (New Zealand Ministry of Education, 2006). Typically the story will take a 'fly-on-the-wall' approach, following a central character through a series of tasks. Alternatively, the prose could be in the second person and the central character could be the student themselves. At certain points in the narrative the student may be asked to suggest further exploration, and/or analyse what is wrong and suggest remedies.

While some details of a particular scenario and how it was used will be elaborated below, describing the scenario or making others aware of its existence is not the main purpose of this paper. While delivery tools and authoring software exist to construct scenarios to be delivered electronically, one of the most important (and time consuming) tasks in scenario-based learning is the design of the scenario itself. There must be real clarity about how the scenarios are created so they produce robust educational discussion (Savin-Baden, 2007). Major considerations include the narrative, what

components will be needed, how the scenario will be used within a lesson, and how it will support the learning outcomes. Although it is a very creative activity, answering these questions can be a difficult intellectual process. However, it is essential that this precise planning is done before constructing the scenario in any authoring/delivery tool—otherwise the result can be a disorganised mess.

This paper details a methodology used to construct interactive scenarios, using an example for illustration. In particular, the paper describes how flowcharts and simple text templates were used as valuable aids to scenario design and planning. The case study illustrates that, although course development is a dynamic and iterative process, quality learning designs require careful planning and appropriate scaffolding using a combination of design techniques. This conclusion supports the view that learning design is about making sure that choices and decisions are explicit throughout course development.

SBL Interactive

Although the methodology outlined below is generic, some explanation of the authoring tool used to convert the scenario to an electronic format is necessary in order to appreciate the headings used in the schema tables and storyboards referred to later in this paper. This tool is SBL Interactive (SBLi) (Anon, 2009).

SBLi is an updated version of PBL Interactive, which is a scenario-based authoring and delivery system made available to all New Zealand tertiary institutions in late 2006 (Stewart, 2007). The what-you-see-is-what-you-get (WYSIWYG) interface makes it easy to construct scenarios and scaffold them during student playback.

The software package consists of a client-based *scenario builder* for authoring, and a *player* for scenario delivery. There is a server version of the player, which can be used to deliver scenarios over the web, and a client version, which can be used to run scenarios direct from media on the client computer. Players extract the scenario from a scenario data file (produced by the scenario builder) which is essentially a package of XML documents.

SBLi uses the same interface for both authoring and delivery (see Figure 1). The root object in a scenario is the *location*, which may represent a real-world location (say a building) or a conceptual location (for example,

reflections). Locations may contain further objects such as *items* and *actions*. Each of these objects is described by the *content window*, which can hold text, images, hyperlinks (to embedded or external content), forms (which provide feedback on clicking), and embedded multimedia, all formatted by standard HTML code. Objects can be set to accrue a cost, either in money or time.

Items linked to a particular location appear in the *environment window*. The environment window background graphic can change depending on the location selected, and gives the user exploring a scenario a feel for what they might see in the general area. Items can contain their own actions and contents, and they can also be collected during the course of a scenario and transported to different locations. In doing so, further functionality of that item may be revealed. Collected items are revealed by the *collection tab*, and can be 'uncollected' and placed in the current environment window.

Figure 1 The SBLi player (top) and builder (bottom) showing part of a scenario

All objects in a scenario are hidden or revealed by a system of prerequisite properties associated with that object. For example, in one point in our scenario, the central character reads a letter of complaint about a course from an ex-student who happens to also work on the campus. Only when that letter is read does the location (the central character's office) become visible in the scenario so that she can be visited and interviewed.

One of the strengths of SBLi is the ease of authoring. A specialist programmer is not required. Properties (prerequisites, costs and so on) are easily attributed to objects, text, and images using a *properties panel* (see Figure 1), and forms can be simply inserted in the content window with no scripting whatsoever. However, while SBLi provides a platform to turn scenarios into an electronic web-based exercise, it does not help in the creative task of developing the original content. Problem-based scenarios are often like a film script (Errington, 2005) with an unfolding story that allows for a number of interactive artefacts (such as web forms for input or graphics representing an object that students may have to examine). Developing such scenarios requires a combination of very good planning and iterative visions of the script, which gradually takes the shape of the 'hard content' that will appear in the final product.

As alluded to above, simple table-based Word documents, flow diagrams, and storyboards are invaluable low-tech planning tools for developing the scenario. The following section outlines the method by which these tools were used to develop the distance education course scenario.

The method

We know that course planning is a creative rather than linear process (Laurillard, 2002). However, this does not mean that teachers should be left to discover (by osmosis) their own idiosyncratic model(s) of learning design. There is growing appreciation of the value of providing teachers with a learning design toolkit to support effective pedagogy (Conole & Fill, 2005). The steps that follow describe a robust framework for developing scenario-based e-learning products and solutions.

Step 1: Scenario descriptor

The first task was to come up with a scenario descriptor. The descriptor summarised the plot and how the scenario would be embedded into a lesson for the learning outcomes (see Table 1). It is an important document, which serves as an anchor for further development. (Note that the word 'student' in this context refers to either a workshop participant or someone working through the scenario external to the workshop.)

Table 1 The scenario descriptor for the distance materials preparation workshop

Name	Home Improvement: A distance course assessment
Synopsis	The plot involves a young lecturer who has been given the job (by their HOD) to revitalise a flagging distance course. The past course convener has retired and our hapless young academic only has a few short months to: firstly, examine the existing course to identify any deficiencies; and secondly, to make improvements where feasible. The narrative will be in the second person; the student plays the role of the central character. Students working through the scenario will see examples of the existing administration and study guides and associated e-learning material. These components will have flaws, which the students will be encouraged to identify. Furthermore, within the scenario our student will have conversations with both ex-students and collaborating staff. Further clues as to course deficiencies will be identified from these videoed conversations.
What are the expected learning outcomes?	Students will be made aware of common deficiencies in study material course design and delivery and how they can affect learners. This should help them to avoid these pitfalls when they design courses in the future.
When and how will the course be delivered?	The scenario will be presented as a walk–through, tutor-led demonstration during a workshop on study material preparation. It will also be available, in modified form, as an online scenario for self-reflective study, and for other institutions to download, amend, and/or use.
What help will students get?	Students will be prompted by the tutor during the live walk-through but they are expected to fully participate in the analysis of the deficiencies.
What reflection is required and what feedback is given?	Students will be prompted for reflection and analysis by a combination of multi-choice and short-answer questions. Feedback will be given immediately.
What study materials/ resources are available? How will they be available?	Students will have workshop materials available. These include paper-based guides on preparing good distance education courses.

What form does the assessment take?	Assessment is formative only. No scores will be kept.
Can the scenario be worked through many times or just once?	Many
Are there model answer(s)?	Yes
Will students work in teams or alone?	The course will be presented as a group exercise in real time, facilitated by a tutor. However, the scenario can also be worked through alone.

Step 2: Flowcharting the scenario

As the scenario was to be presented via the web through a series of clicks, a flowchart was needed to determine the various interactive and content screens. Initially a whiteboard was used in a brainstorming process to flesh out the plot. Once an acceptable structure was produced, this became part of the planning documentation (see Figure 2). A skeleton (a blank SBLi scenario devoid of content) was then produced with placeholders for the main locations, items and actions, just to ensure the proposed flow worked.

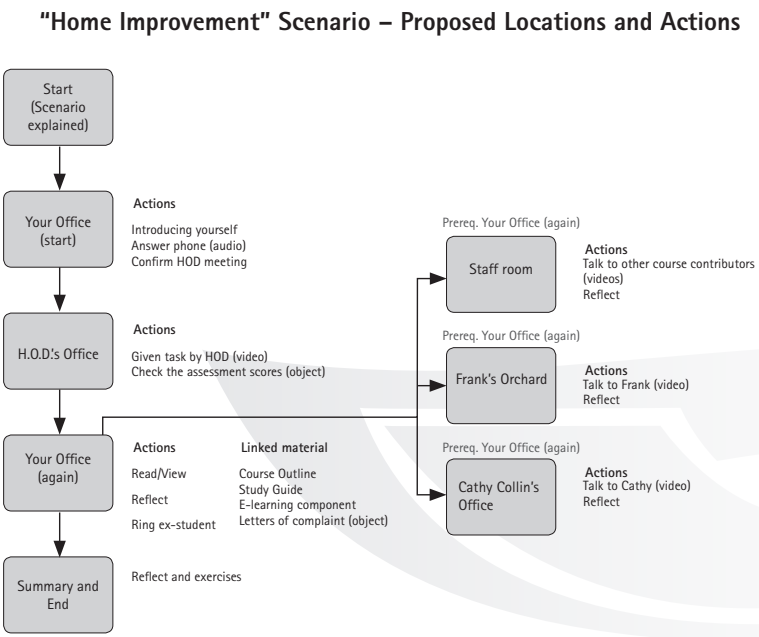

Figure 2 Scenario flowchart

Step 3: Developing the content using table schemas

A planning document containing a series of tables was developed. Initially the table held ideas and (later) final information that related to, or would be transferred directly to, SBLi. These tables were sequential (roughly following the sequence outlined in the flowchart), to make up one large schema.

The main table type was called the *content schema*. Table 2 shows a content schema template. Repeating tables of this type were used to plan (and finally hold) the scenario narrative.

Each content schema table related to a particular *content screen*; that is, contextual information that related to the scenario story was relayed to the student when an object (such as a location, item, action, or hyperlink) was clicked. Each row in the table related to particular properties of the object in the SBLi environment.

Table 2 A content schema template

Where in scenario?	*Where does this object lie in the scenario tree? Insert the pathway here (e.g. General Locations →).*
Object type and name	*Insert the type and name of the object that is clicked on to reveal this content page. It could be a location (e.g. office), an item (e.g. flowers), an action associated with a location or item, or an internal hyperlink associated with an action.*
If object is location **or** **If object is item**	*Specify the image that will be seen in the environment window in SBLi.* *Specify the icon that will represent the item. Is it collectable? (Y/N)*
Prerequisite	*What needs to be done before this object appears?* *or* *What makes it unavailable?*
Content	*What textual content will the student will see when they explore (click on) this object?*
- Media	*What media will be incorporated into the content (i.e. video, audio, still images)?*
- Hyperlinks	*What hyperlinks (to external resources or embedded internal resources) will be included in the content?*
Navigation instructions	*What instructions (if any) should the students be given about what to do next?*

Prerequisites	*Are any prerequisites set elsewhere in the scenario by clicking on this object?*
Cost	*Is there a cost in time or money? Insert it here.*

During the development of the scenario, content schemas became living documents that were refined during a series of iterative visits. The first cut described the content in general terms. It allowed the author to see what needed to be written as narrative, what was needed as reference from the content (for example, an embedded PDF, or information under or through a hyperlink), and which multimedia resources to gather. Once complete, feedback was sought. For example, Table 3a shows a content schema table during the early development phase. Other tables in the whole schema document were of a similar nature.

Table 3a A content schema table during the early development phase

Where in scenario	*General Locations → HODs Office (location) →*
Object type and name	*Action; About Jenny.*
If object location **or** **If object item**	*N/A* *N/A*
Prerequisite	*Prerequisite triggered when the location "HOD's Office" is clicked on*
Content	*The text will introduce us to the HOD. She is female, successful, and politically savvy.*
- Media	*There will be a static "head and shoulders" photo*
- Hyperlinks	*None*
Navigation instructions	*Students will be told to click on "Your Task", which will have appeared in the action window*
Prerequisites	*This will reveal the action "Your Task" immediately under the "About Jenny" action*
Cost	*N/A*

Once the content was described, the schema would be revisited, fine-tuned, and the actual content inserted (i.e., the exact names of the objects and actions and the text the student would see in the content window). The file names of the identified resources would also be given, so the author knew exactly which multimedia or embedded file was associated with particular content (see Table 3b).

Table 3b The same content schema table during later development

Where in scenario	Scenario →HODs Office (location) →
Object type and name	Action; About Jenny.
If object location **or** **If object item**	N/A N/A
Prerequisite	"HOD's Office" is visited
Content	Although only 35, Jenny Fountain has been Head of the Institute of Crops and Pasture for the past two years. Before taking on the post, she had a successful career as a science administrator in one of the Crown Research Institutes, having made her name as a leading researcher in crop science. Her energy and political savvy has seen the Institute start to grow under her stewardship. Although you've only worked with her for a short time, she has your respect as someone with a clear vision and the will to drive it forward.
- Media	jennifer.jpg
- Hyperlinks	None
Navigation instructions	*Now click on the action "Your Task" in the Action Window*
Prerequisites set	General Locations →HOD's Office (location) →Your Task (action) will be revealed
Cost	N/A

The corresponding screen in SBLi appears in Figure 3.

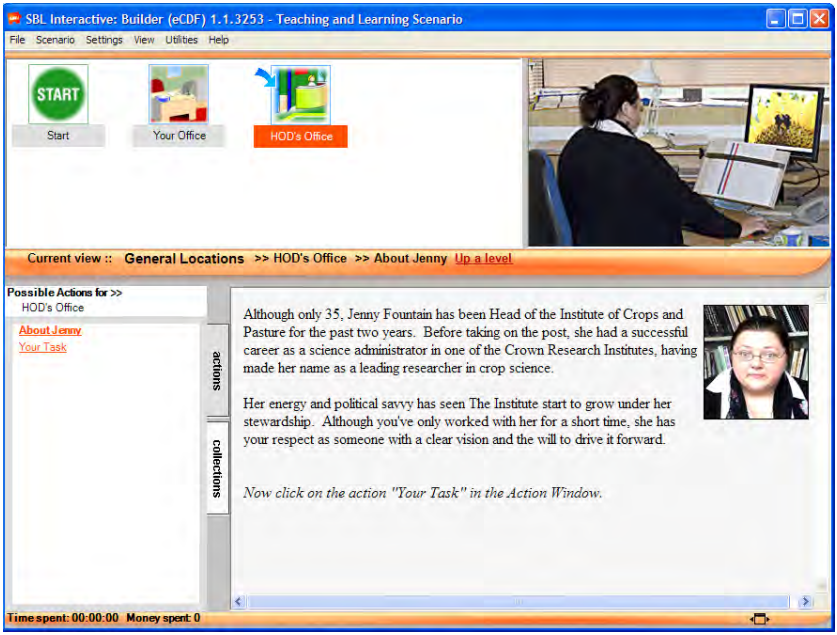

Figure 3 Final screen in SBLi, developed from the content schema table shown in Table 3b

A second type of schema, the *report schema*, was included towards the end of this stage. This schema held interactive exercises and student feedback. Report schemas were themselves of two types. One assisted with content for multi-choice and tick-box reports, and the other type helped with free-text input.

Report schema tables were inserted in sequence (as identified by the flowchart in Figure 2) in the whole schema document following the content schema tables they related to. An example of a multi-choice/tick-box report schema table can be seen in Table 4. As with the content schemas, the tables held the exact questions and feedback that were to appear in the interactive reports in SBLi.

Table 4 A multi-choice/tick-box report schema with questions and feedback content

Where in scenario?	*General Locations → Your Office (location) → Admin Guide (item) →*			
Object type and name	Action: Reflect on Admin Guide			
Prerequisite	Action: "Read Admin Guide" has been visited			
Preamble content	A good administration guide should have a number of components. Just what these are can sometimes depend on the subject being taught, but there are general features that are common to all. Let's examine these one by one, in the context of the Administration Guide you've just read.			
Question	*This Administration Guide...*			
The item the student should select	*Score*	*Score visible*	*Response if selected*	*Response if not selected*
looks good to me	*0*	*N/A*	At first glance it seems ok, but parts of it are very vague, and a number of important items have been missed out altogether!	*N/A*
just needs one or two additions	*0*	*N/A*	No, it needs more than that. Parts of it are very vague, and a number of important items have been missed out altogether!	*N/A*
appears seriously deficient	*0*	*N/A*	Yes. Parts of it are very vague, and a number of important items have been missed out altogether!	*N/A*
isn't worth the paper it's written on!	*0*	*N/A*	Well, let's not go that far. It does have some value. However, parts of it are very vague, and a number of important items have been missed out altogether!	*N/A*
Navigation directions at the end of the feedback	*Now let's go through each section of the guide and critique it. Click on new actions as they appear.* *Some tips on what should be in any administration distance learning guide will be discussed at the end of this scenario.*			
Reveals	Action: Study Guide Elements			

The content of this schema table in SBLi is shown in Figures 4a and 4b.

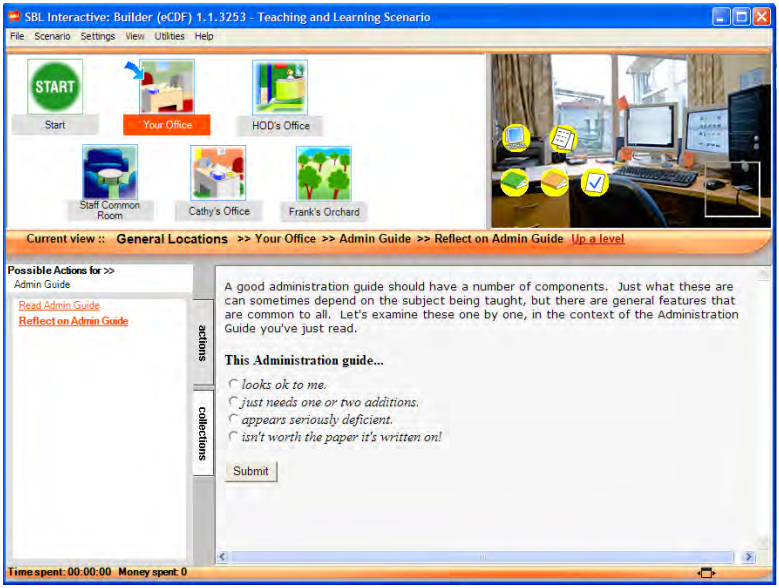

Figure 4a Screen in SBLi developed from the report schema in Table 4, posing reflective questions

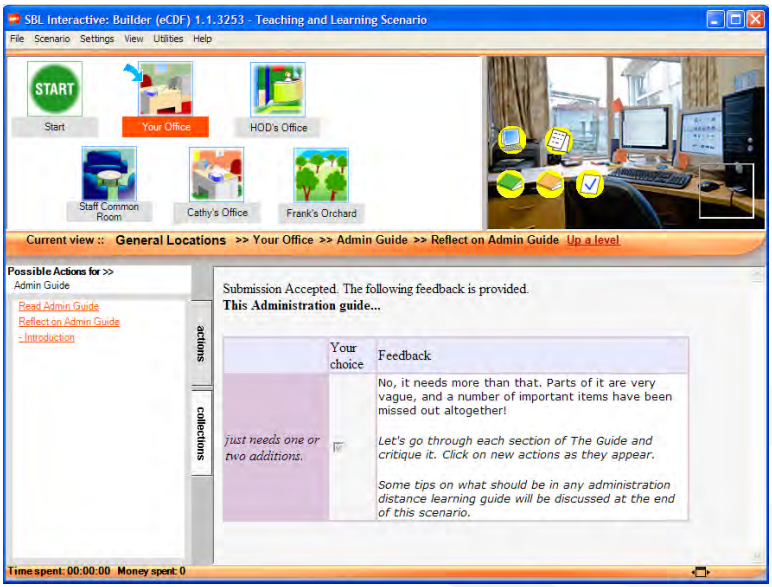

Figure 4b Screen in SBLi developed from the report schema in Table 4 after a selection was made

Once completed, the whole schema document consisted of a sequence of the tables described above. It could be read through, checked, and shared. With the exception of the multimedia content, which still needed to be produced, all the scenario content could now be pasted directly into SBLi to construct a draft scenario.

Step 4: Authoring in SBLi

Actions and items were created, and the textual parts of the content window were simply pasted in from the schema document. Icons for locations and items were obtained from libraries developed for previous scenarios.

Throughout the scenario, font styles were used to distinguish between the different roles the text played in the exercise. Narrative text was presented in Times Roman. Navigation instructions were presented in italics.

For the first draft, the video and audio scripts were included as text in quotation marks, and images representing video clips were used as place markers to show where the video would appear. This allowed the author and other interested parties to view the scenario in a form that was similar to its completed state.

When the scenario's content was near completion, the reflective exercises were included. These exercises, taking the form of either multi-choice exercises or short-answer questions, were spread through the scenario and gave the students an opportunity to reflect and analyse the content. It was a simple job to paste them into the authoring tool from the report schema tables.

Verdana font was used to distinguish reflective prose from the narrative. This prose was also written in the active voice to directly communicate with the user, posing questions and encouraging reflection.

Step 5: Adding the multimedia

The multimedia had two functions within the scenario. The first function was to engage, and the second was to convey vital information.

The multimedia sections are the most expensive part of any e-learning exercise, and they are also the most difficult parts to re-shoot or re-edit. Before these were captured, therefore, the scenario was checked extensively and tried out on volunteers as a usability check. This testing resulted in some minor editing to both the content and the flow. Once these edits were done, video scripts were finalised, actors arranged, and the video was filmed.

It was decided to include a link to a written representation of the script dialogue under the media box in the content window to allow students

exploring the scenario on their own to read the video dialogue if (for any reason) their computer was unable to play the media.

After the video and audio was edited and included, the scenario was checked again by peers. Minor tweaks were made at this point, and then the scenario was ready to use.

Use in a professional development session

This scenario was piloted late in 2008 for a professional development (PD) session on developing distance course material. The session had five participants. After an introduction to what makes a 'good' distance course, the scenario was used as a 30-minute walk-through to show what does **not** constitute a good course, and some of the problems that can arise from less than adequate study material. The reflective questions embedded in the scenario were posed to the group.

Using the scenario in a group environment (even a small group) was a new experience, because online scenarios are usually self-paced to support flexible learning. Using the scenario in a workshop raised a number of issues: Would the scenario text be large enough to be read easily via the data projector? How much of the text should participants read (rather than the facilitator)? Would interest be sustained if the scenario was used in this way? How much value did the scenario add to the workshop?

Participants found the scenario a novel way to start thinking about writing distance materials. Although they found the problems used in the study guide example 'too obvious', they found it useful in terms of reflecting on the complexities of the teaching and learning process for distance delivery. Focusing on 'what should not be done' helped raise questions about levels of support, consultation, collaboration, the curriculum, and student needs. There were problems however, in using the scenario in a small group. These problems related mainly to the form of access; the font was too small, participants had to rely on the facilitator to proceed, so it took longer than expected to work through.

Amendments to the scenario are planned to address these concerns. Nevertheless, the pilot provided sufficient evidence that interactive scenarios have great potential in the professional development of staff, especially when face-to-face workshops are blended with the advantages of flexible delivery through online self-paced learning resources.

Scenario availability

The scenario is available for viewing and/or downloading and amending at the Ako Aotearoa National Centre for Tertiary Teaching Excellence website (Stewart, 2009).

Further thoughts

The scenario produced was a useful addition to Massey University's training materials. Margolis and Bell (1984), summarising Knowles's (1980) seminal work on the way adults learn, make the point that experience is the richest resource for adult learning. They argue that "the core methodology for adult learning programs involves active participation in a planned series of experiences, the analysis of those experiences, and their application to work and life situations" (Margolis & Bell, 1984, p. 17). In accordance with Dewey's (1938) original "'Experience, Reflection and Learning" model, a simulated experience with reflective exercises seems to go some way towards providing this learning experience if first-hand practical experience is not possible. This is what the scenario aims to do, both in a workshop environment and as a self-study module, or through a blend of both delivery strategies. Notably, irrespective of the instructional context, the scenario can be used to implement Chickering and Gamson's (1987) seven principles of good practice for supporting learning:

1. Good practice encourages student–teacher contact.
2. Good practice encourages cooperation among learners.
3. Good practice encourages active learning.
4. Good practice gives prompt feedback.
5. Good practice emphasises time on task.
6. Good practice communicates high expectations.
7. Good practice respects diverse talents and ways of learning.

The key point is that these principles can be implemented through interactive scenarios because they can embed and provide a rich context for active and meaningful learning. Importantly, the crucial ingredient is not the software but rather the assumptions and learning design(s) that underpin the end product. In our experience, a robust planning framework helps to ensure that choices (about content, rich media, learning activities and so on) constructively align with the original learning intentions.

The design approach refined during this process has proved invaluable. Using simple table-based schemas and flow diagrams for scenario development may seem a minor, even trivial methodology. However, this is not the case. It is always tempting to jump right into the authoring tool and start constructing scenarios without a clear plan of all the components. This is a big mistake. The non-linear nature of most interactive scenarios, with their hidden content and pre-requisite triggers, can make it difficult to see all the component parts and how they relate to one another once the scenario is fixed in the authoring tool. Tools such as SBLi are certainly useful to quickly prototype scenarios but, as with designing websites, good planning and storyboarding of scenarios is essential. Some scenario-based authoring tools under development, such as the 'Emergo' toolkit (Nadolski, 2007; Westera, Nadolski, Hummel, & Wopereis, 2008) incorporate planning tools. However, simple techniques such as using flow diagrams and table-based schemas can also provide this framework if they are not incorporated in the main authoring program. In many respects, the major contribution of this article is to show that low-tech solutions to learning design still have a place. They can be viewed as a framework for 'conversation' with one's self. Most of all, they enforce a discipline and methodology on the scenario development process.

Table-based schemas are also flexible. For example, the senior author uses slightly different schemas to develop diagnostic scenarios for plant pathology lessons. SBLi has a collections function where objects (say a plant's roots) collected in one scenario location (say a grower's field) can be used in another location, such as a laboratory. When in the laboratory, many tests and observations on the roots which were unavailable in the grower's field (such as examination under a microscope) are now available. This is made possible by objects being flagged as 'collectable' in SBLi, and associated prerequisites being set on these objects so that their properties can change depending on the scenario location. Because the schemas are simple text tables, they can be adapted easily to this type of scenario simply by adding a few extra property rows, such as collectable items.

Lastly, once scenarios are captured in a generic format such as a fully-fleshed schema, they can be used and delivered in a variety of different ways, perhaps without using computer technology at all! They are an easily accessible archive, independent of any particular software platform. Given the time it can take to create scenarios and the rate at which software is constantly evolving, durable content is especially important.

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Terry Stewart has used and developed tools for scenario-based learning within his own discipline of plant protection for over 21 years. This activity won him a New Zealand Tertiary Teaching Award for Innovation in 2003 and a DEANZ award in 2008. He is currently seconded from his home institute (Institute of Natural Resources) on a part-time e-learning fellowship to facilitate and promote scenario-based learning at Massey University.

M. E. Brown
Director of Distance Education

Mark Brown is the Director of Distance Education at Massey University. He is a member of the New Zealand Academy of Tertiary Teaching Excellence and is past recipient of a National Award for Sustained Excellence in Tertiary Teaching. Associate Professor Brown currently chairs the University's Teaching and Learning Committee.

A. Weatherstone
Teaching Consultant

Anna Weatherstone has worked in distance education for 20 years. Her activity in this time has included designing, writing, and teaching distance courses. She is currently a teaching consultant at Massey University, providing academic development in the area of instructional design for teaching and learning at a distance.