To spray or not to spray? A scenario-based exercise for tertiary-level horticultural students

Terry M. Stewart
Centre for Academic Development and e-Learning (seconded from the Institute of Natural Resources)
Massey University

Mark E. Brown
Centre for Academic Development and e-Learning
Massey University

A scenario-based exercise was developed to expose third-year degree-level horticultural students to the complexities of modern orchard pest and disease management. Using scenarios developed and presented with the e-learning tool SBL Interactive, students are required to analyze four successive scenarios set at different growth stages in the crop, and provide justified recommendations for all. The lesson combines formative and summative assessment and uses sound learning design principles. The exercise could be adapted to workplace training. This paper describes the lesson and discusses the rationale behind the lesson design.

Introduction

Higher-level thinking skills that require integration of knowledge and complex decision-making are practiced in many walks of life. Such skills can be learned "on the job" with practice and exposure. However, controlled simulations which allow students to explore scenarios and make decisions as a result of their analyses, can assist with acquiring these skills.

One person who needs to practice complex-decision making on a day-to-day basis is an export orchard manager. The requirement to produce high-quality export fruit in a competitive global market means apple growing in New Zealand is a sophisticated business. Most fruit are grown under New Zealand Pipfruit's evolving Integrated Fruit Production scheme (Wiltshire, 2003), and hence must conform to "best practice" regarding pest and disease control. This requires growers to use hi-tech monitoring techniques, interpret the results for their particular situation and spray only when necessary and with the most environmentally-friendly products. It is often a balancing act between risk of damage and using sprays responsibly. The day-by-day decision-making involved is complex and the consequences of a mistake can be costly.

Over 2008-2009, a tertiary teaching scenario-based exercise was developed for third-year science students specializing in horticulture, which exposes them to the type of decision-making described above. Although not all of these students will go on to grow apples, the aim was to expose them to complex integrated pest and disease management (IPM), and the tools that support it, in a crop where the science was well developed. The module was funded by The Massey-Lincoln Agricultural Industries Trust, a body which aims to promote industry links with New Zealand's land-based universities. It was developed with the aid of industry experts and has the potential to be used not just with horticultural students but as a workplace training package for the Orchard Industry.

Description

The scenarios have been developed in SBL-interactive (CBIT, 2009, Stewart, 2007), an authoring and delivery system for scenario-based lessons (see Figure 1). The full assignment incorporating the scenarios is calculated to take students approximately 35 hours to complete.

Students are required to work through four web-based scenarios over a period of four weeks, one scenario per week. Each scenario represents a snapshot in time for a fictional grower at a different growth stage of the crop: green-tip, full blossom, end of November and pre-harvest. These stages were chosen as the pest and disease issues differ in each one. Much like a consultant, the students must look over the grower's shoulder, assess the situation and report if anything needs to be done.

In each scenario, students have access to past pest and disease monitoring records and the history of the crop to date, including the spray diary which allows them to see what sprays have been applied so far. The first decision they must face is to decide which pests and diseases (from a list of 12) require some kind of control at this time. Having selected a subset from the given list, they are immediately told the correct subset of problems and the reason why. For those pests and diseases that may require intervention, students are then shown current monitoring data (e.g. insect trap counts), weather data and computer model outputs (as screenshot mockups) of the various decision support systems available to real growers. Students are then required to make “best practice” recommendations for that exact point in time. Does our grower need to act now, or can they wait a day or two and re-assess the situation later? Students must describe what they should do, and justify their reasons for it, in a mini-report that forms part of the student’s assessment. Among the things a student may need to consider are:

- The risk of damage to pest and diseases attack as determined by the monitoring data, past history, recent spray applications (the crop may already be protected by a previous spray) and the time of the year.
- The requirements of the destination country. Most export markets limit the type and number of chemicals that can be used and even if allowed, they must not be applied within a certain number of days to harvest.
- Resistance management strategies. Pests and diseases can become resistant to pesticides and hence overuse must be avoided. Guidelines are drawn up for individual pesticides either limiting applications or requiring growers to mix products. These guidelines should be adhered to.
- The likely effect of any pesticide on the environment and other beneficial organisms in the crop.
- The likelihood of a particular pesticide choice affecting an unrelated pest and disease. For example, some fungicides for diseases affect predatory mites, which control pest mite populations. Overuse of these fungicides will result in mite problems.
- Compatibility between pesticides. If a grower has several problems requiring treatment it is common for them to mix pesticides in the same tank so only one application is required. However, not all pesticides can be mixed this way.
- Non-chemical options.

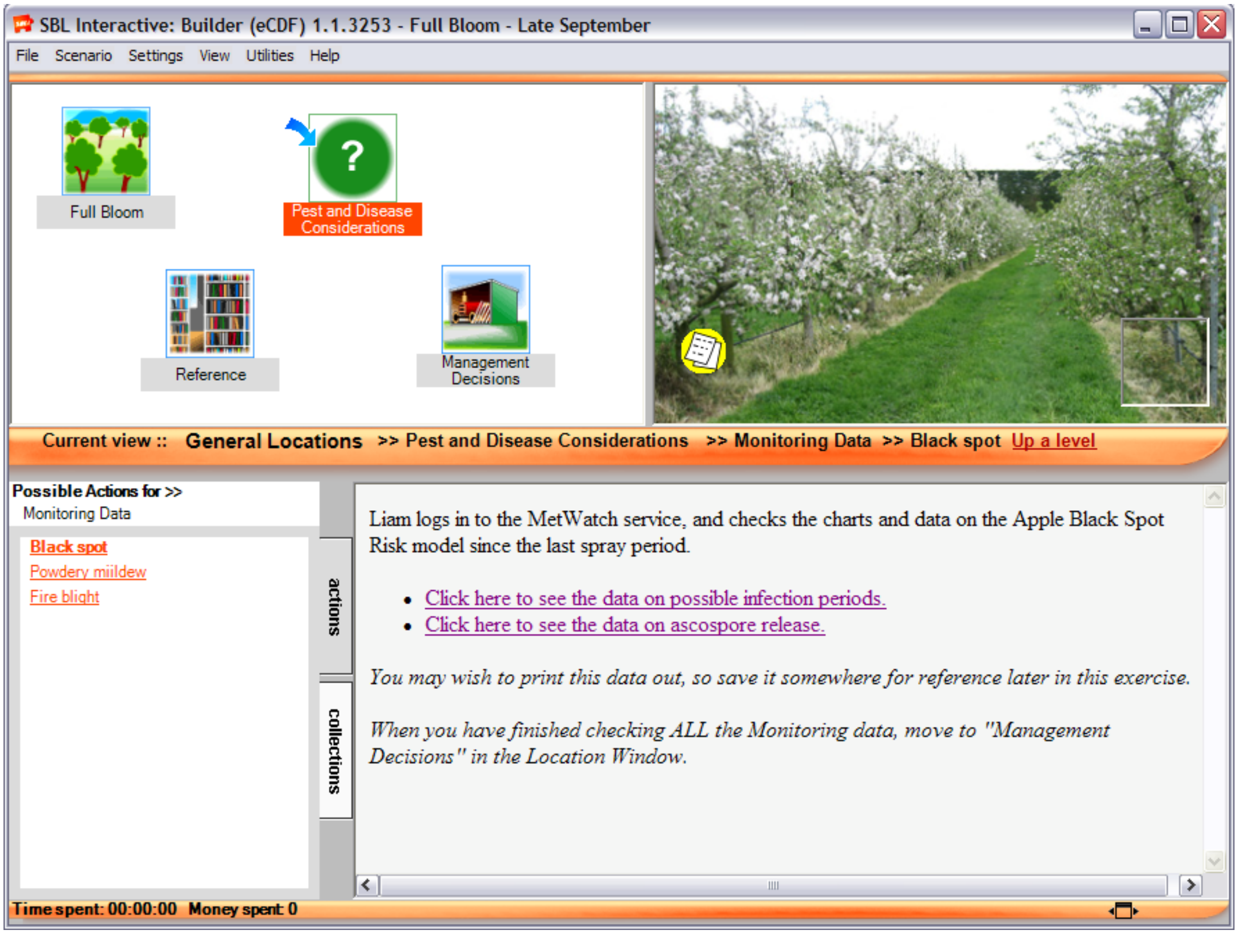

Figure 1. Part-way through a scenario in late bloom, showing disease monitoring links

There are many things to consider and decision-making can become harder as events unfold during the season. The scenarios deliberately include difficult but realistic situations, where trade-offs (say between adhering to resistance management strategy and risking crop damage) may need to be considered. In some situations there is no clear-cut "right answer" but rather the lesser of two evils. This reflects real life!

Students have a week to submit their recommendations. After the deadline is reached the scenario is then closed off and the next scenario will become available. Once this happens, students are informed what the best practice recommendations were, and these are incorporated into the history of the now-current scenario. The latter also includes as history all the events which have taken place in-between the current scenario and the previous one.

The scenarios do have some limitations in scope. Limitations were needed to allow the student to complete the exercise successfully within the allocated time. For example only one variety and crop destination is considered, which is seldom the case in real orchards.

Resources

Students have access to two types of resource to aid their decision-making. The first is advisory material such as a subset of the NZ Pip Fruit Integrated Fruit Production Manual, recommended spray charts, export destination requirements/restrictions and pesticide information. This is available from within the scenario and also in hard copy.

The second resource is orchard and seasonal-specific data, and includes past infestation records (pre- and post-harvest), current spray diary data and past and present monitoring data. This is available from within the scenario.

Assessment

The scenarios get progressively more difficult and at the end of the exercise students have the opportunity to reflect on their management by submitting a short reflective post-mortem of the exercise. The mark allocation is shown below.

- Scenario 1 – Green Tip 2 marks
- Scenario 2 – Full Bloom 3 marks
- Scenario 3 – 30th November 4 marks
- Scenario 4 – Pre-harvest 4 marks
- Reflections 2 marks

The total contributes 15% towards a student's final grade.

Discussion

Although complete, at the time of writing the exercise has not yet been used with a class, so can still be regarded a work in progress. It is due to be first used as described in 2010, but will be walked through and evaluated with a class in a formative mode in later 2009.

Preparation of this lesson drew on education theory and findings, in particular those pertaining to the concept of scaffolding. In the tradition of Problem-based Learning (PBL), scaffolding is a metaphor that refers to the level of soft and hard interactional support that is structured by the teacher to increase understanding and mastery of a given task (Brush & Saye, 2002). Cognitive load theory emphasises the importance of scaffolding when learning complex tasks (Rosenshine & Meister, 1992, Sweller & Chandler, 1994) and several lesson design elements were included to ensure students would not get overwhelmed.

Firstly, the students work through a practice scenario, to get them used to the interface and the kinds of decisions they will be required to take. Next, the lesson is sequenced in complexity. As the season progresses, each scenario becomes more difficult and the issues harder to grapple with. This is what actually happens in orchards during the growing period, but this gradual progression from simple to more complex *task classes* during each scenario is known to aid learning (Bannert, 2002, van Merriënboer ,1997).

Furthermore at the beginning of each scenario, after being given the opportunity to figure them out themselves, students are assisted by being told the important pests and diseases which need to be considered. This is a good example of scaffolding where the novice student benefits from learning crucial information from a more experienced expert. Students can then limit their decision-making to only these organisms. In essence each exercise is a *completion task*, a technique which decreases cognitive load but still forces study (van Merriënboer *et. al.*, 2002)

Students are required to submit a report for each scenario which contributes towards an overall mark. However, once the scenario deadline is closed off, students are given a model answer to further scaffold their learning, the results of which feed into their next scenario. Hence a combination of both formative and summative assessment is incorporated in the lesson.

Reference material is provided not only electronically but also in print form. There is evidence to suggest that students find it easier to use print-based material when they need to refer to it frequently, and make frequent cross-references (Liu, 2006). Hopefully this decision will be validated through the pilot and initial use by a class of students.

Finally, at the end of the scenarios student are given the opportunity to reflect on their performance. Reflection is a well-known contribution to learning (Moon, 2000). The nature of this reflection and the best way to scaffold it will be determined after an evaluation of the first use of the scenario with students.

The exercise was developed in the first instance to give degree-level horticulture students exposure to the complexity of modern pest and disease management. However, it may also form the basis of a grower and workplace training package. This option is likely to be explored in the future. The scenarios are still a work in progress but early indications from colleagues and those in the industry are promising and we hope to report the outcomes of this project in future accounts of this work.

References

Bannert, M. (2002). Managing cognitive load—Recent trends in cognitive load theory. *Learning and Instruction*, 12, 139–146.

Brush, T. A, & Saye, J. W. (2002). A summary of research exploring hard and soft scaffolding for teachers and students using a multimedia supported learning environment. *The Journal of Interactive Online Learning*, *1(2)*. Retrieved on August 9, 2009 from http://www.ncolr.org/jiol/issues/PDF/1.2.3.pdf. [viewed 12th Aug 2009]

CBIT. (2009). *SBL Interactive*. http://www.sblinteractive.com [viewed 8 Aug 2009].

Liu, Z. (2006). Print vs. electronic resources: A study of user perceptions, preferences, and use. *Information Processing & Management* 42(2), 583-592

Moon, J.A. (2006). *Reflections in learning and professional development.* London, Kogan Page.

Rosenshine, B. V., & Meister, C. (1992). The use of scaffolds for teaching less structured cognitive tasks. *Educational Leadership*, 49(7), 26–33.

Stewart, T.M. (2007). Tools and techniques for scenario based e-learning for New Zealand tertiary students: Prototype to adoption. In *ICT: Providing choices for learners and learning. Proceedings ascilite, Singapore 2007*. http://www.ascilite.org.au/conferences/singapore07/procs/stewart-t.pdf

Sweller, J. & Chandler, P. (1994). Why some material is difficult to learn. *Cognition and Instruction*, 12, 185–233.

van Merriënboer, J. J. G. (1997). *Training complex cognitive skills: A four-component instructional design model for technical training*. Englewood Cliffs, NJ: Educational Technology Publications

van Merriënboer, J. J. G., Clark, R. E., & de Croock, M. B. M. (2002). Blueprints for complex learning: The 4C/ID*-model. *Educational Technology Research and Development*, 50(2), 39–64

Wiltshire, J.W (2003). Integrated Fruit Production in the New Zealand fruit industry. http://events.lincoln.ac.nz/kelloggs/Jono%20Wiltshire%20-%20IFP.pdf [viewed 8 Aug 2009].

Acknowledgements

The authors would like to thank The Massey-Lincoln Agricultural Industries Trust for funding the project. We would also like to thank Mike Butcher of Pipfruit New Zealand Incorporated and Dr Jim Walker of The Institute for Plant and Food Research Limited who provided much of the advisory material.

Author Contact Details

Dr Terry M. Stewart (t.stewart@massey.ac.nz)

Associate Professor Mark Brown (m.e.brown@massey.ac.nz)

Centre for Academic Development and e-Learning (CADeL)
Massey University
Private Bag 11 222
Palmerston North

Bios

T.M. Stewart

Terry Stewart has used and developed tools for scenario-based learning within his own discipline of plant protection for over 21 years, an activity which won him a New Zealand Tertiary Teaching Award for Innovation in 2003 and a DEANZ award in 2008. Currently he is on secondment 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 generally

M.E.Brown

Mark Brown is the Director of Distance and Blended 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.

Please cite as: Stewart, T.M. and Brown, M.E. (2009). To Spray or not to Spray? A scenario-based exercise for tertiary-level horticultural students. In *Same places, different spaces. Proceedings ascilite Auckland 2009*. http://www.ascilite.org.au/conferences/auckland09/procs/stewart.pdf