

Sir Victor Davies Foundation for Research into Ornamental Horticulture

Grant report

Dr Bruce R MacKay
Institute of Natural Resources
Massey University

This grant supported my research into the use of scenario-based learning techniques to aid understanding and uptake of new information and ideas in nursery production. The funds supported an overseas trip in which I delivered a poster and attended workshops at the Annual Conference on Case Study Teaching in Science (University of Buffalo, State University of New York) and visited horticulture faculty from the University of New Hampshire and University of Minnesota to discuss and learn more about case study teaching.

The overarching response from all these audiences to my approach to interactive online case studies was extremely positive and as a consequence, I am currently involved in two collaborative projects with faculty from the University of Minnesota and the University of Florida.

I have also initiated projects that I expect will benefit industry sectors across the New Zealand horticulture industry by attracting more young people into the industry and further educating those already involved in the industry.

- In August I presented a paper to the Horticulture Education & Training Symposium at Lincoln University. In this paper ("Growing together: collaborative opportunities in horticulture education": Appendix 1) I suggested that outcomes for learners at all levels of horticulture education would be improved through a more collaborative approach to providing learning resources. I detailed how a proposed online learning site would benefit both teachers and students involved in horticulture from secondary school through to university.
- As a result of this presentation, I am now working with a leading group of secondary school horticulture teachers to develop interaction case studies for students. Our first case involves potato production, with subsequent cases planned for fruit production and plant propagation. My long term goal in this project is to develop cases that will be useful in other school subject areas (e.g. science, physics, engineering, mathematics) to demonstrate to students that a career in horticulture is much more than simply "picking fruit or weeding".
- Together with colleagues from Massey and Lincoln universities, I am developing a proposal for developing interactive cases in fruit, vegetable, flower, and nursery production for our students to improve their ability at integrating soils, nutrition, plant health, crop physiology, and business management principles into practical

solutions that meet business goals. We hope to begin developing these cases by mid-2007.

- The December/January edition of *Commercial Horticulture* contains an article on interactive case studies being used at Massey for training in greenhouse crop production (Appendix 2). The article contains a link to a web site containing one of the case studies we use; I will be basing decisions on further expansion of the site for the nursery industry on feedback from those participants who test themselves against the case study.

I thank the Sir Victor Davies Foundation for Research into Ornamental Horticulture for their grant. It has helped my project considerably and the initiatives now underway will benefit not only the New Zealand nursery industry, but the wider horticulture sector.

Appendix 1

Growing together: collaborative opportunities in horticulture education¹

Dr Bruce R MacKay
Institute of Natural Resources
Massey University
Palmerston North

The possibilities, the challenges and the rewards of a career in horticulture are substantial, but I'm sure that most of you here today would agree that horticulture is not generally perceived this way by young people and their advisors – it has an identity problem. To many of these people, horticulture is perceived as a job, not a career; an occupation, not a profession; wage rather than salary-based, and most importantly, associated with manual rather than thinking skills.

I wonder how many of you will agree with me that this perception is one that horticulture educators have helped create and are certainly responsible for sustaining.

One of the particular characteristics of horticulture is that it requires a diverse range of skills and knowledge: from field and practical skills and the understanding that goes with them, to the integrative skills associated with solving problems, managing complex production systems, and developing innovative products and solutions. This complete spectrum of abilities is needed in a horticulturist, but in my view, the current (traditional) approach to horticulture education is too preoccupied with the need to establish a firm practical skills base; how to prune, how to graft, how to cultivate and how to spray. This emphasis on practical skills permeates horticulture syllabi from school to tertiary level and has moved laterally into the job descriptors of horticulturists in career information resources, both print and online. As a result, it is hardly surprising that, to an outsider, a career in horticulture is seen as largely a job involving manual labour, and as a corollary, a less than favorable career path to choose.

Now I hasten to emphasise here that I am not just some ivory tower dweller suggesting that the practical skill side of horticulture is not important – it is important and I can prune and graft and cultivate and spray with the best of you and I am proud of those skills. My point is, however, that the prominence of the practical skill side of horticulture in educational programmes is resulting in a distortion of the picture of horticulture being presented to young people - the equally important thinking side of horticulture is not being seen.

I am focussing on the relationship between practical and thinking skills in this presentation for two reasons. First, I want you to join with me in a project that addresses this relationship and will help us all better develop the thinking skills in our students needed for success in horticulture. Second, I believe that this project has the potential to improve horticulture's identity problem particularly in our schools.

Addressing the thinking side of horticulture

To illustrate my view on the importance of thinking skills, consider this scenario:

¹ Presented to the Horticulture Education & Training Symposium, 15-17 August 2006, Lincoln University, Christchurch.

It's Monday morning in late spring and the production manager is walking through the twin-skinned polythene greenhouses, having just got back from two week's holiday. She immediately spies a batch of plants that just don't look right – the crop looks “patchy”, growth is not as vigorous as it should be, and some of the plants are showing nutrient deficiency symptoms, especially on new growth.

After examining the plants carefully, she questions her staff about their management of the crop, tests the fertiliser dilutor, the fertigation EC and the growing medium's pH and EC, and checks the crop's graphical track and the archived logs of greenhouse temperature and light records. From her observations and the information she has collected she concludes that the cause of the problem is poor root health due to Pythium which has been accentuated by low greenhouse temperatures and overwatering. As a consequence of the poor root health, inadequate levels of nutrients have been taken up. Given the stage of the season and the market, she decides the most economic solution is to dump the crop rather than spend money and greenhouse time trying to coax the crop back to health.

This scenario embodies what I believe horticulture is all about: an amalgam of biological and chemical sciences, physics, art, plant empathy, communication, numeracy, innovation, and business. The practical skills element of this amalgam is important, but a more important measure of potential career success in horticulture is the ability to think: to conceptualise, to integrate, to analyse and to strategise.

Over the past decade and against a background of falling levels of resources, reduced levels of student contact, and seasonally-unfriendly course timetables (where production horticulture papers are routinely scheduled for delivery in a 13 week period during winter!), I have been grappling with the problem of how to get our students to think and to integrate like our production manager. The default response amongst many of the educators I've spoken to both in New Zealand and overseas has been that this ability comes with experience – our job is just to make sure the building blocks are in place.

Over more recent years, however, I've come to the conclusion that this response has been more a reflection of our inability to teach our students to think and integrate like an experienced horticulturist in the time we have available with them – the tools have just not been available. My belief is that now we do have those tools. I have made progress towards solving this educational challenge by developing a unique set of online, interactive learning tools that promote the active thinking in my students that I'm seeking to achieve. These tools include:

- virtual crop simulators that “grow” crops of vegetable and houseplant crops to aid learning in crop density and crop scheduling
- degree C-day simulators that generate temperature data to support learners of crop scheduling and plant responses to environment
- dynamic numerical problem generators that supply unique questions (and worked answers) on irrigation and nutrition
- interactive e-books that allow learners and teachers to question/query/discuss subject content from “within” the book
- interactive case studies in which learners are presented with an applied problem and one or more pre-defined pathways, each containing a series of decision nodes. Some of the pathways are dead ends, while one or more lead to solutions. Sets of additional data (e.g. laboratory analyses of growing media), cost constraints associated with accessing additional information or services, and a range of possible courses of action are provided at the decision nodes

These tools now form the “jewels in the crown” of a fully functional e-learning platform (ProLearn) that I have been developing over the past decade in association with colleagues at Massey and overseas. In addition to these tools, the platform has a full array of conventional e-learning functions including summative and formative quizzes, slideshows, forums, and chatrooms etc. along with a full complement of administrative tools such as classrolls, gradebooks, group management, site content publication, and lesson aggregators.

The concept

As this project has developed and matured, my attention has been drawn to the wider opportunities that the platform, its tools and its content could provide New Zealand horticulture education at all levels.

Picture a web site that:

- can achieve a degree of learning that conventional face to face teaching methods cannot achieve
- accommodates an unlimited number of individual classes each acting independently of, and invisible to, each other on the site, while simultaneously accessing material from the same resource “pool”
- provides horticulture educators from all levels of the framework the ability to easily establish multiple online classes with full e-learning functionality (e.g. classrolls, gradebook, forums, slideshows, file transfers, etc *plus* unique interactive learning tools designed for horticulturists) with content for a particular educational activity/training course selected from the site’s databases and organised into modules using online aggregator wizards
- allows industry organisations to access e-learning material specific for their members to meet continuing education services/responsibilities for their members
- has quality content collaboratively provided by contributors from across the education and industry spectrum who use their areas of expertise for the benefit of all in exchange for gaining access to quality learning material in areas in which they don’t have expertise
- gives secondary school teachers of science, biology, chemistry and mathematics (and horticulture) access to downloadable or interactive online real-(horticulture) world examples relevant to their curriculum and that demonstrate the thinking side of horticulture
- significantly reduces the hurdles faced by many educators in providing online resources of sufficient quality and range to sustain their students’ interest
- provides support, training in e-learning pedagogy and has an ongoing programme of development and refinement of new and existing learning tools
- has content which is up-to-date, accurate, appropriate to its audiences, sustainable, and adds value to its contributors’ education programmes due to the presence of an overarching steering group consisting of representatives from industry and contributing education providers

As this is a new model for managing and delivering collaborative online resources, I think it is important to highlight what the site is not.

- It is not simply a portal containing organised lists of links to horticulture resources held at other sites.
- It is not an organised structure of countless pages of information (e.g. in the style of those sites run by the horticulture departments of some of the larger American universities).

With all due respect to the people running both these types of sites, such sites do not encourage learning; they simply provide information and so in this regard they are no more useful in helping a student learn how to solve nutrition problems in a greenhouse crop (for example) than is a book on greenhouse crop nutrition on a library shelf. Moreover, while the information they contain might be relevant and valuable in the context of the horticulture industry they serve, the information is often not relevant or appropriate for the New Zealand context.

The site I envisage encourages learning; it is an e-learning site that will allow you to organise content and use the integrated learning tools appropriate for your students (apprentices, undergraduates, or growers) to actively transform that content into knowledge.

Proof of concept

This model has developed beyond being just a concept. For the past three years I have been involved in a collaborative project (<http://www.florasoil.com/>) using the platform with horticulture educators at the University of New Hampshire. We have independently operated classes for our own students, those of another university (Cornell), and staff from US greenhouse companies (the latter in both English and Spanish) on the platform, sharing content that each of us has contributed. Additionally, the platform is being used on a commercial site (<http://www.plantdocs.biz/>) providing online training in greenhouse crop nutrition independently yet simultaneously to several different industry groups on the same site, again in both English and Spanish.

The collaborative nature of the relationship between the contributors in these projects, coupled with the open-source nature of the software underpinning the platform, has resulted in substantial refinement of existing e-learning tools and the development of new ones. The value of not being constrained by a proprietary e-learning platform in achieving significant advances in e-learning pedagogy is important. We have used this freedom to develop applications that exactly meet our needs as horticulture educators. We are not forced to try and make someone else's application fit our needs – those of you who have experienced this problem know that the fit is rarely perfect and unsatisfactory compromises are frequently needed to be made in order to “make it work”.

We know from our students that we are making a difference in their learning and approach to learning. We survey our students at every opportunity about their learning experience. The response has been overwhelmingly positive with considerable enthusiasm for the functionality of the site's learning tools and activities.

The proposal

I propose that we establish a collaborative e-learning site for New Zealand horticulture educators using the ProLearn platform.

This educational resource (Fig. 1) will:

- provide training/experience for students in real-life decision making/problem solving activities encountered in horticulture
- provide educators and their students access to a range of novel learning resources developed purposely for horticulture education
- gain the benefits of the different specialisation and skills of horticulture educators throughout New Zealand for the greater educational good
- encourage greater innovation and development in online learning tools for the benefit of education/training throughout the New Zealand horticulture sector

- reduce the inertia faced by individual educators in establishing and maintaining an online element to their programmes
- provide an alternative view of what horticulture means and entails to young people and their advisors

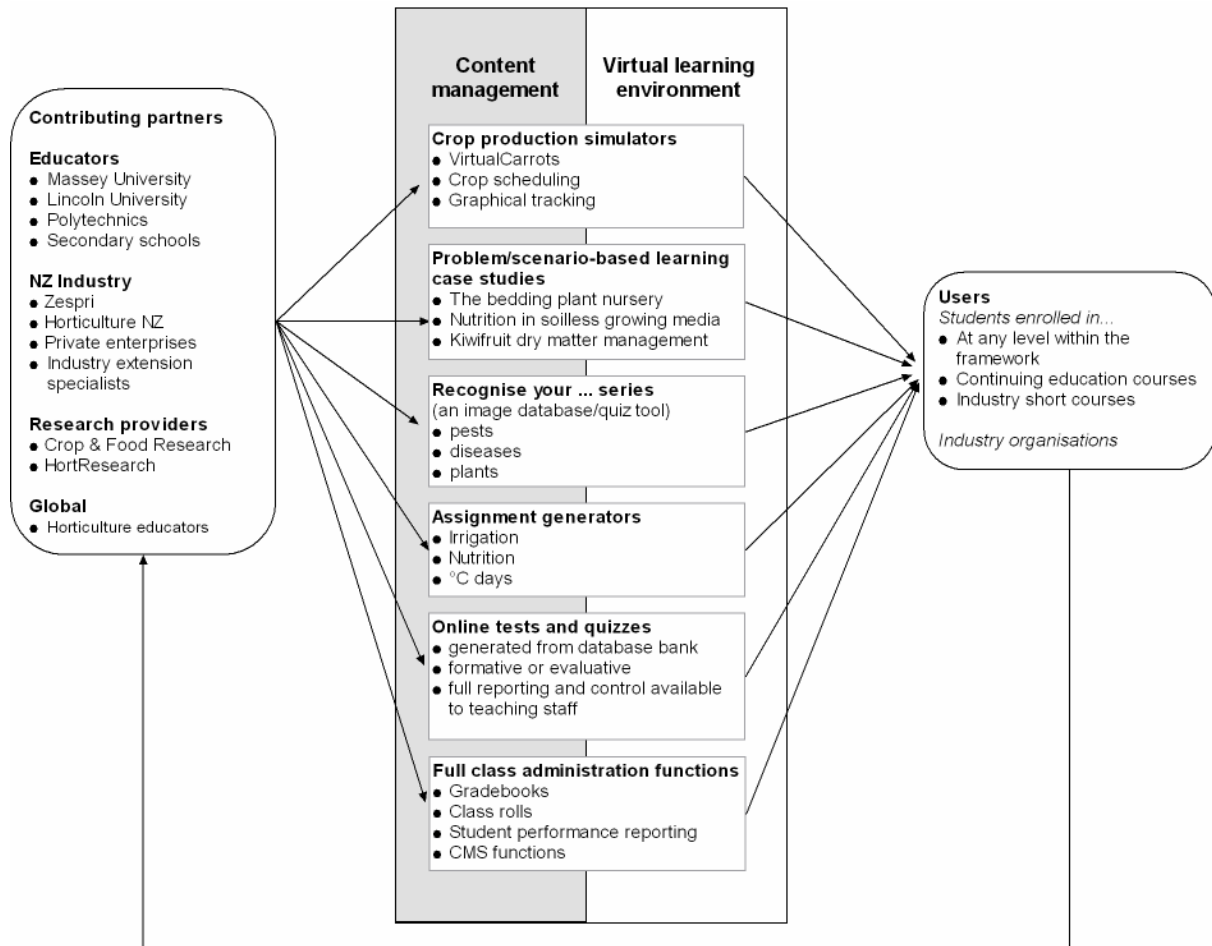


Figure 1. Schematic structure and possible partners of proposed collaborative educational resource.

“Frequently asked questions”

From a solely technological point of view, bringing this proposal to a tangible online entity is entirely achievable. However, as we all know, technology considerations will be well down the checklist of the administrators to whom most of us will need to present a case before a final “proceed” decision can be made. There are some important issues that must be addressed, and without wanting to preempt policy decisions that would be the result of wide consultation amongst potential users and supporters of this resource, I’d like to address some of these issues as I see them.

1. Is this a Massey University web site?

No. In terms of ownership, the site will be owned by the contributing partners – the education providers and industry groups, and decisions about the site’s operation will be made by a steering group made up of the partners. The URL would not be a Massey domain name.

The site may well be *hosted* at Massey University given that I already have a server running ProLearn and the ancillary third party software it uses, but this fact would be invisible to all users.

2. *Who owns ProLearn? Is there going to be an annual fee to use it?*

I own ProLearn and I will be making it available to this project on a non-exclusive license at no charge for an indefinite period.

3. *How stable is the ProLearn platform?*

ProLearn is very stable – and very easy to use. ProLearn has been servicing teaching sites at Massey University since 1998 in disciplines ranging from creative writing, poetry and academic writing through to horticulture, weed science and capstone papers. In the majority of these sites, specific learning tools have been developed to meet the distinctly different needs of the disciplines using it. This year it will provide the e-learning environment for over 1800 students.

4. *Why should I prepare teaching material that someone else will use? What will I get out of it?*

The same question could be asked of scientists who publish the results of their research. Why tell others of my findings so that they can use them for their own benefit? The answers are much the same:

- Your contributions to the site will go through a peer-review process before they are brought online so you will be able to claim your contributions as peer-reviewed outputs.
- Additionally, every time your learning activity is used by a student, a log will be generated so that you will be able to subsequently demonstrate to your line managers how useful your learning activity is to learners and other educators
- The quality/approach/innovation shown by you in your learning activity will set standards or benchmarks for others to follow, thereby raising the overall standard of e-learning resources
- In addition, by providing content, you will be able to access the content provided by others.

5. *But won't other educators be able to pass off my work as their own?*

No. The names and contact details of the author(s) of each learning activity on the site will appear on the activity and will not be erasable by other educators using the activity on the site.

6. *Will I have to learn about HTML and javascript etc and how to use web editors?*

No, not at all. If you can copy and paste from your wordprocessor and click your mouse, you will be sufficiently skilled to use all the functionality offered by ProLearn.

7. *Our institution uses a proprietary e-learning platform. Will my students be able to access the resources on the proposed site from within our platform?*

A qualified "Yes". Your students will be able to access the resources but they may need to log into the site (from within your platform).

8. *When do you see this site being launched?*

Assuming we can attract funding and institutional support, we could be ready for launch in 2008.

9. *Who is going to pay for all of this?*

I would hope that government agency funds will help us through the first two years of the site's operation. While continued funding past this period would be nice, it is not something we should realistically expect or plan for. Subsequent funding could come from a variety of sources:

- The site's partners – this site will substantially reduce the costs associated with their courses/programmes and so it would be appropriate that they contribute to the site's upkeep and development

- Industry organisations – several sectors of the horticulture industry currently offer funding assistance to educational initiatives in the form of scholarships and grants²
- Subscriptions – we might offer annual subscription-based access for educators who cannot contribute content but want access to the site, or for overseas educators wanting access to the site
- Advertising/sponsorship – providers of horticultural services and products could be allowed promotional space in “designated areas” on the site.

The next steps

If sufficient interest is forthcoming as a result of this presentation, I suggest that the action plan to make this proposal happen would look something like:

- Establish a working group to:
 - develop a business plan
 - secure institutional-level support
 - identify and secure funding
 - develop policy for site use and access
 - identify and prioritise content areas
 - establish communication channels within the NZ horticulture education community
- Establish a prototype site for training and testing purposes
- Conduct training courses in e-learning pedagogy and the use of the site

Summary

As an industry, we have well established educational structures that ensure that the practical and conceptual sides of horticulture are taught and taught well. In the past we may well have done as good a job as we could in training our students to think and integrate given the available pedagogy, but my belief is that this part of our educational effort will be well served by the opportunities inherent in online presentation and engagement. I believe that the model for a collaboratively developed online learning resource for horticulture education presented here will provide a positive contribution to improving our students’ training and addressing the identity problem we need to fix if we are to attract and support more talented and capable young people into a career in horticulture.

² The Sir Victor Davies Trust Fund has supported the author in developing some of the concepts and tools that are part of this proposed horticulture education site.

Appendix 2

Practical lessons from virtual crops³

Soldiers do it, airline pilots do it, astronauts do it, and now horticulture students do it – they learn practical skills in a virtual world. Dr Bruce MacKay, a senior lecturer in horticultural science at Massey University, writes about how the virtual world is changing the way horticulturists are being trained.

The evolution of the Internet over the past 25 years has seen an unprecedented change in the range, availability, and distribution of educational programmes for the horticulture industry. To those of us involved in horticulture education, this evolution has brought new challenges as we seek to take advantage of the educational benefits that are said to occupy the virtual classrooms of the Internet, while still meeting the need to provide students with sound practical skills and knowledge.

Do these virtual classrooms actually improve student learning and practical skills development compared to the conventional “hands-on” approach? Because I know for sure that no one is ever going to seriously suggest we teach budding and grafting skills in a virtual classroom, I can answer this question with a confident “Yes – sometimes”.

Think about those practical skills you employ when you notice a crop that isn’t growing as well as it should. You either recognise the symptoms and remember the likely cause because you’ve encountered the problem before, or you’ll start reviewing the symptoms and possible causes against a mental checklist until you identify the cause of the problem and, as a consequence, a solution. Regardless of the path you take, the skills you employ to identify the problem are practical in nature, and your solution will also be practical.

Training students to develop these types of practical skills has always been difficult in a conventional classroom setting. It is difficult to provide “hands on” experience with any more than one or two real examples given the constraints imposed by course timetables and availability of greenhouse space and production staff. Given the large number of inter-related factors that can go wrong during the production of a crop, students only get experience with one or two examples – and that is insufficient for them to gain useful skills in this area.

Over the past two years, we have been developing an Internet-based learning tool that gives our students much better opportunity to develop these types of practical skills – and it’s all done within a virtual classroom.

The learning tool, appropriately called Ramosus (Latin for “full of branches; branching”) allows us to create case studies within a virtual world in which the student is placed at the centre of a real-life scenario and problem. The student must find a solution to the problem from amongst a range of options and additional pieces of information, many of which

³ Submitted version of article due for publication in *Commercial Horticulture* (Dec/Jan)

incorporate real-life constraints. As they work their way through the problem, the students learn to filter the options into those that might yield valuable clues from those unlikely to be useful. They learn to prioritize potential sources of useful information subject to constraints such as time, weather, cost, and actual likelihood of gaining useful information. For example, should they measure a growing medium's pH and EC themselves and get reasonably accurate values more or less immediately, or wait a couple of days for a commercial laboratory to provide more accurate measurements? What impact will this delay have on final crop quality and is it the best use of available funds? Indeed, is it even a valid option to measure the medium's pH given the scenario they are facing?

Our virtual classroom can be accessed from anywhere in the world, so our students are able to benefit from the input of knowledge and experience of world-class authorities. For example, several of our greenhouse crop case studies have been written jointly with Professor Paul Fisher (University of Florida) and Dr Bill Argo (Blackmore Company), both world-class experts in greenhouse crop nutrition. Paul and Bill benefit from being able to use our unique learning tool for their students and growers. This win-win outcome would not have been possible in a conventional classroom-based educational setting.

Student response to this form of learning has been extremely positive and it is noticeable that students who complete the case studies do have a wider understanding of what can go wrong in a production system and how best go about identifying and solving the problem.

We are developing the concept further and creating more case studies in a wide range of topics – and in this regard I'd like to acknowledge the financial support of the Sir Victor Davies Trust.

"The case of the sick greenhouse crop" is an example of how we teach practical skills in a virtual classroom. It can be freely accessed from the web page at <http://horticulture.massey.ac.nz/lessons.asp>.

Dr Bruce R MacKay
College of Sciences
Massey University
b.mackay@massey.ac.nz