Developing a multimedia package for university teaching and learning – lessons learnt

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Abstract

A team of staff at the University of Western Sydney (UWS) were involved in developing a multimedia package, called Sustainable Water Use in Agriculture (SWAG), to assist the first and second year students to learn about the use, management and conservation of water in agriculture. A range of media techniques including text, sound, diagrams, pictures, video clips and animation were used to present the subject matter in an interesting, interactive and effective format. It also contained activities that students can undertake interactively to reinforce and test their learning. An important lesson from this project is that developing a multi-media package is a complex task and requires considerable time, effort and budget to develop an effective student learning package. It also requires a multitude of skills that are not always available in university lecturers who are more likely to be content experts than programmers of such packages. The effort, time and budget required for developing a multimedia package is another important consideration and should not be taken lightly. Further, to ensure success, due consideration must be given to make up and size of the project team and issues of compatibility of the package with the future hardware and software. Overall, the lessons learnt provide a starting point for academics who intend to develop similar packages for the first time. It may also help to handle some key issues and challenges that could occur in developing such packages more effectively.

Introduction

Over recent decades electronic technology has penetrated all aspects of society (Strommen and Lincoln, 2002). With continuing advances in the power of computers and the internet, particularly the speed at which data can be transmitted, and the volume of data that can be stored continues to change the way we teach, learn, and interact inside and outside classroom settings. In effect the use of this technology is changing and redefining teaching and learning in the classrooms (Strommen and Lincoln, 2002; Provenzo et al., 2005). The challenge is to find ways to employ these advances to enhance the effectiveness and efficiency of student learning and make the whole learning process easier and more fun (Buckley, 1999). Another challenge in the use of this technology is establishing information, knowledge, concepts and practical examples for students to gain the required level of competency (Peled, 2000). The success of computer technology for teaching and learning will therefore depend on the design of content delivery, use of media techniques and appropriate packaging for efficient learning outcomes for both student and teacher (Provenzo et al., 2005).

The term multimedia is often used in teaching and learning through the use of computers and the two words multi (many) and media (communication/transfer medium) define the broad meaning of the term. It basically means many media (text, graphics, animation, video and sound) working together to present information to the learner via the computer. One important feature of multimedia package is its human interactivity.

Interactive multimedia experience is based on the combination of television and computer technology (Strommen & Lincoln, 2002). However, a useful multimedia package needs to be more than a collection of multiple forms of media (Provenzo et al., 2005). It particularly needs to emphasise a complex interaction of stimuli to make learning interesting and exciting (Lee, 1999; Kiili, 2005). Well designed multimedia packages help the learner to easily interpret and understand the material presented and provides adequate clues to navigate through the functions of the program. In contrast, a poorly designed package can be difficult, frustrating and uninspiring (Lee, 1999).

With ease of accessibility and interactive capabilities, computers have enormous potential to increase awareness, knowledge and skills in complex subjects such as

water resources management. They can (i) store considerable information; (ii) present the learner with text, sound, diagrams, pictures and animation; (iii) respond to contributions keyed in by the learner; (iv) give immediate feedback to the individual learner; (v) meet specific needs of learners; and (vi) provide opportunities for learners to self-test and monitor their learning. No other available teaching method easily offers the above features for learning at the student's own pace. In particular, distance education courses can greatly benefit from such innovative technologies (Hitchings et al., 2001) and well designed self directed multi-media packages can be an effective resource for delivery of subject matter.

Multimedia packages have been used in teaching and learning to reduce face to face teaching and make student learning more effective (Laurillard, 1987; Heerman, 1988; Hativa & Lesgold, 1991; McNaught, 1995). A variety of programming languages and subject areas have been attempted (e.g., McBratney et al., 1992; Carter, 1995; Felix, 1995; Smerage & Beck, 1996) in the production of such packages, however, the availability of the packages (particularly for science related courses) is still somewhat limited. With pressure increasing globally on universities to deliver quality learning outcomes while saving staff time in teaching, the role and potential of multimedia package needs further exploration. Also, there is a need to provide appropriate support in the development of such packages.

In Australian context, the higher education sector has experienced funding cuts and associated increased staff-student ratios (Cairns, 2007; Marks, 2002; Pollard & Chan, 2006). The outcome has been an increased need to develop alternatives to the traditional teaching and learning approaches of 'talk and chalk'. Increasingly there is also pressure on academics to increase their research activities and improve the teaching and learning outcomes. A significant proportion of students these days also work part-time and substantial numbers subsequently skip traditional lecture schedules that clash with work commitments (McInnes & Buckridge, 2000). Furthermore, students use computers and the internet on a regular basis to access learning material and undertake research for their assignments and projects (Provenzo et al., 2005). In most science and engineering subjects, there are often some teaching contents that are easily amenable to self-study mode by students through multi-media packages. In particular, well designed packages can be valuable and probably more effective in the study of concepts and processes and explaining facts and figures about a particular aspect of the subject matter. Therefore, multi-media packages can play an important role in the current

higher education sector environment to reduce staff workload and facilitate improved teaching and learning, and they thus can create a 'win-win' situation for both staff and students.

The main aim of this paper is, using the multimedia development project at the University of Western Sydney (UWS) as a case study, to discuss the process of package development and to examine the key issues and challenges that are encountered in developing a multi-media package. We also reflect on some key lessons that may benefit future package developers.

Motivation for developing a multimedia package at UWS

A number of undergraduate courses related to natural resource management, agriculture and environmental sciences at UWS emphasise experiential education (*cf*. experiential learning) philosophy that focuses on learning through action (e.g., Burgin et al., 2005; Vickers et al, 2004). The emphasis of this philosophy is to purposefully engage learners in direct experience and focused reflection to increase knowledge, skill, competency development and understanding of their values (see e.g., Bawden, 2005; Vickers et al., 2004). In this educational approach media techniques are a powerful option as they can help in self-directed learning. Further, they can facilitate interactive and active learning experiences to enhance the student's creative and critical thinking abilities.

A range of subjects in the above courses require an in-depth understanding of water resources management, including issues, concepts and theory related to water quantity and quality management, river ecology, irrigation management and environmental hydrology. Students are encouraged to learn through experiencing real-world situations by initiating field projects, but they also require access to relevant theory and concepts. Student learning will be greatly improved in these courses if some user-friendly, interactive and self-directed resource materials are made available. The current alternative is that students working on tasks approach resource staff for help in understanding relevant subject matter on an *ad hoc* basis. To provide adequate resources for these students is demanding on staff time and frequently less than optimal for the needs of individual students. Printed material is limited in its effectiveness without staff support, particularly if students have limited backgrounds in water resources management and its associated theory. As indicated previously, with increasing pressures on staff, there is an urgent need for

measures to improve their teaching effectiveness and efficiency. Computer-assisted learning (CAL) packages, widely known as multimedia packages, provide a tool to enhance teaching and learning outcomes, particularly in project based, experiential learning subjects at UWS. However, there are no suitable packages available in the area of water resources management. For this reason a group of staff at UWS secured a grant and embarked on developing a suitable package that would supplement teaching and learning needs of students studying in natural resource management, agriculture and environmental science courses.

Developing the package contents

The total duration of the project was 12 months, although the evaluation and fine tuning of the package continued for another 12 months. There were a total of six key tasks in this project (Table 1). The main funding for this project was through a Federal Government grant that was administered by Committee for University Teaching and Staff Development (CUTSD). The total cost of the package development was A$46,843, and the breakdown of costs for different expenses involved in developing the package is given in Figure 1. As can be seen from the Figure 1, the salary of computer programmer and associated staff was the main cost (83% of the total cost) in this project.

Task	Description	Time (months)
I	Employment of staff; acquisition of software and computer	1
II	Detailed outline of package contents	1
III	Developing the contents and incorporating them into the software	5
IV	Validation and modifications in the package	2
V	Evaluation and improvement of the package	2
VI	Report writing	1
	Total	**12**

Table 1. Timeline for different tasks involved in developing the multi-media package.

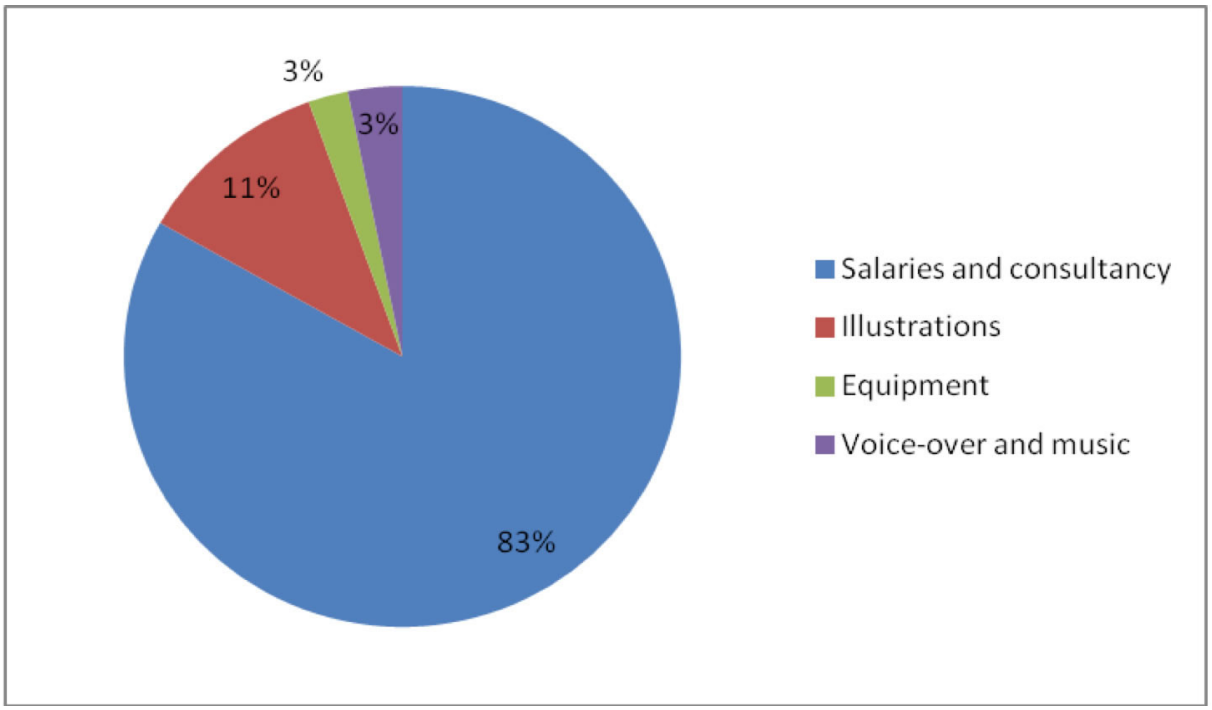

Figure 1. Breakdown of costs for different expenses involved in developing the package. The total cost of the package development was A$46,843.

The original plan in this project was to cover a broad area of water, irrigation and hydrology. During the initial phase of the project we had many discussions about the contents and format of the package. We soon realised that the resources available made it unrealistic to produce an effective and useful package covering all areas initially envisaged. The project was therefore, focused to more specific aspects of sustainable water use and its management in agriculture in recognition that this would become one of a series of packages under the acronym SWAG (**S**ustainable **W**ater Use in **AG**riculture).

The SWAG package was initially targeted at tertiary students (undergraduate and postgraduate) and professionals new to this subject area. The package contained four main sections (see Figure 2), and it was designed for the learner to take between 60 and 80 minutes to complete all of the tasks presented in the package. An example of screen shot of one of the sections of the package is shown in Figure 3. In the development of the package's content effort was made to present the concepts in a lucid, highly interactive and interesting way through the extensive use of sound, diagrams, pictures, cartoons and animations. The use of text was kept to a minimum. For example, to illustrate how salinity rises in an irrigated field, the learner views an animated diagram that shows how excess water applied during irrigation moves down through the soil profile to below the root zone, meets the groundwater table, and the combined waters raise to within the root zone. The animation finishes by showing how the salts associated with the groundwater may get deposited within the root zone and even on the surface as a result of water-logging and subsequent evaporation.

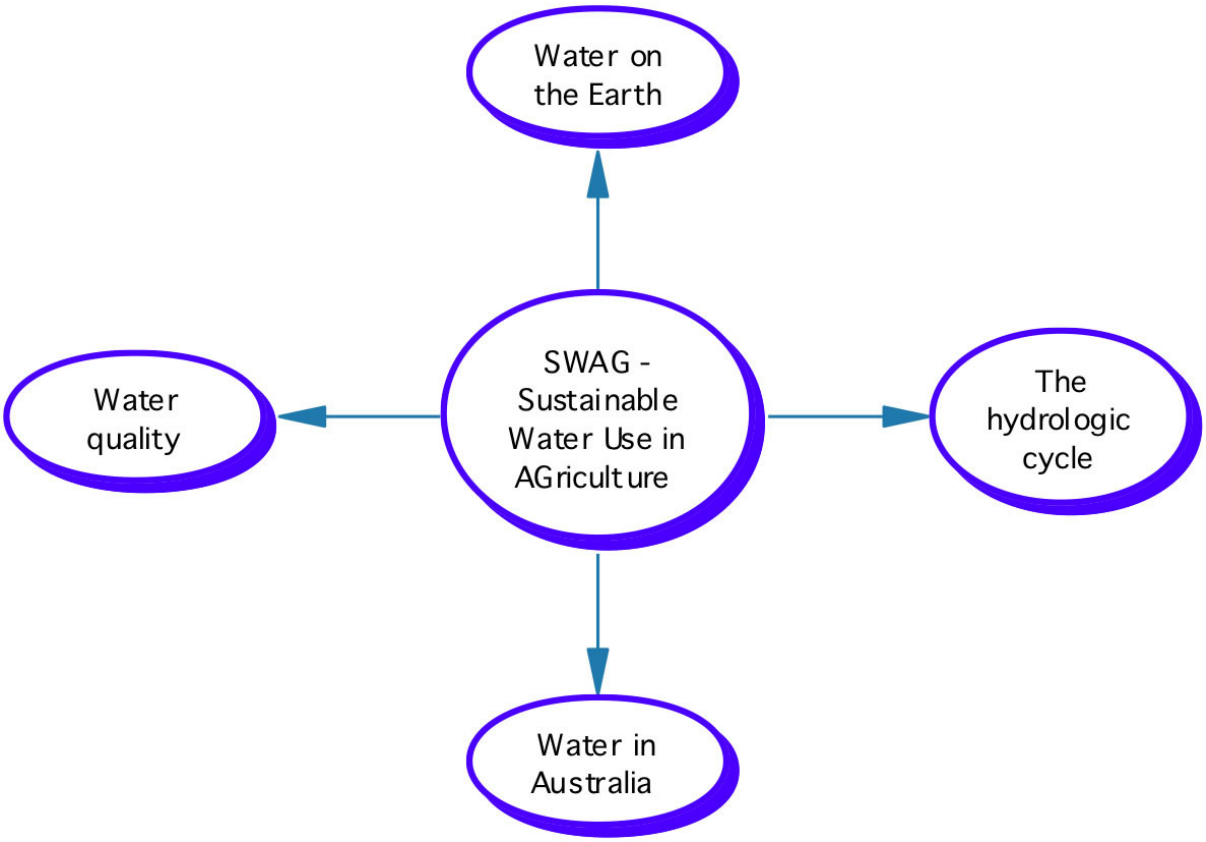

Figure 2. The main sections in the SWAG package.

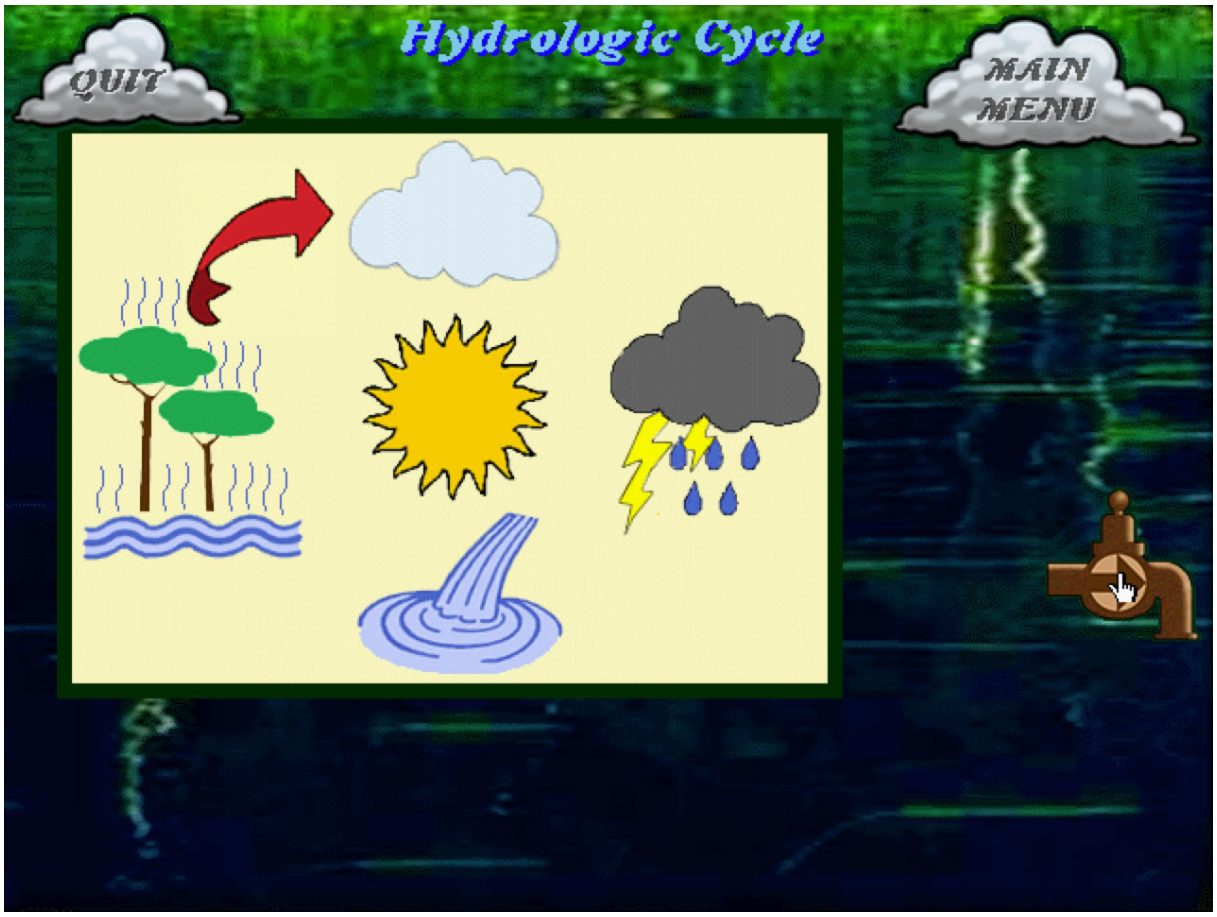

Figure 3. Screen shot of one of the sections of the package.

The package was designed to provide multiple opportunities for learners to input or respond to the different aspects of the concepts presented through a range of self-assessment exercises. We also included a variety of other exercises: some required a short answer and others a relatively detailed response. Also provided was instant vocal feedback that was triggered when the student's response was incorrect. Overall, the strategy was to stimulate students and engage them while supporting and building their confidence in the subject matter.

The Authorware Professional™ was used for developing the overall package while Director™ was used for developing the required animations. The package was initially developed for use on a Macintosh™ platform but at completion stage, a version compatible with Windows™ platform was also developed. Expert technical advice was sought during the development of the package for its content, accuracy, relevance and pedagogical treatment. This minimised any serious drawbacks that may hinder usefulness of the package for the students.

Issues and challenges of developing multimedia packages

Multi-media package development is demanding

Developing the package contents

The development of a multi-media package is demanding in terms of time and effort and involves a number of key steps (Figure 4). There was often a 'trial-and-error' component in deciding which illustrations, photographs or video clips to include as visual material for conveying specific messages in the package. Collecting relevant photographs and video clips and taking photographs and shooting videos involves considerable investment of time and effort as it requires elaborate planning and co-operation of people outside of the project team. At times, the quality of the visual was insufficient and image manipulation became a major task in the production of sharp and contrasting images. Inclusion of animations in the package made the presentation of concepts interesting and clear but their development required enormous effort to conceptualise a design that worked in terms of programming and student learning. Writing and implementing the computer code for animations was also quite time consuming. For example, in some instances, the complete development of an animation consumed the equivalent of a person's working week or more.

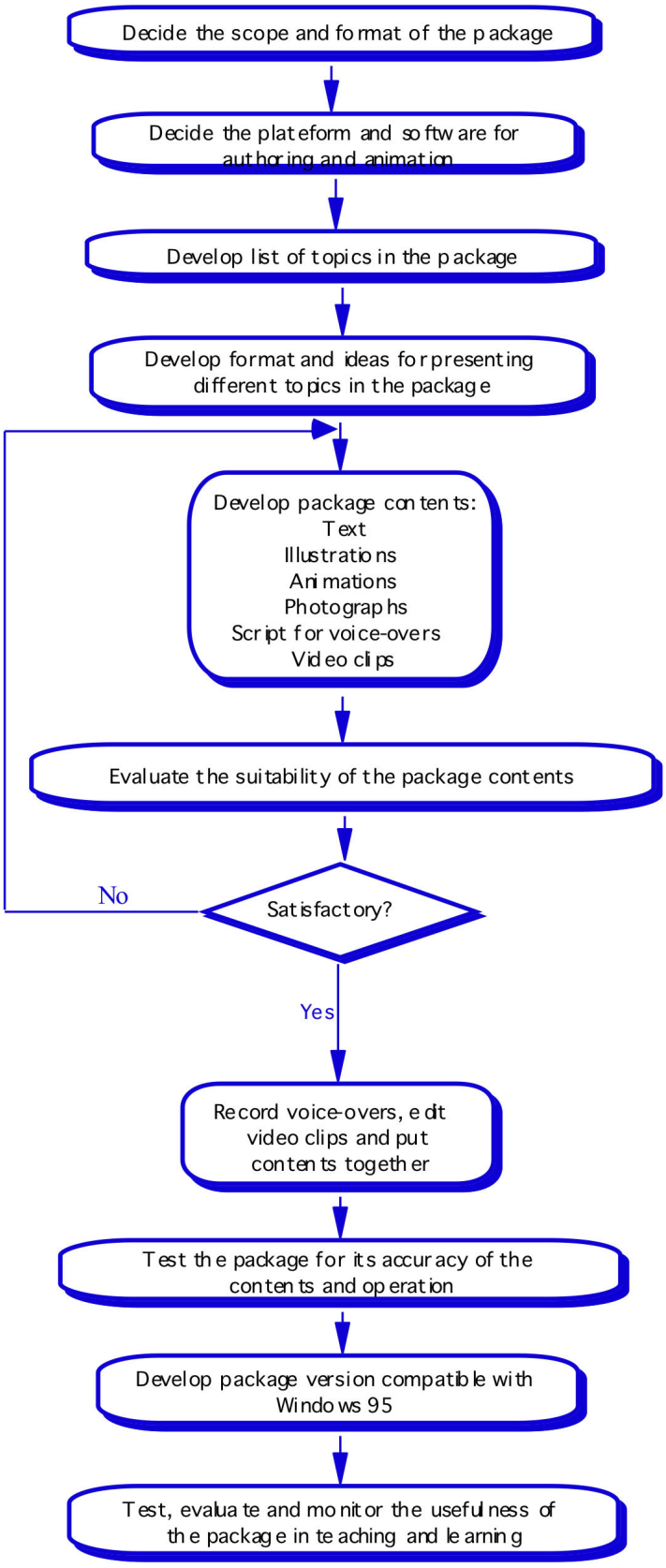

Figure 4. Main steps in developing the SWAG package.

The task of script writing required careful consideration to ensure that the message was conveyed accurately and clearly but in plain English. The voice over also had to be synchronised with the visual and the audio segments of the multimedia package. This meant 'learning' the script and practicing its presentation before it was ready for sound recording in the studio.

Organising the team with multitude of skills

By its very nature the development of a multi-media package requires a multitude of skills and expertise including conceiving an idea, developing visual material and the script, and production and editing of the final product. All these skills are traditionally not available within a science school like ours and not easily accessible within the university's teaching and learning unit. The package also needed to be rich in variety (e.g., photographs, video clips and cartoons) if it was to be interesting, stimulating and effective. This demanded substantial effort from the project team, considerable time at their disposal and substantial resources (including cash funding) to carry out the task. This aspect should never be underestimated when venturing into the development of a multi-media package.

Engaging with commercial partners

Multimedia packages are also not something that a commercial company specialising in programming can readily develop. It is an academic pursuit that needs to be supported by people who have a range of expertise to develop the product. In the development of any effective multi-media package, there is a critical role for a person who has teaching experience and is passionate about innovative student learning. However, multimedia package development is a challenge in the current environment of resource constraints in universities (Cairns, 2007; Marks, 2002; Pollard & Chan, 2006) and currently the funding opportunities for producing the packages are often extremely limited. This means that, unlike publishing a book, a strong partnership between the multi-media publishing house and the university is required to work closely with authors, and this usually means commercial partners need to invest substantially more resources to publish multimedia teaching and learning materials than is usually the case for printed material.

Size and commitment of the project team

The project team consisted of four lecturers with expertise in different aspects of the multimedia package contents. All team members have a substantial teaching experience in a self-directed experiential learning program at tertiary level. The work of the package development was shared among team members based on their individual expertise and time available to them. The project team was supported by a Project Reference Group consisting of another four lecturers, an information technology specialist, subject matter specialist from industry and five students. Thus, the members in the Reference Group represented a range of expertise and interests, particularly the commercial farming and rural land use, soil management, management and implementation of self-directed learning program, interactive multi-media techniques and sustainable use of land and water resources.

The genuine commitment of all team members is important for successful package development due to a range of skills and expertise that must be integrated and coordinated to prepare the complex subject matter such as the one chosen for this project. Our experience gained in the project revealed that a small team of two or three team members, together with supporting staff whose knowledge spanned the range of technical support required (e.g. programmer, technical coordinator) was the most efficient approach to ensure that the outcome achieves its aims. More members in the project team (especially content experts) results in a wider range of ideas, but to harness their energy and maintain their interest and commitment is often challenging. With a large number of enthusiasts in the project team, there was often no shortage of academic ideas but the price of this is often limited progress towards a tangible project outcome. Our team suffered from this syndrome but we soon recognised and cured the problem by limiting new ideas and focusing on actions or ideas previously generated. This is confirmed by Davis and Fill (2007) who experienced that a large team combined with initial slow progress often leads to self-doubt and loss of confidence in the project. Furthermore, 'side-tracking' and confusion as a result of superabundance of ideas, if allowed to continue without clearly defined boundaries, may slow progress without necessarily enhancing the outcome.

Programming support

Multi-media development requires trans-disciplinary skills and the ability to work with people from very different discipline areas. It is often difficult for the subject

experts in the project team to comprehend the technical aspects of package development. For example, available multi-media software, such as Authorware Professional™, requires a significant level of training and subsequent practice before a multi-media package can be developed successfully. However, the basic workload of academics has increased substantially in recent years and so time is limited for activities such as developing multi-media packages and, as result, such development may only occur at very irregular intervals. With the speed of advances in computer technology and the number of support programs being released and/or upgraded, it is unlikely that most academics will ever be proficient across the range of skills required to develop such packages. Therefore, the role of professional multi-media programmers in the package development can not be underestimated as there are tasks (e.g., developing animations) that are beyond the scope of expertise and experience of an average academic.

The recruitment of a suitable programmer at reasonable salary is often difficult because of the disparity between industry and academe and the short-term nature of the task. However, despite the expense involved, in general, experienced multi-media programmers and designers are imperative for a professional outcome. In this project, our strategy for recruitment of key project staff was to advertise for a part-time programmer in industry networks and particularly looked for someone who was a keen team player, had a reasonable experience in developing a similar package and willing to learn with the project team. We also recruited two undergraduate students who were studying multi-media design and information technology course at University of Western Sydney. This strategy helped us to recruit appropriate staff within the funding constraints of the project.

Another issue in the area of programming is that the software used for the package development may change, with new more complex versions with additional features introduced at any stage of the multi-media package development. Within the 18 months that it took to develop our package, we saw three major versions of a particular software program, although it was easy to learn, and achieve proficiency with the increased complexity of subsequent new versions. The expense of software upgrades also acted as a drain on resources available in the project. An alternative would have been to persist with the original version purchased for the project, however, with this option there is a risk that the package may not incorporate some important feature, it may not operate properly due to some 'bug' that existed in the older version of the software or switching over to a newer version at a later stage may prove time consuming.

Lessons for future multimedia package developers

Details of idea development

A critical lesson about package development is how important it is to be very clear at the outset about every detail of the idea being developed in the package before it is handed over to the programmer for implementation. This is because the programmer in most cases will have a limited understanding of the subject matter and may need clarity and guidance on learning outcomes envisaged from the design of the particular part of the package contents. Therefore, the programmer needs to be given explicit instructions about what is to be developed, how it will be presented to the audience and how it will help in student learning. Therefore, the team members with subject matter expertise often spent hours with the programmer and associated staff explaining their ideas and coming up together with a design of the multi-media that will work and can be implemented in the package. In some instances, the programmer was given a step-by-step written guidance about the content implementation through multimedia. We learnt that this was particularly important in using the programmer's time and project resources effectively and thus maximising the chance of completing the project on time and within the allocated budget.

Managing the content development

Multi-media development is a very creative task and every new idea to improve better presentation was tempting to the uninitiated academic who was seeking to obtain the multi-media program that will provide the excitement to engage students in their learning task. There was much enthusiasm within the project team for developing the package in the initial stages of its development. There were often detailed discussions on the scope, format and ideas on the various aspects of the package. In such a development, one can be easily enticed into new ideas and develop a desire to cover more of the subject. In this way, the project could quickly become out of control and stretched beyond its scope.

Our experience from this project clearly showed that it is critical that boundaries are set for the work early in the project, both for the subject matter and the depth of coverage. It is therefore necessary to maintain boundaries and focus on developing a high quality product within the subject matter coverage and within the allocated

time and budget, rather than try and cover a broader range of topics superficially. That is, it is preferable to do less but do it well, than to do more but do it poorly and to ensure that the project remains focused on a quality outcome in terms of content and production.

During multi-media development it is generally useful to be open minded to better ideas for presentation. However, there is a limit to how far one should go in the search for more ideas as it could affect the progress of the project and it should be remembered that there is no single correct way to present a particular scientific concept. In gathering material, the focus should therefore be on the development of an acceptable rendition of the scientific concepts that convey the message effectively and interestingly. For any extra effort beyond this, 'the law of diminishing return' applies and some other aspect of the project will have fewer resources available.

Hardware and software

The technology of multi-media changes rapidly and the hardware and software available at the commencement of the project may be superseded before the project is completed. This is particularly true as work in such projects are often a segment of the academic's total workload and, as a result, the development of multimedia product can take from 12 to 18 months from start to finish for a few hours of effective student learning material. Due consideration should therefore be taken of the distribution and potential compatibility with software packages that will be expected to run the program. For example, if the package is to be made widely available, it should be developed for both Macintosh™ and Windows™ operating systems. This is not straightforward and requires considerable work and testing to ensure smooth operation of the package in both systems. This is potentially a time-consuming task and should be decided in the initial allocation of resources.

It is also necessary to consider the hardware on which the package will potentially be targeted for student use. This will influence the size of files for animations, video clips and photographs. If they are too large it will slow the pace of the display on the screen on some computers and will reduce the student's engagement with the program and hence their enjoyment and learning outcomes.

The future of using multimedia packages

The package was implemented in two subject units, Soil and Water Management and Water in the Landscape offered at 2nd year level in agriculture and environmental science program at University of Western Sydney. The feedback from students on the package has been positive, particularly in learning the concepts at their own pace and time. They also suggested a number of additions (e.g., some advanced topics) and changes to make the package more comprehensive and interactive. This meant the package structure and programming need to be flexible to allow future changes and addition to the package, particularly to cater for student needs and future changes in teaching programs.

The work reported here was more of a trial to develop a prototype and explore and learn about the process of multi-media package development in water management. For this reason, it was difficult to evaluate the cost of the package development against the benefits derived through its use in teaching program. However, once the process of package development is streamlined and thus the cost associated with 'trial and error' element of the development is minimised, the next step will be to evaluate the costs and benefits of such multi-media package development and its use in university teaching and learning.

Online learning is relatively new in science courses and most academics have little or no personal learning experience through using multimedia packages. However, there is general openness, excitement and motivation among academics to employ such new technology (Bongalos, et al., 2006). The important issue is for institutions to support such activities by providing appropriate resources for the development of packages.

With computers and the internet now widely available, the multimedia packages can provide further resource support for students involved in off-campus, industry experience or for those enrolled in distance education programs. In general, such packages can complement face-to-face teaching and thus can be readily integrated into existing teaching programs. By using multimedia packages, student learning can be more effective, and staff time more productive, because students are able to access concepts covered in the package at their own pace and time in a self-directed mode. If need be, they can further reinforce their learning of the concepts presented

in the package in discussion and consultation with fellow students and resource staff.

The application of computers, internet and e-learning are increasing in universities throughout the world and increasingly more courses are being offered through distance education. The facilitation of student learning in distance education is frequently achieved through making the teaching resources available online and through tools such as WebCT (Evans and Fan, 2002; Bongalos, et al., 2006; Scott and Cong, 2007). Blended learning, the combination of traditional face-to-face teaching methods with online and off-campus learning activities, has the potential to transform overall student-learning experiences and outcomes (Davis & Fill, 2007). It is now increasingly recognised that there is a place for CD-ROM multimedia packages in the overall teaching scenario (Ellis & Cohen, 2001) but the key question is whether the benefit of the packages as a teaching resource is commensurate with the associated cost of producing them. There is certainly a need for careful balancing of the cost of producing packages versus the anticipated benefits and research in this area has been limited to date.

Conclusions

Developing a multi-media package is a creative, interesting and rewarding task but it is complex and requires considerable time, effort and budget to develop an effective package. It also requires a multitude of skills that are not always available in university lecturers who are more likely to be content experts than programmers of such packages. As such the effort, time and budget required for developing a multimedia package should not be taken lightly. To ensure success, due consideration must be given to make up and size of the project team and issues of compatibility of the package with the future hardware and software. There is a potential for multimedia packages in both face-to-face and distance education but due to the cost of multimedia package production there is still a long way to go before the use of the packages in teaching becomes a routine practice.

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References

Bawden, R. (2005). Systemic development at Hawkesbury: some personal lessons from experience. *Systems Research and Behavioural Science, 22*, 151-164.

Bongalos, Y.Q., Bulaon, D.R., Celedonio, L.P., de Guzman, A.B. and Ogarte, C.J.F. (2006). University teachers' experiences in courseware development. *British Journal of Educational Technology, 37*(5), 695-704.

Buckley, J.E. (1999). Do it now, learn it later. *Educational Technology and Society, 2*, 1-3.

Burgin, S., Tayebjee, F. and Hunter, G. (2005). Policies may be made in heaven but sustainable partnerships are borne, natured and maintained through good relationships between the partners. *The Australasian Journal of University Community Engagement, 1*, 1-12.

Cairns, G. (2007). Submission on the current discipline groupings and relativities within the cluster funding mechanism. La Trobe University, Melbourne. http://www.dest.gov.au/NR/rdonlyres/4F87BF6-042E-4083-9943-CEF166E4FE27/15876/010CairnsMathematicsSectionLaTrobeUniversity.pdf

Carter, H., (1995). Australian history CAL - from prototype to production. In Proc. Apple University Consortium Conference, University of Western, Perth, 3-6 July, p.47-51.

Davis, H.C. and Fill K. (2007). Embedding blended learning in a university's teaching culture: Experiences and reflections. *British Journal of Educational Technology, 38*(5), 817–828.

Ellis, T. and Cohen, M. (2001). Integrating multimedia into a distance learning environment: Is the game worth the candle? *British Journal of Educational Technology, 32*(4), 495-497.

Evans, C. and Fan, F.P. (2002). Lifelong learning through the virtual university. *Campus-Wide Information Systems, 19*, 127-134.

Felix, U. (1995). Curtain call: developing multimedia materials for advanced language learners. In Proc. Apple University Consortium Conference, University of Western, Perth, 3-6 July, p.105-110.

Hativa, N. and Lesgold, A. (1991). The computer as a tutor - can it adapt to the individual learners? *Instructional Science, 20*, 49-78.

Heerman, B. (1988). Teaching and learning with computers: a guide for college faculty and administrator. Jossey-Bass, London, 244p.

Hitchings, B.D., Harper, J.G. and Buriak, P. (2001). Using innovative technologies to deliver web-based instructional activities. ASAE Annual International Meeting, July 30 – August 1, Sacramento, USA.

Kiili, K. (2005). Participatory multimedia learning: engaging learners. *Australasian Journal of Educational Technology, 21*, 303-322.

Laurillard, D. (1987). Computers and the emancipation of students: giving control to the learners. *Instructional Science, 16*, 3-18.

Lee, S.H. (1999). Usability testing for developing effective interactive multi-media software: concepts, dimensions and procedures. *Educational Technology & Science, 2*(2).http://ifets.ieee.org/periodical/vol_2_99/sung_heum_lee.html

Marks, R. (2002). Corporate governance or where does ownership lie? *Australian Journal of Management 27*, 1-6.

McBratney, A.B., Cattle, S.R., Stewart, J.B., Tolmie, D.B., Young, S.R. and Elton, K.L. (1992). The Soil Stack. The University of Sydney, Sydney, 51p.

McInnes, C. and Buckridge, C. (2000). Study shows uni students spend more time in paid work. http://uninews.unimelb.edu.au/articleid_41.html

McNaught, C. (1995). Evaluating the impact of technology on student learning in higher education. In Proc. Apple University Consortium Conference, University of Western, Perth, 3-6 July, p.195-206.

Peled, A. (2000). Bringing the internet and multimedia revolution to the classroom. *Campus-Wide Information System, 17,* 16-22.

Pollard, C. and Chan, E. S. K. (2006). A review of information systems programs in universities in Victoria. *Australasian Journal of Information Systems, 14*, 231-247.

Provenzo, E. F., Brett, A. and McCloskey, G. N. (2005). Computers, curriculum, and cultural change: an introduction for teachers. Routledge, New York, p. 328.

Scott, B. and Cong, C. (2007). Designing interactive learning environments: an approach from first principles. *Campus-Wide Information Systems, 24*, 174-186.

Smerage, G.H. and Beck, H.W. (1996). Experiences with hypermedia in engineering education. ASAE paper no. 963052, ASAE, St. Joseph, MI, USA, 8p.

Strommen, E. F. and Lincoln, B. (1992). Constructivism, technology, and the future of classroom learning. *Education and Urban Society, 24*, 466-476.

Vickers, M., Harris, C. and McCathy, F. (2004). University – community engagement: exploring service learning options within the practicum. *Asia – Pacific Journal of Teacher Education, 32*, 29.