

Multimodal design for hybrid learning materials in a second level economics course

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In 2003 the University of Southern Queensland announced that, owing to cost and demand pressures, student learning materials would be progressively migrated to a 'hybrid' model, the centrepiece of which was to be a resource-rich CD-ROM. This was to be supplemented, where appropriate, with print and online material. One of the first courses in the Faculty of Business to be converted was ECO2000 Macroeconomics for Business and Government. In this paper the pedagogical underpinnings of the hybrid model are outlined and its application to ECO2000 is discussed. Results of surveys of students and assessment outcomes are also discussed.

Introduction

The University of Southern Queensland is a dual-mode institution with 'triple-option' teaching modes (on-campus, traditional distance education, and online) and, in its total student population of some 26,000 students, almost 70 countries are represented. Over more than a quarter of a century the University has adopted a range of approaches to instructional design in the context of distance delivery (Sankey & Smith, 2004), namely:

- correspondence—printed materials delivery (traditional distance education);
- multimedia—print-based, but supplemented by audiotape, videotape, computer-based learning and interactive video;
- telelearning—videoconferencing, audiographic communication, broadcast TV/radio, and audioconferencing; and
- flexible learning—interactive multimedia, Internet-based access to WWW resources, and computer-mediated communication

Elements of all of these four generations of distance delivery were present in the new century *plus* traditional on-campus lectures/tutorials. However, it was clear by then that maintaining so many different approaches to delivery was becoming economically unsustainable and that distance students were demanding much more than correspondence materials. Taylor (2004) argued that traditional approaches to learning and teaching would not have the capacity to meet the escalating demands of higher education in the future.

As a consequence of cost and demand pressures, particularly in relation to the printing and postage costs, the University announced a change in policy in early 2003. Under the new policy all courses, regardless of whether they were offered on-campus or off-campus, would be moved progressively over a period of three to four years to a so-called

'hybrid' delivery mode. In this context, 'hybrid' was to be interpreted as a combination of delivery media, the centrepiece of which was to be a resource-rich CD-ROM that contained all the essential learning resources, support materials and significant multimedia enhancements. The CD-ROM was to allow direct linking to a course web site hosted on the University's learning management system (*USQConnect*) and additional web-based resources such as publisher's web sites and electronic library resources. As of 2005, hybrid mode courses have been developed and are being trialled in a number of different discipline areas, including economics.

In moving to the hybrid mode, the University recognised that it would be necessary to identify a range of pedagogically robust approaches to instructional design for hybrid mode delivery. The course ECO2000 Macroeconomics for Business and Government was one course chosen for the hybrid trial in 2003 (first delivered in semester 1, 2004). This paper provides background to the trial, discusses the pedagogy involved in instructional design and describes its application to the course. There is also some discussion of surveys of students and assessment outcomes.

Features of the hybrid model

The basis of the hybrid model

The term 'hybrid' in the educational context embraces a range of approaches to learning and teaching that integrate a number of delivery media facilitated by the proliferation of information and communication technologies (Parsons and Ross, 2002). This has allowed considerable expansion of support mechanisms for both on-campus and distance education students and made them available *en masse* (Cookson, 2002). Therefore, the objective of the hybrid model is to deliver to all students a package of learning materials of consistent quality regardless of their mode status. In practice, this has required delivery based on a CD-ROM that provides the opportunity to create a resource-rich learning environment, supported by a combination of relevant teaching activities and the University's e-systems (Smith, Sankey and Cottman, 2004). CD-ROM technology is readily accessible by virtually all of the University's students and although access to the Internet is problematic for many, the use of the CD limits the amount of time students are required to have this access. The CD-ROM also allows considerable standardisation among courses—the look and 'feel' of core generic information such as the University Handbook, Student Guide, 'getting started' information, help files, software updates and plug-ins are all provided on the CD-ROM and are the same for all courses. The CD-ROM also contains specific course elements such as introductory materials (course specification, assessment schedule, sample examination paper, etc.), a study guide, study modules, selected readings, multimedia elements, PowerPoint presentations (sometimes with voice-over), interactive quizzes, case studies, reference lists, and web links.

All students are required to have access to the Internet. This requirement derives partly from administrative requirements and partly from the University's approach to learning and teaching. Each course has its own Study Desk on *USQConnect*, which enables course leaders to supplement the CD-ROM with discussion groups (synchronous or asynchronous), announcements, and e-mail. In addition, *USQConnect* provides students with access to library services, the University Bookshop, *USQAssist* (for information about University systems and individual courses), and *USQAdmin* (for enrolment, access to assessment results and to change personal details). The use of Study Desk varies among courses depending on each course leader's approach to course design and delivery, but, as noted below, Internet access is not easy for many students.

The process of hybrid development

In 2000 the University launched the Generic Online Offline Delivery (GOOD) project which is an e-content management system that allows cross-media publication from a single source document in eXtensible Markup Language (XML) that can easily be converted into Hyper Text Markup Language (HTML) for CD-ROM/DVD/online delivery or into Portable Document Files (PDF) for print delivery (Taylor, 2001). An editor is available that allows updating of the source file by staff from the Distance and e-Learning Centre or academic staff (with appropriate training). The updated version of the source document can be accessed and rendered into whatever format is needed for the next offer of a course. This has obvious advantages of economy and allows easy reproduction of course materials in the event that enrolments grow faster than expected (a common event in international markets).

It might be argued that there is little point in developing an approach to learning and teaching delivery that is so flexible when the learning resources could be made available online. This is primary due to what has been termed the 'tyranny of broadband' (Bruch, 2003), or the inconsistency and variability of Internet connections both within Australia and in many of the countries in which the University enrolls students. In China, for example, many students report that they can only access the Internet for the purpose of downloading PowerPoint presentations or completing online assessment during the early hours of the morning. (This paper is being written in China during a series of visits to international partners and inadequate access to the Internet is being consistently reported by students and their tutors.) Students in some countries, such as Germany, typically study while commuting on trains and they therefore have difficulty in accessing the Internet. In Australia it is expected that rural and remote areas will not have the same level of access to the Internet as metropolitan areas for a considerable period of time (National Office for the Information Economy, 2004). Given the unreliability and/or difficulty of access, the delivery of high quality web-based learning resources is problematic, which is precisely the reason why USQ has adopted the CD-based approach.

Because over 75 percent of the University's students study by distance and are spread over almost 70 countries equitable access is a major consideration. Therefore, online delivery cannot be realistically considered until a consistent level of broadband technology is available in Australia and in the University's international markets (van Merriënboer, *et al*, 2004). The CD-ROM offers the most reliable and equitable platform for the delivery of learning materials because most students have access to a computer and can, therefore, access electronic materials on a CD with ease.

Pedagogy and the hybrid CD-ROM in EC02000***Multimodal design***

Fundamental to the instructional design incorporated in the hybrid CD-ROM in ECO2000 Macroeconomics for Business and Government are the principles of multimodal design. These are based on research that demonstrates that learners, for many reasons, use a variety of learning/cognitive styles to process information. Although most researchers agree that different learning styles exist and readily acknowledge their significance in learning, current research indicates that many instructional events, particularly at the higher education level, only target generic cognitive styles, or certain types of learners, particularly read/write learners (Sarasin, 1999). This has led to some students feeling disenfranchised, especially students whose learning preferences are not

matched by the style of presentation and this, in turn, may impede student performance (St Hill, 2000).

The hybrid model makes it possible to present information in ways that use multiple sensory channels which should enhance both students' enjoyment of the learning experience and their assessment outcomes. In this context, the use of images is important. Felder and Soloman (2001) and Stokes (2002) argued that using visual content in teaching improves learning outcomes. Although visual images are an integral part of human cognition, they have tended to be marginalised and undervalued in contemporary higher education (McLoughlin and Krakowski, 2001).

This discussion cannot be limited to visual literacy because learners in contemporary societies are required to decode information from a variety of media (Grisham, 2001). If material such as verbal texts (audio), diagrams, drawings, photographs, and videos are regarded as texts to be read and understood they can be applied to the development of new, inclusive curricula (Roth, 2002). Development of theories and strategies for the multiple representation of a whole range of instructional concepts is required in a multiliterate society that recognises a full range of learning/cognitive styles.

Use of multiple representations, particularly in computer-based learning environments is recognised as a powerful way to facilitate understanding, e.g. when the written word fails to fully communicate a concept, a visual representation can often remedy the communication problem (Ainsworth and van Labeke, 2002). Ainsworth (1999) concluded that 'where the learner employed more than one strategy, their performance was significantly more effective than that of problem solvers who used only a single strategy' (p. 137). However, representation of information in multiple ways in the electronic environment can be detrimental to learning because this can place excessive cognitive demands on the learner. If, for example, learners have to direct their attention simultaneously to different representations that combine other dynamic components, such as complicated sound, animated movement and interactive text, their cognitive capacity can be overburdened with the result that they learn very little (Bodemer and Ploetzner, 2002). Therefore, if multiple representations are to be used important issues concerning cognition need to be considered in the design of those representations.

Important issues concerning cognition

Two theories are worth considering in the design of the hybrid model, namely cognitive load theory and dual coding theory.

Cognitive load theory suggests that when large volumes of information are presented simultaneously, the learner can experience overload in their working memory, owing to limited capacity. In effect, the learner becomes overwhelmed with what is presented, resulting in a loss of direction and focus (Sweller, 1999). Therefore, it is essential that learning material is clear and concise as the 'Bells and whistles' can often impede learning (Doolittle, 2002). In the context of multimedia, the main factors influencing cognitive overload are designs incorporating text, graphics and animation. Although these might focus the learner on the exciting or entertaining aspects of a presentation, the learner often bypasses thoughtful analysis of the underlying meaning (Stokes, 2002). Using illustrations or simple images can minimise the load on working memory. In contrast, written text is read in temporal sequence requiring more cognitive processing (Kirsh, 2002).

A factor that appears to be related to cognitive overload and is often observed is probably caused by risk aversion. Some students seem to believe that they need to master *all* representations of a concept. This increases the time involved in studying the course considerably and clearly stresses some students. It was necessary to assure students in ECO2000 that they were not expected to employ multiple representations in assessment and to show them how to use representations that were appropriate to them in their responses to assessment items. However, this is not to argue that multiple representations should be avoided. Indeed dual coding theory, which is outlined below, implies that multiple representations are very effective if complexity is minimised.

Dual coding theory suggests that the working memory consists of two distinct processing systems, one verbal and the other nonverbal. The verbal system processes narrative (spoken) information while the nonverbal system processes visual (image and text). Therefore, one way to enhance the capacity of working memory is to utilise both processing systems simultaneously (Mayer, 2001). By using the human visual system to process information in parallel with verbal information (see figure 1.), it is possible to bypass or reduce the ‘bottleneck’ effect that can occur within working memory (Zhang, *et al*, 2002). If text can be presented in audio format, the learner can listen to a narration while simultaneously viewing an illustration, thereby using both areas of the working memory. Clearly, the CD-ROM offers a suitable delivery platform for this kind of presentation.

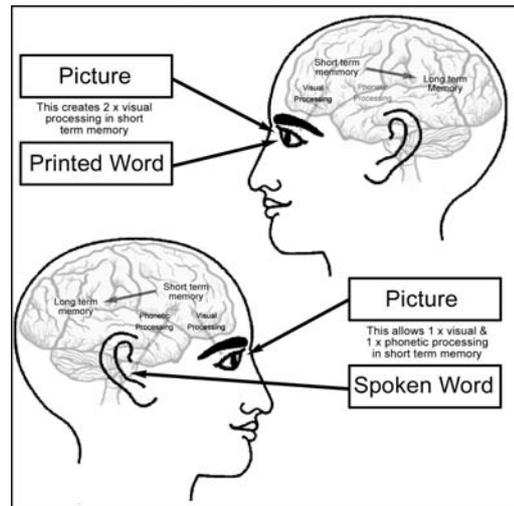


Figure 1: If picture and spoken text are used together working memory can process the two representations concurrently.

A further advantage of using the CD-ROM is that it allows hyperlinks to different media elements designed to suit a combination of learning styles, e.g. where a learner is presented with a choice of representations the one or combination that best suits that learner can be selected. Research by Ainsworth and van Labeke (2002) demonstrates that this design strategy can significantly enhance learning opportunities for students. Indeed, Jona (2000) asserted that this kind of learner choice represents the paradigm shift that needs to occur in higher education. If students have a degree of control over their learning experience they are more likely both to enjoy the experience more and adopt appropriate information processing approaches (Shu-Ling, 2001).

The ECO2000 hybrid model was designed using multiple representations and included a number of learning resources: a CD-ROM containing text and multimedia, including (with the publisher’s permission) the complete web site for the required text book, and links to online resources including *USQConnect* that hosts a course web page containing discussion groups and PowerPoint presentations from lectures and tutorials. This is in addition to the required text book. The intent of the CD-ROM was to represent key concepts in multiple ways that cater for a range of learning preferences. Examples include using point-form text with video and audio (mini lectures introducing each topic in the course), animated examples with voiceovers, interactive diagrams, audio explanations of algebraic relationships, and still images. All of these were created using Macromedia ‘Flash’ and use the features of HTML to allow contextual linking within the learning environment.

In order to assist students in using multiple representations they were encouraged to complete a learning styles (modal preference) inventory in the third week of the semester. This was intended to help them identify the representations that would suit their modal preference. The inventory was available on the course CD-ROM and was automatically scored. The CD-ROM contained a series of Study WithOut Tears (SWOT) helps based on the four modal preferences (Visual, Aural, Read/write, and Kinaesthetic). In passing, it is noteworthy that based on the VARK inventory only about 40 percent of all students have a clearly identified modal preference. About 60 percent are bimodal or multimodal.

Student reaction to the hybrid model

Surveys and focus groups

As noted above, ECO2000 was one of the courses in which the hybrid model was trialled. Research into student reaction to the model commenced in March 2004, focussing primarily on the ease of use of the CD-ROM and the value of multiple representations in helping students to learn. In the third week of the semester two surveys were administered: a self-reporting learning styles inventory; and a ten-item questionnaire using five-point Likert scales. These surveys were completed by 95 students (out of 120 enrolled in both on-campus and distance study modes). Two focus groups were also conducted, one with four distance students and one with six on-campus students. The focus groups were used mainly to triangulate the ten-item survey of students.

In the last week of the semester a longer survey of 31 items (both quantitative and qualitative) was administered, with 65 responses (the lower number of responses reflected lower numbers of students attending lectures at the end of the semester and, probably, the fact that distance students had to complete the survey online, which was not the case with the first survey). The lower number of surveys might have introduced some sample bias. There were only trivial differences between assessment outcomes of students who did and did not complete the second survey, so it is likely that any sample bias did not materially affect the results. Focus groups were also convened in the last week of semester (with responses from six distance students and 12 on-campus students). The main objective of the survey and focus groups at the end of the semester was to more closely examine student perceptions of the learning material, particularly the use of multiple representations and multimedia elements. Full details of the research results may be accessed at <http://www.usq.edu.au/users/sanke/MDML/pages/ECO2000results.htm>. In this paper, only brief comments are made.

The research indicated that there was strong acceptance of the CD-ROM. Not only did students like the learning materials delivered in this medium, they liked and used extensively the multiple representations. In the initial survey this acceptance was moderated by a desire to receive printed learning resources, with the CD-ROM being perceived as a 'nice extra'. This might have reflected the fact that the students had already been studying at the University for one or more years and most had not used a CD-ROM for learning before. They were used to the standard printed learning resources or traditional lectures. (Incidentally, students indicated that they would be prepared to pay a cost recovery charge for printed materials.) By the last week of the semester students indicated in the focus groups that they *preferred* the CD-ROM to printed learning resources—they indicated that they would prefer to have the CD-ROM than printed materials if they had a choice.

Students also reported that they found the learning styles inventory helpful, with 75 percent reporting that they felt more confident with their learning materials for having identified their own preferred learning modality. Only three percent of students reported negatively on the learning styles inventory. At the end of the semester 91 percent of students indicated that they believed that the use of animations and multiple representations had catered for their preferred learning modality. Only one student reported negatively.

Students also liked the hyperlinking within the learning resources on the CD-ROM, with 88 percent of respondents to the survey indicating that they found the CD easy to navigate and 63 percent indicating that the animations and multiple representations catered for their preferred learning modality (22 percent indicated that this was not the case for them).

Student evaluation of teaching and student results

Towards the end of each semester students at the University are invited to complete a Student Evaluation of Teaching (SET) which contains an inventory of questions (Likert scale) covering course design, course delivery, and the quality of the lecturer's own teaching. The mean score on *all* questions in the SET was higher than the mean for both the Faculty and the University. This was a significant improvement on SETs for ECO2000 in previous years and seemed to reflect the student reaction to the hybrid trial. It is plausible to conclude that the student learning experience improved as a result of the hybrid model.

Assessment outcomes showed significant improvement, with the pass rate increasing by 12 percentage points and the distribution of grades becoming more skewed towards higher grades (about 14 percent of students received higher grades than in the previous year). It is acknowledged that it is always difficult to draw conclusions about whether or not assessment outcomes have improved based on results for a single year because there are so many factors that cannot be controlled. These factors include quality of student and composition of the class (e.g. by age, country of residence, ethnicity and advanced standing). Quality of student is usually indicated by high school performance, but in the context of ECO2000 data are not available owing to the large proportion of students who are mature age or who are admitted to their degree program with advanced standing. However, the first assignment in the course is designed to assess the state of each student's prior learning in macroeconomics. The results for 2003 and 2004 indicated a slight improvement in quality (the means and standard deviations were 43.6 and 45.9, and 5.0 and 3.8 for 2003 and 2004 respectively—the maximum mark being 50). The composition of the class was stable between the two years. The course leader, who was responsible for the development of learning materials and delivery of the course, remained the same. It will be interesting to see what the distribution of grades is like in 2005 (although interpretation will be complicated by the fact that the lecturer for the course has changed and, enhancements to the learning resource package notwithstanding, the multimedia elements and multiple representations have not received as much emphasis as they did in 2004).

Conclusion

In 2003 the University took the initiative in announcing a policy that all courses would be progressively migrated to the so-called hybrid model, the core of which is a resource rich CD-ROM. A number of courses were involved in a trial, one of which was

ECO2000. The design of learning materials in this course aimed to provide resources to students in a user-friendly, pedagogically sound manner. Surveys and focus groups, the results of the SET and assessment results indicated that the aim was achieved. It is anticipated that continuing research will lead to a better understanding about how students access the material in the hybrid model. Of particular interest will be the ways in which multiple representations are used by students to enhance their mastery of key concepts. Results will be used to develop further the resources available on the CD-ROM and *USQConnect*. It is hoped that this will improve the learning experience and assessment outcomes for students.

References

- Ainsworth, S. 1999. The functions of multiple representations. *Computers and Education*, 33(2-3), 131-152.
- Ainsworth, S. and van Labeke, N. 2002. Using a multi-representational design framework to develop and evaluate a dynamic simulation environment. Paper presented at the International Workshop on Dynamic Visualizations and Learning, Tübingen, Germany.
- Bodemer, D. and Ploetzner, R. 2002. Encouraging the active integration of information during learning with multiple and interactive representations. Paper presented at the International Workshop on Dynamic Visualizations and Learning, Tübingen, Germany.
- Bruch, A. 2003. A treatise on the new skills needed for the creative student to be able to operate as successful practitioners in the new economy. Paper presented at Create.ed 2003: eLearning for the Creative Industries, RMIT, Melbourne, 2 October.
- Cookson, P. 2002. The hybridization of higher education: cross-national perspectives. *International Review of Research in Open and Distance Learning* 2(2), 1-4
- Doolittle, P. E. 2002. Multimedia learning: empirical results and practical applications. Paper presented at the Irish Educational Technology Users' Conference, Carlow, Ireland.
- Felder, R. M. and Soloman, B. A. 2001. Learning styles and strategies. <http://ncsu.edu/felder-public/ILSdir/styles.htm>
- Grisham, D. L. 2001. Technology and media literacy: what do teachers need to know? http://www.readingonline.org/editorial/edit_index.asp?HREF=april2001/index.html
- Jona, K. 2000. Rethinking the design of online courses. Paper presented at the ASCILITE 2000 Conference, Coffs Harbour, 14-19 December.
- Kirsh, D. 2002. Why illustrations aid understanding. Paper presented at the International Workshop in dynamic visualizations and learning, Tübingen, Germany.
- Mayer, R. E. 2001. *Multimedia Learning*. Cambridge: Cambridge University Press.
- McLoughlin, C. and Krakowski, K. 2001. Technological tools for visual thinking: what does the research tell us? Paper presented at the Apple University Consortium

Academic and Developers Conference, James Cook University, Townsville, 23-26 September.

National Office for the Information Economy. 2004. *Australian National Broadband Strategy*. Canberra: Australian Government.

Parsons, P. and Ross, D. 2002. Planning a campus to support hybrid learning. http://www.mcli.dist.maricopa.edu/ocotillo/tv/hybrid_planning.html

Roth, W. M. 2002. Reading graphs: contributions to an integrative concept of literacy. *Journal of Curriculum Studies*, 34(1), 1-24.

Sankey, M. and Smith, A. 2004. Multimodal design considerations for developing hybrid course materials: an issue of literacy. Paper presented at the Third Pan-Commonwealth Forum on Open Learning, Dunedin, New Zealand, 4-8 July.

Sarasin, L. C. 1999. *Learning Styles Perspectives: Impact in the Classroom*. Madison, WI: Attwood Publishing.

Shu-Ling, L. 2001. Controlling the display of animation for better understanding. *Journal of Research on Technology in Education*, 33(5).

Smith, A., Sankey, M. and Cottman, C. 2004. Hybrid delivery issues and approaches. Paper presented at the Staff Development Workshop, 30 March, University of Southern Queensland, Toowoomba. Available at <http://www.usq.edu.au/hr/odt/acstaff/content/hybrid.htm>

St Hill, R. L. 2000. Modal preference in a teaching strategy. Poster paper presented at the Effective Teaching and Learning Conference, University of Queensland, Brisbane, 9-10 November.

Stokes, S. 2002. Visual literacy in teaching and learning: a literature perspective. *Electronic Journal for the Integration of Technology in Education*, 1(1), 10-19.

Sweller, J. 1999. *Instructional Design in Technical Areas*. Melbourne: ACER Press.

Taylor, J. C. 2001. *Fifth Generation Distance Education*. Report No. 40. Canberra: Department of Education, Science and Training.

Taylor, J. C. 2004. Will universities become extinct in the networked world? Paper presented at the ICDE World Conference on Open and Distance Learning, Hong Kong, 18-21 February.

van Merriënboer, J., Bastiaens, T. and Hoogveld, A. 2004. Instructional design for integrated e-learning. In *Integrated E-Learning: Implications for Pedagogy, Technology and Organization*, ed. W. Jochems, J. van Merriënboer and R. Koper. London: RoutledgeFalmer.

Zhang, J., Johnson, K. A., Malin, J. T. and Smith, J. W. 2002. Human-centered information visualization. Paper presented at the International Workshop on Dynamic Visualizations and Learning, Tübingen, Germany.