

# Multimodal Design Considerations for Developing Hybrid Course Materials: An Issue of Literacy

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## ABSTRACT

The University of Southern Queensland is currently moving towards hybrid modes of course delivery across all discipline areas, reconceptualizing many current teaching and learning practices as a consequence. This paper reports on two research projects that highlight the importance of cognitive style, visualisation and multiple representations on future course designs.

## BACKGROUND

The University of Southern Queensland (USQ) teaches and researches as a dual-mode university with triple-option teaching styles (students can study on-campus or by 'traditional' distance education or online via the Internet). It offers over 300 accredited awards, consisting of over 1,000 subjects/courses across five Faculties and provides access to educational opportunities to approximately 25,000 students annually.

The quality and standing of the University's teaching and learning activities are widely recognised, having been joint Winner of the Good Universities Guides 'University of the Year' for 2000-2001 for developing the 'e-university' where students learn and are supported through the innovative and strategic use of educational web-based technologies. In addition, USQ was judged the best dual mode university in 1999 for its global education initiatives and expertise in providing flexible learning opportunities.

Through the years, the University has prospered across the four mainstream generations of distance education development, namely,

- the correspondence model (with print),
- the multimedia model (print, audiotape, videotape, computer-based learning and interactive video),
- the telelearning model (audioconferencing, videoconferencing, audiographic communication, broadcast TV/radio and audioconferencing),

- the flexible learning model (interactive multimedia, Internet-based access to WWW resources, and computer-mediated communication).

Elements from each of these models are used across all Faculties, where appropriate, in the preparation of teaching materials.

## **INTRODUCTION**

At the beginning of 2003, in a major shift in policy, USQ decided that all courses of study, for both on and off campus students, would be developed in hybrid delivery modes over the next 3 - 4 years. Central to this new hybrid delivery would be a resource-rich CD-ROM containing all the essential study materials supported with multimedia enhancements. The CD would then allow direct linking to a course web site hosted on USQ's learning management system (LMS) and in some cases be further supported by print material.

As USQ moves towards this CD based hybrid mode of delivery, the need to establish a range of pedagogically sound, cost effective guidelines for the delivery of these materials is regarded as paramount. Consideration of the most appropriate delivery combinations related to each course is currently taking place in many course development teams. This paper reports on the pedagogical issues considered when designing for CD-based delivery and comments on two individual research projects being undertaken with the view of establishing a set of sound process guidelines for the University.

To help illustrate the design concepts being proposed for USQ's CD based delivery, two courses currently being researched have been chosen; ECO2000 'Macroeconomics for Business and Government', run in first semester 2004 and MGT2102 'Optimisations Applications II', run in second semester 2003. Specifically, this paper examines issues involved in redeveloping these courses such as the role learning styles play in preparing instructional material and the importance of visualisation in the representation of concepts. In addition, catering for a multiliterate clientele and how the use of multiple representations may enhance the learning opportunities for USQ students is explored. Finally this paper will report on the initial research findings from MGT2102 and ECO2000 and reflect on what impacts this may have on the design of future USQ's CD based hybrid courses.

## ESTABLISHING A NEED FOR MULTIMODAL DESIGN

In developing CD based multimedia materials today educators are keenly aware 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 freely acknowledge their significance on the learning process, they are unable to reach consensus regarding the establishment of a single set of accepted principles (Vincent & Ross, 2001). Even with this understanding, current research indicates that many instructional events, particularly at university, only target genetic cognitive styles, or certain types of learners, usually read/write learners (Sarasin, 1999). Unfortunately, this approach inadvertently leads to some students feeling disenfranchised, particularly student's whose learning modalities do not match the style of the information presentation, which may inturn ultimately result in a student's performance being reduced (St Hill, 2000 & McKay, 1999).

As De Porter (1992) states 'many people don't even realise they are favouring one way or the other, because nothing external tells them they're any different from anyone else' (p. 114). Consequently, some students struggle with the text-based learning materials provided in a variety of traditional learning environments. If however, multiple sensory channels can be allowed for in the design of a presentation, learning can become more effective.

An important aspect in catering for a variety of learning styles, and particularly relevant in today's highly visual culture, is the use of images. Stokes (2002) asserts that using visual strategies in teaching results in a greater degrees of learning. Felder and Soloman (2001) agree, further suggesting that if sufficient visual content were included in learning materials students would retain more information. Although visual images are an integral part of human cognition, they have tended to be marginalised and undervalued in today's higher education systems (McLoughlin & Krakowski, 2001). Unfortunately, in the case of traditional distance education courses, many students are left to interact with study books or computer screens that contain very few visual references (Sankey, 2001).

Visual thinking is a unique part of the perceptual process with visualisation being the indispensable partner to the verbal and symbolic ways of expressing ideas and thoughts (McLoughlin & Krakowski, 2001). Fortunately, with advances in technology, the ability to transmit and display both realistic images and graphical representations of information has become a lot easier.

However consideration should not be limited to just visual literacy, as literacy generally is on the verge of reinventing itself and by implication require learners to decode information from all types of media (Grisham, 2001). Once material such as verbal texts (audio), graphs, drawings, photos, videos and other communicative

devices are seen as texts to be read, they may then be applied to the development of new, inclusive curriculum (Roth, 2002). Being multiliterate in a society that recognises a full range of learning styles requires the development of theories and strategies for the multiple representation of a whole range of instructional concepts.

The use of multiple representations, particularly in computer-based learning environments, has been recognised for many years as being a powerful way of facilitating understanding (Ainsworth and Van Labeke, 2002). Bodemer and Ploetzner (2002) believe that, 'multiple representations can complement each other, resulting in a more complete representation of an application domain than a single source of information does' (p. 2). For example, when the written message fails to fully communicate a concept, a visual element may be relied upon. This is further supported by research into multiple representations conducted by Ainsworth (1999) that found, '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). Simply put, 'students learn better from words and pictures than from words alone' (Doolittle, 2002, p. 1).

For CD based multimedia, the notion of 'visual and multiple literacy' can therefore be seen to take on increased importance. Computer screens are clearly more graphic (visual) and interactive than traditional media and the use of animated pictures, it would appear, have an enabling function that allows the user to perform a higher degree of cognitive processing than with static pictures (Schnotz, 2002). Therefore, when verbal explanations are presented with animated graphics a greater understanding is achieved than when a single representation is used (Mayer, 2001).

This important feature of multimedia however, if not handled correctly, may prove detrimental to the learning process, as multiple representations on the screen may place additional, and quite often unnecessary, cognitive demands on a learner. For example, learners may have to direct attention simultaneously to different representations, especially if these representations are combined with other dynamic components, such as complicated sound, animated movement and interactive text. Often these demands overburden student cognitive capabilities, resulting in them learning very little (Bodemer & Ploetzner, 2002). Therefore, if multiple representations are going to be used there are important issues relating to cognition that first need to be considered.

Two specific cognitive processing theories should be taken into account when considering the design of instructional multimedia. These are Dual Coding Theory and Cognitive Load Theory. Both theories focus, to different degrees, on the use of short-term or working memory, in which text (either auditory or written) and images are processed simultaneously.

Cognitive Load Theory suggests that when large amounts of information are presented at one time the learner can experience overload in their working memory, which has only a limited capacity. In effect, the learner becomes overwhelmed with what is being presented, resulting in a loss of direction and focus (ChanLin, 1997 & Sweller, 1999). Therefore it is essential that multimedia presentations focus on clear and concise presentation, rather than on the 'bells and whistles' that will potentially impede student learning (Doolittle, 2002). In the context of multimedia, the main factors influencing cognitive load seem to be the overuse of designs incorporating text, graphics and animation.

The overuse of these elements may steer the learners to the exciting or entertaining aspects of a presentation, but usually at the expense of encouraging the thoughtful analysis of the underlying meaning, thereby interfering with the intent of the lesson (Stokes, 2002). Some cognitive psychologists now acknowledge that a more effective processing capacity is available if instruction can be presented in multiple modes (McLoughlin, 1997), given reasonable constraints are provided.

Dual Coding Theory suggests that the working memory consists of two distinct processing systems, verbal and nonverbal. The verbal system processes narrative (spoken) information, while visual information (both image and text) is processed by the non-verbal system. Thus, one way to enhance the capacity of working memory is to utilise both processing areas simultaneously, allowing both narrative and picture to be processed at the same time (Clark, 2002), thereby maximising the amount of working memory available.

By utilising the human visual system to process information in parallel with verbal information, one can bypass or reduce the 'bottleneck effect' that can occur within working memory (Zhang et al., 2002). Further, utilising illustrations or simple (rather than complex) images, can also minimise the load on working memory. Text, by contrast, is read in temporal sequence and requires extra memory to keep all the parts in one place, therefore requiring more cognitive processing (Kirsh, 2002). If text is presented as audio however the learner can listen to a narration while viewing an illustration, thereby utilising both areas of the working memory. In essence, students will learn better from animation with narrative rather than from animation, narration, and on screen text (Doolittle, 2002).

A further advantage of CD based multimedia is that a number of different media elements can be included to suit a combination of learning styles. If, for example, the learner is presented with a choice of representations the one that best suits their needs can be selected. Evidence in recent research conducted by Ainsworth & Van Labeke (2002) suggests that this strategy can significantly improve learning opportunities for students.

Jona (2000) believes that this notion of learner choice is a paradigm shift that needs to occur in the delivery of education. If students perceive they have a level of control over their learning experience they are more likely to both enjoy the experience and utilise appropriate information processing approaches (Shu-Ling, 2001). However, one must be careful, as allowing too much freedom may generate a level of insecurity, particularly within the inexperienced learner, leading to increases in cognitive load.

When a presentation is broken down into learner-controlled, stepwise segments, rather than being one continuous presentation, learners can understand a larger number of different concepts (Schnotz, 2002). In Figure 1 we see a screen capture from the MGT2102 course. In this example students are taken through four animated sequences that demonstrate how to construct a network flow diagram. They are initially led through the presentation in a pre-determined sequence, and allowed to experiment the environment, to see effects of changing certain perimeters. At any time a student can view the text being narrated by clicking icon at the top right of the screen. This feature is added for those who prefer to read, rather than listen to, the presentation. Students can replay or jump to the next sequence if they feel they are familiar with the concept being presented.

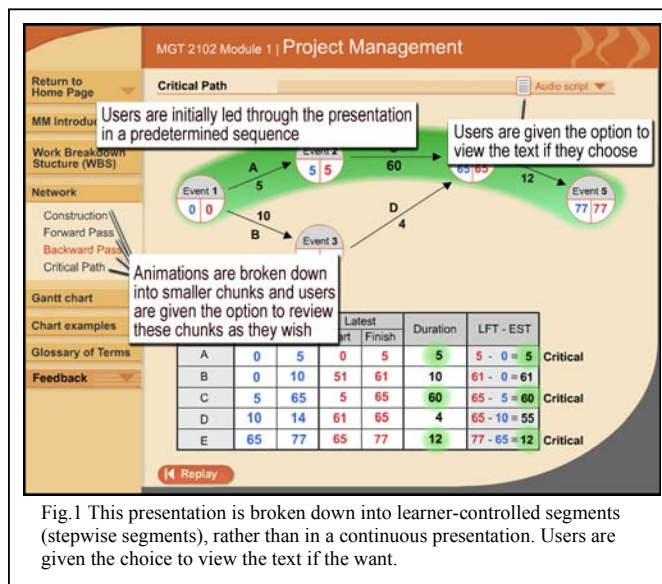


Fig.1 This presentation is broken down into learner-controlled segments (stepwise segments), rather than in a continuous presentation. Users are given the choice to view the text if they want.

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Many universities are involved in the translation of courses to CD and Web delivery. However, instead of utilising the unique attributes these technologies provide, most e-courses simply replicate a transmission of information model of delivery common in classrooms and traditional distance education. Jona (2000) believes that most online courses are simply fancy 'page turners', purely being digital presentations of lecture notes, facts and concepts that the learner progresses through sequentially. Sometimes with the aid of a learning management system (LMS) that provides the added advantage of some neat communication tools to help teachers and student interact with each other. Academic staff at USQ are keenly aware of these issues and have developed a range of strategies to help overcoming these issues.

## CD BASED HYBRID DELIVERY

The CD based hybrid delivery used by USQ has begun the process of reconceptualising how to provide distance education to students. Figure 3 (over leaf) illustrates the structure underpinning the Hybrid CD for ECO2000. All the core learning materials are created in an XML editor, allowing materials to be rendered to both a navigateable html structure (see figure 2 above) and a series of pdf files, for those students wanting a print friendly version.

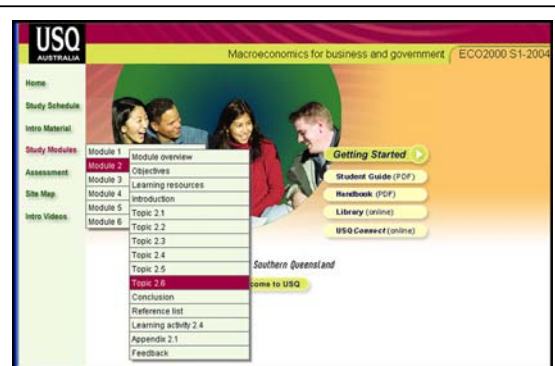


Figure 2. Showing one of three forms of navigation on the ECO2000 CD.

The materials that are then further enhanced by the inclusion of supporting multimedia elements contained on the CD and links to relevant material on the internet see Figure 4 below.

USQ has chosen to deliver this material on CD as opposed to simply online for a number of reasons. Firstly, due to what has been called, the 'tyranny of broadband' (Bruch, 2003) is variability and inconsistency of internet connection within

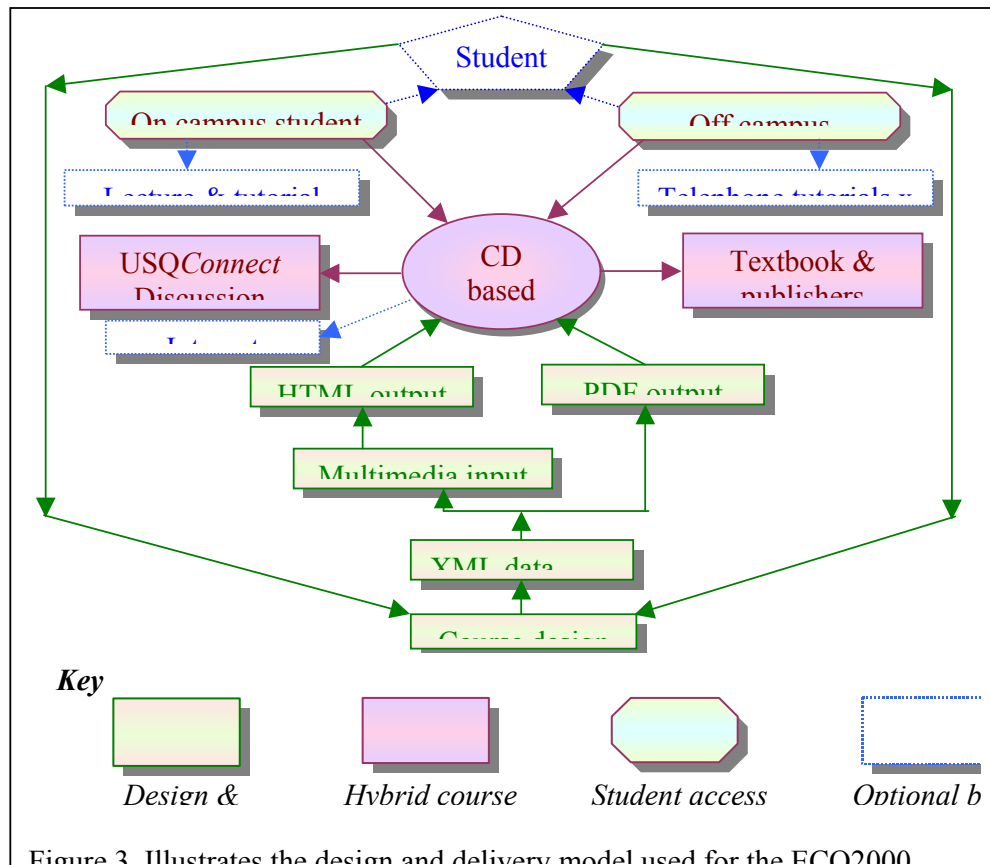


Figure 3. Illustrates the design and delivery model used for the ECO2000

Australia, to which there appears no easily solution in the short term. The National Office for the Information Economy recently released its Australian National Broadband Strategy on behalf of the Australian Government, in this report it stated,

“Australia covers a large geographical area which presents challenges for the rollout of infrastructure. In

addition, very low population densities in most of regional, rural and remote Australia make it difficult from a commercial perspective to provide access at affordable prices equitable with those in more populous markets” (NOIE, 2004, p.4). Given that over 75% of USQ’s students study by distance education, in countries all over the world this is a major consideration, both domestically and internationally.

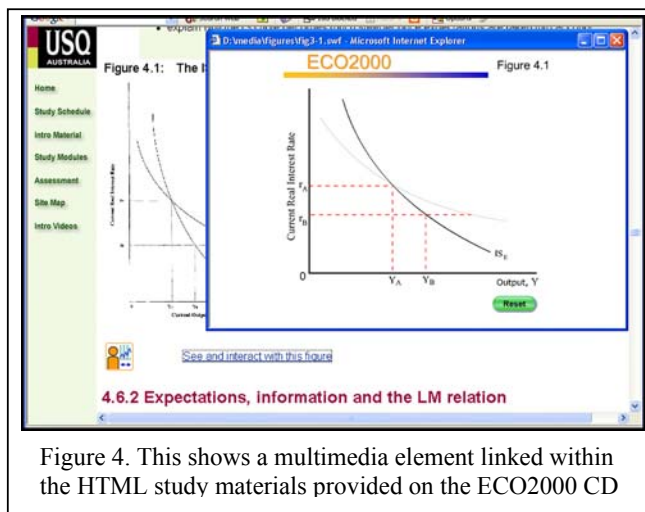


Figure 4. This shows a multimedia element linked within the HTML study materials provided on the ECO2000 CD

Due to this restriction, it is considered that CD will allow large quantities of electronic information to be provided directly to students, limiting the need for them to access large amounts of core data from the internet. It also allows the University to directly supply a range of multimedia enhancements to study materials. Having said this, the web still plays a significant role in the delivery of most courses, but more so from the perspective of support, communication and discussion. It is also expected that all students have some access to the internet to fully participate in their courses.

The CD also allows USQ to deliver its material at a fraction of the cost of traditional print-based distance education materials. To compensate for the absence of printed materials students are encouraged to use the navigable version of the materials that have been richly enhanced with the additional multimedia elements. If students prefer to print their

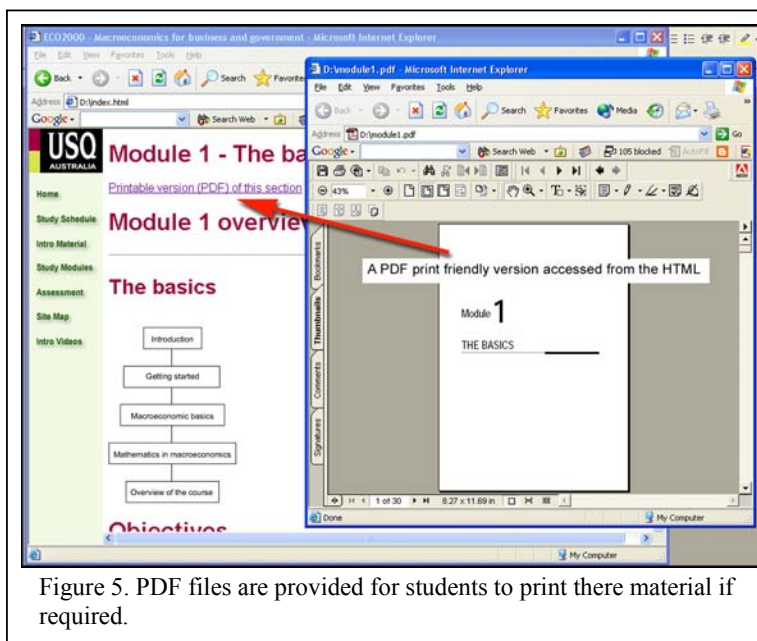


Figure 5. PDF files are provided for students to print their material if required.



materials they may do so from the printer-friendly files (figure 5) that have also been supplied on the CD.

## INVESTIGATING STUDENT PERCEPTIONS

MGT2102

In 2003 research was conducted on 101 students associated with the MGT2102 course. Students were presented with both a print-based and a multimedia based version of the study materials. They were then asked to respond in a three part questionnaire containing 26 questions. Part A contained 10 questions based on a five choice instrument, where respondents choose an appropriate response. Parts B and C, both contained an 8 question, 10 point Likart scale instrument.

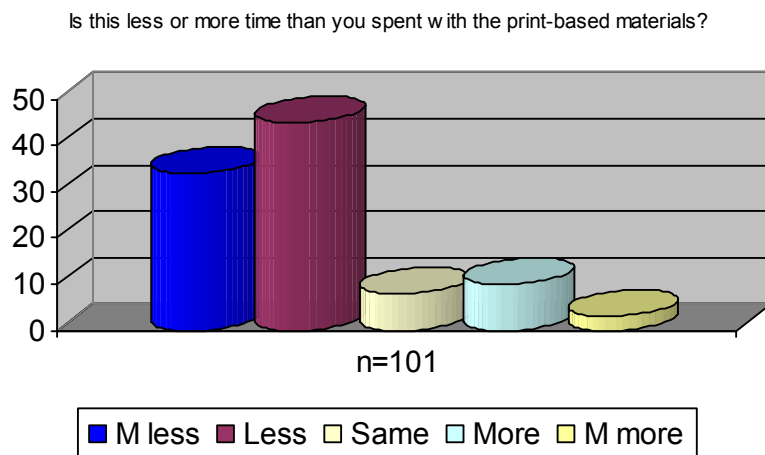


Figure 6. This shows that students found the multimedia materials less time consuming than the print based version of the same material.

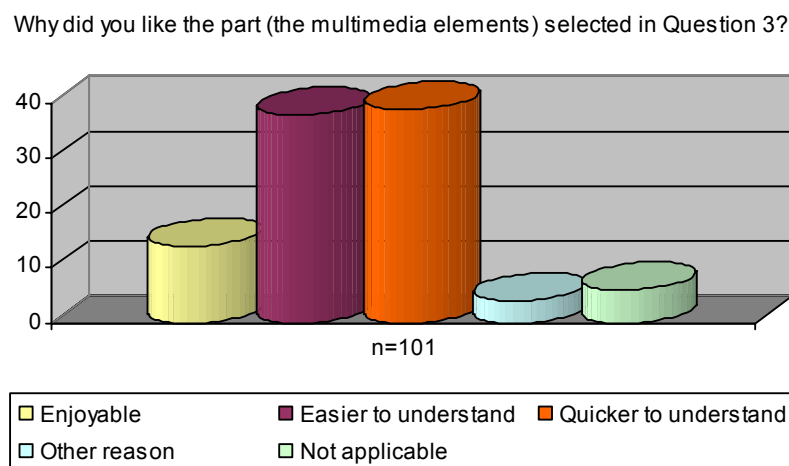


Figure 7. This shows that students found that when the course concepts were presented in their multimedia forms they were either quicker or easier to understand.

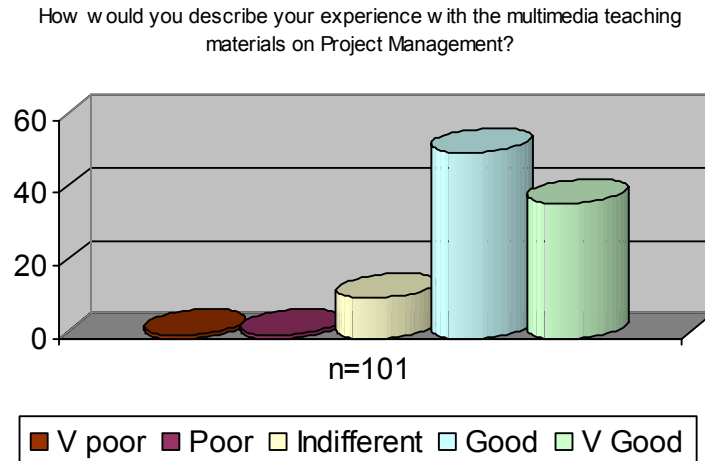


Figure 8. This shows respondents found the multimedia materials good or very good.

The data revealed that 80 percent of students found the multimedia version of the materials quicker and easier to use than the printed based version (see figure 6 above). 77 percent found the project management concepts contained in the course easier to understand when using the multimedia version (see figure 7 above). There was also an extremely high acceptance rating of these materials, with 90 percent of respondents reporting that they found them either 'good' or 'very good' (see figure 8 above). Interestingly when asked if they would prefer to receive most of their learning materials electronically only 17 percent responded positively, with 56 percent preferring to receive a combination of both electronic and print based materials (see figure 9 below). Only 5 respondents preferred to receive solely print based material.

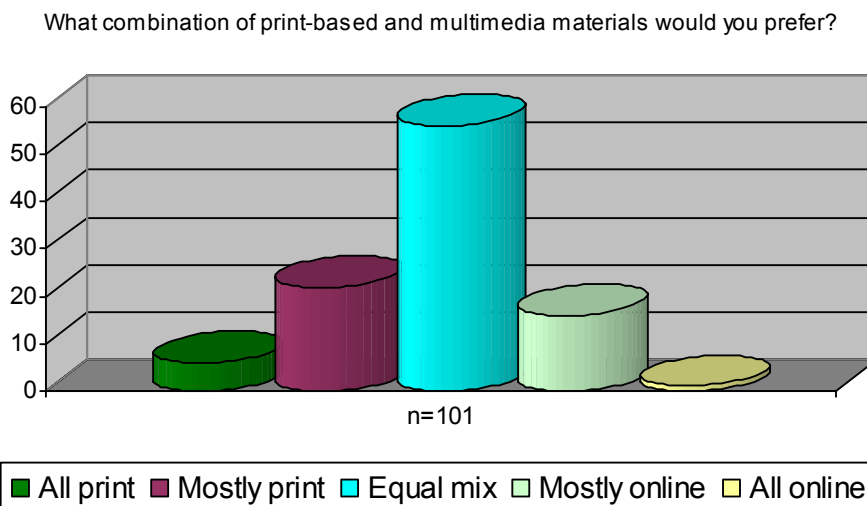


Figure 9. This shows how a majority of students would prefer to receive an equal mix of both print based and multimedia materials.

It was evident from these results that while many students wanted to retain some level of access to printed materials, it was not necessarily seen as the primary source of instruction. It was also seen in MGT2102, that when concepts were presented in a multimedia format, students generally found them to be both quicker to use and easier to understand. A complete list of results from this study can be found at: <http://www.usq.edu.au/users/sankey/mgt2102/results/results.htm>

## ECO2000

Research into the ECO2000 course began in March 2004. This study focused on the use of the hybrid CD and, more particularly, the multiple representations of the key concepts within the course. At the time of writing an initial short questionnaire of 10 questions, based on a five point Likart scale instrument, had been administered to 160 students. Two focus group interview sessions had also been conducted with 5 off-campus students and 6 on-campus students participating. Initial results showed very strong acceptance of the multiple representations contained on the CD, but again moderated with a desire to still receiving some printed material. Further and more extensive research will be conducted into this course in early June, the results of which will be reported at the conference. These results can also be accessed from: <http://www.usq.edu.au/users/sankey/MDML/pages/ECO2000results.htm>

## CONCLUSION

USQ has taken a bold step in implementing a policy that will see the production of the majority of its study materials being committed to a CD based hybrid mode of delivery over the next few years. This challenge, if handled correctly, will provide resources to students in a highly user-friendly, pedagogically-sound way and will keep USQ in the forefront of providing distance education and e-learning opportunities for many years to come. This paper has demonstrated that considering such a change in delivery direction must be thoroughly investigated from both a theoretical and practical perspective. More research in this area is needed but the results to date have been most encouraging.

## REFERENCES

- Ainsworth, S. (1999). The Functions of Multiple Representations. *Computers and Education*, 33(2-3), 131-152.
- Ainsworth, S., & 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, Tubingen, Germany.
- Bodemer, D., & 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, Tubingen, 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 the Create.ed 2003: eLearning for the Creative Industries, RMIT, Melbourne.
- ChanLin, L. (1997). The Effects Of Verbal Elaboration and Visual Elaboration on Student Learning. *International Journal of Instructional Media*, 24(4), 333-340.
- Clark, R. (2002). Six Principles of Effective e-Learning: What Works and Why. *The eLearning Developers' Journal*, 10 Sept, 1-8.
- 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., & Soloman, B. A. (2001). *Learning Styles and Strategies*. Retrieved March 2004, from [www.ncsu.edu/felder-public/ILSdir/styles.htm](http://www.ncsu.edu/felder-public/ILSdir/styles.htm)
- Grisham, D. L. (2001). *Technology and Media Literacy: What do teachers need to know?* Retrieved 1 July, 2002, from [http://www.readingonline.org/editorial/edit\\_index.asp?HREF=april2001/index.html](http://www.readingonline.org/editorial/edit_index.asp?HREF=april2001/index.html)
- Jona, K. (2000, 14-19 December). *Rethinking the Design of Online Courses*. Paper presented at the ASCILITE 2000, Coffs Harbour.
- Kirsh, D. (2002). *Why Illustrations Aid Understanding*. Paper presented at the International Workshop on Dynamic Visualizations and Learning, Tubingen, Germany.
- Mayer, R. E. (2001). *Multimedia Learning*. Cambridge: Cambridge University Press.
- McKay, E. (1999). An Investigation of Text-based Instructional Materials Enhanced with Graphics. *Educational Psychology*, 19(3), 323-335.
- McLoughlin, C. (1997, 7 -10 December). *Visual Thinking and Telepedagogy*. Paper presented at the ASCILITE Conference, Curtin University of Technology, Perth.

- McLoughlin, C., & Krakowski, K. (2001, September 23-26). *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, Queensland, Australia.
- NOIE. (2004). *Australian National Broadband Strategy*. Canberra, ACT: The National Office for the Information Economy.
- Roth, W.-M. (2002). Reading Graphs: Contributions to an integrative concept of literacy. *Journal of Curriculum Studies*, 34(1), 1-24.
- Sankey, M. (2001). *Are images widely utilised as learning tools in instructional materials produced by USQ? If not, why not and what would be the benefits?* Toowoomba: University of Southern Queensland, Distance Education Centre.
- Sarasin, L. C. (1999). *Learning Styles Perspectives: impact in the classroom*. Madison, WI: Atwood Publishing.
- Schnotz, W. (2002). *Enabling, Facilitating, and Inhibiting Effects in Learning from Animated Pictures*. Paper presented at the International Workshop on Dynamic Visualizations and Learning, Tübingen, Germany.
- Shu-Ling, L. (2001). Controlling the Display of Animation for Better Understanding. *Journal of Research on Technology in Education*, 33(5).
- St Hill, R. (2000). *Modal Preference in a Teaching Strategy*. Paper presented at the Effective Teaching and Learning at University, 9-10 November, Duchesne College, The University of Queensland.
- Stokes, S. (2002). Visual Literacy in Teaching and Learning: A Literature Perspective. *Electronic Journal for the Integration of Technology in Education*, 1(1, spring), 10 - 19.
- Sweller, J. (1999). *Instructional Design in Technical Areas*. Melbourne: ACER Press.
- Vincent, A., & Ross, D. (2001). Learning Style Awareness: A Basis For Developing Teaching and Learning Strategies. *Journal of Research on Technology in Education*, 33(5).
- Zhang, J., Johnson, K. A., Malin, J. T., & Smith, J. W. (2002). *Human-Centered Information Visualization*. Paper presented at the International Workshop on Dynamic Visualizations and Learning, Tübingen, Germany.