OPERATIONAL INFRASTRUCTURE FOR QUALITY DISTANCE AND ONLINE GEOSPATIAL PROGRAMS

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ABSTRACT

The Surveying and Land Information Discipline at the University of Southern Queensland (USQ) has delivered full time and distance education programs in surveying and related areas for over 26 years. Academics at USQ have recently embarked on multimedia enhancement and online delivery of curricula to provide an even broader and more contemporary learning environment. These enhancements, when developed professionally, require a significant commitment of resources and expertise, and often necessitate a team approach to their design and development. Although there has been a proliferation of activity in the area of online delivery, little consideration has been given to the support infrastructure that is necessary to establish, deliver and maintain these offerings. This paper examines the operational infrastructure that is critical to distance education students receiving a comprehensive, timely and quality learning experience.

INTRODUCTION

Academic institutions throughout the world are grappling with the impacts of the Internet, technological advances and the new global higher education economy. The emergence of this global higher education economy has acted as a catalyst in overcoming the institutional inertia that has typified the culture of many universities (Taylor, 2001). In the past twenty years distance education has matured as a legitimate form of higher education, but it is now technology and economics that are driving its development.

A recent World Bank report (Daniel, 2001) stated that the four challenges for distance education include:

- Gaining recognition of the economic importance of universities;
- Overcoming the low political and financial support;
- Recognition of the baseline needs of staffing and equipment; and
- The globalisation effects on students and student movement.

These challenges are not just unique to universities providing distance education, but are common to all higher education institutions. This paper will discuss some of these issues in the context of distance and online learning, but will specifically address the issue of quality, and in particular, the quality of the learning experience for students.

The term *quality* means different things to different people and is often difficult to measure. Mayadas (1998) defined quality through five pillars for effective asynchronous distance learning including: (i) student satisfaction; (ii) access to desired courses and accompanying support; (iii) learning effectiveness; (iv) faculty (staff) satisfaction; and (v) cost effectiveness. In the context of this paper, quality is referred to as *the standard of the infrastructure provided to the student*. Therefore, from this perspective, quality may encompass issues such as development of course materials, staff, delivery systems and support mechanisms.

Technological advances within our industry and the trend towards geo-information management has seen academic institutions reshape, re-market and transform their traditional programs (McDougall and Dowling, 1996). While much of the geospatial community has embraced the new technologies and media (Cartwright and Miller, 2000), many educational institutions are experimenting with the potential of this new technology for the delivery of teaching (McDougall *et al.*, 2001) and (Shortis and Cartwright, 2000).

A survey by the United States Department of Education (USDE) in 1998 revealed that 44% of universities were offering some form of distance education, an increase of almost one third from the corresponding survey in 1995 (Phipps and Wellman, 2001). Even universities that had not previously had a major involvement in distance education are now moving to online delivery in the hope of attracting new students (Inglis, 1999). In the United Kingdom, a new public-private partnership initiative, UK eUniversities Worldwide, is poised to enter the market in 2003 (UK eUniversities Worldwide, 2002). This initiative is designed to establish and share distance education infrastructure to enable UK universities affordable entry to the flexible delivery market. However, in order for existing distance education providers, and indeed, the newcomers to be successful, it is essential to understand the needs of the learners and the significant infrastructure required to support their learning.

This paper examines the infrastructure that is required to support the development, operation and sustainability of these enterprises. Specifically, the developments and issues that relate to the provision of flexible delivery of the geospatial programs at the University of Southern Queensland (USQ) will be discussed.

DISTANCE EDUCATION, OPEN LEARNING AND FLEXIBLE DELIVERY

Terms such as distance education, open learning and flexible delivery are often used interchangeably, however, there are distinct differences, limitations and support requirements that characterise each (Young, 1994; McDougall and Dowling, 1996; Young, 1997; McDougall *et al.*, 2001). Bennett (1986) refers to *distance education* as an educational process that is characterised by:-

- separation of teacher and learner;
- the influence of an educational institution that distinguishes it from private study;
- the use of technical media, usually print, to unite teacher and learner;
- the provision of two-way communication so that the student may benefit from, and initiate dialogue;

- the teaching of people mainly as individuals and rarely in groups; and
- the elements of a more individualised form of education.

This mode of education is commonly classified as *flexible delivery* indicating the basic strengths of this form of education. In contrast, other forms of delivery, such as *open learning*, are inherently different and include some administrative and educational constraints including specific attendance times and places, need to form groups, sequential teaching and a teaching strategy that suits the teacher rather than the learner.

The delivery systems required for distance education and open learning are, therefore, quite different as they cater for differing markets. The expectations of off-campus students are also often quite different to on-campus students and the provision of service is generally more demanding. Distance education systems are perceived to be more complex than conventional on-campus systems (National Board of Employment Education and Training, 1994) with the level of complexity being largely dependent on the educational model, or combination of models, employed. Taylor (1995) summarises the development of distance education through the classifications of generations or models. A summary of these historical models and their key distinguishing characteristics is provided below as a basis for discussion.

Correspondence Model (First Generation)

The *Correspondence Model* of distance education was characterised by the provision of study notes and assignments with students mostly left to their own devices to study. Offerings were generally sporadic and often determined by the availability of documented course (subject) notes. Most forms of correspondence teaching have now disappeared as the institutions involved generally had limited infrastructure to support these programs.

Multimedia Model (Second Generation)

Institutions that continued as significant providers of distance education services developed a range of support services and learning strategies to provide a more personalised and interactive mode of delivery. Instructional designers were employed to assist in the development of comprehensive study guides and examples, and to provide a consistent *look and feel* to the presentation of materials. A range of other media including audio conferencing, facsimile, audio-tapes, videos and computer assisted learning packages provided added enhancement. Regional study centres were established to facilitate lecturer-student and student-student interaction. The support and administrative services to ensure these activities were maintained and coordinated became increasingly centralised and specialised: less controlled by the teachers of the material.

Enhanced Model (Third Generation)

The *Enhanced Model* built on the previous two models through the addition of enhanced electronic resources in the study materials to improve the understanding of the theoretical components of the course. These included:

- Application software;

- Demonstration software;
- Sample data sets;
- Access to unit web site for lecture notes, *PowerPoint* displays and other materials;
- Electronic discussion groups; and
- Electronic submission of assignments.

The maintenance and management of these facilities, and the subsequent higher level of demand, led to further centralisation and the development of specialised support infrastructures to deliver these more sophisticated resources.

Flexible Learning Model (Fourth Generation)

The *Flexible Learning Model* incorporates the recent technological trends in the delivery of materials over the Internet. In this model, the provision of the teaching and learning materials is focused on almost complete electronic delivery. The study materials are provided online in an interactive multimedia environment that may encompass digital video, audio and demonstrations.

Communication to the lecturer and other students is largely channelled through electronic discussion groups and email. Assessments may be submitted and returned electronically with some assessments marked by computer managed learning systems. One advantage of electronic delivery is that it can also provide benefits to on-campus teaching through improved flexibility in teaching resources (Young, 1997).

The complexity of the supporting infrastructure is not based on any one particular model but more likely on the combination of a number of models. Different study modes are offered to meet different student needs and are crucial to providing flexibility. The above chronology of the developments in distance education highlights the increasing complexity of the distance education environment and the need for a quality support infrastructure

GEOSPATIAL PROGRAMS AT USQ

The University of Southern Queensland (USQ) was established in 1967 with the Faculty of Engineering and Surveying as one of the foundation faculties. USQ rapidly established on-campus and distance education offerings and built a reputation for offering quality academic programs. These are recognised worldwide by other higher education institutions and internationally accredited by many professional bodies. In 1998, the Faculty of Engineering and Surveying gained third-party ISO9001 quality certification of its operational and management systems. In 1999, a panel of experts from the International Council for Open and Distance Learning (ICDE) judged USQ as the best dual-mode university in the world. This award recognises USQ for its global education initiatives and its expertise in providing flexible learning opportunities to the world. Further recognition came in 2000 when USQ was the joint winner of the Good Universities Guide *Australian University of the Year 2000-2001* for criteria focussed on developing the e-university.

The current (2002) USQ enrolment is approximately 22,300 students, including 5,600 on-campus students and a further 15,700 students studying by distance learning. The international program segment of this population has a current enrolment of almost 5,600 students from over 45 nations: approximately 1100 students study on-campus, and the remainder study in their home country by distance learning (University of Southern Queensland, 2002). This international program is set to continue expansion in 2003/2004, adding significantly to the supporting infrastructure requirements.

Comparatively, the Faculty of Engineering and Surveying has over 2,500 students (350 in geospatial programs) with approximately 30% attending on-campus whilst the remainder study off-campus by distance education.

The current USQ ratio of off-campus to on-campus students expressed as a percentage: 71%:29% (University of Southern Queensland, 2002) reflects the emphasis that USQ places on distance education. With approximately 60% of the external population between the ages of 20-35, the majority of these students could be classified as *mature-aged* (McDougall *et al.*, 2001). Similar age profiles are reflected at other institutions engaged in distance education around the world e.g. Penn State University (Wright *et al.*, 2002). This clearly indicates that distance education addresses the needs of those in full-time employment and those other sectors of the community unable to attend on-campus. It is also apparent that these students require appropriate and flexible delivery to *fit in* with their diverse work and family circumstances. The USQ enables students to choose to study on-campus or off-campus or to study either part time or full time. This flexibility enables students to move back and forward between study modes or to study concurrently in different modes.

Specifically, the Faculty of Engineering and Surveying operates as an integrated unit and close links amongst staff and across discipline areas has facilitated the design and development of its on-campus/off-campus programs. Over the past six years the Surveying and Land Information Discipline has developed its teaching programs to form an articulated suite of offerings that enable students to progress to their highest potential. The programs include two, three and four year undergraduate Degrees, postgraduate Certificates and Diplomas and research Masters and PhDs.

DISTANCE EDUCATION INFRASTRUCTURE

In its simplest form distance education consists of two components; a materials development component and a student support component. The process of materials development normally culminates in the delivery of specifically prepared material designed to meet the educational objectives of the course. It is important to recognise that although materials delivery is increasingly giving way to electronic formats, a quality development process still requires planning and design of the course, materials development and writing, production and dispatch.

Delivery technologies such as printed materials, internet delivery, CD ROMS, videotapes, computer managed learning etc. simply provide students with access to information and instruction to facilitate an educational experience. What really matters is the quality of the instructional message, rather than the inherent characteristics of the instructional medium (Taylor, 1999). Therefore, it is possible to provide students with

the most sophisticated graphics and electronic delivery systems without any significant increase in the pedagogical efficacy.

A key process in the improvement of the quality of teaching and learning has been the incorporation of a systematic approach to the instructional design of materials. In its simplest approach, instructional design entails the systematic analysis of the knowledge base and cognitive skills, in order to design a sequence of well structured learning experiences (Taylor, 1999).

This process tends to be beyond the expertise of discipline or subject experts and often demands the skills of educational professionals. These include specialists in system design, information systems, graphic design, educational processes, electronic publishing and project management. The team approach to instructional design has been institutionalised at USQ since 1977 (Figure 1). It is supported by a quality management system and an imperative to deliver materials on time.

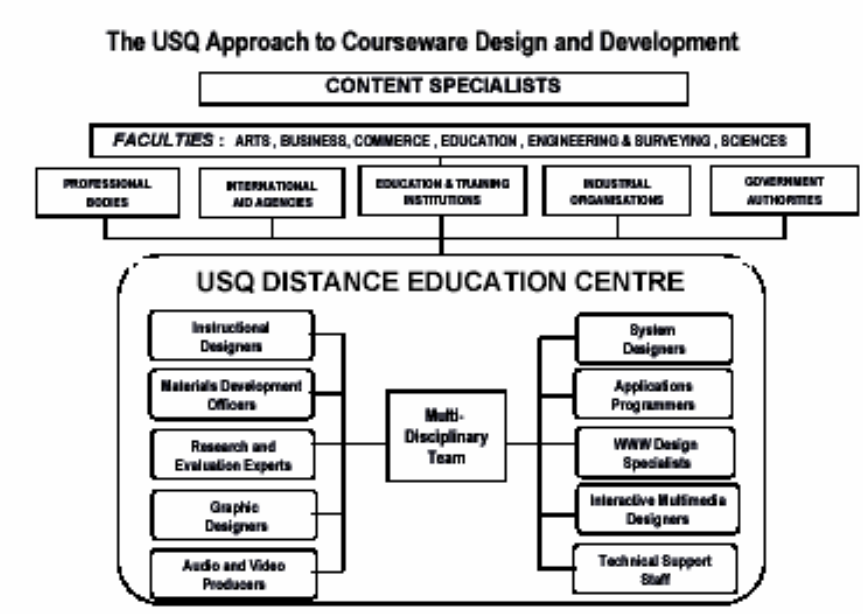

Figure 1: *USQ Development Team Model*
(Adapted from (Taylor and Swannell, 2000))

There is no doubt that delivery of online educational services needs to be founded on good teaching practice (Youngblood, 2001). It also requires teachers to acquire new competencies and teaching skills. The following comment illustrates the point:

> *I studied a unit online with .. (a USA institution) ... It was only when the lecturer began teaching that 'life was breathed into' the online materials – the teacher provided the energy and the direction that lifted the experience above the mundane. Paradoxically, in placing masses of learning materials free for use on the web they (a USA institution) may simply be adding to the mass of unused information that 'gathers virtual dust' on the web. It will be interesting to see how they plan to encourage learners to engage with these materials.* (Jones, 2001)

This comment highlights the problem of providing students with materials that are unsuitable for online learning. The materials need to be highly interactive and supported by multimedia enhancements and feedback. The problem of engagement of the learner in this new environment is well recognised by those in the distance education sphere. Laurillard (2001) identifies that the transition from the traditional one-way *Transmission Model* to a more progressive *Conversational Framework,* where interactions occur at each stage of learning, is not easy for academics. She argues that although the materials and tools are now digital, little has changed with respect to the teaching process.

Interaction with course lecturers and administrators also plays a crucial part of the learning experience, especially when the student (*client*) is paying for privilege. Figure

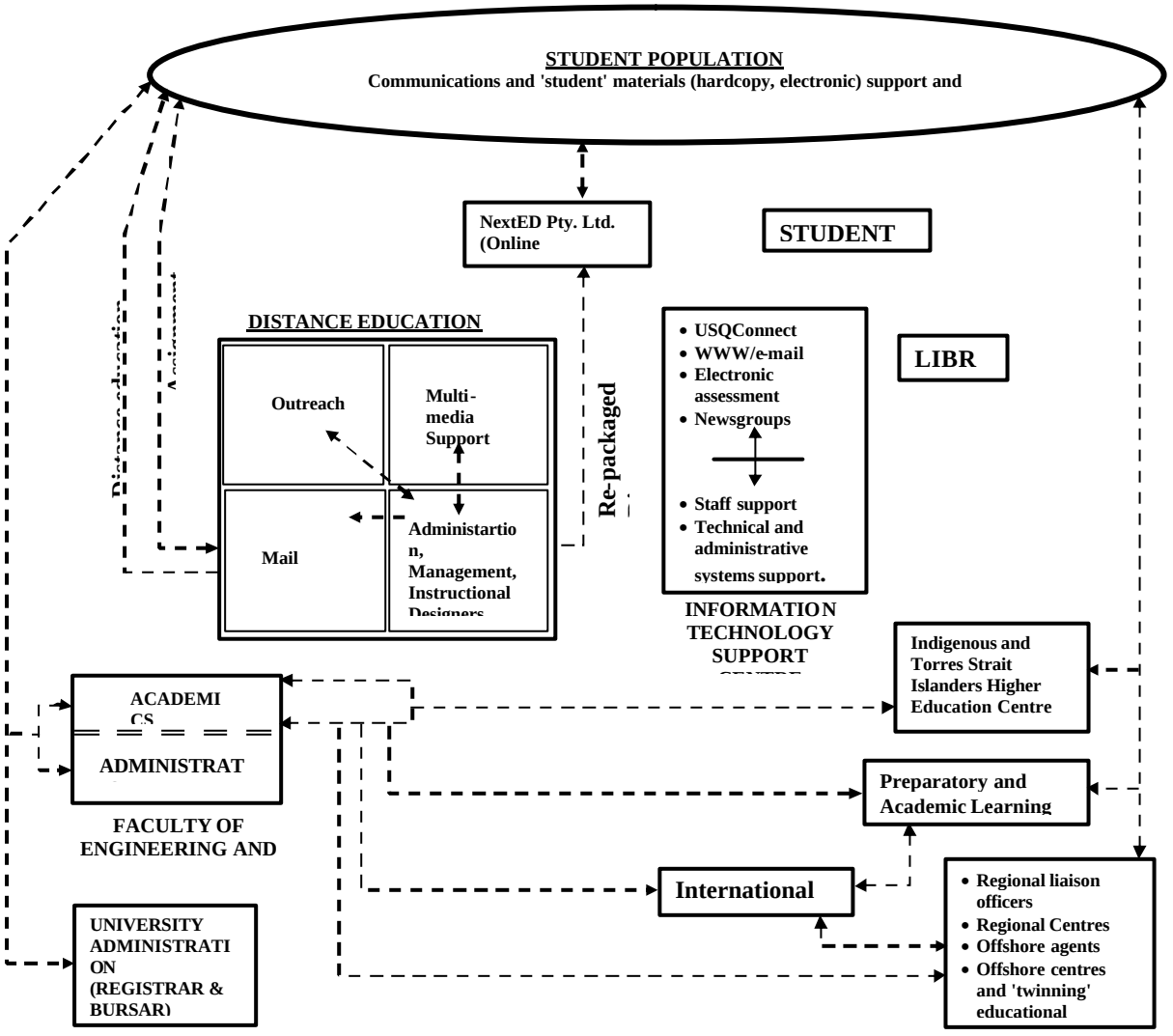

Figure 2: *USQ Support Infrastructure and Management*

It is this underlying infrastructure that enables a student to interact with the learning institution and teaching staff, and thereby receive a quality learning experience. The University of Southern Queensland has a comprehensive support infrastructure that is designed to meet the needs of GIS and surveying students both locally and

internationally. It is sufficiently dynamic to accommodate the changing user needs, technological advancements and the increased demands for flexibility.

Student Support Facilities

Student support facilities for distance education require a broad range of services on-campus, in regional study centres and in offshore agency offices. Advisory and academic staff are contactable through a variety of mechanisms including: directly (email, phone), via *Outreach* (a specialised student support service – Figure 2), through regional centres, via the on-campus international Office, offshore agency offices and through *USQConnect*, the student web portal. These services assist in the prompt turn around of assessments and enquiries. This is essential for distance education students, as the timely and informative feedback helps to increase their sense of *involvement*. Evidence indicates that distance education students without frequent contact or support are more likely to drop out of their course of study (Rumble, 2000).

The overall management and administration of student assessment material is critical to the success of distance education. At USQ the assessments for the 15,000 external students are all sent to a central mail location, the Distance Education Centre (DEC), to be logged in and distributed. Online assessments are sent directly to the relevant staff via the online services unit. Each hardcopy assessment has a unique barcode, which, once scanned, is listed on the database so students can see that the assignment or exam has been received. These are then distributed to the appropriate academic staff who mark and return them again via the DEC. On completion of marking, assignments and marks are once again logged at the central mailroom and the results made available to students via *USQConnect*. The assessment database provides a quality assurance process to control the enormous amount of assessments (in excess of 100,000/semester) that come into the university.

Electronic support services now provide students with the ability to access a greater range of information and facilities. At USQ, the *USQConnect* web portal (http://www.usq.edu.au/usqconnect/brochure/index.html) provides students with an increasing range of services including:

- Electronic course materials;
- Access to up-to-date library catalogues, electronic journals and articles, and text databases;
- Secure access for enrolment details, assignment lodgement and return dates, and assessment results;
- Access to general university campus student services;
- Faculty information on departments, courses, programs, policies, and staff details. Students are now able to selectively choose information sections to compile a personalised handbook, set of regulations etc.;
- Electronic mail (email) – for communicating with academic and support staff and other students;
- Conferencing and group communication;
- Internet learning resources; and
- Electronic Noticeboard for external students including Residential School and telephone tutorial timetables, learning circles and other information.

Until recently, the management of all student communications at USQ was controlled through *Outreach* (one small unit of the total support infrastructure shown in Figure 2). An example of this unit's enquiry management process is shown in Figure 3. With online courses the communication channels between the examiner and the students are now generally more direct. However, the comprehensive management and timely response to enquiries is critical to student satisfaction and progress.

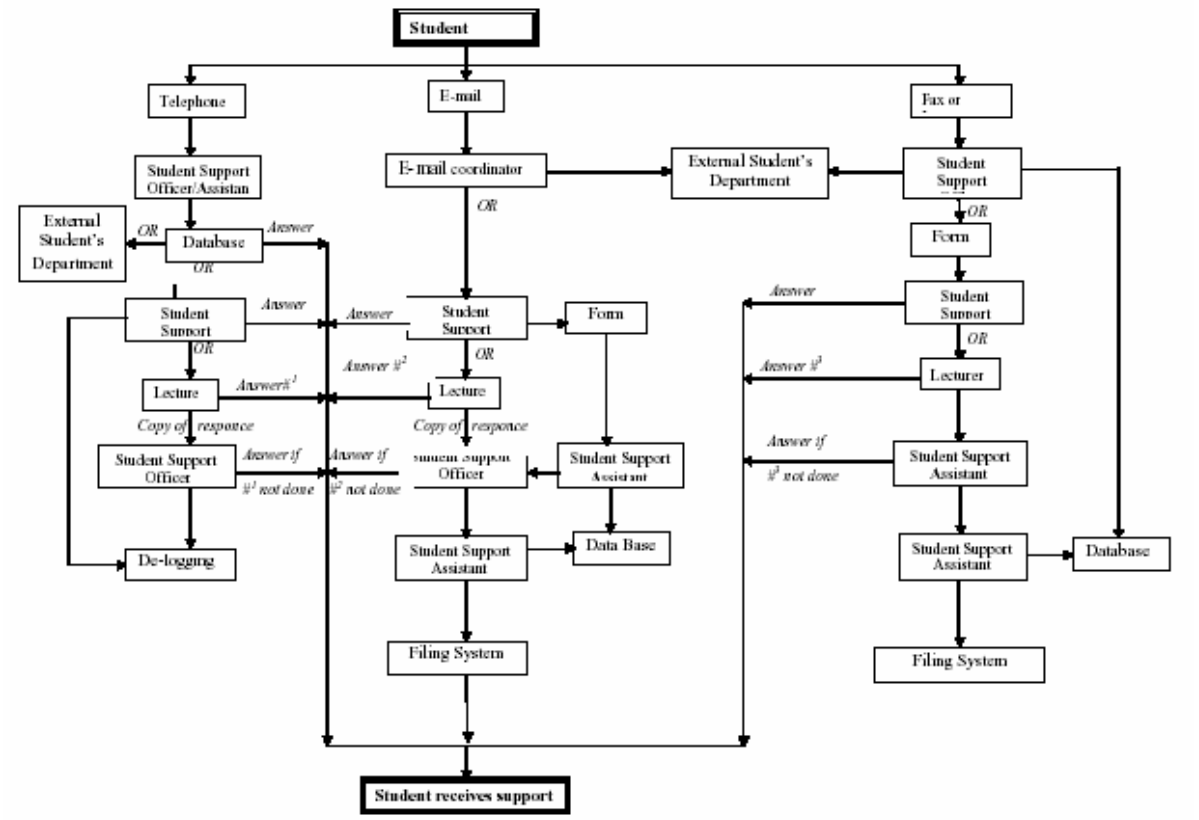

Figure 3: *Outreach student request-support model at USQ*

The organisation of examinations for external and online students is a massive task in its own right. At USQ, with students in over 45 countries, it is a considerable task to organise and manage the distribution of examinations, invigilation and secure return of examination scripts in these remote locations. Some centres can be as small or remote as a mine site in central Australia, a one-teacher school in remote Papua New Guinea or the British embassy in Italy.

These services alone require a significant management and resource allocation with continuing maintenance commitments. The quality and usefulness of the full range of services demands a dynamic and sophisticated infrastructure.

FLEXIBLE DELIVERY OF GEOSPATIAL PROGRAMS

The Internet and electronic delivery has now opened up the *distance education* and *flexible delivery* market place to greater range of potential providers. Within the geospatial information sector, a number of flexible delivery initiatives have emerged. Notably, collaborations such as UNIGIS (http://www.unigis.org/) have enabled individual universities to establish distance education programs in GIS. UNIGIS is a worldwide network of educational institutions offering distance learning courses in GIS. Their website claims that institutions within the UNIGIS network offer internationally recognised qualifications for GIS professionals and those seeking to enter the field. Their member institutions are located in Europe, UK, South Africa, Canada and the USA. Most of the institutions only offer the graduate programs in GIS via distance education, whilst their other undergraduate offerings are almost all undertaken through traditional on-campus teaching.

Another significant global offering is Environmental Systems Research Institute's (ESRI) Virtual Campus (http://campus.esri.com/) which provides a range of online courses to support training in their products as well as specific GIS applications. The courses cover a wide range of applications and enable academic institutions to integrate the practical aspects of training in GIS software through the completion of individual courses. The virtual campus is well structured and offers access to facilities such as a library, self-help support, records and networking. Although ESRI's Virtual Campus does not provide a traditional university qualification, completion of its courses are recognised as partial credit towards some university courses and continuing professional development (CPD) programs.

The University of London's Birkbeck College offers an interesting online MSc in GISc (http://www.bbk.ac.uk/gisconline/index.html). The coursework consists of short weekly summaries on the topics being studied, assignments, an applications building project, a virtual conference and a dissertation. It is offered completely online and utilises the University of London's infrastructure to facilitate examinations for distance education students. At Penn State University's on-line Certificate Program in GIS (http://www.worldcampus.psu.edu/pub/gis/index.shtml), students may work anytime they wish during the week, and do not need to enroll at exactly the same time as the on-campus students. Similar programs can be found at University of Maine, University of Colorado at Denver, Curtin University of Technology and many others, however the degree of sophistication, level of interaction, quality of materials and support varies greatly.

There is no doubt that resourcing constraints play a major role in any significant strategic developments within the area of distance education. The decision to proceed with our approach has been based on sound pedagogical grounds but also with a realisation of the economic constraints, both from the university and student perspectives. The quality and timeliness of the support given to our students have contributed significantly to their academic progress: a *near* replication of the on-campus student's opportunities for immediate face-to-face response.

Given that our distance education materials are already in electronic desktop publishing format, conversion to a suitable on-line format is not difficult. However, the delivery of static digital materials (non-enhanced) offers limited benefit to the student above and beyond a hardcopy text, and in some cases, might be considered a

disadvantage in terms of cost and flexibility. Therefore, we have adopted a measured approach to the development and delivery of our on-line courses which includes:

- On-line development of a selected number of courses using limited video and audio enhancements;
- Greater utilisation of CD ROM enhancements to include additional software and imagery;
- Development of some Computer Assisted Learning (CAL) marking for external assessment;
- Greater use of supporting application software for areas such as GIS, remote sensing, digital photogrammetry, laser scanner imaging, GPS, 3D modelling, and adjustments;
- Development of course web pages that enable external students access to the same lecture materials and examples of past examinations as internal students;
- Incorporation of discussion groups and mailing lists to enable improved communication both amongst students and also with the lecturer;
- Development of techniques to provide flexible and generic materials through the use of XML technology;
- PDF file use with fully functioning Internet links;
- Expanded on-campus access for students including Wireless Networking for web access of materials;
- Development of a new web interface to provide greater flexibility for students, staff teaching and access to resources and administrative facilities; and
- Twinning arrangements with other higher education institutions where USQ distance education materials and full electronic student access privileges to USQ are enhanced with local lectures and tutorial sessions.

Although there has been frantic activity in online delivery of courses in recent times, little has been done to evaluate its success (Youngblood, 2001). The assessment of the outcomes of enhanced educational methods is not easy (Shortis and Cartwright, 2000) and immediate results may not be available until a student graduates. Student evaluation feedback from USQ courses is a continuous and formal process and has provided a wealth of anecdotal evidence to consider within the developmental processes. Unsolicited comments from employers and graduates assist in confirming that the educational infrastructure is providing appropriate support for our educational endeavours.

DISCUSSION

There is little doubt that distance education clearly offers the potential to provide greater flexibility to those seeking access to higher education or life long learning (Wright *et al.*, 2002). However, the method of engaging students, the resources provided and the support mechanisms required are quite different from traditional on-campus teaching. Although distance education, particularly online delivery, is a relatively recent phenomena, much can be learnt from institutions such as USQ, which has been involved in distance learning for more than 30 years. The issues facing higher education institutions that provide geospatial courses via distance education are similar to those in other disciplines. A recent White Paper on the Distance Education in GIS (Wright *et al.*, 2002) has identified a number of issues that need to be addressed

including: intellectual property, digital libraries, support, interaction of multiple technologies and cost/funding models.

The approach adopted by USQ in its delivery of distance education programs is quite different from some of the other institutions mentioned above. Firstly, at USQ the materials development is co-ordinated at a centralised level thereby providing a corporate approach that results in a consistent *look and feel* for all courses. It also enables input from instructional designers and follows a quality management process through to production. Secondly, the support infrastructure established at USQ follows a more centralised model which facilitates a comprehensive quality support environment for students. In contrast, most of the emerging geospatial programs being offered through distance education have limited centralised institutional support.

Although there are differences amongst institutions, there are also many similarities. One of the most challenging issues is the provision of suitable resources to students in the form of software and data. Like most institutions we have established alliances with key industry providers to facilitate access to software and data at affordable cost. However, with the rapid changes in technology, particularly software versions, it requires significant time and effort to maintain current linkages between the theory and the technology.

Recent surveys of USQ students have indicated that, although students would like access to more on-line courses and further multimedia enhancement, they also value the flexibility and convenience of the printed media. In remote areas it has been found that although there may be access to the Internet, its performance and reliability is often inconsistent. USQ has addressed this issue by establishing local servers that mirror the study materials throughout mainland Australia, SE Asia and the USA. This has significantly satisfied the student's desire for instant interaction. However, the main value of web delivery is still largely as an enhancement media and a tool to access student support facilities.

Student's comments have also shown dissatisfaction with studying and reading materials only from the computer screen. Being required to print out large volumes of web material is not only time consuming but also a very costly impost on the student. Hence, our efforts have concentrated on the improvement in the other areas of delivery, namely the quality and diversity of materials, assessment mechanisms, improving communication and developing the widest range of quality and useful student support infrastructures.

The perception by some universities that the click of a mouse will enable courses to be *virtually* available is somewhat different to the reality in the surveying and GIS areas. It is important to understand the limitations of the technology and the student's ability to access equipment, computers and the communication infrastructure. In addition, surveying and GIS courses normally have a significant practical component that requires the completion of on-campus residential school assessments. Employment related difficulties, accommodation and travel all need to be managed, which add to the significant demands already on the student support facilities.

Institutions that have recently ventured into online delivery of courses to counter declining student enrolments and/or resources, are now beginning to realise the significant time and cost implications required to develop and maintain these offerings. It has been shown by (Inglis, 1999) that online delivery is not necessarily more efficient or cost effective than the traditional print based media. In addition, the costs to provide such educational products continue with the ongoing maintenance of course materials, development of new assessment instruments and enhancements to specialised services.

New technologies bring new resource issues and problems. Some of the issues that now face universities with the advent of improved communication technology include:

- Email – students expectation of immediate responses to their questions;
- Internet resources lead to plagiarism and *cut and paste* answers;
- A world wide student body with diverse cultures and expectations;
- Variations in terminology with the global offerings;
- Need for 24/7 service as we deliver to an expanding global market;
- World-wide technology differences; and
- Relatively rapid political and university administrative changes that conflict with academic structures.

A significant component of time and resources for distance education is devoted to the management of assessments and timely turn-around of the feedback. Not only is it easier to communicate using modern computer technology, it also provides the ability to electronically cut-and-paste large quantities of data which increases the size of assessments and hence marking times. The study by (Youngblood, 2001) in web based delivery of public health courses found that the workload required to run online courses is invariably underestimated. It was also found that lecturers' expectations for online participation were quite different from the reality, with participation rates reflecting the structure of learning i.e. optional versus compulsory.

CONCLUSIONS

Distance and online students must be able to interact with both the learning institution and teaching staff in order to receive an educational experience comparable to on-campus students. The more effective the distance education systems that are provided for the students, the closer the learning experience replicates the services provided to conventional on-campus students. The initiatives cited in this paper emphasise the need for an appropriate organisational support infrastructure to ensure students are provided with quality materials and adequate interaction. Without the support mechanisms described above, it is unlikely that the distance education students will feel assimilated into the university environment or acquire the important collegiate ethos that has become part of an university education.

As institutions throughout the world clamber to offer courses via the Internet, many are blissfully ignorant of the support infrastructure that is required to deliver a high quality service to their new market. Within a globally competitive environment, the USQ's strategically planned, systematically integrated and institutionally comprehensive

student support infrastructure provides a model for sustainable and quality distance education.

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