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Proceedings of the 20th Annual Conference
of the Australasian Society for Computers in
Learning in Tertiary Education (ASCILITE)

Adelaide, Australia
7–10 December 2003

Editors
Geoffrey Crisp, Di Thiele, Ingrid Scholten, Sandra Barker, Judi Baron

ascilite
**Australasian Society For Computers
In Learning In Tertiary Education**

A LEARNING MANAGEMENT MODEL FOR MIXED MODE DELIVERY USING MULTIPLE CHANNELS (INTERNET, INTRANET, CD-ROM, SATELLITE TV)

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Abstract

The African Virtual University (AVU) Computer Science Project is a World Bank initiative where four Universities in Sub-Saharan Africa deliver Computer Science degree and diploma programs from RMIT University, Australia via the internet and other channels.

For this multi-campus, mixed-mode E-learning experience we designed a multi-channel learning management model (MCLM) to accommodate expected technical difficulties and intermittent service interruptions. E-learning materials are delivered to students via multiple channels - internet, intranet, satellite TV, CD-ROM, even paper. Ideally, each channel supplies the same content in the format most suited to that mode of delivery. Each local site selects its preferred channel(s) day by day, depending on local conditions, cost / benefit analysis, reliability, staff / student preferences, etc.

The functionality provided by each channel dictates its preference, so multi-channel delivery provides an up / down-gradable service, e.g. if all other channels fail, the channel that provides handout of hardcopy notes can maintain a service. The model's hallmark is inbuilt redundancy.

We have operated this MCLM model for the first semester. We explain the model's architecture, report the operational results, and reflect on the model's success in meeting design parameters - cost-effective? scalable? maintainable? robust? sustainable? portable?

Keywords
Up/Down-gradable, Cascading, Multi-Channel, Learning Management Model, Mixed Mode

1. Introduction

The African Virtual University (AVU) Computer Science Project is a World Bank initiative where the University of Cape Coast, Kigali Institute of Science and Technology, University of Dar es Salaam (UDSM) and Addis Ababa University deliver Computer Science degree and diploma programs from RMIT University, Australia via the internet and other channels. The 1st semester is just concluding. Approximately 250 students enrolled, paying USD500-1000 per year's tuition. In 4 years time our lead partner, UDSM, will take over accreditation of these programs following a detailed capacity building process.

This paper addresses the design and implementation of a multi-channel learning management model (MCLM) to accommodate expected technical difficulties and intermittent service interruptions during

this multi-campus, mixed-mode E-learning experience. First we summarise the existing AVU I.T. infrastructure - internet, intranet, satellite / phone communication, server hardware and software. Section 4 explains how our model operates with African learning facilitators in cooperation with RMIT course coordinators. In section 5, we evaluate the model and arrive at recommendations for improvement. In conclusion we reflect on the model's success in meeting design parameters - cost-effective? scalable? maintainable? robust? sustainable? portable?

2. AVU I.T. Infrastructure

We summarise the existing AVU I.T. infrastructure features in Figure 1 and its major facilities below. For bandwidth, storage capacity and other specifications, see (AVU I.T., 2003). For telephone and electricity costs, reliability, etc, see (AAU ICT Report, 2000), (Elliot, 2000).
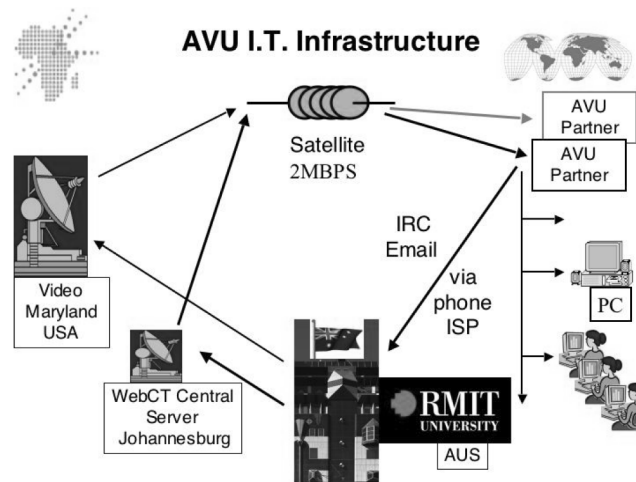

Figure 1: AVU I.T. Infrastructure

2.1 Central site

A central WebCT Campus Edition 3.7 server in Johannesburg, South Africa broadcasts internet packets to local sites via satellite. Students access WebCT central learning materials and news forums via local PCs. Live and pre-recorded video is also periodically broadcast via satellite to local sites from Maryland, U.S.A. Students view these materials in theatres. The satellite link is only one-way at present - central to local. Burst bandwidth is 2MBPS. Two-way satellite transmission is planned.

2.2 Local sites

Student PC workstations at each local site transmit internet packets via intranet, phone line and an ISP. Bandwidth in the local to central direction can vary between 28.8KBPS and 64KBPS when students and staff interact with the central WebCT materials and news forums. Each local site also has a WebCT Campus Edition 3.7 server with local copies of learning materials from WebCT central, Johannesburg. Each local WebCT server maintains its local news forums. Universal power supply (UPS) backup reduces downtime. Synchronising material on the central and local WebCT servers is a manual process, pending possible upgrade. The AVU may consider WebCT Vista, the enterprise solution.

2.3 Design constraints

Our research into the existing AVU infrastructure concluded that the constraints we have to work within are :
1) probable expansion from 4 to 10 or more African partner universities,
2) possible introduction of 2-way satellite communication with African partner universities,

3) piecemeal infrastructure upgrading, possibly without comprehensive analysis and load testing,
4) intermittent service interruptions between central and local sites, and within local sites,
5) varying quality in technical services at local sites.

3. Learning Management Model

For the AVU multi-campus, mixed-mode E-learning experience we designed a multi-channel learning management model (MCLM) to accommodate expected technical difficulties and intermittent service interruptions. E-learning materials are delivered to students via multiple channels (Figure 2):
- central WebCT via internet (satellite incoming, telephone / ISP outgoing)
- local WebCT via intranet
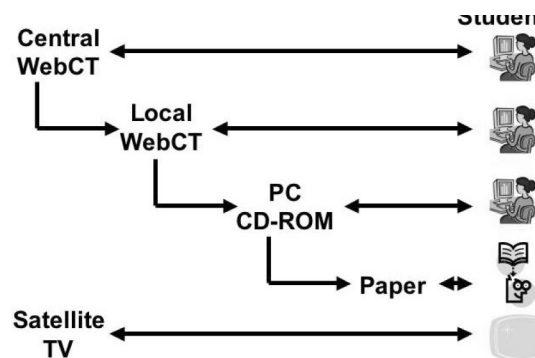- CD-ROM via PC
- Paper based handouts
- Video via satellite TV

Figure 2: Multi-Channel Learning Management Model

Ideally, each channel supplies the same content in the format most suited to that mode of delivery. Cascading learning materials from one channel to another reduces overall developments costs. It requires the initial design of learning objects to be as channel independent as possible, but with a view to translation from one channel to another. Our course content experts (academics) are assisted by experienced online developers to this end. Cascading learning materials also benefits students by exposing them to alternative presentations of the same concepts. All channels preserve the benefits of face-to-face tutorials and hands-on practicals to reinforce learning.

Each local site selects its preferred channel(s), day by day if necessary, depending on local conditions, running costs, reliability, staff / student preferences, and functionality trade-offs. Delivery via multiple channels provides an up / down-gradable service, e.g. if all other channels fail, the channel that provides paper handouts can maintain a teaching and learning service. Our MCLM model's hallmark is inbuilt redundancy.

3.1 Central WebCT
This channel is ideal for student browsing of centrally stored materials at any time from any place, and for downloading materials for offline study. The central WebCT server also supports uploading to a single repository of all remote student responses to quizzes, tests and assignments. These can be marked more economically and efficiently from the one central site, enabling quicker turnaround time. Pedagogical benefits are gained from open discussion between students and staff across various African Universities. Student performance across all local sites can be more readily monitored. Additionally, capacity building is more efficient and effective.

Where this AVU internet channel is not available or reliable, or cost of access is high, the local WebCT channel (3.2) is preferable. Certainly the current AVU internet channel needs to expand access and

increase bandwidth. Cost effectiveness, reliability, accessibility etc will determine when this channel no longer requires local WebCT backup.

3.2 Local WebCT
As local WebCT access is generally faster, this channel is ideal for student browsing of materials at an AVU centre, and for downloading larger materials for offline study. A local WebCT server also supports uploading student responses to quizzes, tests and assignments. However, localised marking incurs administration overheads to collect results at a central site and to monitor student performance across all remote sites.

Where this AVU intranet channel is not available or reliable, or cost of access is high, the local workstation channel (3.3) is preferable.

3.3 Local PCs with CD-ROMs
Most WebCT learning materials are burnt onto CD-ROMs; the main exception is any object involving interactivity. CD-ROMs can be used in local PCs in the event of central or local WebCT failure. This channel is ideal for student browsing or downloading of materials anywhere a PC with a CD-ROM drive is available. Of course this channel cannot support uploading student responses to quizzes, tests / exams and assignments. Instead, students write their responses to a floppy disc for collection and transmission to the central WebCT server, thereby incurring higher administration overheads. This channel can supply supplementary audio / video more efficiently than via internet or intranet, e.g. a 1 hour recorded lecture is likely to be less viewable and cost-effective when streamed via internet or intranet.

Where PCs with CD-ROM drives are not available, the following channel (3.4) is the fall-back.

3.4 Hardcopy
All printable WebCT and CD-ROM learning materials can be distributed to students in the event of power outage, PC failure, or WebCT inaccessibility. Interestingly, hardcopy is often the source from which WebCT and CD-ROM learning materials are originally derived and developed. So, if there is a commitment to the reliability of paper-based delivery, it provides the least technology dependent back-up. However, we have found that mass printing / photo-copying at local sites should not be taken for granted.

Obviously this channel cannot supply video, audio and interactive formats. Materials cannot be downloaded in computer format. Nor can students upload their responses to quizzes, tests / exams and assignments. Instead, students write their responses on paper for collection. Assessment results would be uploaded to the central WebCT server, once accessible, thereby incurring higher administration overheads.

3.5 Satellite TV
Live and pre-recorded video can be periodically broadcast via satellite to students in local theatres. Some interactivity can be provided by internet chat, phone or fax from students at local sites. Course materials broadcast via satellite TV can be recorded at the local site for later re-use.

This channel can supply the same formats as the above channels do, except for interactivity; e.g. students may watch a scrolling PC monitor just as if they were scrolling their own screen. Of course, materials cannot be downloaded in computer format. Nor can students upload their responses to quizzes, tests / exams and assignments. Instead, students write their responses on a floppy disc or paper for collection. Assessment results are uploaded to the central WebCT server, once accessible, thereby incurring higher administration overheads.

Satellite TV can also supply supplementary audio / video more efficiently, e.g. a 1 hour recorded lecture is likely to be less viewable and cost-effective when streamed via internet or intranet. Further, one-way

audio / video broadcasting (via satellite TV or internet streaming) with return audio (via international phone line conferencing) can enhance learning with interactivity. However the distance between source (AUS) and destination (Africa) incurs time lag, which undermines effectiveness. There are also technical difficulties caused by satellite reception issues and limited windows of broadcast opportunity. Mixed phone line audio control problems can also intervene. Faxed messages can be more practical.

This channel should only be seen as 1st preference if student hands-on use of PCs is limited. Where possible this channel should supplement other channels, preferably local or central WebCT, or else CD-ROM.

4. Course Delivery

The proportion of central versus local WebCT use is determined largely by the participating sites. Cultural sensitivities as well as cost-effectiveness, reliability, etc. play their part (Gilpin, 2000). Initial site visits convinced us that the design and implementation of our MCLM model must empower the local sites, e.g. to choose channels and plan face-to-face classes. Only then would our lead partner, UDSM, gain the flexibility to customise, leading to their ownership of the learning management experience following completion of the capacity building process in 2007.

Each local learning facilitator handles students' queries. Any issues for RMIT are emailed via an alias to the course coordinator and the AVU operations manager. Each email alias for a course provides one point of contact, without depending on individual staff availability. A response will come from the most appropriate staff member, depending on the student query, and who is on duty at the time. To ensure consistency, and allow responses to be re-used where appropriate, all responses also CC the email alias. A convenient audit trail is a by-product.

Each WebCT server (central and local) provides news or discussion forums for each course. The central WebCT provides a forum for staff only, and another for staff and students from all sites. Each local WebCT provides the same forums, but intended more for site specific local issues. These discussion forums not only reduce the need for individual emails, but also provide material for a Frequently Asked Questions (FAQ) bulletin board. FAQs are carried over between delivery cycles whereas discussion forums are emptied at the start of each delivery cycle.

The central WebCT discussion forum is the main medium for electronic queries. The learning facilitators respond to queries from students from all sites. Students are strongly encouraged to assist each other, reinforcing a student centred learning approach. RMIT course coordinators respond to outstanding queries and monitor progress of facilitators and students.

Students submit assignments via WebCT. Central WebCT is preferred because administration and moderation of the overall assessment process is less fragmented. This necessarily makes all student results accessible to all facilitators. This poses a security and privacy risk, which is under discussion. Submission via local WebCT avoids this risk, and is still preferable to handing in a floppy disc or hardcopy. RMIT's operations manager monitors assessment progress in consultation with AVU learning centre directors and individual learning facilitators to ensure timely completeness and overall consistency.

5. Evaluation and Recommendations

Observation and evaluation of our MCLM model during delivery of 6 courses over the 1st semester leads us to the following recommendations.

Access by students and staff to the central WebCT has not been as reliable as expected. The unreliability of telephone ISP links from some sites to the central WebCT is the major problem. The best solution is 2-way satellite internet, as planned (AVU I.T., 2003). Access by students and staff to their local WebCT has been marred by imperfect UPS and data backup. Often daily brownouts can cause disc crashes in PCs on

the intranet as well as the local WebCT server. The most practical solution is UPS upgrade and increased backup frequency.

An underlying issue is the accreditation of each site to participate in the AVU programs from RMIT. The AVU has responsibility for I.T. infrastructure, and in particular, load testing. We now know that RMIT technical experts need more time on site to comprehensively measure staff and student usage statistics under high and low load in order to adequately gauge response rates, and interruption frequency. RMIT has responsibility for signing off local staff selection, and orientating staff to our MCLM model. We now believe that face-to-face or phone interviews safeguard selection based on resumes alone.

The AVU learning facilitators have performed very well, particularly where facilities have been below expectations. But it is difficult for RMIT to remotely orientate fellow academics from different institutions to RMIT's ethos, culture and pedagogy. Before higher level courses begin in future semesters, we believe AVU learning facilitators should visit the course coordinators at RMIT. A next best option would be for RMIT to develop training videos, supplemented with video conferences, preferably via 2-way satellite. Currently, the pedagogical effectiveness of 1-way satellite video conferencing with synchronous return IRC (chat) via telephone ISP is questionable, although it does fulfil a social engagement function with remote staff and students. Generally, the feedback from sites indicates that it is a very positive experience.

6. Conclusion

The success of our MCLM model can be measured in terms of its design parameters :

cost-effective? Our MCLM model was accepted by the AVU as tendered by RMIT, including budget. We believe the installation of satellite and WebCT infrastructure by the AVU was cost-effective. We know our development of course materials is cost-effective, as we have used a refinement of a methodology previously proven for Open Learning Australia (OLA), Global University Alliance (GUA) and RMIT Vietnam (Zuluaga, Morris, Fernandez, 2002). AVU delivery cycles will become more efficient over coming semesters.

scalable? Where services are provided centrally, they are readily scalable. Localised services incur linear overheads for AVU and RMIT. However, duplication across new local sites can be done in parallel. Further experience will lead to greater efficiencies.

maintainable? Centralised services are readily maintainable under current arrangements, but 1-way internet broadcasting needs to be upgraded to 2-way. Maintenance of local intranet and workstations, including system and application software, is subject to changing personnel, varying technical quality, and insecure funding.

robust? Redundancy built into the multiple channels in our model support its cascading and up/down-gradable functionality. Temporary or permanent removal of a channel, either local or central, is not destructive overall.

sustainable? The AVUs mandate for the RMIT originated degree and diploma programs is expansive. Student demand is clear. The only issue is student capacity to pay fees. As RMIT hands over program accreditation to its lead partner (UDSM) in 4 years, it will be important to know how UDSM views sustainability.

portable? Our MCLM model for delivering mixed mode courses remotely is portable, depending on intranet and internet capacity. As our model is up/down-gradable, it can be installed in stages, and expanded cost-effectively. Our model could work well in, say, the South Pacific, embracing many islands into a multi-channel, mixed-mode learning management environment.

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