Real-time interactive environmental teleducation between the United States and southern Africa

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Distance learning offers opportunities for educational experiences to faculty members and students where time, expense, or location otherwise inhibit offering or taking a particular course of study. However, there are severe pedagogical limitations to traditional Web-based courses that suffer from a lack of personalized, spontaneous exchange between instructor and student. The technology to establish a real-time, interactive teleducation programme exists, but to our knowledge is relatively untested in a science classroom situation, especially internationally over great distances. In this pilot project during the 2001/02 academic year, we offered a real-time, interactive class at three separate universities, which communicated instantaneously across an ocean at a distance of greater than 13 000 km and seven time zones. The fall (autumn) 2001 course, Seminar on the Ecology of African Savannas, consisted of a series of 11 lectures originating in either Mozambique (at the Eduardo Mondlane University), South Africa (University of the Witwatersrand) or the United States (University of Virginia). We combined ISDN, Internet and satellite linkages to facilitate the lectures and real-time discussions between instructors and approximately 200 university students in the three countries. Although numerous technical, logistical and pedagogical issues arose — expected and unexpected — throughout the pilot year, the project can be viewed as overwhelmingly successful and certainly serves as proof-of-concept for future initiatives, both internationally and locally.

The fundamental issue is neither new versus old education nor of progressive against traditional education but a question of what [is] to be worthy of the name education.1

Origins of the initiative

Not long ago, we were told that it takes a village to raise a child.2 However, with the changing nature of information access that has been brought about, first, by the advent of the Internet and, now, by its pervasiveness, educating a young person for citizenship in the 21st century is likely beyond the resources and capabilities of even an entire village. For example, a student in Charlottesville, Virginia, can no more be prepared for global citizenship and intellectual opportunity by local resources alone than a student in South Africa or Mozambique, or anywhere else in the world for that matter.

The Department of Environmental Sciences at the University of Virginia (UVA) believes that it is at the forefront of technology to facilitate student-paced, time indifferent (that is, available 24 hours a day) and, to varying degrees, instructor-independent instruction to individuals who are geographically removed from formal classroom instruction — is constrained by severe pedagogical limitations associated with a lack of personalized, spontaneous exchanges between the instructor and students.5 Before distance learning and other technology-based learning initiatives can become effective means of instruction, practitioners must address and overcome the ‘transactional distance’6 that can so often develop between instructor and student when either party finds the technology so unfamiliar as to create a barrier to effective communication.7 If these

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Fig. 1. Teleducation across space and time. During the 2001/02 academic year, this pilot project offered two real-time, interactive classes to more than 200 students at the Eduardo Mondlane University (Mozambique), the University of the Witwatersrand, Johannesburg (South Africa), and the University of Virginia (U.S.A.), communicating instantaneously via a combination of ISDN, Internet, and satellite links at a distance of more than 13 000 km and seven time zones.
pedagogical concerns could be overcome, the power of the Internet and other 21st-century technologies could be harnessed to enhance instructional opportunities over great geographical, and even cultural, distances. This is especially true about the delivery of science education in southern Africa.

Thus, despite the technological and pedagogical hurdles associated with this endeavour, we were optimistic when collaboration between the participating universities extended to the science classroom via teleducation for the first time during the 2001/02 academic year. We believed that by tailoring an instructor’s pedagogical approach to complement cutting-edge technology, we could reduce the transactional distance, both geographical and pedagogical, between the instructor and student through real-time, interactive teleducation, as would be evidenced by our pilot project between the United States and southern Africa.

A history of collaboration

One of the chief goals of this project was to enhance the capacity of Africa to solve the challenging health and environmental problems in Africa. We saw this initiative as a way of using regional expertise, while expanding educational opportunities, and introducing global perspectives to the students in all locations. Thus, the full and equal participation of the institutions in southern Africa was crucial to the development and implementation of this endeavour. Having said this, it should be noted that this project may not have succeeded without a previously established foundation of cooperation between participating institutions. In this case, the University of Virginia had collaborated with the University of the Witwatersrand and the Eduardo Mondlane University to conduct environmental research within the region for nearly 25 years. This collaboration included joint field studies and laboratory work between faculty and students, the integration of technology into our research (for example, the acquisition and use of satellite imagery and the development of computer-based environmental models), and academic exchanges between faculty and staff. Moreover, UVA, Wits and EMU (as well as the University of Botswana’s Harry Oppenheimer Okavango Research Centre, and the University of Venda, South Africa) had formalized this commitment to research and educational collaboration through a series of memoranda of agreement signed throughout the course of the previous five years.

| Table 1. Lecture schedule for the interactive, real course ‘Seminar on the Ecology of African Savannas’ broadcast between the University of Virginia, the University of the Witwatersrand, and Eduardo Mondlane University, as drawn from the fall (autumn) 2001 course syllabus. |
|---|---|
| Fall 2001 | Lecture titles |
| September 18 | ‘Elephants and long distance communication in southern Africa’ Michael Garstang, Department of Environmental Sciences, University of Virginia |
| October 2 | ‘Nutrient cycles and the African savannas’ Mary Scholes, University of the Witwatersrand |
| October 9 | ‘African global change’ Paul Desanker, Department of Environmental Sciences, University of Virginia |
| October 16 | ‘Effects of the Limpopo River floods on agriculture’ Rui Brito, Edward Mondlane University |
| October 23 | ‘Ecological models of African savannas and woodlands’ Hank Shugart, Department of Environmental Sciences, University of Virginia |
| October 30 | ‘Atmospheric pollution in urban regions of South Africa’ Harold Annegarn, University of the Witwatersrand |
| November 6 | ‘The oral tradition and history of Africa’ Joseph Miller, Department of History, University of Virginia |
| November 13 | ‘Evolution of mammals in southern Africa’ Lee Berger, University of the Witwatersrand |
| November 20 | ‘The US long-term ecological research program and Africa’ Bruce Hayden, Department of Environmental Sciences, University of Virginia |
| November 27 | ‘Dust in the winds of southern Africa’ Robert Swap, Department of Environmental Sciences, University of Virginia |
| December 4 | ‘Advancing our understanding of the environment by graduate study’ Graduate students, universities of Virginia and the Witwatersrand |

How it worked and who was involved

Course offering

Collaboration among the participating universities extended to the classroom via teleducation for the first time during the Fall 2001 semester with the ‘Seminar on the Ecology of African Savannas’. Students at the University of Virginia and those in southern Africa participated in the seminar, a traditional lecture-based course that was organized and offered by eleven different faculty members, each of whom prepared and presented one 30-minute lecture about an aspect of the southern African environment (Table 1). Each lecture was broadcast over the Internet live before students at the host institution (e.g. UVA) and to students at the other institutions (e.g. Wits and EMU). Instructors used PowerPoint presentations, photographs, overheads, and other media to supplement their lectures. At the end of the prepared lectures, students were given opportunities to ask questions in a live, real-time manner to the lecturers. Barring occasional technical difficulties, participants at all sites were able to both see and hear the student posing the question and the instructor’s response. Because of the nature of the presentations, the course was offered as a one credit, pass/fail class, with grading based upon attendance. Students at all locations gave us feedback on the lectures, and the class itself. We were able to use the University of Virginia’s ‘Classroom Toolkit’ to post additional questions from students, which could not be addressed following the lecture because of time constraints.

Technical approach to teleducation

All links between UVA, Wits and EMU were established via the three primary protocols used in digital videoconferencing: H320 ISDN, H321 ATM, and H323 IP. Classroom endpoints at the University of Virginia were equipped with VTel Galaxy Room Systems connected over an ATM backbone, or using 512 or FX Polycam units. An FVC VGate 5000 Gateway was used to make connections between the H320, 321 and 323 endpoints. A Videoerver 2020 Hybrid H320 / H321 Multipoint bridging unit (ATM and ISDN) were also employed, as were a Cisco IP MCU and Polycam H323 endpoint. The University of Virginia served as the central hub for all communications (even for ‘direct’ discussions between Wits and EMU). Wits connected to UVA directly via ISDN, whereas the EMU connection to UVA required ISDN to the World Bank Satellite network from Africa to the United States and then ISDN to the University of Virginia. All connection speeds were at 384 kbps.

Technical challenges

While this was not a cutting-edge
project in terms of the technology, it did represent the state-of-the-art for two-way videoconferencing, especially over the distances involved, and going to and from Africa; as such, it presented several particularly interesting challenges. In short, the satellite linkage had a habit of failing, but reconnection was easily facilitated. ISDN and IP can be unpredictable with regard to bandwidth and quality. A 384-kbps connection speed was typically used and is acceptable, although 512 or 768 kbps (1/2T) may be desired. 256 kbps is the minimum recommended speed for real-time interactive audio-visual display (typically 64 kbps was allocated for audio). However, on the ‘commodity Internet’ there is no guarantee of quality of service to ensure available bandwidth from Virginia to southern Africa. Thus, even when the display looked to be of high quality, it could occasionally fade as bandwidth was temporarily degraded. The next generation Internet (Internet II) will likely be able to guarantee quality of service, so this problem may not be of concern in the next few years.

Finally, it should be noted that work on a heavily technical pilot project such as this benefits from the adoption of a general working philosophy as espoused best by one of the technical advisors to this project: ‘If you expect an international videoconference to go off without a hitch then you are asking for trouble ... a sense of humor and a flexible schedule will always come in handy.’

**Pedagogical approach to teleducation**

Our experience with this project is consistent with the notion that the use of technological tools to convey course content, even in real-time, will undoubtedly change traditional teaching styles most frequently seen at the university level. Thus, instructors must appreciate that there are limits to the technology in the teleducation setting and adapt their methods of instruction.

First, speakers had to prepare themselves (or be trained) to use the teleducation equipment, including how to manage camera views to and from supplementary material (for example, a PowerPoint slide). While multi-media presentations (possibly involving PowerPoint slides, overhead transparencies, still pictures, and video) can be supported by teleducation technology as described in this project, some of these options cannot easily be invoked on demand without previous testing and iterative quality control measures.

Additionally, instructors had to consider carefully their selection of supporting media during their presentations. Font style, size, and colour determined the clarity of PowerPoint slides, overhead transparencies, and front lilt pictures alike. Also with regard to the use of supplementary materials, our experience shows that it is of great help to remotely located students if presenters share lecture outlines and PowerPoint slides in advance of a teleducation session.

Instructors had to be acutely aware of their body position and posturing. For example, speaking to the camera, rather than to students on site, contributed to the visual quality of the lecture. Similarly, maintaining a clear voice at constant volume that was directed into the microphone enhanced the audio quality for remote listeners. Moreover, it was imperative that sound checks be performed before every presentation because of variations in the projection of different speakers’ voices.

Finally, instructors had to accept that it was more difficult to gauge the attentiveness and reception of a remote audience (that is, ‘Are they getting it?’) during a teleducation broadcast than in a more traditional classroom setting. In fact, we noted that even when students were in the same room with the broadcasting lecturer, they tended to watch the lecture on the monitor rather than the live presentation. This loss of eye contact between the instructor and student can be overcome, but doing so demanded adaptability on the part of our teleducators.

Despite the pedagogical concerns that are magnified by a teleducation setting, it should be noted that both instructors and students alike appeared to accept both the expected and unexpected obstacles that invariably presented themselves during transmissions. In fact, one instructor mentioned that he was astounded by the patience demonstrated by his students during an extended interruption of a lecture due to technical difficulties — patience that would be unheard of during interruptions in an unlinked classroom (for example, if there were problems with a PowerPoint presentation). He attributed this to the esprit de corps established during this initiative, which was novel to both student and instructor alike.

**Administrative and logistical approach to teleducation**

Coordinating events between three organizations, 13 000 km, and six or seven time zones proved to be no small task. To begin with, the UVA is administered on a different academic schedule from Wits and the EMU (that is, ‘American’ versus ‘British’ systems). Thus, while courses at Virginia are run on 14-week semesters, coursework at the southern African institutions is focused in intensive 3–6 week modules. While such a difference might be insurmountable in some circumstances, commitments made by high-ranking officials at each of the institutions ensured the administrative flexibility to overcome these concerns.

The seven-hour (six-hour with daylight saving time) difference in time zones between the eastern United States and southern Africa proved to be another obstacle, albeit a manageable one. Lectures emanating from Virginia began at 10:00 eastern U.S. time so that they could be viewed instantaneously at 16:00 or 17:00 local time in southern Africa. Lectures starting in southern Africa, on the other hand, were broadcast at 22:00 (two at 23:00 because of the start of daylight saving) in Africa so that they could be viewed in Charlottesville at 16:00 in a large classroom, occupied by over 100 students, with the remote images projected onto a large screen. One major point that we learned was that changes associated with daylight saving time (in both autumn and spring) have to be scheduled before courses begin so that lecture halls and student schedules could be arranged for both pre- and post-daylight saving adjustments.

Because of the nature and potential inconvenience of these administrative and logistical issues, it was imperative that each university had a single individual to serve as the point person for the project. Thus, when last minute modifications had to be made (and they did), planners at one site would know that they needed only to make contact with the point person and word of the change would be communicated to the participants as necessary. Also, classroom discussions with participants at three locations should have a question moderator to direct the conversation. This moderator could be at any of the sites, not necessarily at the broadcast location.

Finally, the complex issue of course management must be addressed when offering teleducation classes. For example, if a class is the result of collaboration among three universities, which institution issues the credit? Which receives the tuition? Which instructor issues the grades? While the simple answer to these questions is that a student’s university
of enrollment should manage these concerns, this may not suffice as a solution when courses are offered by individual instructors rather than via collaborative efforts between faculties, as was the case with our ‘Seminar on the Ecology of African Savannas’ pilot. Mechanisms for mutual recognition of tuition credits remain one of the main obstacles to inter-university strategic partnerships.

The future of teleducation among collaborating institutions

The Internet is a truly distributed public medium and, as such, holds great potential for disseminating information, instructing students, and bridging intellectual and cultural divides around the world. To date, much of the work to use the Internet as a mechanism for providing educational opportunities has focused on student-paced, time-indifferent (24 hours a day), instructor-independent distance learning materials. However, the technology now exists for real-time, interactive instruction over great distances, as evidenced by our pilot programme offered to students at three universities separated by an ocean and six or seven time zones during the 2001/02 academic year.

The Virginia—southern African consortium and project sustainability

In May 2002, the Vice-Chancellors and provosts of the participating universities met at the University of Virginia to discuss plans for enhancing our collaborative research and educational activities. The agenda included topics such as teleducation course management and student-faculty exchanges. We expect that our pilot will serve as proof-of-concept. Additional courses are being and will be offered through the consortium in this manner.

In addition to direct continent-to-continent interaction, various regional and local spin-offs have resulted. The first is the creation of a regional network of Virginia universities — UVA, the College of William and Mary, and the Virginia Institute of Marine Sciences now share speakers within the network. Again, this new pilot effort served as a proof-of-concept for the sharing of academic resources and experts within the state of Virginia. An expansion of this concept is the linkage of multiple Virginia sites to their colleagues in southern Africa, using the teleeducation system. A further benefit for the international use of these technologies is that we can test locally novel transmission systems (wireless modems, cable connectivity) and approaches to delivery of course material for classroom lectures. PowerPoint images, overhead transparencies, slides and videotapes can easily be viewed at both ends of the teleeducation link to evaluate quality and clarity. This experimental use has also led to new perspectives on the problems that could have been encountered with international transmissions. We were fortunate not to have experienced them.

A final note on sustainability and adaptability to other institutions: following an article in the Chronicle of Higher Education, we received numerous inquiries from other universities about the costs and ease of starting up an international interactive classroom as we did. Within our own university, faculty members travelling abroad have used our technologies to broadcast lectures to their classes at UVA while they were overseas or engaged at remote field locations.

Associated costs and funding

We received support for this project from a private benefactor, the International Program of the National Science Foundation and the World Bank (through access to their satellite to link Washington, D.C. and Mozambique). Additional resources were provided by UVA (Office of the President, Office of the Provost). Three Polycom cameras and peripherals (cost approximately $20 000) were purchased and made us independent of fixed broadcast facilities that we initially used but were a large part of our original expenses (approximately $10 000 of the original pilot project cost was for use of the facility). We presently use Internet linkages between Africa and the US. Classes had minimal real-time costs of about $3.00 per minute for ISDN linkages. Much advice and organizational time was provided by individuals at participating institutions interested in expanding educational programmes and outreach capabilities.

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In Brief...

Call for proposals for the European Developing Countries Clinical Trials Partnership

The EDCCTP is an initiative of the European Union, linked to the Sixth Framework Programme, to reinforce research into the development of new clinical interventions against HIV/AIDS, tuberculosis and malaria. The focus of EDCCTP activities will be on accelerating the clinical evaluation of candidate new interventions, including conducting controlled trials of the highest quality of new and improved drugs, vaccines and microbicides against the target diseases, and increasing the capacity of scientists and institutions in developing countries to undertake such trials. The partnership has an initial budget of €400 million, which it is envisaged will be supplemented by an additional €200 million through contributions from industry and elsewhere. It is foreseen that the programme will run till 2007. The first call for proposals has now been published.

Information on the EDCCTP is available on http://www.edctp.org. Information on the Sixth Framework Programme and related activities is available from Daan du Toit at the Department of Science and Technology (daan.dutoit@dst.gov.za).

Geo-information sciences in support of Africa’s development

The 5th African Association of Remote Sensing of the Environment (AARSE) Conference will be held from 18–21 October 2004 in Nairobi. The AARSE conferences are the premier fora in Africa for scientists, practitio
ers, developers and policy-makers to discuss the latest advances, applications, capacity-building for and promotion of geo-information technologies for development in Africa. Strategies for the promotion and use of the technologies in the continent are also discussed.

To learn more about the conference go to http://www.ltc.nl/~aarse/acase/index.htm.

The conference director is Dr WK. Ottichilo, RCMRD, P.O. Box 18118, 0050, Nairobi, Kenya (e-mail: rcmrd@rcmrd.org).