DISTANCE LEARNING COURSES FOR DISSEMINATING REMOTE SENSING TECHNOLOGY AND ENHANCING UNDERGRADUATE EDUCATION

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Commission VI, WG VI/4

KEY WORDS: Remote Sensing, in-service teacher training, e-learning, distance education, TelEduc, CBERS, SPRING.

ABSTRACT:

This paper presents the results of three seven-week distance education courses entitled The Use of Remote Sensing for Environmental Studies for Undergraduate Professors. In Brazil distance learning has become a crucial tool for broadening education outreach to its territory and making available quality programs and materials to different audiences. Among selection criteria, student geographic location was one of the most important. Students residing far away from the Brazilian Institute for Space Research (INPE) headquarters had preference, because they have less chances of attending courses at INPE and less access to information.
The main goal of these introductory courses is to diffuse the use of remote sensing as part of the curriculum and pedagogical resource to teaching science topics in universities. The objective is to create collaborative learning opportunities through on-line courses for in-service college educators fostering their continuing professional development, reinforcing the importance of applying new technologies and encouraging them to disseminate what they have learned among students and colleagues.
A free distance education software called Teleduc has been used to support these web-based courses. It has facilitated the interaction among students with different backgrounds (Geography, Geology, Agronomy etc.) creating a rich cooperative environment.
Hands-on exercises have been made available through specially structured tutorials and selected datasets. Students are encouraged to use SPRING (INPE's image processing free software) and gather data for their own study areas among the several public sources available (CBERS and LANDSAT images, digital maps, SRTM topographic data etc.).
The outcome of these courses has been extremely positive. It turns out that on-line courses meet the need for flexible and interactive training enabling students to increase their knowledge and dissemination skills. Our group intends to keep improving and encouraging the creation of more advanced distance courses such as remote sensing applied to Hydrosphere, Agriculture, and Urban Studies.

1. INTRODUCTION

One of INPE's main goals is to foster scientific research and build professional skills in the fields of Space and Atmospheric Sciences and Applications, Space Engineering, and Earth Observation Technology Applications. Remote Sensing education started in 1972 as one of the missions of INPE´s Earth Observation Coordination (OBT) when a Masters degree program was created. More recently, in 1998, a Doctoral program was also established.

In July of 1998, the Remote Sensing Division (DSR/OBT) offered a first forty-hour course for elementary and high school in-service teachers from both public and private schools entitled “The use of Remote Sensing for studying the Environment at School Settings”. Since then, INPE has been offering this course every year and it has been very successful in disseminating the use of remote sensing as an educational tool among teachers. Since 1999, the Image Processing Division (DPI/OBT), in partnership with SELPER-Brazil (Society of Latin-American Specialists in Remote Sensing), has offered conventional (presential) short-term courses aiming at supporting the usage of geotechnology in Brazil. The students come from a variety of backgrounds and application interest areas such as geology, geography, engineering, cartography, etc. Most of them work at institutions or companies that require an application of remote sensing at some level.

The demand for courses has been increasing over the past few years and INPE has not been able to match it. There is a limitation in the number of instructors available for teaching as well as suited facilities. Moreover, students usually have limited financial resources that precludes them from traveling since many of them live in cities far away from São José dos Campos (where INPE headquarters is located). Therefore, most of them have to pay not only for the course but also for accommodation, food, and local transportation.

In order to provide means of access to information considering the current scenario, the authors of this article formed a group at INPE with the task of redesigning the educational outreach program and defining new methodologies that could effectively replace traditional classroom learning environments. With the strong belief that e-learning (a combination of education and Internet using different web technologies) is the answer for attending INPE´s demand for an effective educational delivery system, our group has decided to invest on distance education courses.

There are several advantages in using this new approach to education, such as flexibility of time, independence of geographic location and distance, more cost-effective meaning than in-person training, and the adoption of a learner-centered approach where learners control their learning pace and development. The efficiency of distance education must involve constant interaction among teachers and students, students and e-learning environment, and among students themselves. One of the main challenges that our group (and most other groups) faces today is to reach a high quality standard on e-learning courses.

In May of 2004 we created our first e-learning course (“The Use of Remote Sensing for Environmental Studies for Undergraduate Professors”) aiming at disseminating Remote Sensing as part of the curriculum and pedagogical resource to teaching science topics in universities. The main idea was to create collaborative learning opportunities for college educators fostering their continuing professional development, reinforce the importance of applying new technologies, and encourage them to disseminate what they have learned among students and colleagues. There has being offered a total of three courses up to this date and the last two were offered in August, 2004 and February, 2005 with improvements based on suggestions received from students.

The remainder of this paper is organized as follows. Section 2 presents the materials used in the courses. Section 3 describes and compares the three courses taught and the methodologies applied in each of them. Finally, conclusions are drawn and suggestions made for further initiatives related to improving remote sensing e-learning.

2. MATERIALS

The in-service teacher training courses were carried out using a distance education managing system called TelEduc. A combined image processing and GIS freeware package called SPRING (www.dpi.inpe.br/spring) with Portuguese, Spanish and English versions was also used. This software is a state-of-the-art GIS and remote sensing image processing system with an object-oriented data model which provides for the integration of raster and vector data. Selected instructional materials including books, CD-ROM, and specific tutorials were used in the courses. The book entitled “Satellite Images for Environmental Studies” (Florenzano, 2002) was one of the main sources of remote sensing information. This book provides information on satellites and sensors, image interpretation, and remote sensing applications to environmental studies. The interactive educational CD-ROM entitled “Remote Sensing: Applications for Preservation, Conservation and Sustainable Development of the Amazon (Dias et al., 2003), along with the book, were sent to all students by mail. This CD-ROM is divided in three sections (1) introduction to preservation and conservation, (2) introduction to remote sensing principles and satellite image processing, and (3) Amazon case studies based on LBA-Ecology research. The CD includes several high quality graphics, animations, audio, video, interactive activities and quizzes. Many aspects of this CD-ROM are based on an existing set of CDs developed by Indiana State University under a NASA grant (Mausel et al., 2001). Specially structured tutorials for guiding students on digital image processing techniques including procedures for image registration, enhancement, segmentation, and classification (Mello et al. 2004) were prepared and made available to students for download. These tutorials include a selected example of satellite images over the Brazilian Amazon (CCD_CBERS images Orbit_Point: 165_112 of bands 2, 3, 4 for 2004/06/24 - http://www.dgi.inpe.br/CDSR) for student hands-on experience. The GeoCover Orthorectified Landsat Thematic Mapper Mosaics were used for geometric correction of CBERS images (Figure 1) during the course (GeoCover Mosaic - Chart S 21-10 ; https://zulu.ssc.nasa.gov/mrsid/).

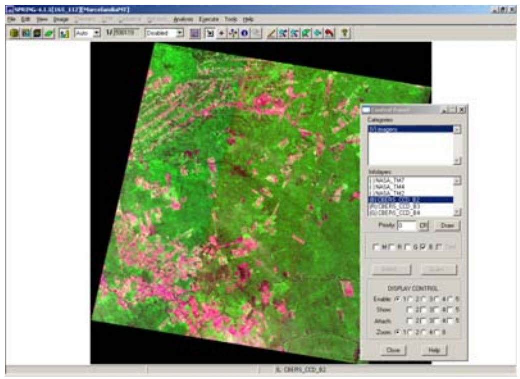

Figure1. The color composite image of the study area processed and displayed by SPRING (CCD_CBERS bands 2, 3 and 4)

3. METHODOLOGY

The first e-learning course (a pilot experience) lasted three weeks and had four instructors and 18 students. The second and third courses lasted seven weeks and had 30 students selected in each course. There were four instructors for the second course and seven for the third course. Undergraduate professors with different backgrounds (Engineering – Civil, Agronomic, Agriculture, Environmental and Fishing, Geography, Biology, Architecture, Chemistry, Physics and Geology) were selected (see Table 1):

Course	Eng.	Geog	Bio.	Arc.	Che.	Phy.	Geol
1	8	2	3	1	-	-	-
2	10	5	1	1	1	-	4
3	7	8	2	2	-	3	2

Table 1 – Backgrounds of enrolled undergraduate professors

Student selection criteria included geographic location as one of the most important. Students residing far away from the Brazilian Institute for Space Research (INPE) headquarters had preference, because they have more difficulty in attending courses at INPE and, also, have less access to information.

The first course was structured with a predicted student involvement of twelve hours per week, distributed between classes (mandatory ones), activities, and complementary and optional readings, in addition to a weekly chat with instructors. The activities included the development of a project proposal that should incorporate an environmental theme addressed by a remote sensing technique. Students were encouraged to use the software SPRING and gather data for their own study areas among the several public sources available (CBERS and LANDSAT images, digital maps, SRTM topographic data, etc.).

The total of nine classes (three per week) in the first course covered the following topics: 1) How to use TelEduc and prepare a project proposal, 2) Basic environmental concepts, 3) Remote Sensing principles, 4) Image Interpretation, 5) Image processing, 6) Examples of Remote Sensing applications, 7) Proposal preparation help through distant student advisement, and 8) Final evaluation and assessment.

The content of the second and third courses was basically the same as the first course, but with more emphasis on digital image processing and divided in two classes per week. The increased length of these courses, as well as the extended chat sessions in two periods (morning and afternoon) were implemented due to student suggestions received during the evaluation of the first course. Besides these changes made in advance, several small adjustments were made during the courses, such as, the addition of three more instructors and the use of extra chat sessions (some at night).

The instructors, students, instructional materials and software (TelEduc and SPRING) were evaluated at the end of the three courses by all participants. Students were also asked to make a self-assessment of their performance during the course.

4. RESULTS AND DISCUSSION

According to the literature, the average dropout of distance education courses is near 30%. This percentage was also observed in the three courses implemented (see Table 2).

Course	Candidates	Selected	Enrolled	Conclusion
1	61	18	14	11
2	96	30	22	14
3	65	30	24	18

Table 2 – Number of candidates at the beginning and at the end of the courses

Table 3 presents some of the results obtained from the three courses regarding the widespread participation of undergraduate professors from all regions of Brazil with different academic backgrounds.

Courses/ Regions	N	NE	SE	CW	S	Latin-America	Total
Course 1	1	2	7	3	1	-	14
Course 2	5	10	4	2	1	-	22
Course 3	5	7	3	3	4	2	24

Table 3 – Enrolled students by region

During the chat sessions the average participation was six students. However, most of the instructors were present in all sessions. At the beginning of the third course the students were asked about the best times to conduct the chat sessions considering their own schedules. Based on their answers the most selected weekday and times were used for setting the schedule of the chats. Their relative participation in the chat sessions, however, did not increase significantly (seven students). Our experience shows that chats are one of the most important tools for e-learning since it provides synchronous interaction among all participants. In the other hand, this tool, according to Otsuka et al. (2003) is the most difficult to utilize successfully in a distance education environment. Our group intends to explore new ways of improving and encouraging student participation with synchronous strategies.

The best student performance was obtained in the third course mainly due to the introduction of the specifically designed image processing tutorials. This is because students usually have little background in image processing techniques and have difficulty learning such complex and unfriendly packages (e.g. SPRING) in a couple of weeks.

Overall both materials and instructors received good evaluations for most of the students in all three courses. TelEduc demonstrated to be a robust and reliable distance education managing system that had the crucial role of supporting courses' development and performance during implementation. All the students evaluated this system as being very efficient and friendly.

5. CONCLUSIONS

Despite of the traditional difficulty in learning complex knowledge such as remote sensing techniques, most students had a good performance in the tasks proposed and were able to learn the concepts, principles and processes presented. The results were even more satisfactory considering the wide range of topics covered and the diversity of the student population that usually affect negatively the learning that takes place in distance education courses. The outcome of these courses was positive showing that learning about image interpretation and image processing is possible through e-learning. We attribute the success of teaching such complex topics via e-learning to the quality of the materials provided to students and the amount of support given to students by each and every instructor on top, of course, the exceptional dedication to learning demonstrated by most students.

However, additional adjustments are needed in order to improve course performance, such as course duration, tutorial updates and evaluation improvement. Exploring additional tools that constantly become available via new versions of TelEduc released every year is also needed. One of the improvements that will be implemented in the next version of the course in providing an extended session on cartographic concepts and a new session presenting semi hands-on case studies.

The experience acquired during the first three courses encourages this group at INPE to invest in developing new courses focusing on more advanced topics to be taught via distance education courses, such as remote sensing applied to the hydrosphere, agriculture, and urban analysis.

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