

NEW APPROACH ON TEACHING GEOTECHNOLOGY

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ABSTRACT:

Geotechnology is the practical application of knowledge especially addressed to geoprocessing. In Brazil, geoprocessing is an emergent field making use of mathematical and computational tools to process geographical information. This field undergoes constant changes and researchers and professionals need to improve their understanding of geosystems and to develop new methods for specific applications to keep up-to-date with the latest technologies. The Image Processing Division (DPI) at INPE (National Institute for Space Research) in a partnership with SELPER – Brazil (Latin American Society of Remote Sensing Experts) have offered some courses aiming at supporting the usage of geotechnology in Brazil. These courses have been taught using a traditional delivery system in a classroom setting with an instructor giving a lesson and students listening and writing notes. Standard educational resources have been utilized, for instance multimedia laboratory, slides and printed material. The demand for courses has been increasing over the past years and we have not been able to satisfy it. In this work we propose to develop Web-based distance learning courses in the geotechnology area, in which all participants can access the information, communicate directly with the instructor and with each other through the Internet. Many e-learning packages have been developed and commercialized around the world. We have chosen Teleduc (from State University of Campinas, SP – Unicamp), a free distributed virtual distance education environment that has been developed since 1996 and through which many courses have been supported. In order to test the efficiency of this system, we have shown an example of one of our basic courses – Introduction to Geoprocessing - built in this environment.

1. INTRODUCTION

Geotechnology offers a unique combination of geographical, geophysical and geological capabilities applied in the geoprocessing area. Geoprocessing is a set of techniques used to collect and treat spatial information for a specific goal. These activities are executed by special designed systems known as Geographical Information Systems (GIS). These systems are aimed to process geographically referred (georeferenced) data like maps, reports, digital archives and images. In addition, they must provide storage, management, manipulation and analysis resources.

INPE/DPI, since 1991, has been developing the SPRING system, which is a state-of-the-art comprehensive GIS and Remote Sensing Image Processing Software. It is freely distributed via Internet or CD-ROM. SPRING contains functions for digital terrain modeling, spatial analysis based on vector and raster maps, database queries and map production facilities, as well as traditional and innovative image processing algorithms (Freitas et al., 1997).

Since 1999, the Image Processing Division in a partnership with SELPER – Brazil has been offering courses aiming at supporting the usage of geotechnology in Brazil (DPI, 2002). SELPER is a technical scientific civil organization that intends to promote development and research in the remote sensing area as well as to maintain a straight contact and cooperation with the main associations and institutes related to this area.

Among the main courses available we have Introduction to Geoprocessing, Introduction to Remote Sensing, Digital Image Processing, Spatial Analysis, Geographic Database, SPRING (Georeferenced Information Processing System) and Digital

Terrain Model. These courses have been taught in traditional settings, at INPE as well as at clients' institutions, with a basically face to face relationship between the instructor and the students.

Trying to provide a balance of theory and practice, the classes are usually taught in a computer laboratory equipped with microcomputers (IBM-PC). The practical sections are done using the software SPRING. Students are required to try out examples and run simulations in the computer. Consequently, these courses could be classified as "learning-by-doing" (Schank, 2001). After the lessons, students go through a trial-and-error affair, building their knowledge over their own experience.

After teaching several courses we came up with an optimal number of twelve (12) students. We also concluded that having groups of two students per machine was more productive. This way, students can exchange ideas and help each other, making learning easier and more pleasant. Therefore, the multimedia laboratory includes six microcomputers for the students and one for the instructor (which is connected to multimedia projector). The students come from a variety of application areas such as geology, geography, engineering, cartography etc, and they usually work at institutions or companies related to remote sensing applications. Most of the time we have very heterogeneous classrooms, whose students have different interests, which makes the instructor's job more difficult.

The demand for courses has been intensively increasing over the past years. In 2001, we trained, here at INPE, a total of one hundred sixty three (163) students, in the following courses: SPRING (70), Introduction to Geoprocessing (22), Digital Image Processing (17), Introduction to Remote Sensing (10),

Spatial Analysis (20) and Geographic Database (24). We also sent our instructors to other companies and trained one hundred and eighteen students (118) in the several courses listed above.

We have not been able to satisfy this crescent demand. In our case, we have a limitation in the number of instructors and physical space. Moreover, students usually have a budget restriction because many of them come from far away places and besides having to pay for the course they still have to pay for accommodation, food, transportation etc.

In order to meet the needs of our clients we must redesign our courses and redefine new methodologies, replacing traditional classroom learning environments. One new trend related to learning that is already taking hold in the world is called e-learning (the combination of education and the Internet, i.e., distance learning programs that use web technologies). We believe this is the next logical step in an educational delivery system.

Within this context, we propose to develop Web-based courses in the geotechnology area. In a virtual classroom, the instructor would maintain control of the class and would be able to chat and clarify their doubts and questions. It would be possible to gather in the same group, students working in similar application areas. More homogeneous groups would lead to more productive results. In the first approach the content would be delivered using a textual format.

The remainder of this paper is organized as follows. Section 2 presents a short historical view of distance education in the world and in Brazil. Section 3 describes the environment we have used – TelEduc - and the basic outline of our e-learning courses. Finally, conclusions are drawn and suggestions for further research are presented.

2. DISTANCE EDUCATION

More and more, institutions are challenged to find new ways to effectively attract students, improve course quality and flexibility increasing efficiency and student success.

Until the late 1980's, the primary educational delivery model was essentially the traditional lecture - a professor/instructor giving a lecture/lesson and students listening and writing notes. Interaction between the professor/instructor and student has been viewed as an essential learning element within this arrangement. However, innovations in educational delivery mechanisms have challenged this paradigm. Advances in information technology (IT) are enabling distance education to gain new life. In addition, the advances in IT have ushered in a new paradigm, on-line learning (O'Malley, J. and McCraw, 1999).

Distance education is then characterized by physical separation of teacher and student. However, the use of a communication channel is necessary to mediate the interaction between them. In the course of time, several channels have been adopted, from mail to Internet. With the computer networks, a variety of new communication resources such as e-mail, chat, bulletin boards were introduced in the Web-based distance courses. Thus, the Internet seems to be a very appropriate way for the development of collaborative learning environments.

Due to this variety of tools, it is expected that the students would assume the control of learning, exchange significant

experiences and collaborate for mutual learning in the Web-based distance education environments (e-learning). However, recent experiences show that there are few collaboration among students in these courses. Therefore, we must be aware of how much that move away from the basic face to face relationship between a professor and students impact student learning and student perceptions of learning.

E-learning covers a wide set of applications and processes, such as Web-based learning, computer-based learning, virtual classrooms, and digital collaboration. It includes the delivery of content via Internet, intranet, audio and videotape, satellite broadcast, interactive TV, and CD-ROM. There are many advantages of using this new approach such as time flexibility, independence of geographic distance, more cost-effective than in-person training, learner-centered - learners control their learning pace and development, learning is more enjoyable and meaningful to the student and he can participate more in the learning process.

In Brazil, one of the first institutes to develop and apply distance learning and e-learning was University of Santa Catarina (UFSC/LED, 2002) which has trained more than 175,000 students in various areas. Following the same steps, other companies and institutes have also used this technology for teaching via Internet, for instance University of Anhembi-Morumbi (UAM/SP, 2002), PUC-Rio, University of Pernambuco, State University of Campinas (Unicamp) and others.

Many e-learning packages have been developed around the world (most of them are commercialized). Just to name a few we have: WebCT (Goldberg et al., 1996), Lotus Learning Space (Lotus, 2001), Aulanet (2002), Teleduc (2002) and ProjetoVirtus (2002). We have chosen Teleduc, a free distributed virtual distance education environment that has been developed since 1996 and through which many courses have been supported.

In order to test the efficiency of this system, we have shown an example of one of our basic courses – Introduction to Geoprocessing built in this environment.

3. COURSE IMPLEMENTATION

3.1 TelEduc Tools

TelEduc is an environment for the creation, participation and administration of web-based courses. It has been conceived to target the teacher's formation process for computational education, based in the contextualized formation methodology developed by researchers at Unicamp. TelEduc was developed in a participatory way where all of its tools were idealized, planned and purified following the needs reported by its users. Thus, it presents some attributes which make it different from other environments for distance learning available today, such as the easiness of use by people who are not specialists in computers, the flexibility with the way you use it, and sharp set of functionalities.

In essence, its structure includes tools for making contents available, proposing activities, suggesting additional readings and supporting communication between course participants, such as bulletin boards, email and chat.

Many problems related with the interaction and students' accompaniment have been discussed in the literature (Oeiras et al., 2000). In distance courses, cooperation is expected and trust is necessary to build communities. Thinking of that, the TelEduc team created the Profile tool. It allows participants (students and teachers) to know more about each other. Participants are required to fill out a form with personal information (academic formation, hobbies, spare time activities etc.) and to include their pictures on it, so they can have physical clues of their colleagues.

The Portfolio is another tool that has been helping to unchain collaboration. This tool is like an individual directory where students can insert the result of their works and tasks. Each item of Portfolio can be seen by all, only by the teachers or only by its owner, depending on how it has been configured.

3.2 Courses outline

As Schank (2001) points out: "... simply deciding to offer an online course doesn't really tell you what gets incorporated online". Many new variables have to be taken into account, even in our situation where we have used a "ready to build" environment (TelEduc). Nowadays, our courses have been taught in the following format:

- 1- Total duration: 40 hours (usually 1 week, 8 hours per day)
- 2- Maximum number of students: 12
- 3- Minimal technical requirements:
 - 6 microcomputers (IBM-PC) for the students and 1 for the instructor : Pentium 300 Mhz or higher with Windows 95/98/ME, NT, 2000; 64 MB of RAM or more; Disk of 2.5 Gb/3Gb – with a minimum of 1Gb for SPRING installation and data.
 - Multimedia Projector
 - White board or flip-chart;
 - 1 Color Inkjet Printer, Postscript option;

The intended public must include professionals from a variety of application areas (geology, geography, engineering, cartography etc.) involved with environmental projects aiming at the usage of geotechnology and geoprocessing to solve their problems.

All students who attend the classes and successfully complete the required tasks and exercises receive an official certificate.

As mentioned before, a Web-based course, with the same content, is not a pure "transposition" of the material to the Internet. Many adjustments need to be done in order to take advantage of all the tools available in the environment. Furthermore, it is very important to keep in mind this new learner-centered philosophy where the instructor works more like a mentor who is there to conduct the study and clarify all questions.

E-learning deals with flexibility and self-paced courses where the learner can access the information anytime, anywhere. It must be clear that it is a self-paced course but we expect that the students commit at least eight to nine hours per week to their coursework. Students might get lost if they do not attempt to accomplish the reading and the practical assignments every week. The total duration of the course is still 40 hours but now they are distributed in five weeks.

To help students to use their time wisely, instructors make use of the TelEduc's tool called Agenda – everyday they need to accomplish some reading assignments and practical exercises. Sometimes there are also some extra readings, assigned in the Agenda. Notice that the material (tutorials, extra readings and practical assignments) is made available progressively, every week of the course.

The Bulletin Board is a place where students and instructors can place information they think is relevant. Students can also participate in discussions using the Forum tool.

The instructor is responsible for taking notes of the most frequently asked questions and making them available at the FAQ tool.

The internal mail and chat ensure a communication channel to mediate the interaction between the participants, reducing the isolation feeling very common in distance education environments. We believe that the instructor plays a very important role to avoid this feeling, encouraging students to participate in chats, form groups, talk to each other, present questions, discussion topics etc. At least 2 chats per week, supervised by the instructor, should be carried out.

The technical requirements now should include an Internet service and a 56k modem, and compatible browsers (Internet Explorer 4 or higher or Netscape 4 or higher). The official site of our e-learning courses is: <http://www.dpi.inpe.br/~teleduc>

4. CONCLUSION AND SUGGESTIONS

In our present face to face courses, we notice that students come from different application areas and different places. The courses turn out to be a good opportunity for them to exchange data, information and methodologies. We would like to keep this enriching environment of exchanges also in the e-learning courses. This can be achieved making use of the TelEduc tools Portfolio and Profile and actively participating in the chats, discussion and forum.

Videoconference allows people at different locations, in real time, to see and hear each other and also to share data for collaboration, resembling the typical face-to-face learning situation. Desktop videoconferencing is an emerging communication medium which has the potential to replace face-to-face meetings, enhancing verbal and written communication, as well as increasing the efficiency of communication for group work. It only requires a webcam, microphone and headphone, turning out to be cheaper than the videoconference. In spite of the fact that both of them are highly recommended tools for e-learning, at the present moment we can not afford to implement them.

Presently we have been working on our prototype course – Introduction to Geoprocessing. We expect to take all the advantages of an e-learning environment by offering a self-paced course where students can access the course anytime and anywhere, supporting savings through the elimination of travel and all costs involved in it. We hope we can provide flexibility and assistance, making the learning efficient and enjoyable.

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