# Development of e-Learning Modules for the K-12 Programs of Brazilian Public Schools

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## Abstract

In this paper one presents a description of the work being developed by the PGL/UNICAMP team to interconnect public schools and deploy PGL modules in metropolitan networks. The PGL project is a joint effort of international universities and corporations to produce e-learning culture in three areas: teacher training for K-12 programs, academic teaching and research, and corporate training. Among the PGL/UNICAMP activities are the study of embedded educational solutions for the metropolitan networks, the development of multimedia contents for K-12 schools, training of teachers and computer technicians based on PGL approved methodology, and evaluation of course management systems for Distance Education. A particular result of these activities is "The Knowledge Connection" project, an educational component of the Metropolitan Network that looks at the use of the information technology in the teaching-learning process, with special emphasis in distance learning. The project is being implemented in the metropolitan networks of the cities of Morungaba and São José do Rio Preto, in the State of São Paulo, Brazil.

## 1. Introduction

The Internet present teachers with a new and powerful tool to help in the process of teaching. In the last years, the Internet moved from a specific best effort data driven network to a multiservice network capable to offer users a very generic and powerful environment for multimedia applications in addition to a high speed QoS enabled communications network. This certainly can result in important benefits for the educational area, allowing carrying the knowledge besides the walls of the class room and providing a sharing of the information between students and teachers of other cities and countries.

The PGL goals are to create a capable infrastructure to give support to the development distance learning programs among the participant institutions, to bring technological contributions for an advanced and distributed learning environment on global scale, and to qualify teachers to innovate in educational processes.

The PGL/UNICAMP group is enrolled in the development of a series of activities connected to two main projects: the Knowledge Connection and Municipal Info-Highway. In this paper we describe these activities. We also present the cases of deployment of these two projects in two cities of Brazil, São José of Rio Preto-SP and Morungaba-SP, where metropolitan networks are being deployed to support the development of a series of experiments in distance learning. The location of these two cities are presented in the map shown in Figure 1.
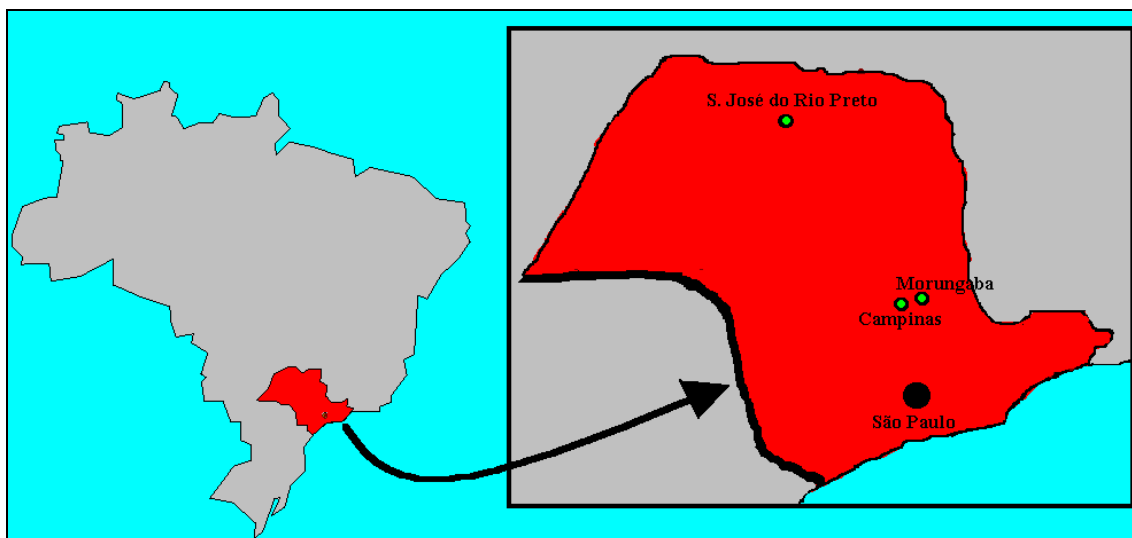
Figure 1: Location of Morungaba and São José do Rio Preto.

## 2. The PGL Project

> *"The focus of PGL is on building an international e-learning infrastructure to support collaborative teaching and research projects among countries in North and South America. PGL is dedicated to the application of research-based methodologies to promote sharing of reusable content resources that are adapted to meet local requirements. This infrastructure includes technology, but it is targeted to the development of mutually supportive clusters of K-12 schools and local universities that inform the research goals and evaluate their results. These clusters become localized e-learning communities that form a national and international alliance."*

The PGL project intends to create a worldwide community, devoted to the development and use of e-learning technology to foster cooperation and based on technological learning for an economical, social and cultural accelerated progress, and it is based on a partnership among five universities:

- University of Florida, Gainesville, Florida, USA
- Getúlio Vargas Foundation, EAESP, São Paulo, Brazil
- State University of Campinas, Campinas, SP, Brazil
- Pontifical Catholic University of Rio de Janeiro, Brazil
- Technological Institute of Superior Education of Monterrey, Monterrey, Mexico

PGL consists of three main phases:

- PGL Module
- PGL Process
- PGL Training

PGL Module describes how the content of the module will be available to the students. Two types of modules are proposed: distance learning module, in which the student has all material and necessary resources to use through the Web; and the complementary module,

used by the teacher as an in-class or out-of-class activity, which can be assessed in the computer laboratory of the school or at home, as a complement to the classes.

The PGL Process describes the nine stages that the teacher or module developer should proceed for the elaboration of the conceptual project of a module. These are:

1. Decide the subject to be developed in the module;
2. Define the student's profile;
3. Describe the module;
4. Define the strategies;
5. Relate the contents to the chosen subject;
6. Describe the sequence of the module;
7. Look for alternatives for presentation of the content;
8. Draw a sketch of the module;
9. Fill out the proposal of the conceptual project.

PGL Training is the process of teachers' formation to use the PGL methodology in the elaboration of the conceptual project of a module. The team of the PGL project is composed by the following professionals: Subject Matter Expert, Instructional Designer and Technical Expert.

- Subject Matter Expert is the professional that has the domain of the content of the module and supplies the material of the module in any format as text, image, picture, illustrations, videos or audio, for the other members of the team.
- Instructional Designer is the professional with several abilities, responsible for the instrucional and computacional modeling, which makes the relationship among the specialists in content and the computer science professionals.
- Technical Expert is the professional of the computer science area able to develop and to implement the module content in multimedia didactic material.

Among the activities of the PGL/UNICAMP group is the study of educational solutions that can be built in the several projects of metropolitan networks.

The metropolitan network is made of services in the areas of health, education and administration. The educational component of the metropolitan network, called PGL Knowledge Connection, includes teachers' training and development of pedagogical content for the teachers in schools of the cities of Morungaba and São José do Rio Preto. The Knowledge Connection also allows the interconnection of the cities network with PGL central server installed at UNICAMP.

## 3. Municipal Infoway

Morungaba is a city located in the interior of the State of São Paulo, at about 80km off São Paulo City. The city has a population of about 10,000 inhabitants and is considered a Brazilian Good Climate Region because of the excellent condition of its weather. The reason to install this experimental testbed in Morungaba is due to its excellent localization, close to the cities of São Paulo and Campinas, and its proximity to the interstate network backbone that is being deployed between Campinas, São Paulo and Rio de Janeiro. Because Morungaba is a very small city, the burden generally associated to the installation of network backbones in large cities doesn't have a large impact in the project.

To attend the demand of the Brazilian Public Administration Modernization Program, the project of the Metropolitan Network of the city of Morungaba must consider not only the Metro Ethernet Network but also the applications to allow the providing of services to the municipal citizen. This modernization program requires development of applications in three main areas: Public Management Applications (Fiscal, Tributary and Human Resources systems), Management of Community Services Applications (Educational Systems, Health Systems, etc), and Telecommunications over the MEN (VoIP, VoMPLS, TVoIP, etc).

The installation of the network will be divided in two phases. In the first phase, that shall take from June to September of 2004, a WLAN backbone will be launched to support Ethernet and IP interconnection among the city main public institutions. In this phase the following services will be developed and installed:

1        Public Management Applications:
        1.1  Fiscal and Tributary Systems
2        Management of Community Services Applications:
        2.1  Public School Administration System
        2.2  PGL e-Learning system

In the second phase the full MEN network will be installed, from the optical backbone to the real time protocols that shall allow the development and deployment of the QoS Telecom over MEN solutions. In this phase, the main characteristic of this project as an experimental backbone will become more apparent when the several research and development initiatives in the most different areas, varying from Optical Engineering to Social Research, start to be implemented. This phase shall start in the beginning of 2004 and must last for three years. During this phase is our goal not only contribute with the national and international development of the technology related to the Metro Networks, but also contribute to leverage the MetroNet as a new concept in Communication Engineering in Brazil.

São José do Rio Preto is also located in the state of São Paulo, at about 455 Km off São Paulo city. It has population of 330.000 inhabitants. São José do Rio Preto is today a businesses center and a decisions pole of the west area of the State of São Paulo.

The activity developed in São José do Rio Preto includes support in the implantation of the metropolitan networks, development of multimedia content for K-12 schools' programs, teacher training, and adaptation of the system LON-CAPA to suit brazilian (Portuguese language) and São José's reality.

With respect to the contents development, we are developing PGL modules for the schools that embrace the whole content of the official program used in Fundamental Level (from the first to the ninth grades) of the Brazilian schools. The contents were divided in small modules to allow each theme to be used in an independent way, what provides multidisciplinary applications. These modules will be applied as exercises that have the purpose of complementing the themes worked in classroom.

With respect to teaching training, the main goal is to qualify the teachers with the basics of computer literacy. Teachers also receive training to apply the modules using the LON-CAPA management system. Finally, they learn how to elaborate new modules or customize PGL's to be used in virtual classes.

The training also include a program of courses to prepare the technicians of the schools to give technical support in the installation process, maintenance and management of the

computational resources of the schools, and assist the teachers in the application of the modules.

# 4. The Knowledge Connection

The "Knowledge Connection" is an extension of the original PGL project that aims at taking the benefits of an information society environment to remote communities. It includes providing the community with a computer system connected to the Internet, called "Knowledge Station", provide this system with PGL modules and other pieces of software to help the community in the development of its information culture, and connect the knowledge station with the PGL network of communities scattered around the world.

Because most of the Brazilian population can still not be considered as included in the world information society, we decided to apply the concepts of the Knowledge Connection project to the cities. In this case, instead using the Knowledge Station that would be appropriated for a small community located away from the main community centers, we proposed the integration of the Knowledge Connection project with the Municipal Infoway project. This integration creates a large city network connecting all city's schools and provide de education community with sophisticated, but yet easy to use, tools for the development of the learning processes in the city.

# 5. Some Implementation Details

In this section we present some details about the implementation of Knowledge Connection and Municipal Infoway in the cities. , we use the information technology in the teaching-learning process, with special emphasis in the distance learning. Here, the pedagogic methodology and the domain of support tools are crucial for the efficient application of the Multimedia contents under demand.

In this context, three aspects need to be approached:

- Development of didactic multimedia content: to produce texts, videos, audio, images, and animations, with base in appropriate pedagogic orientations, using appropriate tools to the production of each media type. These contents will support the teachers' activities in the schools.
- Study, adaptations and implantation of the course management systems.
- Teachers' and computer technicians training. The teachers are qualified for the use of the computer resources, the use of the course management systems, elaboration and project of new modules, and use of the developed PGL modules. The technicians are trained to give technical support and to assist the teachers in their work.

We will see in the sequence more details regarding each aspect of this work.

## 5.1 – Distance Learning Management System

One of the goals of PGL is the development of a tool for content management out of a multimedia object oriented metadata enabled e-learning database. Our researches and developers are working in order to obtain an environment that is, at the same time, a thorough tool and easy to use. However, we can find today several tools available that can deliver at

least part of these characteristics. One of these tools, named LON-CAPA, is in development at Michigan State University.

LON-CAPA is a virtual environment for delivering distance learning through the Web that aids in the organization, administration and presentation of courses. It is being developed and can be distributed, modified and adapted under GNU - General Public License. LON-CAPA allows the implantation of virtual domains distributed and interconnected through the Web, allowing content sharing among the domains. Out of the several features provided by LON-CAPA, we can detach content sharing, automatic evaluation system for students, and automatic content replication system.

LON-CAPA is a sophisticated system, with a strong focus in sciences and mathematics in higher education. However, in the Brazilian reality, most of the teachers don't know how to read or to speak in English, and don't have the basic computer knowledge to use a system like LON-CAPA. So, its use requires some adaptations such as translation of its interface into Portuguese and the customization of the interface to simplify the everyday use of the system. Other important modifications necessary are the integration of LON-CAPA with an Oracle DBMS for creation and automatic population of the courses and the development of mechanisms that allow the evaluation of problems solved jointly by groups of two or more students.

Figure 2, below, shows the initial page of the LON-CAPA server installed at UNICAMP.
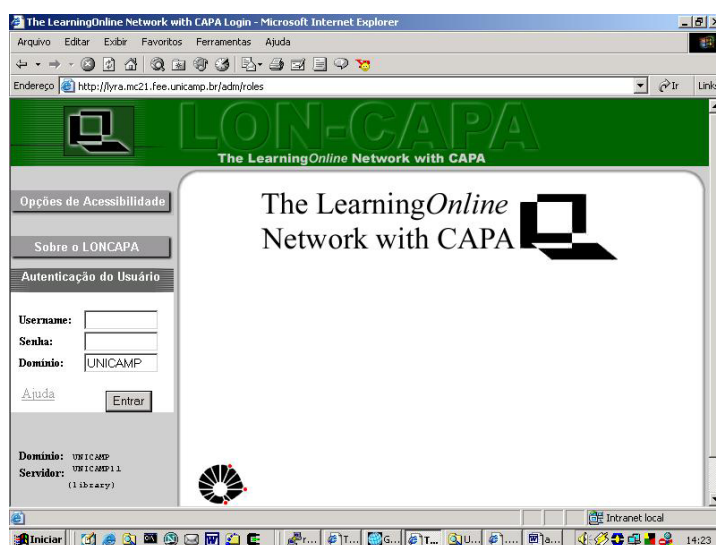


Figure 2: Initial page of LON-CAPA

A more detailed description of LON-CAPA can be found in the LON-CAPA site http://lon-capa.org.

## 5.2 – Development of Multimedia Contents

The contents developed for the schools are defined on the basis of the Brazilian National Curricular Parameters of the Fundamental Level (equivalent to the first to the ninth grades). These parameters offer support to teachers and contribute to the maintain an equalization of the teaching in the country.

The modules are elaborated based on the methodology proposed by the PGL project and following some definitions proposed by the pedagogical coordination of the project. The modules are developed exploring multimedia resources, audiovisual, illustrations and animations. The tools used for assembling the content in the web site are basic HTML, Macromedia Flash, Adobe PhotoShop and SoundForge. The modules development team is composed by a general coordinator, pedagogical coordinator, educators, pedagogical reviewers and web designers.

## 5.3 – The Training of Teachers and Technicians

The Knowledge Connection project offer teachers and technicians of the schools a special training, so that they can suitably use all the resources offered by the project. Between the second semester of 2002 and the first semester of 2003, three trainings were accomplished with about 60 teachers trained in the city of Campinas.

The trainings have a duration of 40 hours and, beside an introduction on computer literacy, the trainings cover the PGL methodology, web designing, tools for web designing, elaboration of web courses, and an introduction on LON-CAPA. The classes are separated in theoretical (Figure 3) and practices (Figure 4).



Figure 3 – Theoretical class



Figure 4 – Practical class

After the trainings, the teachers must elaborate and submit a conceptual project of a module. The projects are analyzed by a specialized team and developed by a team of technicians in computer science. The developed modules already developed at UNICAMP are available in http://www.mc21.fee.unicamp.br/~pgl/pgl.htm.

## 6. Conclusions

The deployment of the projects Knowledge Connection and Municipal Infoway brings many benefits to the cities. The Municipal Infoway provides the city with a modern high speed network. The Knowledge Connection project guides the teacher in the elaboration of modules and it stimulates him/her to go beyond classroom, improving education and supplying students with resources for an interactive study outside classroom. Another important aspect of the project is that it aims at improving the quality of the teaching-learning process and at propitiating an education with focus in science and technology.