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Hewlett-Packard Company
Applied Mobile Technology Solutions in Learning Environments
2003 Grant Initiative - Latin America

FINAL REPORT

AMERICA@UTN

Project

Aprendizaje basado en MEDIos

y Recursos Informáticos y Comunicacionales de Avanzada

en la Universidad Tecnológica Nacional

**(Learning through Advanced Communication and Information Technology
Resources and Means @ UTN)**

Introduction

This final report on the Project could well be referred to as “the end of the beginning”. Precisely, and just as it was set in the original proposal¹, as we are approaching the conclusion of tasks provided in the schedule, the project extensions and enlargements have started to take shape in the Facultad Regional Avellaneda itself; that is, on the premises where the pilot experience has developed, as well as in other faculties of the UTN and other universities in Argentina that got interested in AMERICA@UTN. In fact, the professor who conducted this program at the Facultad Regional Avellaneda has already taken this educational experience to Facultad Regional Buenos Aires where he also holds a faculty position. As a result of this, a plan for furnishing thirty classrooms with Tablet PC’s and projectors was presented before the Ministry of Education, Science and Technology in the framework of the PROMEI² project which stands for Engineering Teaching Improvement Project in English. On the other hand, other private and public universities, such as UADE, UNLP, UNLu and UNLaM have taken an interest in this undertaking and asked us to participate at classes being delivered at present with a view to replicating this modality in their facilities.

Although the project will be described in more detail below, we would like to mention the main reasons of this outcome:

- 1) The success of the project in terms of improving the teaching experience; in the professor’s opinion: “the use of this equipment was a prime mover to learning, promoted discipline in the case of students and teaching transposition in my personal case. It improved student-student interaction and enhanced their communication with me.”
- 2) The experience was divulged widely, both in the national and international ambit. Apart from the Web site which showed its creation and kept an update of its development, the project was presented at ten subject-related congresses and was well covered in the media with the press giving us considerable publicity³.

The various tasks and activities carried out by the work team as well as some important experimental conclusions will be described later on in this concise report.

¹ Reference included in the original RFP: “Once the hypotheses raised in this project have been verified, we shall proceed to replicate this model in as many Regional Campuses as possible and gradually incorporate other subjects within the curricula of the various degree programs until most of our students – about 60.000 at present – have been included in our plan”

² http://www.me.gov.ar/spu/guia_tematica/CALIDAD/calidad____promEI.html

³ This information is available in <http://www.america.utn.edu.ar>

Technical aspects

The Virtual Campus

While this is about a software development running on the appropriate hardware, it is important to explain that the software design was primarily based on the requirements which the specialists involved in our project found necessary to be met from a pedagogical and methodological viewpoint. Thereby, both the software functionalities and the interface design were proposed by taking those requirements into account which had to be solved by the application from a technical point of view.

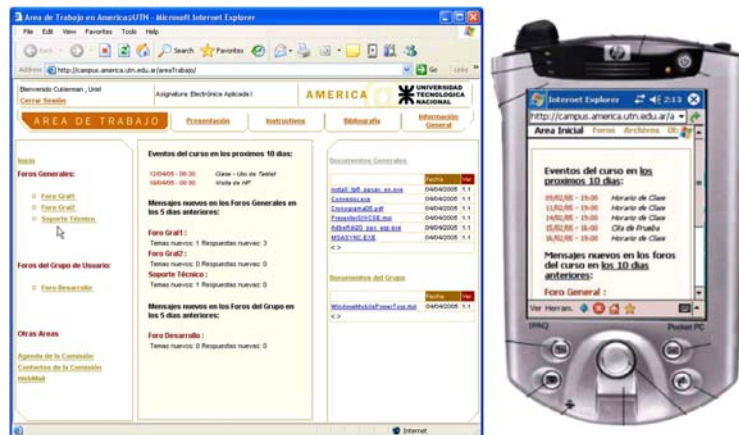


Figure 1 – VC interface

The VC is a Web based application entirely developed over VB.NET running on IIS 6.0, which displays different information and options depending on the “type of user” and the type of device accessing, which is authenticated by using Active Directory (figure 1).

One of the most challenging requirements that the application had to meet through the development phase was its accessibility whether it was from a conventional PC or Pocket PC devices with Windows Mobile. Regarding the latter, while they can handle most of the standard HTML, their display is quite small in size and resolution and they have minimum support for script type languages. This limitation called for the use of various strategies intended to reduce the entire application code rewriting to the slightest possible, namely:

- Screens had to fit the device by considering its limitations at all times. Interface logic was implemented for the contents to be shown.
- The Forum (main area) could not be developed by conventional means; rather it had to be generated and persisted almost entirely on the server side. It was necessary then, to take care of its resources and keep an acceptable answer time in wireless networks.
- A very restricted use of ViewState aiming at reducing the page size, the answer time and the time to load Web pages in general.

Apart from its capability to be accessed through various devices, other functionalities in the development are worth emphasizing; for example, it can configure various work teams among the users who may have differentiated permits according to their profile, and allows them to share documentation both in a general way and by groups, keeping previous versions of those documents saved. Another important feature is its capability to handle several divisions of different courses where a particular professor or student may have enrolled for.

Because of the characteristics of this project, requirements have changed along the development. For this reason, we opted for an iterative and incremental development cycle with delivery terms ranging from two to three weeks. Every new version was evaluated and tested to determine whether it met requirements set or new ones emerged from the work team’s recommendations. On account of this, it was provided that the page would be flexibly customized in terms of design while easily extensible and brought up to date. To achieve these aims, several objects were developed for data persistence as well as interface and security management, scripts (mainly SQL and Javascript) which simplified most of the complexity to change and an easily adaptable and extensible security scheme.

For security reasons and tolerance to changes, data in the application cannot be accessed directly but through a set of objects that are specialized in certain complex tasks such as maintaining the forum and calendar scheme jointly with the use of Stored Procedures (in the data base).

Hardware infrastructure

All pieces of equipment handed over to us by HP were used during the project. They were distributed according to the people’s profiles involved; for example, the research team members were given a Notebook Compaq Evo N610c and some PocketPC’s and every professor and student taking part in the educational experience was assigned a TabletPC Compaq TC1000 and a PocketPC.

In designing and implementing the infrastructure for services and applications, full consideration was given to the project needs and aims (figure 2). Consequently, three servers were set up in the Headquarters (Rectorship building) and one in the Remote Node – all of them based on Windows 2003 Server Enterprise Edition. Servers at the Headquarters provide DNS and Active Directory and they are configured such that the project is present on the Internet, management is centralized and

mobile devices are furnished with safe work environments. Additionally, they run IIS 6.0, Exchange Server 2003 Enterprise Edition applications that afford electronic mail to the project members and SQL Server 2000 Enterprise Edition, a data base motor of applications developed for it.

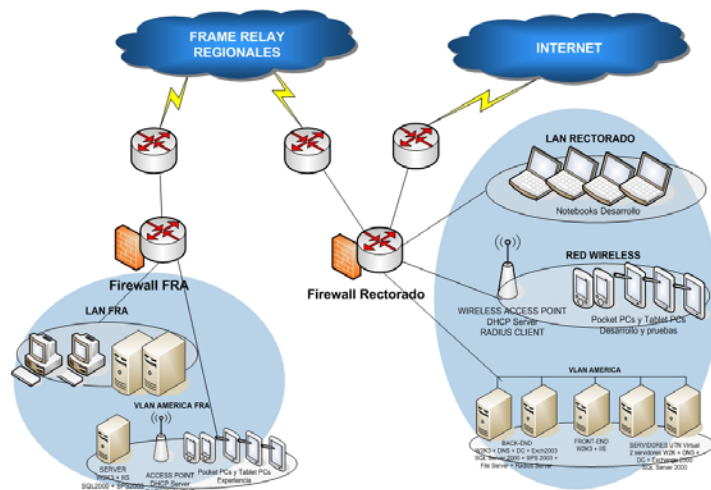


Figure 2 - Infraestructure

whether out of the classroom. Incidentally, there are other three access points at the Faculty – one at the library, another one at the cafeteria and another one at the University Management Office – which allow students to work in different places while keeping connectivity with the internal network and Internet.

As a complement to field experiences, a digital video streaming server has been implemented and all classes are being filmed, digitalized and published on the server so that students can access to lessons delivered by lecturers any time out of the class timetable.

The communications infrastructure

Firstly, all project members were trained on issues related to those applications and technologies which, altogether, afford access to an advanced telecommunications infrastructure through wireless networks.

Next, a wireless FRA work area was implemented on the Central Node; that is, one of the Access Points (520wl) was connected to the local area network at the UTN Rectorship building in order to integrate the rest of the project team into a wireless environment for development and research with access to the local network and Internet. In this way, the first tests regarding wireless connectivity performance could be run with solutions developed until then. It is worth mentioning that the Access Point was incorporated into the UTN Rectorship building LAN by means of a VLAN so that flow could be controlled, limited and protected by our Firewall.

Once the previous stage was completed, a wireless work area with the same characteristics as those on the Central Node was built up on the Remote Node, where the classroom events took place. Because the UTN Rectorship building is the center of a star which links all university sectors while providing access to Advanced Networks (like Internet2) and the Internet, we took advantage of our own resources, such as streaming servers, to store, code and compress lessons delivered in several formats.

We also made use of the University network topology in order to allow these transmissions to be seen both by unicast (something that can be done on the Internet) and multicast, for those connected to Advanced Networks.

Pedagogical aspects

Teaching modality

Some elements that faculties want to underline from this educational experience are closely linked to changes in their professors' role. On the one hand, they became aware they had to reflect on the subject in general terms again, and focus on teaching and learning processes from a different perspective.

The professor reported that he had to plan the "entire" course all over again to incorporate technological resources in everyday tasks. This renewed approach became tangible in the classroom on the occasion of explaining new topics or dealing with previously prepared activities. In their opinion, the use of resources caused them to be "much more comfortable" in the class.

On the other hand, students often express high appraisal of a better use of time in the classroom. One of them says: "the lecturer speaks about devoting ourselves to the essential things as a way to save

time during the class”. Another one declares: “we hold more attention, retain more concepts and need less time to study”.

Finally, the higher level of students’ motivation stands out in the following professors’ words: “Classes are longer because students do not want to leave”.

Learning

If the traditional teaching modality is compared to this one based on technology, it can be seen that the latter allows a different work dynamics which empowers communication. It is clear from watching the classes that there is increasing autonomous work while a great interchange among peers. Group work is customary as a result of interactive situations generated by the professor who also resorts to socializing students’ doubts, answers and solutions as a means to promote discussion. Students talk about what they are doing in a natural way; they make their developments public by showing them, describing them and explaining their performance to their classmates.

Professor-student exchange does not only take place at the classroom but also through the Virtual Campus.

In the professor’s opinion, the technology, just like the software, helps students to arrange their classes. Consequently, they say they can pay more attention to the lecturer’s explanations as they need not take notes of everything he says or writes down.

Ink writing

Soon after the modality in which classes would develop was put forward, the research team found that they had not provided for any tool that would allow everyone to share the professor’s and students’ class notes in real time. Various alternatives were thoroughly analyzed, OneNote and Journal Microsoft products among them. After several test runs, the University of Washington development called “Classroom Presenter 2.0”⁴ proved to be the most suitable application since it fit the project requirements and the teaching modality as well. With this application, professors can deliver their classes on their own Tablet PC’s as if they were using the blackboard (figure 3). The image is then projected on a screen at the front of the

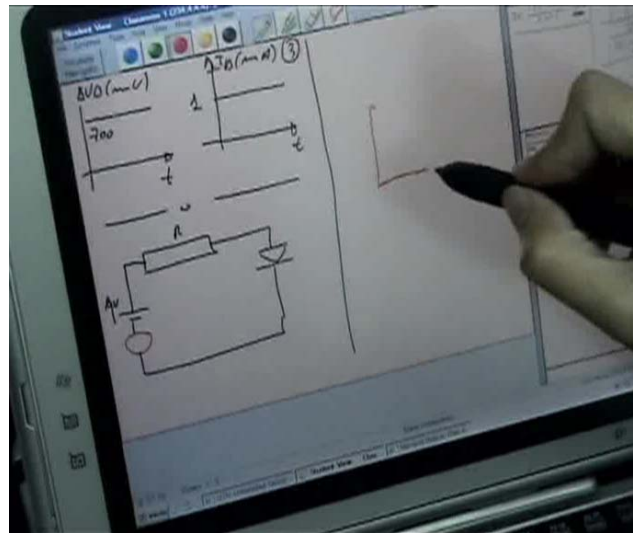


Figure 3 - Ink writing on TabletPC

classroom and transmitted simultaneously to all students’ screens. Students may then

add their own annotations and comments thus generating their own and individual “class notes”. They may even wish to share their annotations with their classmates or make them public and this application allows them to do so.

CP is a useful tool for professors because they can go back to previously designed screens any time during the class or even insert screens in advance. When these functionalities can be combined with access to digital materials and the Virtual Campus, the class grows unbeatably richer and more dynamic.

Finally, students can keep their class notes, which also may include the lecturer’s notes as we said before, either as a printout or in digital form in the hard disk of their computers, in the Pocket PC’s (figure 4) memory or in the appropriate sector of the Virtual Campus so that they can retrieve them later from anywhere they wish.

According to the professors’ opinion, the possibility to project individual or group works and talk about students’ design strengths and weaknesses openly in the class has generated a virtuous learning environment which everyone can benefit from.

Added value regarding the effect of technology use

Students say they use the technology not only for the project subject but for the rest of the courses. This means there is a higher demand of the equipment before and after the timetable of the subject in question.

“I have found that computers are much in request during the week, now for the assignments of my subject now for those of another...” reported the professor conducting this course.

⁴ www.cs.washington.edu/education/dl/presenter

It is important to point out that students' remarks account for a progressive use of the technology both in relation to the time computers were used and to the range of applications resorted to. At the beginning, students used computers exclusively during the course timetable and run the software that the subject required. As the course went forward, they declared they spent more time in front of them and felt encouraged to use other software.

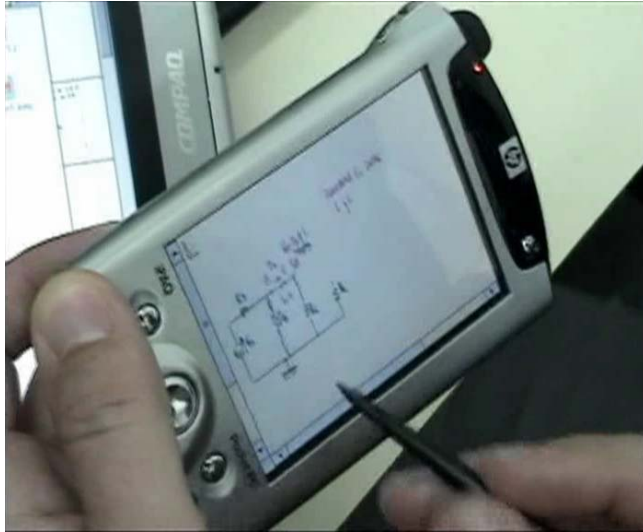


Figure 4 - The PocketPC as an additional resource

They also say there is high connectivity with new devices. One of them expressed: "I also use it to check my e-mail and search for information in the Internet..."

The professor and students keep on saying how agile their work has become thanks to technological resources and access to networks; and students in particular, were of the opinion that the use of the technology for academic purposes have been highly motivating for them. The lectureship is trying to replicate this program at another Regional Campus and the professors who had been invited to watch some classes asked to take part in new programs some time.

Conclusion

When learning achievements involving innovative pedagogical proposals are to be evaluated, everyone knows it is not possible to arrive to forceful conclusions in the short term. However, there are certain aspects of this educational experience that give an account of some changes in the way students connect themselves with the knowledge object and the way it is constructed.

In one of the main learning activities of the course, we could appreciate a higher level of appropriation in a shorter time. Such an assignment consisted of developing a circuit design and presenting it to professors and classmates. This year designs were more original and of a higher quality than those of last year and students were more self-confident and presented their works more freely. One of the reasons of this improvement was that the proposal was carried out with the resource (TabletPC) they had been studying with along the year.

Another issue standing out from this project was the development of the "expanded interaction" concept, which lies on five distinctive though complementary characteristics, namely:

1. Mobility: It relies on the use of mobile devices (Notebooks PC's, Tablet PC's and Pocket PC's) and the access to Internet and networks through wireless communication services.
2. Suitable Methodologies: They were described in detail in the "Pedagogical Aspects" section.
3. Digital Materials: They are those traditionally available in printed format and/or eventually digitalized for certain purposes, apart from specifically developed multimedia resources.
4. Ink writing: It is supported by the specific functionality of Tablet PC's complemented by the use of the "Classroom Presenter" application.
5. Virtual Campus: A new and specially developed learning platform based on the latest and most advanced Communication Means and Information Resources available.

In our opinion, the objectives set at the beginning of the project have been fully satisfied. Moreover, changes introduced along its development, in line with its dynamics, have empowered and enriched our original approach.

We believe this successful experience opens new lines of research and deeper study. Of course, everything may be improved, from the base software to the teaching proposal. It is necessary to go on producing new materials and optimizing existing ones. The use of the Virtual Campus should be made more indispensable and some of its tools should be put to review. All of this makes the project future even more promising.

Acknowledgments

The first and main acknowledgment goes to Hewlett Packard's University Relations Program, especially to the Latin American Division. HP made our project possible by means of a very important grant.

The second one goes to Microsoft's Argentine subsidiary which had provided the whole software platform.

A very special acknowledgment to Richard Anderson's team at the University of Washington for the Classroom Presenter Tool, which is a perfect companion for our project.

Last, but not least, a very sincere gratitude to Mabel Giraldo who helped us with Spanish-English professional translations.

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