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Virtual Laboratories and M-Learning: learning with mobile devices

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ABSTRACT

This paper introduces the concept and the advantages of using virtual laboratories through mobile devices. It will also be introduced some concepts related to learning objects and m-learning. We also present the virtual experience used for the virtual mobile laboratory. In the end, we indicate the ideal methodology to use these technologies when teaching chemical experiments.

Keywords: Virtual Laboratories, Mobile Devices, M-learning

1. INTRODUCTION

With the development of ICT (Information and Communication Technologies) students go to school knowing more and more, which means that they explore a world full of contents and information through the computer and the Internet. They are able to meet new people, enrich their knowledge and even to visit virtual places, which they will never physically visit, only by clicking in the mouse for a few times. Now teachers face this context, which means that they are no longer the only knowledge resources, but they moved on to a position of managers of all paths that students take in their search for knowledge through digital devices.

The great growth in sales and usage of mobile phones, Smart Phones and PDA with Internet access makes the creation of contents to these devices a discussed issue in the educational and technological field. We live in a society where knowledge has more value and, with so many activities that we have, we don't have time to manage so many duties at the same time. To learn *anytime* and *anywhere* is attracting more persons to this modality, which means that each day education and distance learning gain a new space in our daily routine.

We believe that the Internet's future is mobile and learn through the distance method will attract more students. Having this idea in mind, we developed a virtual laboratory prototype to be accessed through mobile devices. The main goal of our proposal is to use the pedagogical and technological advantages of a virtual laboratory in the interests of mobile teaching and learning.

In this paper we begin to define the concepts of virtual laboratories and their main advantages, we talk about the learning objects and the m-learning and afterwards we introduce our proposal and its methodology and the conclusions with some notes to future researches in similar contexts.

2. VIRTUAL LABORATORIES

The creation of virtual laboratories happened because it was necessary to use them in real-time, which means to be accessed by a huge number of persons anytime of the day, since dozens of persons can share the same experience whether they are in the same town or geographically apart. Besides, the expenses of using a real laboratory can be, in many cases, a burden to companies or institutions. The availability of virtual laboratories is made through the Internet using multimedia (sound, images, graphics and animations), so it can be possible to simulate the experiences. Their objects are mainly drawn images or pictures of real things.

Virtual laboratories are presented as a solution to distance learning through computer, because they offer to students the possibility to interact and practice the content of the course in a livelier and enrich way, comparing distance learning only with physical contents (books, videotapes, notes…).

In summary, virtual laboratories have virtual elements, the access is made virtually and all experiences are exclusively virtual experiences. To [1], [2], [3], [4], [5], [6], the advantages of virtual laboratories are:

- Good to explain concepts;
- There's no time or place restrictions on the access;
- To allow interactivity;
- To have a low development, usage and maintenance cost;
- To offer security, which means that it will not occur any risky operation or unwilling effect;
- They allow the establishment of patterns to divulge scientific work, mainly in experimental areas, as researchers can show their methods through simulations;
- To rise the productivity by reducing the time of travels and by giving to students the capacity to participate in several experiences that are geographically spread;
- To allow the share of resources that were limited to a number of persons, since several users in different

towns can share one single resource in a cooperative way;
- To allow the student to work with cooperative tools;
- To develop new abilities;

3. LEARNING OBJECTS

Researchers from informatics and educational fields discuss more and more about Learning Objects and when we talk about distance learning and virtual learning environments, we have to refer them because they are related with each other. In recent English literature, several terms are being used, such as "*Learning Objects*", "*Educational Objects*" and "*Content Objects*". For [7] and [8], a learning object is a digital file (image, film, sound, multimedia file, etc) used for pedagogical proposes and that has, by itself or by relations, signs about the context where it can be used. These objects have the following characteristics: reusable (can be used again), portability (can be used in different places), modular (use modules) and metadata (has data information), adaptability, sustainability, durability and interoperability.

The major difference between a digital file and a learning object is that the last one can be built so it can be combined and recombined with other digital files in order to produce new educational contents (e-contents).

When creating learning objects to be used with mobile technologies, we have to consider several points and the main ones are related to the screen size and the usage, which means the content must be very well structured so it doesn't leads to a cognitive overload of the users. [9] say that the cognitive load refers to the demands on the work memory of the learner during education. In education based on computers or in education based on web, this term refers not only to the mental process needed to access and interpret the screens, icons and objects, but also to the cognitive process used to understand the real education content. The main aim of a good educational material design is to reduce the amount of processing directed to the interaction with the system and to maximize the processing of the teaching contents.

4. M-LEARNING

The *m-learning* or *mobile learning* is characterized by the use of mobile devices in teaching and education.

For [10], the advantages of using these devices in education can be numerous if we think about the portability that students have to access updated information on several matters whether in school or at home.

Some of the advantages of teaching through mobile learning are:

- To increase of the number of users, as almost every student owns a mobile phone;
- The devices that students have are of a model that allows Internet access;
- The access to the contents can be done anywhere, at anytime;
- To learn how to use a mobile phone is easier than to learn how to use a computer;
- The mobile device cost is lower than the computers cost.

Besides the advantages, we can also present as main disadvantages:

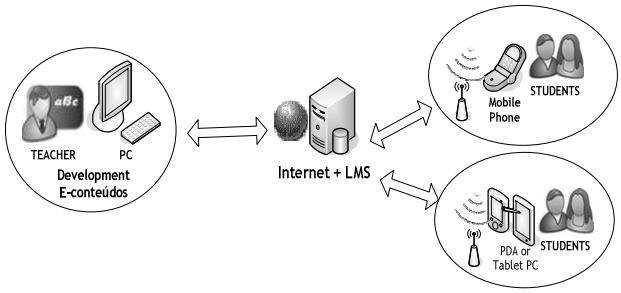
- The small size of the screens;
- Limited keyboards;
- Less processing capacities;
- To access Internet through mobile devices is still very expensive.

A research made in 2005, named *From e-learning to m-learning,made by ericson*[11] shows that (86%) of students think that it is easy to use applications through mobile devices, (67%) believe that the educational goals can be achieved and (61%) state that the e-learning quality improves with the use of these resources.

5. M-LAB: PROPOSAL AND METHODOLOGY

M-lab or mobile laboratory is a prototype of a virtual chemistry laboratory accessed through a mobile device. The virtual experiences presented in this work were part of the virtual Organic Chemistry laboratory developed by Dr. André Arigony of the Pontifica Universidade Católica do Rio Grande do Sul – Brazil, who gave us full support to use and modify the experiences. In this research we work on an experience created for the 7th grade and the subject that was chosen was organic chemistry, because it is a precise area and there is a great demand for e-contents, which can motivate even more the students.

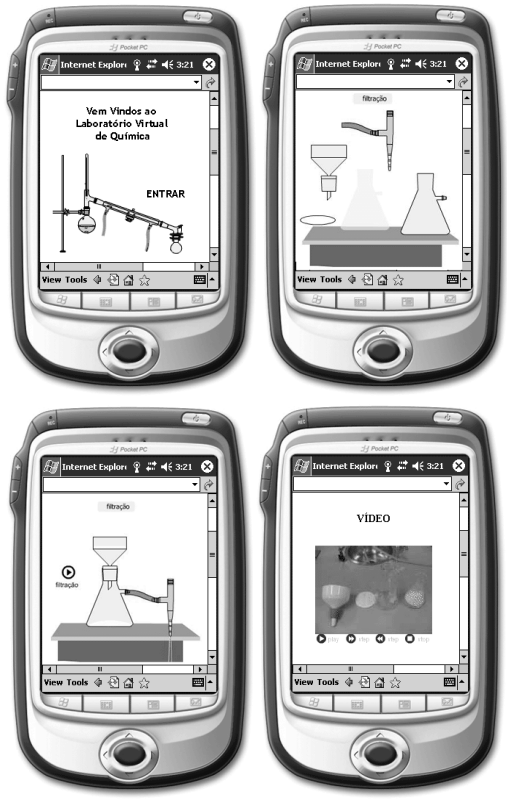
The virtual experience changed by us can be accessed through two procedures, as it can be seen in picture 1.



Picture 1. Scheme of access to experiences through mobile devices.

- The observation of the experiences simulations is available to those who have mobile phone.
- For those who have more complete devices, as PDA or Table PC, the interaction with the experiences can be greater because they can move the objects with the pen to the correct place, instead of only seeing it.

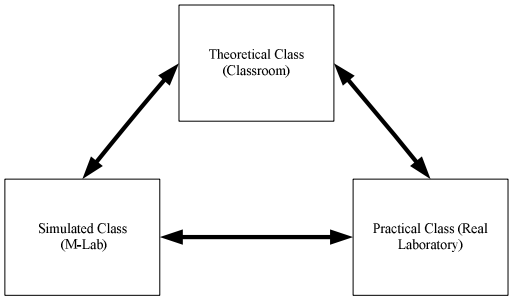
It would be ideal if the two users could perform the same tasks, but the mobile phone has fewer resources than the PDA. In picture 2, we will see the virtual experience of filtration that we use to access through mobile device. In the first screen we see the opening of the laboratory and in the second screen we have the objects needed to perform the experience. To finish the process, the users must put the objects in the correct place, so the experience can be conclude has shown in the third screen. The fourth screen presents us another resource that is a video of a real experience, in which the users have the possibility to have a stronger contact with reality, besides watching how things happen in a real laboratory.



Picture 2. Phases of the experiences in the virtual laboratory

When teaching chemistry, whether in presence or in distance, two aspects have to be considered: the theoretical part, composed of the content, and the practical part, where all knowledge is applied through the experiences in laboratories. To perform some experiences, it is necessary to have time and money, which is beyond the possibilities of many institutions. To overcome the financial problems and to raise the access to practical experiences, studies are made to develop the virtual laboratories that can be a solution if applied in distance education through computer.

They offer to the student an easy production, creation and active interaction with the learning content. They are tools that allow the simulation or improvement of the systems by data, sounds and images processing via web, which promote the integration of their computer and laboratorial resources through the interoperability of data and applications. They can also be used as pedagogical resources and assistance to teachers, but they don't replace real processes and they will never replace the teacher in a classroom, as they are only tools in the construction process of the knowledge. As a Chinese saying goes a good travel worths more than one thousand words. Therefore, a good use of the virtual laboratories of high technical and pedagogical quality can worth more than a lot of classes without using any kind of laboratory. So, the ideal model to apply teaching with the virtual mobile laboratory would be (see picture 3):



Picture 3. Methodology of the usage of the laboratory in the classroon.

New technologies renew distance learning, especially with communication through computer and mobile devices, which are characterized by their fast and range in the process of transmission of information.

6. CONCLUSION

In this paper, we started to define the concepts of a virtual laboratory (simulated experiences using multimedia), then it were presented the advantages and disadvantages of these laboratorial experiences based on Internet as well as the proposals to implement and develop them through mobile devices in a pedagogical context.

The mobile technologies will very soon be the most used ones because there is more demand for an education adapted to a great amount of extra activities that each person has to perform. Besides this fact, teaching methodologies that respect the rhythm of the student and his availability will be the most successful ones in information society. We present as suggestion to future studies in this area the following:

- Improvement of the use of the experiences;
- Evaluation of all learning gains when teaching contents through mobile devices;
- Creation or adaptation of more e-contents to a virtual mobile laboratory;

We hope that very soon the results of this research on using a virtual laboratory through a mobile device can be presented to all scientific community of the education sciences, favouring the possibility to implement identical experiences in other contexts, namely in non presence teaching activities or b-learning. [12] says that "We need to bring education to people instead of bring people to education".

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