
DEVELOPMENT OF A VIRTUAL FORUM FOR PHYSICS PROFESSORS

R. Castañeda¹, F. Gamboa², J. L. Pérez, L. Salas, C. Terrazas, L. Eslaba & A. Miranda.

Center of Applied Science and Technological Development, UNAM, Apdo. Postal 70-186, México, D.F. México.

¹casr@aleph.cinstrum.unam.mx, ²gfer@aleph.cinstrum.unam.mx

Received October 10th 2001 and accepted December 3th 2002

ABSTRACT

Nowadays sophisticated authoring tools allow developers to design and develop sophisticated web sites, in a fraction of the time that was required a few years ago. These tools have also allowed non-experienced users to create their own web pages, contributing in that sense to the expansion of the Internet. Nevertheless, while most of these sites are technically correct (links work fine), they too often result to be very difficult, and sometimes impossible, to be used. Our position is that the use of development tools is not sufficient. The development of web sites, as any other software requires of a methodology that maximizes the chances of the project success. In this paper we present a user-centered methodology employed in the development of a web site that will help physics professors of high school to communicate among them, and to share their experiences. The characteristics of the methodology and its different stages are detailed in this paper and the final product is presented as well as future works.

RESUMEN

Actualmente, sofisticadas herramientas de autoría permiten a los equipos de desarrollo diseñar, implementar y probar sitios web sofisticados, en tan solo un fragmento del tiempo que se requería hasta hace unos años. Estas herramientas también han permitido a los usuarios no experimentados crear sus propias páginas web, siendo en ese sentido, parcialmente responsables de la asombrosa expansión que Internet ha mostrado en los últimos años. No obstante, mientras que la mayoría de estos sitios son técnicamente correctos (las ligas trabajan bien), a menudo están organizados de tal manera que son demasiado difíciles (en ocasiones imposible) de ser usados. Nuestra posición es que las herramientas de desarrollo no son suficientes: el desarrollo de sitios web, como el de cualquier otro tipo de software, requiere de una metodología que maximice las oportunidades de éxito del proyecto. En este artículo presentamos un sitio web que deberá permitir que los maestros de físicas de nivel preparatoria se comuniquen entre ellos, y compartan sus experiencias. Se detalla el método seguido durante su desarrollo, el producto final, así como los trabajos futuros.

KEYWORDS: Virtual communities, user analysis.

1. INTRODUCTION

The development of quality software is beyond the helps and tools that commercial environments can provide to development teams. This is due to the fact that some of the crucial aspects of software (e.g. where will it be used? Who will use it? Or which are the user's fundamental tasks and goals?) tend to stay out of these tools aims. Thus here comes a simple and obvious conclusion: while the importance and utility of authoring environments can not be

denied, they are not enough to develop good quality software, understanding as quality software, the one that exhibits two main characteristics [1, 2]:

- *it is useful*: the software contains all the tools and necessary functions to carry out the user's task; it is robust and stable.
- *it is usable*: the software is designed based on user's goals, his/her tasks and procedures; it is easy to learn and remember; it reduces the necessary time to carry out a specific task; it minimizes the error; it gives a personal satisfaction; etc.

In this article, we present a virtual forum for physics professors, developed following a user-centered methodology. This methodology includes the consideration of the services that should be developed, as well as the explication of why these and no others were chosen, and how are they supposed to work. The definition of the problem is presented in the following section.

2. A VIRTUAL FORUM FOR HIGH SCHOOL LEVEL PHYSICS PROFESSORS

The Universidad Nacional Autónoma de México (National Autonomous University of México) has two equivalent systems for high school level: the Escuela Nacional Preparatoria (National Preparatory School), and the Colegio de Ciencias y Humanidades (Sciences and Humanities College). These two systems make a total of 14 schools spread in México City. With this infrastructure, the UNAM has capacity for 101,062 students and 5390 teachers, 440 of which are physics professors [3].

One would expect this huge amount of teachers to be part of an active community, with an intensive exchange of experiences obtained in the classrooms, interesting experiments, information from magazines and books, etc. Unfortunately, the reality is the other way around. Even worse, teachers don't exhibit any feeling of belonging to a community that shares common interest and problems, as they do. This attitude could be explained by the fact that the professors are not only divided in different schools and shifts, but also are belonging to different high school systems, as well as submerged in a huge bureaucracy and a completely vertical system that concentrates the entire decision making in a few people. As a way to revert this situation, at the Center of Applied Sciences and Technological Development (CCADET) we have developed a web site which offers to the professors from all schools, a forum in which the information can be discussed and exchanged.

The communities and virtual forums were born in the decade of the seventies, and they evolved from news servers, discussion lists and discussion forums to talking rooms and MUD'S (Multi-User Domain). Although the use of these systems by the public is recent, one can find some works that provide information about the general behavior of the users, and people's reactions in these virtual environments [4 - 7]. These data show how people use efficiently these virtual environments to organize a community, to discuss, to reach conclusions, and to give support to other members, in a very similar way as the face to face interaction. Encouraged by these results, we decided to use the internet as possible solution for the mentioned problem.

At the same time we know, by first hand as well as by literature that technology by itself has few opportunities for solving a social problem such as the one we present in this paper. It is for this reason that inspired in other methodologies for the development of web sites [8 -10], we defined a methodology that not only allows us to develop a technically correct product, but also maximizes the opportunities of its acceptance and use by the community of professors for which it was created. This methodology is detailed next.

3. ANALYSIS OF THE USERS AND THEIR REQUIREMENTS

The idea of a virtual community for physics professors appeared in CCADET in the context of the program PAAS, an up-to date program to which fifteen professors of physics have to attend every year. This program is organized by the General Direction of the Academic Personnel of UNAM. The idea of the forum arose as a solution for a problem identified in the previous version of the same program: once the course finished and the teachers returned to their

schools, they confront an infinity of problems in order to be able to share their experiences with their colleagues, mainly concerning to their final project, in which professors dedicated to develop new proposals about how to teach physics. This way, the time and money invested in the professors end-up as personal experiences, with limited impact in the schools.

Discussing this situation with the directors of both systems, we had concluded that the communication problem was not only between the professors that had attended the program and those who had remained in school, but among all the five hundred physics teachers of the systems. Aiming to give a solution to this problem, several meetings were organized, in which the idea of the virtual forum was developed, as well as were stated the four main goals that must be fulfilled:

1. Any teacher, from any school, can put to disposition of his /her colleagues, the material, experiences and ideas that he/her has developed. The teacher should also be able to send and receive comments from these colleagues.
2. The teacher can find and recover useful material, or strategies proposed by other teachers or institutions. The idea is that this kind of materials or recommendation can be more effective if they are made by colleagues who work in similar contexts;
3. Teachers can meet, talk, and discuss about physics, daily life or any other topic of their interest;
4. The sense of belonging to a community, where similar interests and problems are shared, might be developed.

With these goals in mind we started to design the software that satisfied the mentioned characteristics. However one should be aware that solutions that are not being demanded by the community, but that will cause a tremendous impact on it, can not rely only on technical solutions. Indeed, it is primordial for the success of the project to involve since the beginning, and in an intensive way, the final user of the product (the professor), minimizing in this way the risk of future rejection of the final product.

In order to achieve this, the development team worked with the teachers that attended the above mentioned program of PAAS. Their participation not only allowed to define the site, but also to redefine the services, to evaluate the use comfort and the most important; to involve them in the creation of it. In this way we hope that professors can return to their schools filling themselves as a part of the project, and therefore promoting its use. This point is detailed later on.

4. DEFINITION OF SERVICES

The definition of the services that we should include in the forum was carried out in two phases:

At the beginning, a set of services was defined with the directors of both systems, in accordance with the above mentioned goals. Lately this group of services was refined and modified through the interviews with the professors that assisted to the program. The final group of services was divided in four different sections:

- a) Socialization:
 - Room of chat and discussion list
- b) Recovery of material, put at the disposal of the professor.
 - Encyclopedia: theoretical material written ad hoc for the plans of studies of the UNAM. The material was written by well-known physics teachers as well as by the ones participating in the forum.
 - Experimental tasks: laboratory practices suggested along with the material existing in the high school, video based experiments [6]; practices with sticks and pellets of very low cost.
 - How the machines work: explanation with devices that are related with the class of physics. These explanations are made up of text and in 3D animations [12].
 - Virtual walks: walks into laboratories with restricted access, related to the studies plan.
 - Tests: proposed tests to evaluate the students.

- Solution of problems. A methodology to solve physics problems, based on a meta-cognitive theory [13]. The goal is to help the students to solve problems, and to make them meditate on the way they solved them.
- c) Sending of the material developed by teachers:
- Send you material: the way offered to teachers to send their own material about any of the topics above mentioned. Teacher has to specify the kind of material, his/her name, and the nickname with which the material should be announced. Nick names are important for those who want to remain as anonymous authors.
- d) Exchange of experiences, material and others:
- Opportune advertisement. A service in which teachers can announce material that want to exchange, or to request what you/they need for a particular purpose.
 - How do you teach? Stories of successful experiences on how to present a particular topic in the classroom.
 - Review of books: Revision on new books, papers and magazines.
 - Shops: Shops proposed by teachers towards their colleagues.

The development of these services is presented in the following sections.

5. DEVELOPMENT OF A "T" PROTOTYPE

A "T" prototype is a first version of the project in which the main page is developed (see Fig.1), as well as all the pages of first level. One of the branches (the most important or interesting one) is fully developed. The goal of this prototype is to have a system that can be evaluated with final users very quickly.

In these evaluations one can obtain information about how affordable it is for the users the organization of the site; if the offered functions are pertinent; if labels are clear; etc. This prototype also allows to prove with final users other more subjective factors such as colors, sets of characters, fonts, etc. [14 - 17 & 10]. In our case, the developed branch was the discussion forum.

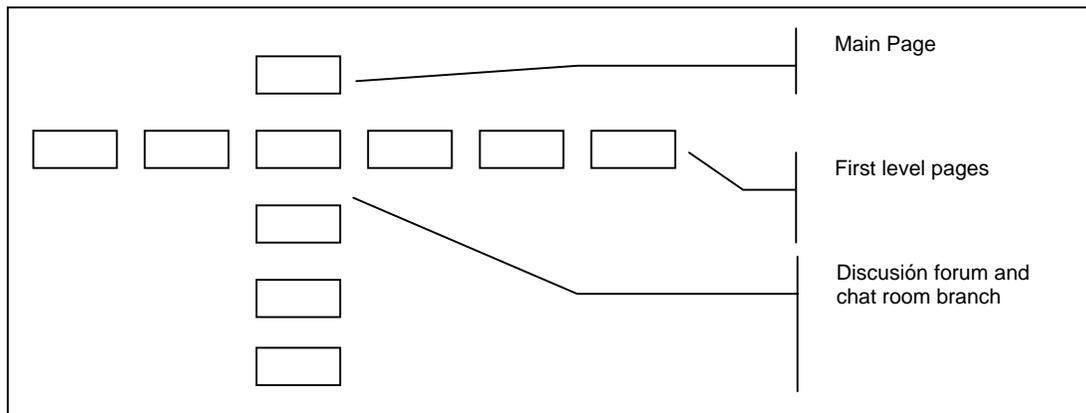


Figure 1. Prototype in "T"

The prototype in "T" was developed and tested with six users (teachers). An interview of half hour was carried out in which the teachers were requested to describe the elements in the interface created by them, and how they imagine its operation. Finally they were asked to make use of the discussion forum. These interviews were recorded in order to be able to carry out analysis later on, in which the difficulties found were numbered, as well as the mistakes and confusions they had, the branches they followed, etc. (see fig. 2)

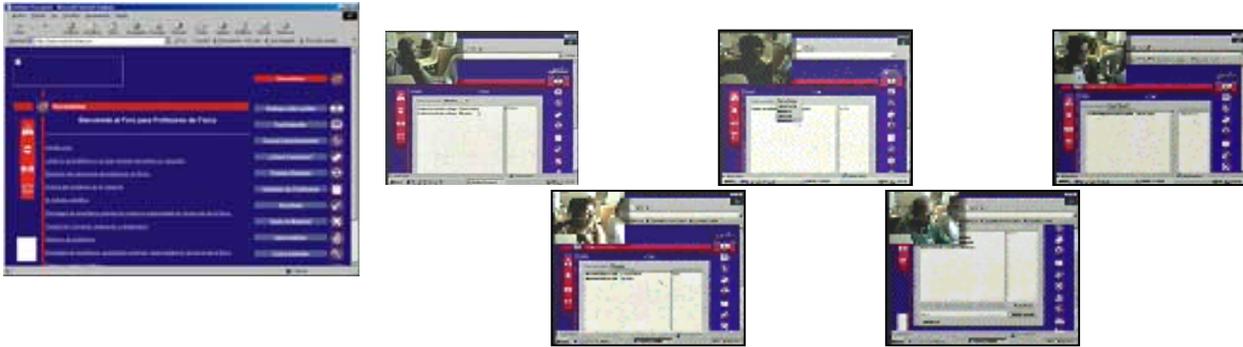


Figure 2. Main page of first prototype and its evaluation with final users

Based on this evaluation we were able to discover some troubles with the graphic design: the colors, the used labels, and some problems the users had identified in the different regions of the screen. With this information we refined the prototype, generating a second proposal that gave more satisfactory results. This will be presented next.

6. SECOND VERSION OF THE WEB SITE

As we already mentioned it, one of the main problems that were detected in the first prototype was the fact that the regions of the interface (work space, commands area, links area etc.), were not clear enough for the users. With the intention of making it more clear and correct these problems, a new interface proposal was generated. In this new version, creative and cold colors were used (blue and gray), to reflect the advances in the technology, and hot colors (red) to enhance the most important points in the site, giving it, at the same time, a modern and vigorous aspect.

In the generation of this second version the comments made by the professors during the evaluations were also considered, as well as some recommendations captured in a written survey that was requested to be answered at the end of the evaluation. The objective was to create a graphic design that became the main message for the user, which invited him/she to visit it in a pleasant and functional experience (see Fig 3).



Figure 3. Main page and discussion forum in the second version

On the other hand, while it was necessary to redesign entirely the graphic interface, the proposed services worked well. None of the teachers requested new services, and just some of them recommended some small changes that were introduced. Nevertheless, the development of this second version introduced other changes in the team- work. These changes are described in the following section.

7. IMPLEMENTATION OF THE WEB SITE

An important difference between the development of the first, and the second version of the site, is that the second one was no longer a "T" prototype, but a complete development. This implied the consideration of other aspects that had not been analyzed until that moment: the final data structures; the information flow; the programming and verification of all the routines; etc. The main challenge consisted in developing a system that allowed the dynamic incorporation of the materials sent by the professors, without having to generate for each one a new page, or new links in a manual way. In the same way, it was important to maintain the control of the published materials, author, origin, material type, reception date, etc. Based on these outlines, a document storage and search engine was developed, permitting us to manage these tasks from an administration module, available only for the administrator of the site.

The developed engine works over a structure of three directories, each one of them containing a particular kind of information:

Directory 1 (root directory):

<http://paas.cinstrum.unam.mx/>

This directory contains the main page index.htm, from which, the rest of the services are called.

Directory 2 (code directory):

<http://paas.cinstrum.unam.mx/sitio-paas/service#>

This directory contains the code of the different services offered by the site. The files are actually "java script pages", a powerful language in web programming. The following list shows the different files that are called when using the different services from the web site. To complete the address, one should replace the word "service#" with the corresponding sentence listed below.

service1: foroachat/temasforo.jsp

service2: enciclopedia/enciclopedia.jsp

service3: tareasexperimentales/muestratareasexpe.jsp?muestra=temario

service4: comofuncional/comofunciona.jsp

service5: paseosvirtuales/paseosvirtuales.jsp

service6: solucionproblemas/solucionproblemas.jsp

service7: reactivos/reactivos.jsp

service8: enviarmaterial/enviarmaterial.php

service9: intercambios/muestramateriales.jsp

service10: comoensenas/comoensenas.jsp

service11: libros/libros.jsp

service12: talleres/muestracursos.jsp

These twelve files are called by the user while interacting with the web site. In order to work properly, some parameters are automatically added by the developed engine, so the information can be properly saved and later gathered.

The material is organized according to the main topics of physics. In turn, each topic is divided into sections. This is specified to the system through several parameters listed at the end of the address, separated by a question mark. (<http://paas.cinstrum.unam.mx/sitio-paas/service/#?Parameters>). This way, the documents sent by teachers are arranged according to a specific topic and section.

Directory 3 (received files directory):

<http://paas.cinstrum.unam.mx/sitio-paas/compartidos/MuestraArchivo?Ruta=r&Parametros>

This directory encloses the received documents from the teachers. For the recovery of the information, the system uses a file called `muestraarchivo.jsp`, as well as the parameters that indicate the topic, section, and kind of document to display.

For example, to recover a document from the service "How do you teach?"; topic "Mechanics"; section "Circular uniform"; entitled "A problem of Physics that cannot be solved.", the corresponding list of parameters is created as follows:

We use the address from the corresponding service. In this case, service number 10.
`comoensenas/comoensenas.jsp`

The system adds the question mark to separate the parameters, and adds the corresponding topic (Mechanics = topic 2), and subtopic (Circular movement = subtopic 2).
`comoensenas/comoensenas.jsp?topic=2&subtopic=2`

In case the user decides to call the link of the founded file, the system searches in the directory in the following way:

`muestraarchivo.jsp?file=../../documento/coordinadores/bolita/no_solucion
.htm&titulo=Un%20problema%20de%20Fisica%20que%20no%20puede%20resolverse`

The file "muestraarchivo.jsp" is a page that is divided in two horizontal frames: the superior one shows the logo of the site, and a button that allows the user to return to the list; in the inferior one is presented the requested file.

At the end of some of the branches, we added a service called "Tell a Friend about this". This service allows the user to send the founded information to a friend through an e-mail.

After evaluations, the Chat Room and the Discussion Forum were only refined, as they have been developed and tested in the first prototype. For the rest of the services we used a technology called "Cascade Style Sheets" (CSS), complementing them with dynamic pages.

In the development of the site were used several well-known technologies and tools: DreamWeaver, PhotoShop, CorelDraw, Java, JavaScript, PHP, JSP, etc.

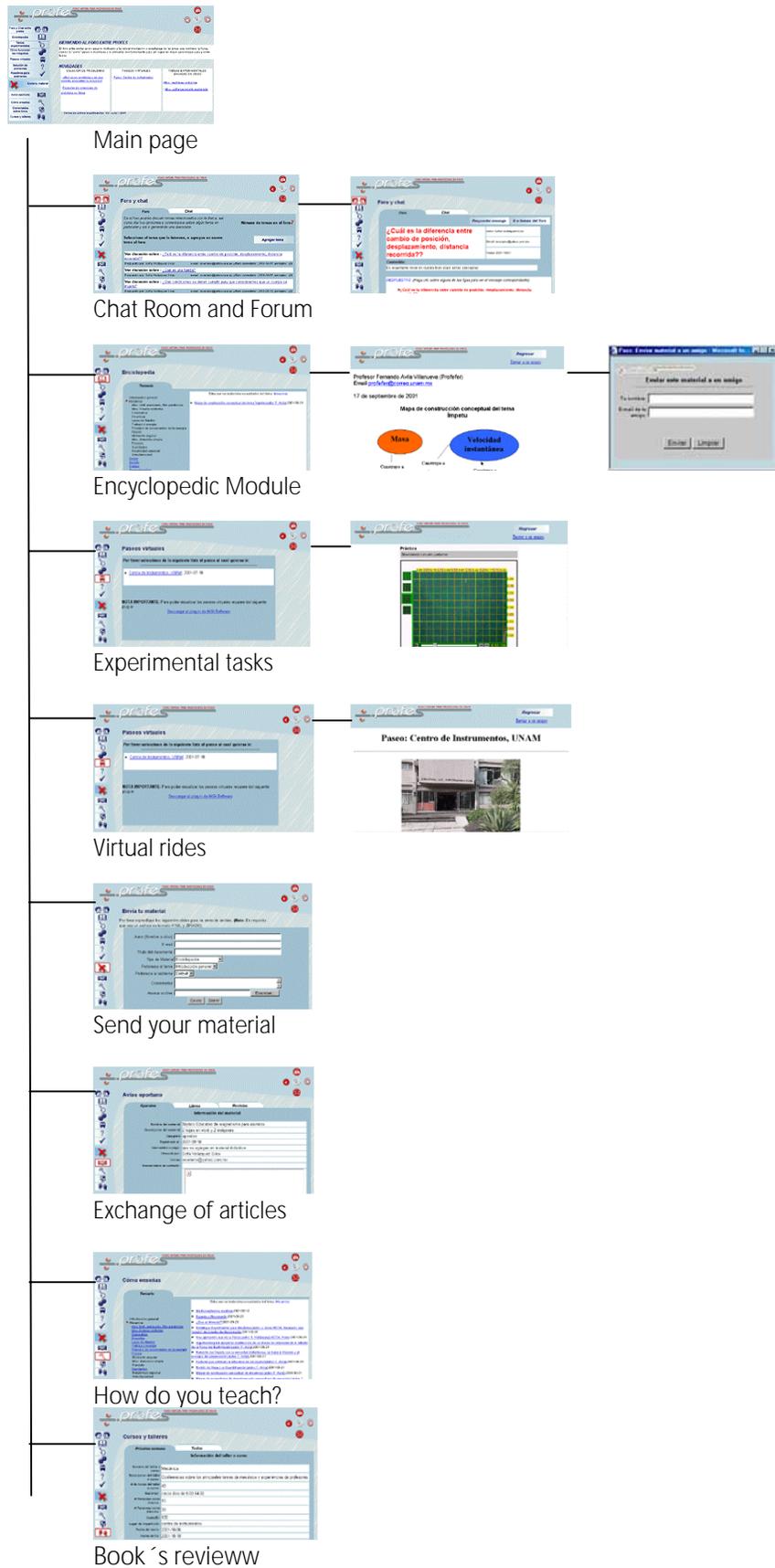


Figure 4. Final structure of the site

8. RESULTS

The web site that we have presented in this article has been called: "Among profess, Virtual Forum for Physics Professors", and it can be visited in: <http://paas.cinstrum.unam.mx> As we already mentioned it, the objective that it pursues is simple: to foment in the high school level professors of the UNAM the conscience and the pride of belonging to a community of professors that shares similar challenges, problems, and opportunities; a feeling that has gotten lost in the current context of the University.

Indeed, we know that many of our teachers have brilliant ideas, but they lack of means to diffuse them. This space will allow them to share their experiences and ideas, to discuss and to learn from other professors, or plainly to comment daily situation with their colleagues. We also know that many of our teachers have never used Internet and that they are reluctant to use these new technologies. For them we have made a special effort, trying to make our site the most accessible and usable possible. Finally, thinking in those teachers who have nor interest in sharing their knowledge, neither in discussing their experiences with other colleagues, we are putting on-line some of the didactic materials developed in CCADET. These materials will only be available in this virtual forum, with which we hope to attracts these, and all the other professors.

Currently the site is mounted in a Linux RedHat server, with an Apache HTTP server that has some necessary extra modules for the handling of dynamic pages (JSP and HP). This server also has installed PostgreSQL, a Databases manager that controls the contributions received; who sends them; if they have been was already published; in which section is to be found it; etc.

The site contains materials created at CCADET (Virtual Rides, Video Based Experiments, etc.), as well as materials created by high school teachers of the UNAM. The following chart shows the number and kind of materials that the site holds right now.

Service	Contributor	Description	Quantity
Discussion List	Teachers	Proposals of discussion subjects	3
Experimental tasks	Teachers	Proposal of experimental task related with Mechanics	1
	CCADET	Video Based Experiments	10
Virtual Rides	CCADET	Virtual Ride to the CCADET	1
Solution of Problems	Teachers	Documents about physics problems	7
Exchanges	Teachers	Books and magazines reviews	3
How do you teach?	Teachers	Successful histories in the classroom	28
Courses & Workshops	Teachers	Courses and workshops offered by teachers	2

Up to the moment the forum has being used successfully by the group of professors that attended the PAAS. Fortunately, the fourteen of them seem to have understood their paper as promoters and they seem to be enthusiastic and full of ideas about the activities that they will carry out when reinstalled in their schools. In that sense, the site counts with contributions made by them, as well as material developed in the CCADET. The second version of the site has been a success since the modifications carried out on it, made it much more accessible and easy to use.

Finally, in this moment we are carrying out a final evaluation which will allow us to refine some minor aspects of the interfaces, but mainly it will allow us to reinforce in the teachers the idea that their proposal of change are taken into consideration making it in this way more of their own. Indeed we are convinced that this is the only way in which they will promote its use, once they return to their schools. Nevertheless, we only will be able to make an accurate evaluation about this topic at the end of the year, when the professors have returned to their schools and we might be able to observe the use that the teachers and their colleagues make of this instrument.

9. REFERENCES

- [1] Senach B., *Evaluation Ergonomique Des Interfaces Homme-Machine: Une Revue De La Littérature.*, Institut National de Recherche en Informatique et en Automatique: Rocquencourt, France, 1990.
- [2] Shneiderman B., *Designing the User Interface*. Third ed. Reading Massachusetts, Berkeley California, Mexico City: Addison Wesley Longman, Inc. 638., 1998.
- [3] Dirección General de Estadística y Desarrollo Institucional, *Agenda Estadística*. Universidad Nacional Autónoma de México: México D.F., 1999.
- [4] Preece J., *Empathic Communities: Balancing Emotional and Factual Communication*. Interacting with computers. 12(1): 1999, pp. 63-77.
- [5] Sempsey J.J. & Johnston D.A., *The Psychological Dynamics and Social Climate of Text-Based Virtual Reality*. The Journal of Virtual Environments. 5(1), 2000.
- [6] Whittaker S., *Talking to Strangers: An Evaluation of the Factors Affecting Electronic Collaboration*. in *CSCW'96 Conference on Computer Supported Cooperative Work*, 1996.
- [7] Whittaker S., Terveen L., Hill W. & Cherny L., *The Dynamics of Mass Interaction*. in *CSCW'98 Conference on Computer Supported Cooperative Work*, 1998.
- [8] Díaz P. & Aedo I., *A Methodological Framework for the Conceptual Design of Hypermedia Systems*. in *Hypertexts and Hypermedia Products, Tools, Methods (H2PTM 99)*. Paris, 1999.
- [9] Newman W.M. & Lamming M.G., *Interactive System Design*. 1st ed. Harlow, England; Mexico City: Addison Wesley. 468, 1995.
- [10] Pearrow M., *Web Site Usability Handbook*. 1st ed. Internet Series. Rockland, Massachusetts: Charles River Media, Inc. 350., 2000.
- [11] Gamboa F., Pérez J.L., Lara F., Miranda A., & Caviedes F., *Specification and Development of a Physics Video Based Laboratory*. Instrumentation and Development. 4(5): 2000. pp. 45-50.
- [12] Pérez J.L., Caviedes F., Gamboa F., Salazar-L E., *Simulaciones De Máquinas Y Fenómenos Físicos En Tercera Dimensión*. En *SOMI XV Congreso de Instrumentación*. Guadalajara Jalisco: SOMI, 2000.
- [13] Barojas J. & Pérez y Pérez R., *Physics and Creativity: Problem Solving and Learning Contexts*. Industry and Higher Education. (In press).
- [14] Andleigh P. K. & Thakrar K., *Multimedia Systems Design*. 1st ed. Upper Saddle River, NJ 07458: Prentice Hall PTR. 654, 1996.
- [15] Buchanan R.W.J. & Charles L., *Measuring the Impact of Your Web Site Proven Yardsticks for Evaluating*, ed. W.C. Publishing. New York: John Wiley & Sons, Inc. 316, 1997.
- [16] Mack R.L., *Usability Inspection Methods*. 1st ed. New York: John Wiley & Sons, Inc. 413, 1994.
- [17] Nielsen J. & Mack R.L., *Usability Inspection Methods*. 2nd. ed. United States of America: John Wiley & Sons, Inc. 413., 1994.