The use of Internet in Engineering Education in Brazil

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***Abstract* - The work describes the experience developed at University of Santa Catarina with the introduction of instructional multimedia material, in a Brazilian site (www.cimm.com.br) dedicated to mechanical engineering matters. The material covers basic information on the areas of: mechanical testing, tool steels and structural steels for civil engineering applications. The purpose is to offer organized technical instructional information to engineers, students and teachers, using multimedia resources, especially animations. The subjects were chosen and organized in modules. The working team included mechanical engineering professors and students. A government education program, in association with the Brazilian Society of Metallurgy and Materials (ABM), sponsored the initiative. The contents do not constitute a formal course of the university, and do not award any college degree. The access is free of charge, since the main goal is to reach the biggest number of professionals and students, creating concise and attractive form of technical information.**

Index Terms – mechanical testing, multimedia education, structural steels for civil engineering uses, tool steels.

INTRODUCTION

The original idea of creating a set of engineering informative modules for Internet came out from a group of Mechanical Engineering Department professors, at Federal University of Santa Catarina –UFSC. From 2000 to 2003 a first project was developed and implemented [1]. This material is available at **cimm.com.br** in a Section named Didactic Material (Material Didático). The subjects chosen at that time were related to manufacturing processes and environmental issues. The success of the initial experience [2] generated a new demand, now focused in mechanical testing, tool steels and structural steel for civil engineering uses.

The objective of the project is to provide a set of organized basic information in each technical subject enhancing the visual models through the use of animations. The product available on-line allows minimizing educational deficiencies present in some Brazilian institutions. Moreover it also helps professionals in revisiting basic concepts and information. The search on the web shows that are only few sites with didactic material of this kind have free access. In Brazil, restricted access models would be ineffective, at least for the present state of development of the country. The idea is to broaden the possibilities of access for professionals and students [3].

The present project was planed for 14 months period (finished in September 2006) and covers the following subjects: mechanical testing of metallic materials, tool steels and structural steels for civil engineering uses. The project was sponsored by two government agencies (National Council for Scientific and Technological Development – CNPq and Studies and Projects Financing Agency – FINEP) and developed in parallel to an ABM complementary project, related to on-line library improvement and creation of a national research laboratories database [4]. The laboratory database can be accessed at ABM site and uses a search tool that can be activated by keyword, institution, subject and/or location. The database is intended to promote the industry-university interaction and to maximize laboratory use capabilities. Also the on-line library, named Hephaestus, was amplified. This part of the project will not be further discussed in this paper, since ABM staff developed it.

Aspects of the didactic project execution are described below, including: acquired experience, selection of topics, staff, computational tools, users response, etc.

SELECTION OF TOPICS

The subjects were selected by an agreement with ABM in order to supply identified educational/professional demands in the country. Each area had a responsible professor, which tailored the structure of his subject and selection of topics to be included. The sequences were then discussed and adapted in such a way as to generate self-contained modules. Some concepts introduced in a module are used to explain phenomena in subsequent modules, so a logical chain of information is respected. Whenever previous published module information was required, links were added to the text, connecting to specific points.

As in the first project, fundamental concepts are treated in a short and direct approach, such that students (undergraduate, professional high school courses), industry/consulting professionals and teachers, all can easily use it. Therefore, complex theories and formulations are not covered.

Three subjects were developed, namely:

Mechanical testing of Metallic Materials, including

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- Tension
- Compression
- Hardness

Impact (dynamic-fracture)

- Bending
- Sheet-formability

Tool Steels, including

- Steelmaking Practices
- Classification and codes
- Thermal treatments
- Surface treatments
- Selection of steels for tools and dies

Structural Steels for Civil Engineering Applications, including

- Classification and Codes
- Usual structural shapes
- The corrosion and its mechanism /protective measures
- Some Welding Aspects

The above topics were included under the title of Special Subjects besides Materials Fundamentals and Environment, as shown in Figure1, at Didactic Material access page [5].

FIGURE 1
SCHEMATIC OF SUBJECTS TITLES IN ACCESS PAGE

WORKING STAFF

The organization and text editing was conducted by two professors and supported by a coordinator. Texts are a compilation of technical data extracted from books, class notes, product catalogs, technical papers and other publications. The coordinator organized the material, filtering and condensing texts, managing the illustration work and creating the final format for Internet.

The illustration work was mainly executed by two mechanical engineering undergraduate students (scholarship students). For an effective production, the students went through one-month training period, including use of the software for static and animated image production, page composition, and file conversion to different formats. The student's involvement is very important because they are also the "clients" to be exposed to the final material and therefore able to criticize the learning results at each step of the project.

DIDACTIC ISSUE

At this point of our experience it can be said that is no 'straight' method to achieve the best results in producing didactic material for Internet. Many times intuition and creativity faculties are used and encouraged. The working team was free to suggest and create models, specially concerning the illustrative material. The usual Internet page model was preserved, i.e., as much as possible long texts were avoided in a single sequence. In some cases, for longer texts, anchor titles were used, dividing the contents in shorter sequences, so the pages can be more attractive.

It must be stressed that the didactic material produced is not intended to be a formal course. Instead, it is a complementary material directed to engineering students, technicians and industry engineers. For engineers it can be understood as a revision of fundamental concepts and even as an update, as mentioned before.

COMPUTATIONAL TOOLS

Conventional software was used for the composition of the material. A text editor (Microsoft Word) was combined with proprietary software for web page generation, named 'Construtor', developed by the site cimm personnel. Most of the static illustrations and animations were created with Macromedia Flash, which allows small file sizes. The images are converted for gif, jpeg or swf depending on the characteristics of the illustration. Graphic edition sometimes also used Corel and Adobe. The aesthetic effects are good, and improving with experience. Examples of frozen frames extracted from animations are shown in Figures 2 and 3.

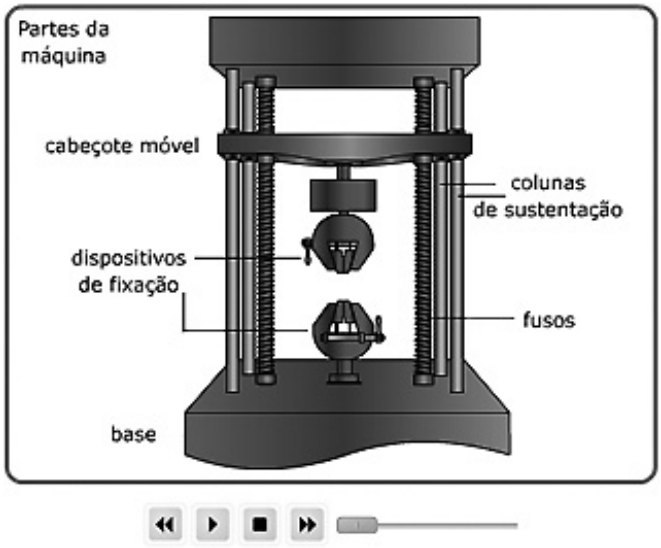

FIGURE 2
FROZEN IMAGE OF ANIMATION SHOWING THE UNIVERSAL TESTING MACHINE USED FOR TENSILE TESTS.

USERS RESPONSE AND NEW TENDENCIES

As a form of collecting the opinions of the site visitors, an e-mail address was created for suggestions and critiques. Most of the messages came from professionals and teachers, nearly all of them trying to obtain copies of the material for classroom use. Some messages suggested the inclusion of new themes and also asked about the possibility of redirecting some of these themes to industry training applications.

From the users response several suggestions were collected for new subjects. Among these are: dimensional

metrology, aluminum and its alloys, and structural steel for ships. Those demands seem to be a positive response, meaning that the visitors approve and trust the quality of the source.

It is our intention to fulfill the above-mentioned requests of new themes, as much as possible. We understand the demands as an indicative of deficiency on available information on the web, therefore a good path to be pursued.

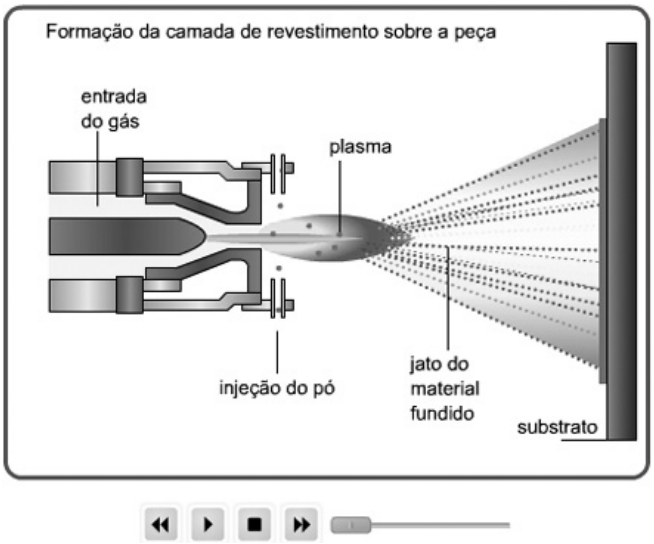

FIGURE 3
FROZEN IMAGE OF ANIMATION SHOWING THE THERMAL SPRAY COATING APPARATUS

FINAL CONSIDERATIONS/RECOMMENDATIONS

From the accumulated experiences until this moment, the following directives can be suggested as guidance to produce web didactic material:

- It is mandatory that the experts of each area define clearly the deepness at which the subjects should be discussed.
- It is impossible to have a rigid standard of presentation format for the subjects. Each subject has its own peculiarities, so the balance between the amounts of text and image must be kept flexible.
- The aesthetic quality of images is directly dependent on the skills of illustrators, not only on the software, but also on the degree of knowledge of the subjects. By this reason it is advisable to use engineering students (not graphic designers) in this kind of project. One must have in mind also that a small working team can be very efficient if properly oriented.
- The infrastructure of cimm, already working at the beginning of the project, was a key element to divulge the material in the country. So, the site structure is an important factor for the success of this kind of initiative.
- It is possible to broaden the project, including some of the subjects requested by the visitors. The feedback information must be considered for fixing new guidelines for the sequence of the work.

CONCLUSION

We hope that this work can be valuable for mechanical engineering professionals and students. The free access through the web is an easy form of collecting feedback information from users, so the critiques add to the 'know how' we try to build in manufacturing the didactic material. Moreover the success of the project may bring new collaborators to the team, expanding the range of subjects.

ACKNOWLEDGMENT

Special thanks to CNPq and FINEP for the financial support, to ABM for its effective partnership, and to students Lauro Schmitz and Ronaldo Tremarin for their dedication.

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[4] http://www.abmbrasil.com.br/portal-tecnologico/portal/default.asp?cdi=0&cdl=0 Acess page to Brazilian laboratories and on-line Hephaestus library database.

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