

# DEVELOPMENT OF DIDACTIC AIDS FOR ENGINEERING EDUCATION: MULTIMEDIA ON STRENGTH OF MATERIALS AND STRUCTURES BEHAVIOR

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## ABSTRACT

*This article presents a project that is being developed at the Applied Mechanics and Structures Department of the UFRJ Engineering School. This project aims at the development of didactic aids for graduation courses (Engineering, Architecture and related areas), Technique Schools and High Schools.*

*The first phase of this project, that is already going on, involves the development of computational support with use of graphical resources and multimedia, for Strength of Materials and structures behavior classes. There are several other objectives involved in this project, like:*

- develop audiovisual aids involving the functioning and the establishment of relations between physical models and theoretical models;*
- promote the study of the students interaction with the development of the didactic material process;*
- promote the study and the discussion of the different possible approaches for use the didactic aids;*
- promote the discussion the forms of enlarging the universe of professors involved with the use of the developed didactic resources;*
- develop specific models and multimedia programs for use in high schools and to divulge the material developed.*

## INTRODUCTION

The technology evolution results in a great increase in the knowledge volume to be transmitted to the students. In this context, the Universities and its professors come across with great dilemma: to transmit the basic scientific knowledge or the recent technological innovations? Or both? And how? This question demands a series of reflections: the professional, to be competitive, needs to be familiar with the technological vanguard; but, at the same time, without the basic knowledge he can't

understand or evaluate the modern technologies. The biggest challenge is to offer adequate professional formation that incorporates the technological advances to education, without harming the understanding of the basic scientific knowledge. The solution of this impasse becomes possible with the improvement of the communication quality and the increase of the speed and the efficiency of knowledge transmission.

On the other hand, it is currently observed an excessively and generalized increasing in the amount of classes. It results, in most cases, in a "false efficiency", which means pupils with extreme request, however, with small assimilation rate. Another worthy note fact is that the "multimedia culture" is already consolidated in the way the new generation thinks and learns. It is impressive the amount of information and the assimilation speed, that the young generation can achieve when dealing with electronic games. It is important to observe how quickly the information contained in these games are assimilated. This is only one simple example of the high efficiency of electronic media in interactive learning. In this context, the production and the use of multimedia systems represent a powerful assistant for education in different areas. This results in the sprouting of a new work field to the Brazilian Universities: the research and development of multimedia systems for education use.

In order to consolidate and expand the emergent work groups, it is necessary to facilitate access to the new education technologies, and to stimulate the incorporation of these pedagogical innovations in the professors' practice. At the same time, it is necessary to equip laboratories and libraries for the production and use of didactic material.

## PEDAGOGICAL METHODOLOGY and OBJECTIVES

The development of educative programs demands knowledge of diverse fields, as computer science, visual programming, learning psychology and the specific content to be taught, this involves the

participation of a multidisciplinary team. This type of work leads the professor, inevitably, to a reorganization of his education methods; in order to get a significant quality change in the teaching - learning process. The students participation, with professors, and specialists of different areas, gives them a new vision of the of knowledge construction process, with more participation and less passiveness.

According to Struchiner [ 1 ], "*The importance of the multimedia systems study in education originates from its characteristics, like:*

(1) *Interactively - allowing, in accordance with the possibilities given for the author, the control and independence of the student / user in the choice of the information and the working rhythm;*

(2) *Integration of diverse ways - presents the information in different forms and, therefore, allows different styles and preferences of learning;*

(3) *Non-linearity of the information - the student / user deals with associations of information; this process has similarity with the natural learning process "*

Still according to Struchiner [ 1 ], "*the principles, the characteristics and the potentialities of these systems seems to be sharpened with an education model that confers to the student autonomy and responsibility in its own learning process, instead of being only stowage of the professor's information. It confers to the professor the facilitator role, creator of learning environments, instead of a simple knowledge transferor"*.

This project also involves other objectives, like:

- develop methodologies to elaborate, implement and evaluate computational teaching aids;
- contribute for the professors formation and the improvement of the engineering education quality;
- enrich the knowledge on the learning process and on the communication level in engineering education ;
- gather a team of professors, students and specialists for a continued production of didactic aids for engineering education;
- extend and facilitate the access to the knowledge of specialists and researchers from the engineering field, who for diverse reasons, are not normally accessible to the students;
- create an environment that extends and intensifies the contact of the students with the research methodology, in an integration panorama with different areas;
- promote the study of the interaction of the students with the process conception development of the didactic material;
- promote the discussion of the forms of use and the forms of enlarge the universe of professors involved with the use of the didactic aids developed;

- develop specific multimedia systems for use in high schools;

## PROGRAMS DEVELOPMENT

The UFRJ's team for Development of Didactic Aids for Engineering Education, is currently involved with different projects:

- Structural Accidents,
- Laboratory Practice in Reinforced Concrete Structures
- Strength of Materials
- etc.

For the development of the multimedia systems, it was used microcomputers Pentium 133 with 16Mb RAM memory. The project is being developed in Windows/95 environment with the Delphi, 3Dstudio, Autocad, Mathcad and Photoshop programs. The Delphi language was chosen because it possess the resources to incorporate the necessary formulas and calculations and, at the same time, do not need advanced programming knowledge.

The programs have already been introduced to the students with in order to make an evaluation of them and get suggestions for the revisions that are constantly being made, before the system is considered finished. These revisions are carried through in an iterative form, searching for analyzing the students reactions, the understanding level and the communicability degree of the documents.

## STUDENTS' PARTICIPATION

This project counted on the students' participation as scholarship holders of the REENGE Project. The students have participate directly in the development of the multimedia systems, together with the professors and the content specialists.

Although these activities are generally seen as complementary, we consider that the abilities acquired in this process have vital importance in the future engineer's education. For this reason, we consider essential the maintenance of governmental incentive programs, like REENGE, aimed specifically to graduation courses, so that it can be offered to the students the chance of deepening in the activities that involve the elaboration of didactic aids for engineering education.

## RECEIVED AIDS

The project DEVELOPMENT OF DIDACTIC MATERIAL FOR ENGINEERING EDUCATION received aids from diverse sources, amongst which we can distinguish: University Foundation Jose Bonifácio (FUJB), Project REENGE-UFRJ/CAPES/CNPq and UFRJ's LIG Project (Project for the implantation of new Computer Science Laboratories for Graduation Courses).

## CONCLUSIONS

The use of the algebraic computation in Strength of Materials problems, helps the student to simultaneously visualizes, with the use of the graphical tools, the theoretical formulas and the results in the parametric form. With this methodology each problem is dealt with as an iterative calculation module easy visualization and results interpretation.

In the discipline Strength of Materials, for example, it was observed a great improvement in the students comprehension degree in subjects like tensions distributions in plain and in three-dimensional state. In general, it was verified a great increase in the students' participation and interest level and in their capacity of understand theoretical concepts. It was also observed, a bigger interaction of the professors' team involved in this project.

The results observed indicate that some of the main objectives of tproject are about to be reached, such as contribute to the improvement of the Engineering Education quality and to gather a team of professors for studying techniques and the production of didactic aids for engineering education.

It must be pointed out, the importance of incentive programs aimed to the improvement of the graduation courses, like REENGE project, without which this project couldn't be carried through.

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