A strategy to improve engineering teaching process based on an e-learning approach

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Abstract- This paper presents a project which was realized with the objective of implementing an alternative solution to teaching methods, solution which involves the assistance of computers working as pedagogical tools complementary to the traditional methods that are used in the teaching of subjects such as Mathematics, Electrics and Electronics.

Besides the background that has motivated the realization of this project, this paper presents not only the strategies, principles and philosophy which were defined for the courses content but also the way in which a solution was implemented, as well as the strategy expected to be carried out to test the solution and evaluate the results of these tests.

In addition, it will also explore the alterations that this type of strategy may cause in the roles traditionally attributed to teachers and students, and the effect that these changes bring about in the teacher-student relationship.

Finally, this paper also contains a brief presentation of the organizational structure of the solution, the phases and main tasks that this project involved, other phases expected to be carried out in the future, as well as its conclusions.

I. KEYWORDS
Education, e-learning, computer supported learning, web-based, mathematics learning, electronics engineering learning, electrical engineering learning

II. PROJECT BACKGROUND

The past years, in Portugal, the teaching of subjects such as Mathematics, Electronics and Electrics at College level has been characterized by a high difficulty of attracting new students, by problems in the learning process, a great lack of motivation and drop outs. In the heart of this situation, which has been worsening significantly over time, are the conjectural factors which go hand in hand with the structural factors.

Among the conjectural factors, there is the thought that the study of these subjects is “out of fashion” and harder - since they usually demand a bigger effort and dedication from the students - than other taught subjects.

Among the structural factors, is the lower will of students to study scientific and technological subjects as well as the little status recognition of these technological professions by society.

Due to these problems it is urgent to find alternatives and complementary solutions to the traditional teaching methods in order to change the existing situation. The solution here presented includes the assistance of computers in the teaching process.

III. PROJECT OBJECTIVES

The objective of this project was to build a solution based on education assisted by computers to learn the basic subjects of technological degrees such as Mathematics, Electronics and Electrics. The goal of the implementation of this solution didn’t consist in replacing the traditional
teaching methods but in creating a complementary alternative meant to contribute to the liking, the interest and motivation of the students for this kind of subjects and therefore, to improve their learning ability.

In the same manner, the objective of this project didn’t consist in adopting conservative and simple strategies to transpose old teaching methods or learning contents into a new support system but to implement a really innovative solution in the pedagogy and the adopted solutions.

IV. STRATEGY IMPLEMENTATION

After defining the objectives, it became fundamental to define the orientation of the strategy lines according to the implementation of the given solution.

This is why the following points were identified as critical factors in order for the solution to succeed:

1. To explain the taught subjects using a language which is simple, clear, direct, adequate and attractive to the public to whom the courses are addressed.

2. To put an emphasis on demonstrating and assisting each theoretical concept with a practical application.

3. To use images and multimedia animations in abundance and in a regular manner to demonstrate the functioning and the ways in which the theoretical concepts can be applied.

4. Not to forget however the components which are strictly theoretical, meaning to complete the simple and practical explanations of each concept with a complementary and more detailed explanation of the origins of the subjects.

5. To insure a total flexibility time and space wise. The courses need to be available in a permanent manner: 24 hours a day, 7 days a week and the studying process needs to be possible from school, home, work or other places.

6. To make available auto-evaluation methods. Through the existence of components such as games, challenges, and entertaining activities students should be able to evaluate the progress of their knowledge.

7. To allow, in case of failure, the repetition of the studying process as well as the practise, and yet to

![Fig. 1 – Example of multimedia animation](image1.png)

![Fig. 2 – Example of multimedia animation](image2.png)
make sure the students are not forced to repeat the exact same content which tends to be saturating, not motivating and therefore, leads to drop outs. This objective can be met through the existence of a big variety of exercises and tests and the stimulation of a game and personal challenge philosophy.

8. To create a reward system based on personal efforts which stimulate the use of the given solution, rewards which will be clearly understood and valorised by the students, for example, through the final evaluation.

9. To study and evaluate the ramifications that the implementation of this type of solution can have on the traditional roles attributed to the teacher and to the respective students, the relationship between the two, and the responsibilities of both.

10. To define measures which permit us to insure the existence of an adequate component of support from the teachers. The global success of the solution depends not so much on the value of the technological solution, but rather on the existence of a human structure which insures adequate teaching support.

11. To create mechanisms that allow the teachers to control the students studying process where they found difficulties, time spent studying and the results of the evaluations.

V. TEACHER AND STUDENT ROLES

Applying this type of teaching method leads to a substantial alteration in the roles traditionally attributed to the teacher and to the respective students, as the learning process is no longer centered on the teacher, but on each student as an individual.

Instead of playing the role of distributor of knowledge and information commonly attributed to the teacher in a traditional classroom setting, the role of the teacher will now be primarily concentrated on:

1. The coordination, facilitation, dynamization and motivation of each student

2. Explaining and clarifying the information as it is presented, answering students’ questions, individually or small groups, whether in person or by electronic means, such as e-mail, chat, newsgroups, video conferencing, and so forth.

3. Evaluating and accompanying the learning process of each individual student, using tools specifically created for this purpose, with the goal of being able to anticipate potential problems and difficulties, as well as being able to evaluate the progress made by each individual student, allowing the corrective measures most appropriate to the student’s individual needs to be taken, if necessary.

A consequence of this role alteration is an increase in the availability and dedication demanded of the teacher, due to the diverse situations the teacher will now face in this new individualized teaching-learning process.

As for the students, the use of this type of tools will lead the students away from their traditional role as mere spectators and, many times, as passive receptors of
and towards a more active, more individualized role in the
search for information and knowledge, investigation, and
their own desire to know more, demanding from them a
greater responsibility, discipline and organization. This
will, obviously, lead to a more attractive, appealing,
stimulating, motivating and innovative study method.

What has been described above will mean that new roles
will have to be defined for both the teacher and students
alike, and that a new relationship and interaction model
will have to be developed between the two.

VI. PROJECT ORGANIZATION

The implementation of this type of solution calls for the
establishment of a multidisciplinary work group, consisting
of various teams, each one with its own competencies and
responsibilities, as illustrated in the figure below.

The Steering Committee is responsible firstly for
defining the goals, the strategies and tools that will be used
to reach these goals with the support of the other teams,
and secondly, for planning the continuation of the project.

The Pedagogic Team should be comprised of teachers
with experience in presenting and teaching the subject in
cause, and will have as their primary responsibility the
definition of pedagogical goals and the development of
course content, more specifically, the creating of texts and
the identification of concepts and ideas to be animated or
illustrated.

In their turn, the Multimedia Content Design Team will
be responsible for the idealization, conception and design
of the multimedia content, such as images and animation,
as well as for the layout and usability of the solution. This
team should be comprised of designers, but with training
and experience in the pedagogical area.

The Multimedia Content Building Team is responsible
for the construction of the multimedia contents
conceptualized by the Multimedia Content Design Team.

At last, the Platform Configuration Team will be
responsible for the technical aspects of the project, such as
the platform installation and content loading.

The work of all involved teams will not end with the
conclusion of the initial phase of the project, that is, the
implementation of the first version of the solution. Once
this phase has ended, it will become necessary to proceed,
initially, to the task of revision and improvement before the
solution can be made available. This will be followed by a
continuous revision and improvement, this time based on
the evaluation and results obtained in the initial phase of
the trial and global utilization of the solution.

In order to assure the success of the implementation of
this type of solution, certain critical factors pertaining to
team makeup and inter-team relationships must be taken
into consideration, such as:

1. The Coordination Team’s capability to assure a strong
   communication and coordination between the other
teams

2. The makeup, competence, knowledge, importance and
distinctiveness of the Design and Multimedia Content
   Team given the great value and importance that
practicality, design and image have on the ultimate success of the solution and on the attainment of the intended result.

VII. WORK DONE

This project involved the realization of a variety of activities. First, it involved defining the objectives, the strategies, the critical factors for its success and the conception of the solution.

Secondly, the tasks that were realized concentrated on the selection of the technological tools that would enhance the concretization of the defined objects, as well as on the definition of the courses contents, accordingly with the orientation lines and the critical factors identified for its success.

Finally, the multimedia contents and the courses were realized through the implementation of the following technological tools: “Web Course builder” and “Server Side Testing” of ReadyGo enterprise. In order to develop the multimedia contents, we used the product “Macromedia Flash Mx”.

VIII. FOLLOWING PHASES

Once the solution has been implemented, it will become necessary to pilot-test the solution, evaluate the results obtained in doing so, and introduce an upgrade to the solution.

As a strategy for this phase, a small group of students, chosen to represent the target body, will test the solution, with the aim of allowing for a better control over the use and evaluation of the solution, thus making it easier to detect possible problems, measure student adhesion and results attained at the level of their scholastic performance.

Equally important will be the trial of the new teacher-student relationship and interaction model.

Once this step has been concluded, and the necessary adjustments and corrections have been made, the solution will then be made available to the general student body. During this step, results should be evaluated and improvements made in a cyclical manner, with a view to the continuous increase in effectiveness and efficiency.

IX. CONCLUSIONS

The use of this teaching method assisted by computers, if correctly conceptualized and built, constitutes an efficient tool complementary to the traditional teaching methods in areas such as Mathematics, Electronics and Electrics.

However, for the solution to succeed this approach needs to be innovative first in the elaboration of its content and then, in its approach.

Using a simple language when addressing the students and demonstrating the concepts through practical examples such as animations and multimedia tools constitutes one of the critical factors for this kind of solution.

This is the only way for the solution to be valuable when compared to more traditional methods and tools. This is the only way also for the solution to be efficient, to motivate and interest the students in the courses mentioned before, and therefore, only way by which their learning process will improve.

On the other hand, once these new teaching processes and organizational methods have been implemented, it will also
be necessary to rethink the role attributed to teachers and teaching staff, as well as the relationship between teacher and student.

X. REFERENCES


