EDBI – An E-Learning Based Project to Improve Engineering Teaching

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Abstract. Elevated rates of failure in Engineering courses at the university level, in addition to the difficulty in attracting new students to courses in this area have made it necessary to implement new and innovative measures to invert this trend. 'EDBI' (Ensino à Distância Baseado na Internet) is a project conceived with the purpose of increasing school success and capturing the interest of the students through the implementation of a computer-assisted teaching solution which acts as a pedagogic tool and is used to complement the other traditional teaching methods commonly used when teaching mathematics, electrical and electronics. Aside from the context and goals that were the motive for this project, the strategies and lines of orientation followed in the implementing of the solution, as well as its phases, steps and organization in the current phase of its development will also be described. 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, and in the responsibilities of each. Finally, it will present the principle conclusions obtained up until now.

1 Introduction

Studies on scholastic performance in Engineering courses have shown an increased rate of failure and a significant number of students who do not manage to complete their courses, as well as a difficulty in attracting new students to these courses.

As it has become made apparent that the high qualification of Human Resources, both academically and professionally speaking, in the areas of science and technology is one of the chief factors in favor of sustainable economic growth, social development, and the well-being of society as a whole, the above-mentioned conclusions lead us to believe that were are facing a grave situation which calls for a rapid alteration.

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This alteration will have to come through the adoption of truly innovative measures at various levels, namely, at a pedagogic, scientific, social and communicative level, which in turn helps to increase the attraction, appetency and motivation of the students to pursue their studies in a scientific or technological field.

In these actions we can place the implementation of computer-assisted teaching solutions, namely, those based on Technologies related to the Internet, as the goals of this project.

2 Project Goals

The main goal of this project is concerned with pedagogic issues, more specifically, with how to combat the elevated rate of scholastic insuccess that has been identified in some of the core components of Engineering, Electronics, Electrical and Mathematics courses.

In order to reach this goal, it was first necessary to define and then carry out a strategy starting with the construction of an internet-based distance-learning solution, which would allow for an increase in the students' interest in the material and in the motivation to study it, thus enhancing their scholastic performance.

Another goal of this project was the use of innovative concepts and practices in its conception and construction, whether it be in the pedagogic approach or in the options chosen, to avoid being guided by conservative, minimalist strategies of a mere transition from the traditional content, habits and methods to an electronic support – a commonly – made mistake that has resulted in the failure of other initiatives of this type.

On the other hand, the implementation of a knowledge transmission model which would act as a substitute for the traditional, classroom - based model was not an aim of this project. The aim was to develop an alternative learning option complementary to the traditional classes and which would come to be included in the methods of teaching and evaluation of the subjects in cause.

3 Project Phases

The implementation of this type of solution is carried out in several phases, comprised of several steps, as illustrated in the figure below.

Fig. 1. Project Phases.

The Design phase covers the planning of the project and the conceptual defining of the strategic orientation patterns to be followed throughout the project, the selection

of the platform, tools and technologic infrastructure to be used in building the solution, and, lastly, the readiness and availability of the physical, technological and human components of the infrastructure necessary to carry out this project.

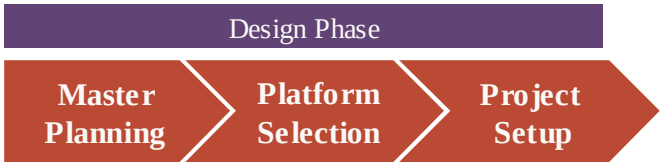

Fig. 2. Design Phase.

Once this phase has been concluded, the project will then enter its Building Phase, which consists of three steps, as shown in the figure below.

Fig. 3. Build Phase.

In this phase of the project, it will be decided which themes and material to present, and all relevant content (textual, animated, etc.) will be developed. The contents must then be loaded onto the technological platform, in accordance with the predefined design, and the solution will be made available to a select group of students in the form of a pilot-test.

Finally, the solution will enter its exploration phase and will be available to the student body as a whole. Once this phase has begun, a continuous evaluation will be carried out through the analysis of the results obtained from the pilot-test and from the students' performance, in such a way as to define and put into practice measures of improvement, with the purpose of continually increasing the solution's efficiency, as well the student's compliance to the solution and scholastic performance.

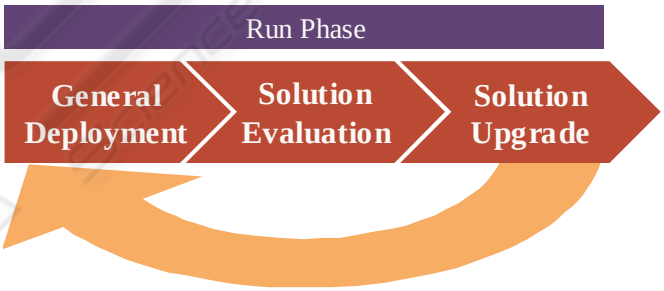

Fig. 4. Build Phase.

4 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.

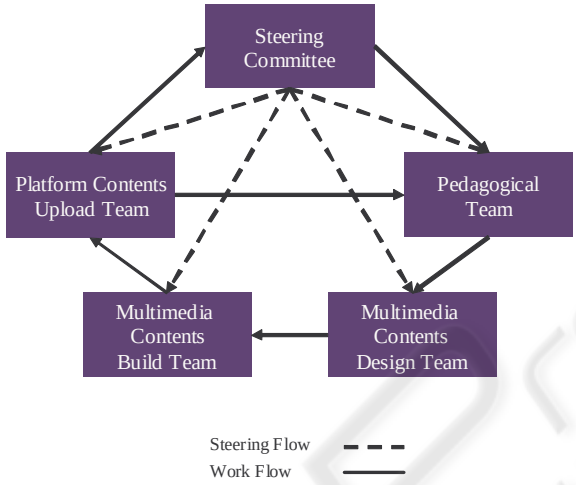

Fig. 5. Project Team.

In the first phase of the project, the Steering Committee was responsible for defining the project goal, the strategies that would be followed, the tools that would be used and the composition and organization of the remaining teams, and, in the following phases, the planning, control and continuation of the project, as well overseeing the progress of the remaining teams in such a way that would guarantee the quality of the final solution, as well as its ability to meet the purpose for which it was intended.

The Pedagogical Team's function is to first define the project's pedagogical goals, course content, more specifically, working up course texts and the choosing themes to be animated or illustrated through multimedia content, and, secondly, for the verification of the solution in both pedagogical and scientific terms. This team should consist of qualified teachers with experience relevant to the material.

The idealization, conception and design of the multimedia content (i.e. illustration, animation, etc.) decided on by the Pedagogical Team, as well as the definition of the layout and practicality of the solution are the responsibilities of the Multimedia Contents Design Team. This team should consist of designers and other creative professionals, but with some training in and familiarity with the pedagogical field.

Once the conception and design of the multimedia content has been concluded, it will then become necessary to begin its assembly, a task which will be carried out by The Multimedia Contents Build Team. This team should be made up of qualified technicians experienced in the use of multimedia content building tools for the internet.

The Platform Contents Upload Team will be in charge of the technical work, namely, the platform's technical installation and upkeep, as well as uploading the content in accordance with the design and practical guidelines defined by the Content Design Team.

The work of all involved teams will not end with the conclusion of the project's initial phase, 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.

5 Work Done

At present, the project's first phase has been concluded, and the principle conclusions and results obtained in this phase will be referred to extensively in the following chapter of this paper, chapter 6. The first two steps of the second phase are currently under way.

Fig. 6. Project Status.

These steps have been carried out in an iterative manner, that is, various modules have been defined for each subject, in correspondence with the chapters of material that will be presented and which have been developed in each repetition.

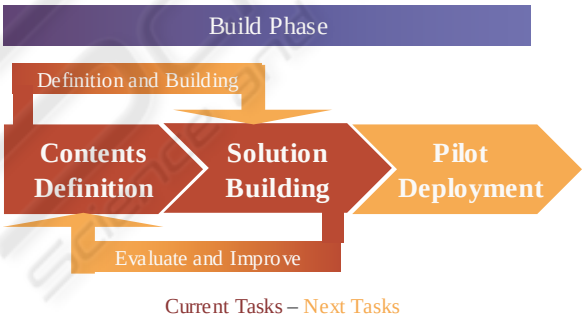

Fig. 7. Build Phase Status.

This iterative approach allows for all work done throughout the cycle to be evaluated, revised at the end of the cycle, and for corrections and improvements to be made right away. Additionally, it allows for the lessons learned in past iterations to be incorporated in the following modules right from the beginning.

Once these steps have been brought to conclusion, a version of the solution will then be made available in the form of a pilot test, with the purpose of measuring the students' compliance with the method, detecting possible problems, identifying any improvements that need to be made, and evaluating the comparative results obtained in respect to the students' scholastic success.

For this purpose, a small group of students will be 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 meet the goals defined for this step of the project.

When this phase has been concluded, the project will then advance to its third phase and the solution will be made available to the student body in its entirety.

6 Solution Implementation Strategy

One of the most important tasks to be carried out in the first phase of this project was the definition of the strategic guidelines to be followed in the conception and implementation of the solution. Below are presented the principle conclusions and critical success factors identified for the solution in the project's first phase.

1. To present the materials using a language which is simple, clear, direct, adequate and attractive to the target for which the courses are intended.
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 action and the manner in which the theoretical concepts can be applied.
4. Not to forget, however, the components which are strictly theoretical in nature, 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 create and make available auto-evaluation methods, in the form of evaluative exercises and tests which allow the student to evaluate his own progress. Through the existence of components such as games, challenges, and entertaining activities students should be able to evaluate the progress.

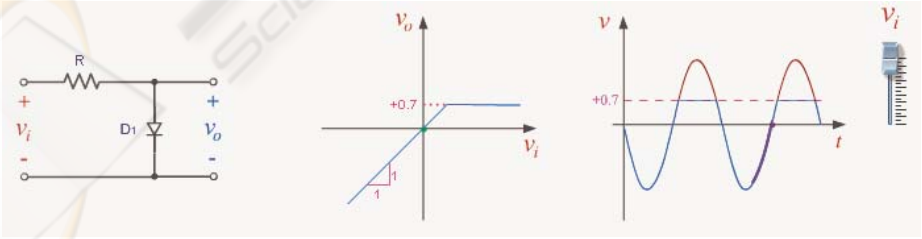

Fig. 7. Example of multimedia animation.

6. To create a study path with a sequential, modular structure. That is, once a student has concluded a particular module, he will first have to do an evaluation test before being allowed to advance to the following module.
7. To allow, in case of failure, the repetition of the studying process as well as the practise, and yet to 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 examine the use of games and other forms of entertainment, so as to stimulate and motivate the student throughout the use of the solution.

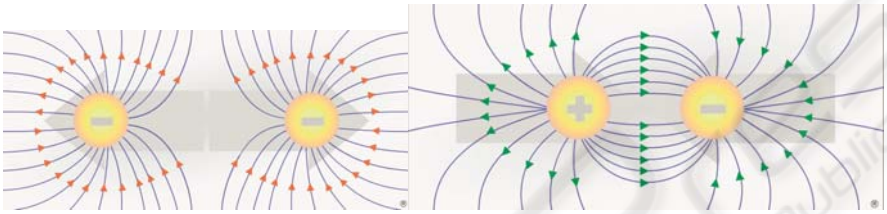

Fig. 8. Example of multimedia animation.

9. 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.
10. To incorporate the results obtained by the students so as to create a rewards 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.
11. To analyze 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.

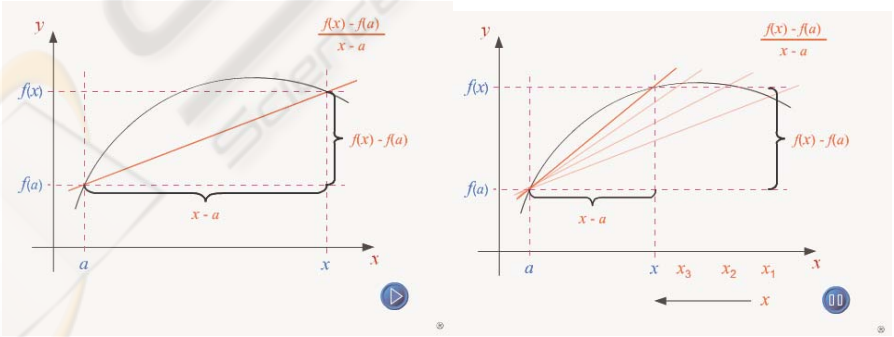

Fig. 9. Example of multimedia animation.

12. To use the information obtained through this analysis to define measures which allow for us to guarantee 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.
13. To devise mechanisms that allow the teachers to control the students' studying process, more specifically, to become familiar with the students who are studying according to this method, when and what they study, where they met their biggest difficulties, time spent studying and the results of the evaluations.

7 Conclusions

From the work that has been done so far, one can conclude that computer-assisted teaching solutions can be an effective tool used to complement traditional teaching methods. However, some care must be taken when building a solution such as this.

It is essential that the solution, when implemented, appeals to, motivates and captures the students' interest. For this reason, it is vital that the language used be straight-forward and appropriate for its target audience, and that visual examples, such as images and multimedia animation be used whenever possible to illustrate the theoretic concepts presented in the material. Equally important is an entertainment component, as well as a rewards system that is continuous in nature and is accepted by the students as being fair and just, and which they feel adequately compensates them for their achievements.

Another important point to consider has to do with the alterations bound to occur in the relationship between the teaching staff and the student body. The use of this type of solution leads to a more individualized type of teaching and in order for it to be effective, it will be necessary to re-define the role of the teacher in a methodical and organizational matter. This re-definition will place more demand on the teacher, in terms of time and dedication.

Finally, to touch on the project execution, some aspects have shown themselves to be critical to the project's success to the formulation of the initially-defined goals, namely the tremendous amount of skill and effort that the Steering Committee will have to put in to the project to guarantee an effective communication and coordination among the other teams, as well as the great importance that the design of the multimedia images and animations, as well as the practicality of the solution, in terms of the quality of the final product.

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