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# Towards the consolidation of the results of an educational project

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ABSTRACT: A project has been recently developed at São Paulo State University (UNESP), Guaratinguetá, Brazil, which aimed at developing new teaching methodologies that are related to the use of new technologies from the Informatics field, including multimedia resources. With the development of the project, it was expected that not only would public technical education be improved, but also the qualification of teachers with respect to the use of these new technologies. In order to accomplish an applied research, the project involved a partnership between an engineering school and two high-level technical public schools in Brazil. The proposal of the project consisted of two major phases, namely: the implantation phase (from June 1998 to June 2000) and the consolidation phase (from July 2000 to September 2002). A brief discussion of the project is presented in the article. Then, the methodology adopted for the consolidating phase is discussed. The authors expect that the project methodology can be applied to other research that is related to engineering and technical education.

## INTRODUCTION

Nowadays, the generalised presence of new technologies has played a significant role in both the domain of competences and the development of abilities. In this technological world, the human being is being increasingly immersed in a transforming society that is governed by communication and information networks [1].

Since a traditional school does not normally incorporate technological advances, these innovations require the improvement of the school so that it is able to form professionals of the calibre expected in the modern world market. The role of the school in this scenario can be significant if the educational politics that value the school are developed, transforming it into a place for the formation of new professionals.

With a view to contribute towards the improvement of the technical teaching, the authors worked at Engineering College of São Paulo State University (UNESP), Guaratinguetá, Brazil, on a project that aims to support new teaching methodologies, consistent with the objectives of the Brazilian Law of Guidelines and Basis for Education (LDB). The project involved a partnership with two high-level technical public schools in the state of São Paulo and was supported by the São Paulo Scientific Foundation (FAPESP) under grant number 97/10855-9.

The development of the project comprised two main phases: the implantation phase (from June 1998 to June 2000) and the consolidation phase (from July 2000 to September 2002).

In this article, the authors seek to give a general view of the conception and development of the project as a whole, and to present some of the elements emphasised in the development of its second phase.

## OVERVIEW OF THE PROJECT DEVELOPMENT

The project aimed at investigating how the new technologies, especially those from the field of informatics (multimedia), could contribute to the improvement of secondary-level (technical) education in Brazilian schools. Another expected result was the qualification of teachers so that they would become familiar with the new technologies. Specific aspects of the project development are discussed elsewhere [2-6].

The general objectives proposed to the development of the project are as follows:

- To characterise an appropriate way of introducing new pedagogical methodologies that are related to the use of new technologies, including multimedia resources.
- To reformulate the techniques applied in classrooms and laboratories.
- To qualify teachers in the use of existing technologies, taking advantage of the apparatus in a diversified and creative way.
- To evaluate the impact of new methodologies, tools and teacher qualifications on the improvement of the quality of technical education.

Three teams worked on the project, namely, the research team, the team of partner schools and the support team. The research team, comprised of teachers from engineering courses held at UNESP, was responsible for the general coordination of the project, participating in all the stages of its development.

On average, 16 teachers in the team of the partner schools worked in the project as scholarship-holders from FAPESP. Subject matters that the partner schools considered in the project included basic electronics, basic electricity, digital systems, CAD and design.

In order to introduce new teaching techniques and methodologies for these subjects, the teachers worked on the development of didactic prototypes [4]. The term *prototype* should be understood as a preliminary model constituted of a set of computational tools and didactic practices that, in conjunction with the educator, could contribute to the improvement of the quality of education.

The support team, formed by computer science technicians and students holding scholarships, assisted in the production of the didactic material. They also gave support in the training and application of that material.

With regard to research methodology, the management method of Plan, Do, Check and Action (PDCA) was adopted in the project for the solution of various problems [7]. A process of continuous improvement has been proposed for the development of the didactic prototypes.

The initial steps of the development of the project comprised a diagnosis of the situation at the partner schools, the detailing of the project, and the planning and application of the training (qualification) activities for all of the project teams. The next objective was the development of the didactic prototypes using appropriate software and their application. An evaluation process accompanied the application of the prototypes, which aimed at permanent feedback in the project.

One of the most important results of the first phase of the project was the implantation, in the University campus, of the Laboratory of Educational Technology (LET) [8]. This includes several classrooms, all of which have appropriate computational resources and wherein activities of the project took place.

## THE SECOND PHASE OF THE PROJECT

In the second phase, the main focus was on consolidating the results obtained in the first phase. Figure 1 gives a general idea of the activities envisaged in this phase. The methodology of the implementation of these activities is described below.

### Improvement of the Prototypes and New Prototypes

Since the first phase of the project, the prototypes were developed in teams [4]. In the second phase of the project, there were five teams working on prototypes for the following subjects: electro-electronics, digital systems, CAD/design, programming languages, and automation and instrumentation.

The proposal was to give continuity to the development of the prototypes, coherent with the continuous improvement approach, and to develop new prototypes for new subject areas considered in the second phase of the project (in the field of automation).

The basis for such improvements was a reflection on what had been achieved previously, aiming at identifying possible improvements and taking into account new knowledge, evaluation results, etc. The proposal for developing the prototypes was supposed to be linked to the new methodologies and teaching techniques under investigation.

### Application and Evaluation of the Prototypes

The prototypes were applied to teams of students in subject areas considered in the project. For the purpose of evaluating such applications, specific evaluation instruments were used. Questionnaires were used to assess the quality of the teaching, the applied methodology, the application of the developed prototypes, and the use of multimedia resources. Key references helped in structuring the questionnaires [9][10].

In the follow-up, some aspects considered in the questions of the evaluation instruments covered the following areas:

- Knowledge demonstrated by the teacher in the development of the contents;
- Attention given to the rhythm of the students' learning and to the domain of the knowledge;
- Didactic and relational competences demonstrated by the teacher;

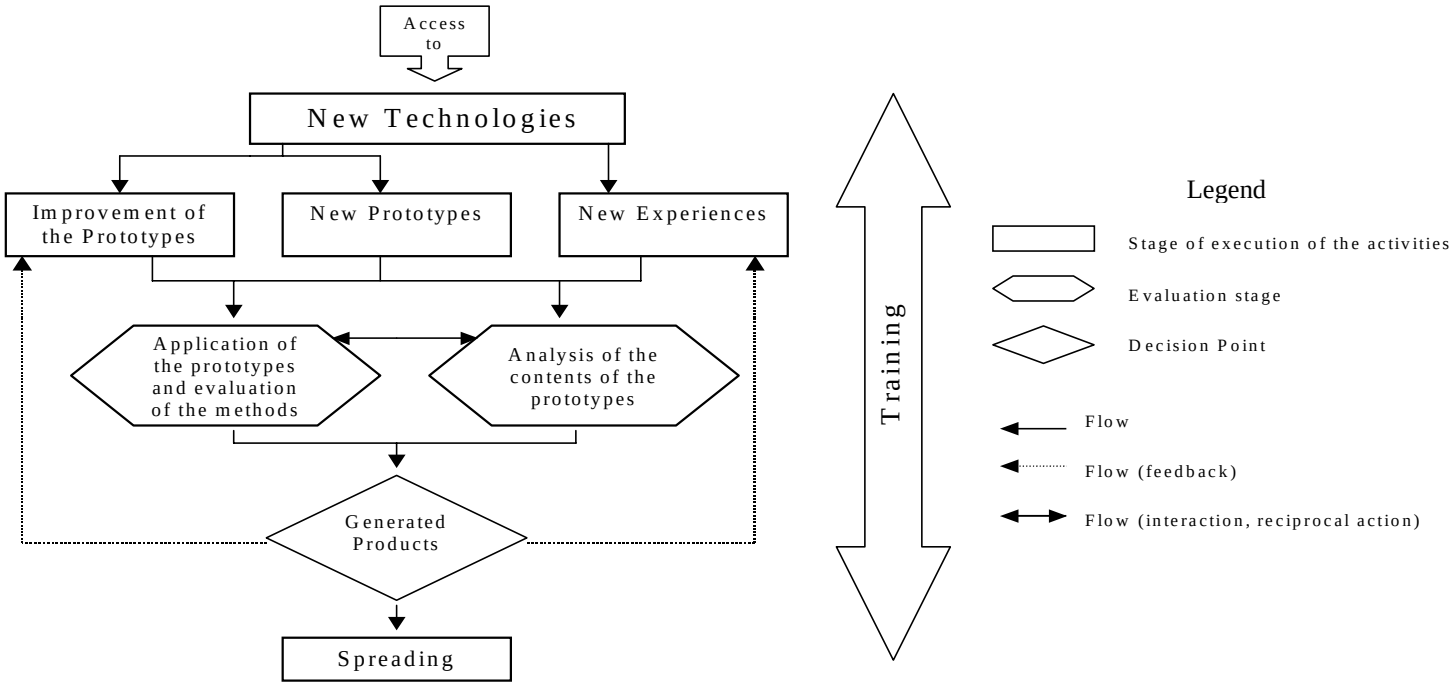


Figure 1: Flow diagram of the activities in Phase 2.

- Teaching materials (prototype and didactic resources) developed and employed in the subject matter classes;
- Global satisfaction and motivation for the classes, applied methodology and resources utilised;
- Conditions of the classroom, laboratories and the projection room.

Several tools were used to tabulate, analyse and interpret the results. One of the most used one was the computational system SPA, designed for dealing with closed-type questions. More details on the use of the tools, as well as on the evaluation activities in the project, can be found elsewhere [5].

Analysis of the Prototypes

During the first two years of its development, the main feedback information to the project came from students through the evaluation questionnaires. In the second phase of the project, the analysis of the prototypes occurred under two approaches. The first one referred to:

- Analysis of the data obtained from students through the diagnostic questionnaires on the use of the prototypes.
- Analysis accomplished by the scholarship-holding teachers through the presentation of the developed prototypes to all the members of the projects teams; this was followed by discussions and other activities.

The second approach referred to the external evaluation of the prototypes. External collaborators analysed the prototypes and contributed criticisms and suggestions. The external evaluation contributed to the development of proposals of extensions and improvements for the prototypes. It also provided information that was relevant to validate the methodology adopted in the project development.

Training: Qualification of the Teachers

In order to promote reflection on the elements of the process of improvement of the quality of technical teaching, the research team worked on the organisation of a cycle of debates from the third year of the project. Each debate in a cycle was organised as a discussion table. This activity gathered well-known professionals of the national (Brazilian) scenario with distinct ideological tendencies. This served to promote reflection on technical teaching and its role in the globalised world. Table 1 presents the themes of the discussion tables held during the second phase of the project.

Table 1: Themes of the discussion tables.

| Period | Theme |
|---|---|
| November 2000 | Technical Teaching in the new LDB: *Perspectives and Tendencies* |
| December 2001 | The Professional in the Enterprise view: *Conditionings of the Education* |
| February 2002 | New Technologies: *Tools for Technical Teaching* |
| March 2002 | New Technologies: *Methodology for the Development of Abilities* |
| April 2002 | New Technologies: *Repercussions in Education* |

The themes developed in the cycle of debates followed a sequence established from a wide discussion that inserted the professionalisation of teaching within the context of the new Brazilian Law of Guidelines for the Brazilian Education. In organising the deabte cycle, it was sought to relate formal education with industry requirements to identify professional competences. In this way, the proposed themes for the event approached, in a general way, aspects that are related to the role of a technical school in the formation of specialists, delineating the professional profile required by the work market and the meaning and psychological and social view of the word *competence*. After considering the notion of competence, it was attempted to correlate it with current educational politics and discuss how it affects the organisation of work at the school.

Besides the cycle of debates, several other training activities took place during the development of the project [3]. These were aimed at developing technical, pedagogical and relational formal capabilities [11]. It was observed that appropriate training promoted autonomy and was coherent with the objective of the preparation of reflexive and critical teachers who were committed with their own professional development. In this way, teachers were prepared so that they could involve themselves in the implementation of projects in which they would be both actors and authors in engineering a transformation of pedagogical practice.

Experiments: New Technological Resources

The developments of this activity were aimed at giving scholarship-holding teachers the opportunity to become familiarised with the new technological resources made available in the environment of the laboratory (LET), and in making investigations related to the spreading of didactic material on the Web.

More specifically, experiments were conducted using educational kits, including instrumentation equipments and a very simple videoconferencing system. Experiments were conducted that targeted making available parts of the prototypes through the Intranet of the University campus.

Spreading of the Results of the Project: the Extension Course

With the specific purpose of transferring the project experience, an Extension Course was organised and offered initially to the teachers from the partner schools who where not directly engaged in the project. The course was structured into three modules, which were offered independently, to answer the demands of a heterogeneous clientele.

The purpose of each module was as follows:

- Module 1: Creation of Didactic-Pedagogical Material. This module identified aspects related to planning, didactics, communication and expression; access to the Internet was also discussed.
- Module 2: Introduction to Informatics. This module presented concepts of how to access and work with computers.
- Module 3: Computational Resources. This module advanced notions of software for presentation, authoring and graphical applications. Participants could develop small educational prototypes in this module.

It could be said that the experience brought benefits to all teams involved in the project. In particular, the scholarship-holding teachers involved in the course gained a deeper knowledge of the applicability of their prototypes, as well as of those of the other teams involved.

## GENERAL REMARKS

New methodologies and teaching techniques were investigated in the project with a view to introducing the use of new technologies to support teaching-learning activities. The project involved a partnership between an engineering school and two high-level technical schools. It is well known that new technologies, especially those related to informatics, are not normally developed primarily for education purposes. It is up to educators to take it upon themselves to apply and evaluate such technologies in their knowledge areas.

During the development of the project, it was observed that the adoption of new teaching techniques, such as the use of projections and prototypes, initially causes students to become enthusiastic. However, as students become used to the new scenario, other factors gain importance. As students themselves suggested in their answers to the evaluation questionnaires, new resources should be used in a more diversified way so that they do not become monotonous. It is interesting to note that, from an analysis of the evaluation data, it was possible to conclude that for some teams of students, factors, such as teacher-student relationships, motivation and clarity of explanations, contributed more to the learning experience than the didactic resources (based on the new technologies) adopted by teachers.

Since the beginning of the project, the scholarship-holding teachers have been encouraged to take part in the development of their own didactic prototypes in order to introduce new technologies in the teaching-learning process. For this purpose, in the first phase of the project, very simple computational tools were chosen so that teachers, with a limited amount of training, would be able to use them in the development and application of computerised didactic material. This strategy fostered greater commitment in teachers with regard to the objectives of the project, thereby contributing to its success. Also, it is probably one of the reasons why, even though the official period of the project is over, most of the teachers continue to develop activities in the LET related to the objectives of the project. In this way, it can be said that the actions towards the consolidation of the results of the project, to some extent, have resulted in success.

During the development of the project, a cooperation agreement was established between UNESP and the National Institute of Multimedia Education (NIME), Chiba, Japan, which aimed at developing investigations into the themes of visualisation techniques for engineering courses, the development of tools to help Brazilian people living in Japan, and methodologies for teacher training. The responsibility for the cooperation agreement, on the part of UNESP, was one of the faculties of the LET research team. In developing the themes cited, the possibility of taking advantage of the background of the project is being considered.

According to Saviani, laws and proposals alone do not make the education system, but rather the active teacher in his/her pedagogical practice [12]. It is through professional practice that we, as technical educators, feel stimulated to think about questions that we constantly face in daily school routines, allowing us to search for a new space for technical education, reformulated to the new Brazilian reality. From the consideration of such aspects, this project was elaborated. The project's focus was to make possible the implantation of a technical education that can take care of the demands of technological development, along with the contribution of the University.

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