An Educational Project for the Technical Education: the Specific Case of FEG/UNESP

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Abstract: This paper focus on the Project of Improvement of the Quality of the Technical Education, which, among other objectives, aims at the improvement of the secondary (technical) public teaching and the continuous formation of the teachers, incorporating in the teaching-learning process the technological advances and the new requirements of the world of the work, prioritizing the quality in education.

As it has been proposed by teachers from Engineering Courses, whose academic experience was linked to both the teaching in the Higher School (tertiary education) and to the scientific research in their knowledge domains, the project has itself been presented as a challenge to this team which has as a common denominator the conviction that the University must participate more effectively in the secondary level education, especially in the continuous formation of the teachers of this cycle, as well as in the transference of technologies and methods.

The article analyses the results of the project, after two years of its development, taking into account aspects such as its impact on the University Unit (Campus), the signs of changes in the educational paradigms observed in the community of the partner schools, the obstacles to the implantation of the project in an University environment, the difficulties in understanding, on the part of the community, that the teaching-learning questions are also of the engineering field, and the experience in managing all the process.

Keywords: New Technologies in Education, Education Quality Improvement, Teaching-learning, Evaluation, Teaching techniques, Teaching Methodologies.

1. The University and the Project of Improvement of the Quality of the Technical Teaching

The project of Improvement of the Quality of Technical Teaching, supported by FAPESP (a Brazilian funding agency), was considered in a university community, College of Engineering of Guaratinguetá - FEG, of the São Paulo State University - UNESP, which presents as characteristics its bond with the area of accurate sciences and its technological nature. Therefore, a project that considers activities directed to secondary education was conceived and formulated by teachers from the engineering courses as an original experience, since, excluding the fact of these teachers to be brought up to date with the new technologies of their areas of knowledge and research, they had never been never engaged in didactic-pedagogical oriented projects. In the sequel we discuss two identified perceptions of the University that had matched the teachers, from different departments, in a common project.

1.1 The University and its Social Commitment

The role of the University nowadays is the first catalyst point of the work team. Agreeing with Kourganoff [1], we see that the cultural, economic and social developments of men are related to their formation. In this way, the essential function of the University is understood to be its formative nature. However, besides forming men, the University must promote the progress of the knowledge through the research. One cannot separate it from its social and technique-economic mission, as it is not a closed set separate from the world.

The feeling that guided the reflections and discussions of the team is supported by the thought that (according to Wolff [2] citing Goodman) the "ideal University is a community of studies and should be a community of people matched by collective agreements, by common and collective goals, by links of reciprocal obligation and by the flowing of the feeling that makes the preservation of the community an object of the desire, and not simply a subject of prudence or a command of duty". In this environment of certainty about the social role of the University and of rediscovery of the importance of education, the project was materialized, having been committed to: (a) *the quality*

related to the excellence and rigor in the investigations, (b) *the reality*, to transform the present and to construct the future, and (c) *the feeling*, to perceive alternative ways to exert the thought and to propose solutions.

1.2 Teaching-learning: also an engineering theme

The second catalyst point is related to the teaching methods. The teachers (coordinators) involved in the project possess a large teaching experience in the higher education, although almost all do not possess backing didactics-pedagogical formation. They recognize the necessity of instituting a politics of continuous formation for the teachers, not only of a technical nature, so that one can guarantee the quality of teaching. However, they agree that in a "pure pedagogy", *in abstracto*, one does not find an answer to the teaching-learning problems. It is necessary to consider it, but not simply as a theoretical and autonomous subject. It is admitted the relative character of the pedagogy, as it cannot be applied generically to any student or subject [1].

The coordinators, even without possessing a pedagogical formation, form a team that discusses the knowledge theories and the ideological, sociological and philosophical aspects that influence the teaching-learning process, taking into account their didactic practices, i. e., they construct a "theory" based on examples of their daily teaching activities. This practice at identifying the pedagogical problems disclosed, as innumerable authors mention, that generally the students learn better when there exists conditions to exercising their aptitudes (learning by doing), and when they participate actively in their proper formation. This conception gives the basis of the pedagogical theoretical model identified as interactionist or constructivist, where the relation citizen-object is seen as a process of mutual interaction [3,4,5].

As the teachers come from Engineering courses, it is imagined that engineering must be a dynamic process, inserted into a historical and collective process, being its members elements co-participants and actives in its construction. One imagines, also, that to guarantee the quality of education it is necessary a culture of continuous formation of the teachers, in all the levels and categories of teaching [6]. The ideals that made it possible the joint work of teachers from distinct areas of knowledge, can be summarized through the following purposes: (1) to identify and to present contents that generate reflections on the practice of teaching, technical and of engineering; (2) to develop discussions concerning the new approaches, methodologies and techniques, on these teaching activities; e (3) to develop and to stimulate new techniques and methodologies of teaching, that can motivate and originate creative solutions in the technical schools, and as a consequence, in the ones of engineering formation.

2. The Project of Improvement of the Quality of the Technical Education – FEG/UNESP

The Project of Improvement of the Quality of the Technical Education [7] aims, in summary, at (i) investigating new methodologies and techniques of teaching, using new technologies, in particular those ones referring to the domain of Computer science, specifically the features of Multimedia, as well as at (ii) evaluating the impact of the use of these tools in the improvement of the quality of the technical (professionalizing) education. In this context it was created the Laboratory of Technological Education ("LET – Laboratório do Ensino Tecnológico") for the development of the proposed activities.

There are two technical (secondary) schools participating in the project, to know, the Industrial Technician College of Guaratinguetá - UNESP ("CTIG – Colégio Técnico Industrial de Guaratinguetá"), and the State Technique School "Prof. Alfredo de Barros Santos" - CEETEPS ("ETE ABS – Escola Técnica Estadual Prof. Alfredo de Barros Santos"). Three are the work teams involved in the project, whose responsibilities, in short, are: (i) *the research team*: the general conduction of the project and the evaluation of the impact of the adoption of new technologies in the teaching-learning process; (ii) *the team of the partner schools*: constituted of teachers (scholarship holders) from the two mentioned schools, responsible for the development and application of the prototypes; and (iii) *the support team*: consisting of technicians in Computer science who assist the teachers of the partner schools in the development and application of the prototypes.

2.1 The Objectives of the Project

The research team considers that the design walks now for a phase of maturation and consolidation of the accumulated experience, pursuing the specified objectives:
- To characterize an appropriate way of introducing new pedagogical methodologies that lead to the operative and interactive knowledge, using technologies of multimedia and computer science.
- To reformulate the techniques applied in classroom and laboratories in the transmission of knowledge.
- To qualify the teachers in the use of the existing technologies: microcomputers, educational softwares, softwares of presentation, video, TV, projectors, camcorders, amongst others, and to take advantage of the equipment that is at their disposal in the laboratories, in a diversified and creative form.

- To evaluate the impact of the use of new methodologies, tools and the qualification of the teacher on the improvement of the quality of technical education, as demanded by the work market.

2.2 The Project Management

With respect to the management of the project, for both reaching the proposed objectives and resolving the problems, we have made an option by the PDCA management method. Here the four letters, P, D, C and A are the initial ones of the words plan, do, check and action. In terms of the methodology for conducting the research, we have adopted the hypothetical-deductive method, which includes three main stages: the appearance of the problem, the proposal of a solution to it, and the corroboration of the proposal. In the present day management paradigms, the institutions should develop themselves through the continuous improvement of their processes, making them compatible with the advances in knowledge, necessities and expectations of the internal and external clientele, their potential as well as the organizational boundaries, in a way to assure the accomplishment of their ends and guidelines.

To introduce new technologies in the teaching-learning process, the teachers of the partner schools have been encouraged to develop their didactic prototypes, using appropriate softwares. The computational tools had been chosen in a way that, with a small training, they could be used by the teacher to plan, to produce and to apply the computerized didactic material in the classes, since difficulties in the production and application of the didactic material could discourage them. The teachers involved in the project participate in all stages of the process, since the planning until the application of the produced material. Thus, there is a bigger commitment of the teachers with the proposal of the project. Which, how and when to use a specific tool and/or computerized didactic material, are questions that must be answered during the planning of the lessons.

The subjects boarded in the project and the scholarship holder teachers responsible for them had been grouped in three work groups, namely: Electro-Electronics, Digital Systems, and AutoCAD/Design. Beyond these teams, taking into account the necessities of the project, one has also constituted a support team for the aspects of New Technologies and Communication (Expression) and Didactic-Pedagogic concepts. These teams had been constituted using as the main criteria, for grouping the scholarship holder teachers, the similarities between the subjects involved in the project (subject teams) and the nature of the activities of the scholarship-holder teachers (support team). The following subjects have been considered in the project: Basic Electronic, Basic Electricity, Electro-Electronics, Digital Systems, Mechanical Design, Electrical Design and AutoCAD.

2.3 The results – the prototypes

The development of the prototypes began in October of 1998, having the purpose of constructing the first modules for application from the first semester of 1999. For the construction of the prototypes the scholarship holders have used the resources made available by the project, in terms of hardware and software, and even other resources to what they had access in other campus dependencies. We have emphasized the use of the Visual Class™as the authorship software for the structuring of the lessons, taking into account its simplicity and its wide use at the moment. However, much of the produced didactic material was organized using the PowerPoint™

The Visual Class™presents some advantages, including, for example, facilities for the composition of exercises, allowing the construction of a small data base of evaluation from tests applied to the students, and making it possible the activation of other programs from a lesson running in the software. The subject teams have constructed the prototypes: thus we have a prototype for Electro-electronics, another for Digital Systems and another for Auto-CAD. These had been recorded in COMPACT DISCS and have been used in the classes. They could not be taken, evidently, as final products, since, as the teachers themselves recognize, there is still much to be improved.

3. The impact

3.1 The changes in the paradigms

Evaluation – One has established that the evaluation of the project would be done from the teachers themselves, pupils and, depending on its evolution, the business companies, since questions related to both the change in the pedagogical practice and the expected impact on the work market would be boarded for the evaluation purpose. An evaluation strategy has been adopted making use of a computational tool, namely the system SPA [8], which includes the determination of values for the Index of Performance in the Factors ("IDF – Índice de Desempenho dos Fatores").

Continuous formation - The use of new technologies can contribute to the improvement of the quality of teaching, through the adoption of new methodologies and teaching techniques. In order that this process be successful, and can also contribute to the teacher in the construction of his or her teaching, it is necessary that specific training activities be organized, aiming at the development of abilities. The process as a whole strongly requires the

transformation of the teacher, so that the identified "faulty aspects" with regard to his or her didactic-pedagogical positions do not come to repeat in the new context (of new technologies), perhaps in a more intensive way.

Interaction between the planning of the lessons and new technologies – one has adopted the proposal that the moments for the introduction of new technologies to support the teaching activities should be defined in the planning of the lessons. The identification of the appropriate moments for the use of new techniques or methodologies of teaching can be carried out, for example, on the basis of the results achieved from evaluations. The scholarship-holder teacher is learning how to elaborate, to apply and to reorganize plans of lessons in a more systematic and organized way, having a better control of the teaching-learning process.

Management of the activities - the use of a method of management, PDCA, contributed to the control of the different factors involved in the development of the project. Moreover, it contributed effectively to the introduction, in the context of the partner schools, of the culture of continuous improvement of the educational processes.

3.2 The impact on the partner schools

Since the teaching-learning processes have been conceived in the project as fruit of an interactive work, in which pupils and teachers construct their knowledge, it is expected that the project provokes curricular reformulation, making it possible the introduction of substantial changes in the school and in the quality of its work. The activities of the project, such as lectures, training, meetings, etc., involve not only the scholarship-holder teachers, but also other teachers, the technician staff and other pupils from the schools.

One should stress that, nowadays, all the teachers, beyond the ones that take part in the project, dominate the basics of computer science, having been made available to them a computer, connected to a network, in which they can carry out their school activities. Another strategy adopted by the school CTIG is the use of regular evaluation of the processes, to obtain the intended improvements, what demanded regular management to establish procedures for continuous evaluation and spreading.

The substantial changes that occurred in the subjects enclosed in the project, which are essential to the professional formation provided by the courses, had started to guide the curricular reformulation of those courses, on the basis of the results reached in the teaching-learning process. An important by-product was that the enthusiasm of the students for this new form of boarding the learning started to affect other teachers. Gradually, in the case of the CTIG, the enthusiasm and motivation originated from the changes had served as the basis for the task of applying continuous improvement to other areas.

Equally, the people in charge of the other partner school – ETE ABS, aiming at reaching the proposed objectives, have engaged themselves in actions such as: the elaboration of special schedule for the scholarship-holder teachers and for the involved groups; the release of the teachers so that they could take care of specific didactic activities, such as the development of the prototypes, training, meetings, etc; the availability of technical and human resources; and the support for the use of the installations of the University.

3.3 Management of the Process

In carrying out the management of the project some factors have been emphasized and discussed by the research team. Three aspects subsidized the option of the members of this team to engage themselves in a process of improvement of the technical education. The first one was related to their conception about the social commitment of the University. The second was associated with the questions of education, improvement of the quality of teaching, and also the boarding of those questions as a scientific research. Finally, the third aspect considered was the academic formations and the specific research topics of the members of the research team, that has allowed them to work on the existing technologies, with a view to transferring the knowledge to the scholarship holder teachers.

Undoubtedly, one of the biggest difficulties in the management of the project was the formation of the teachers of the research team. Those teachers did not possess a pedagogical formation, and, on account of that, have had to search for greater understanding of this subject in specific literature, scientific meetings, lectures, etc., advisement with colleagues of the university or others. Currently, after two years working on this subject, the research team believes that its members already possess a formation that allows them to discuss the subject with specific professionals from the area of Education, having knowledge of what, when, and who with to get in contact for assistance in the decision making process. It should be stressed that, beyond aspects such as the qualification of the scholarship-holder teachers, the planning and evaluation of the activities, the most usual topic in the reflections, discussions and activities of the teams of the project was the didactic-pedagogical question.

Even though that a formal research has not been carried out to verify the degree of interaction between the project and the local community (from the higher education courses), the research team has observed that the reactions are basically of two types: first of all, there are the reactions that are favorable and even encouraging,

coming from teachers who recognize the importance of working on teaching-learning aspects, Learning Theories and similar topics, as they possess a more developed conception on these topics. The second reaction is about the teachers who prioritize the scientific research over the teaching activities. They usually do not consider the research of the project as being at the same level as the "conventional" scientific research, taking, to some extent, the research in education as a "by-product", which results from someone's didactic practices.

One should stress also that, after the implantation of the LET, a number of professionals from the University became surprised with the resources and equipment made available, mainly taking into account that the engineering students do not have a similar infra-structure. Effectively, the repercussions of the employment of the available resources and of the proposed methodologies will only be able to be verified later, when the current students either begin their higher education courses or go to the work market. On the other hand, we believe that, with the observable benefits experienced by the teachers and students, the positions and guidelines of the special-purpose commissions of the University will have to be reviewed to emphasize the quality of the higher education.

4. Final Comments

In short, the evaluation of the application of the new technologies, during the academic year of 1999, showed that, as consequence of the alteration in the teaching-learning relation, the following impacts had been observed, to a certain extension, on the partner schools:

- Reduction in the gap that nowadays separates the work market and the educational system, with respect to the technological innovations, trying to incorporate them in the pedagogical practice, in view of the new requirements of the world of the work.
- Implementation of the innovations in the curricular organization, propitiating the development, in the teaching-learning process, of the abilities and qualifications appropriate to the contents of the professional (technical) qualification, as demanded by the emergent work market.
- Qualification of the teachers in the use of the didactic prototypes (which they have constructed by their own), in the areas of basic technological education, objectifying an efficient technical-pedagogical ability.
- Improvement of the management of the school and of the educational systems, as also of the quality of the teaching-learning process, for the continuous improvement of the process of professional (technical) formation.
- Constant evaluation of the impact of the qualification of the teachers in new technologies on the improvement of the quality of the teaching-learning process, on the curricular organization and on the profile of the formed professional.
- Possibility of reaching a bigger number of pupils and educators, taking into account the number of people involved in the process and the difficulty in keeping several laboratories, socializing in this way the knowledge and the human resources.

In this project we intended to make a criticism about the introduction of new technological resources in the school simply as appropriate instruments. The project has had the proposal of using informatics inserted in a construcionist practice. The adopted methodology formed the basis of the process of production of knowledge by the involved schools, from a set of subject-related available information, the production being supported by activities, where the central axle has been the scientific investigation.

References

[1] W. Kourganoff , "A face oculta de Universidade", São Paulo: Editora da Universidade Estadual Paulista, 1990.
[2] R.P. Wolff, "O Ideal da Universidade", São Paulo: Editora da Universidade Estadual Paulista, 1993
[3] W. Bazzo, "A Ciência, Tecnologia e Sociedade", Florianópolis: Editora da UFSC, 1998.
[4] I.V. Linsingen; L.T. Pereira; W. A Bazzo, "Epistemologia e Ensino de Engenharia" *In*: Revista de Ensino de Engenharia, ABENGE Vol.18, No.1, 1999. ISSN 0101-5001
[5] L.T. V. Pereira; W. Bazzo, A "Ensino de Engenharia: na busca de seu aprimoramento", Florianópolis: Editora da UFSC, 1997.
[6] J.G. Souza, "Considerações sobre a formação didática-pedagógica do professor de engenharia", *In*: Revista de Ensino de Engenharia, ABENGE Vol.18, No.1, 1999. ISSN 0101-5001
[7] Projeto de Melhoria da Qualidade do Ensino Profissionalizante: Relatório de atividades. Guaratinguetá: UNESP, gsena@feg.unesp.br, 1999. (http://www.feg.unesp.br/let/index.html).
[8] G. J. de Sena, C. B. Gomide de Souza, S. H. Fiscarelli, R. M. Bittencourt, M. A. R. F. Gonçalves, J. I. Akamatsu, A. D. Velasco, A. de Sá Leite, On the Evaluation of the Teaching Activities: Description of an Experience. Paper submitted to ICECE' 2000.
[9] C. Buarque, "A Aventura da Universidade", São Paulo: Editora da Universidade Estadual Paulista, 1994.
[10] D. A Moreira, (org.) Didática no Ensino Superior: Técnicas e Tendências. São Paulo: Pioneira, 1997.
[11] M. L. M. C. Vasconcelos, "A Formação do Professor de 3° Grau", São Paulo: Pioneira, Biblioteca Pioneira de Ciências Sociais, 1996.
[12] P. Perrenoud, "Construir as Competências desde a Escola", Porto Alegre: Artes Médicas, 1999.