A Change in the graduate Curriculums in Engineering, a successful case in Brazil

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Abstract *– In 2002, the Brazilian Ministry of Educational homologated the new Curriculum Aims for the engineering courses, determining a deep and an ample change in all engineering graduate courses in the country. Since these recent circumstances, the College of Engineering (FENG) of the Catholic University of Rio Grande do Sul (PUCRS), Brazil, began the project of curricular restructure of all its graduate courses in engineering. This project is situated in a College of Engineering with 44 years of tradition, serving more than three thousand students in eight graduate courses, inside PUCRS, an University with more than 32 thousand students, occupying, in our days, the first position in research among the private universities in Brazil.*

The beginning of the work occurred in 1999, with the national discussion of the new Curriculum Aims, being concluded in 2003, with the implementation of the new graduate curriculums, serving the exigencies of the current moment of change, globally in touch with the educational movements that exist in the European Union – Bologna Declaration – and in North America – Accreditation and Nets.

The work shows the process developed during these four years, with an ample participation of teachers, students and national and international specialists in engineering learning, pedagogical methods and the managers of human resources. It is also reported the adopted proposal of a more general curriculum, with an integrated view and focus in the student. The decision of modifying all the curriculums at the same time, determinant option of the College of Engineering of PUCRS to warranty its identity, has the objective of conceiving and constructing a new scenery for the engineering teaching and learning, where the profile of the future engineer, even coming from several courses of the same University, should pass through unique and essential vertebral elements, independent of the main areas, without losing the inherent speciality of each course. Between the results achieved, can be mentioned, as fundamental, the reduction of the hours in class from 800 to 1000 hours in each course; the adjust of the fundamentals areas of Math, Physics, Chemistry to courses necessities; the valorization of the human sciences, ambient, economical and ethical; the proper number of vacancies offered in touch with the work market; the offering of professional disciplines since the beginning of the course; new modulations of disciplines (teacher/student); the introduction of new concepts: optional disciplines and complementary activities, decided only by the student; and other characteristics. The curriculums of the graduate courses of Civil Engineering, Electric, Mechanic, Chemistry and Control and Automation are being changed since 2003, and are being implanting two new courses during this same period, following these same aims, Computer Engineering, and Production Engineering. The real experience presented in this article was considered pioneer in the country for incorporating the new National Curriculum Aims, and unique for proposing changes in all of its courses at the same time, which permitted the College of Engineering of PUCRS to be invited to present this theme in several universities in the country as a successful case, through the year of 2003.

Index Terms *– Accreditation, Curriculum Guidelines, Curriculum Design, Graduate Engineering Courses, Engineering Teaching and Learning.*

Introduction

Education, in general, has passed by radical changes all over the world. These changes occur due to the definition of institutional, national and international policy which result of a new scientific, social, economical and policy reality through which passes the globalized world. However, the changes here characterized as radical much more for what has been occurring at the specific context of educational institutions and much in particular in what we could call "classroom" environment, where the role and actions of the professor and his/her pupils have been the object of questionings and deep reflections that are in the origin of many concepts and fundamentals of teaching/learning. The higher education, specifically the graduate education, starts to be indeed a reference of the educational system and, so, starts to require a special attention of the formulators of educational policy. Particularly, in Brazil, graduate education starts to be the center of the attentions and lacks of important changes now required by law resulting from the approval of the new Law of Directresses and Basis of

National Education, 1996, and its normatizations, including the Curricular Directresses just approved and constituted, in 2002.

Fortunately, Engineering teaching follows this process. Not only in the so called developed world, but very particularly in Brazil, for the first time in history, a union of factors that will really change the engineering teaching and, consequently, the professionals formed in the XXI century is occurring. The engineering curricula in Brazil were imported models and were reproduced at national institutions as copies adapted for each institutional reality. The instructors repeated in the function as a professor what they had learned when students and, in some cases, added to it their professional experience. On the other side, studious of education worked on the curricular theories without worrying about the daily practice. In the 90's, more intensively in the last years, these efforts were gathered and experiences of actions appeared, where education and engineering professionals work together to change the curricula and the engineering teaching with specific and concrete actions to qualify the engineering teacher in educational aspects as pedagogical approaches, techniques of teaching/learning, evaluation among others.

This article presents PUCRS experience, in its College of Engineering (FENG), which is the pioneer in this important and necessary change in engineering courses. Other institutions of Brazil have dedicated to these curricular changes, at an even more advanced stage, but always considering the individual courses. In FENG case, it is the first time that such a change is proposed uniting all engineering courses and with the consistence and thoroughness showed in this document. This was a result of a more than three year intense work which involved many institutional levels and got the massive adhesion of the FENG teachers who, through this long period, dedicated efforts to understand and prepare for so deep changes interacting with professionals of education and from other areas involved in the engineering teaching including the participation in lectures, seminars, workshops and qualification course in the pedagogical-didactic area [1].

The implantation of new engineering curricula in the FENG certainly represents an institutional mark that places PUCRS as a pioneer of the new frontiers of the national engineering teaching. On one hand we intend to reach a differential for this Institution facing the other engineering teaching institutions of the country and, on the other hand, even most important, this will represent a relevant contribution of PUCRS for the engineering teaching and for the formation of professionals qualified to face the challenges of XXI century. This is one of the aspects of which lacks the national development to be ahead in the competitive scenery of the globalized world.

In April 1999, the College of Engineering starts its process of curricular restructure, having been caressed for a long time, considering that its last review had occurred and had been implemented in 1989. It was this way the development of innumerous activities, which now culminate on this Proposal of Curricular Restructure, began at that time.

In this context and considering as a great challenge to the proposition of forming professionals properly prepared for their entrance in the actual and future market, willing permanently to think hard, we may still comment two dimensions focused here and, together with the deep programmatical modernization of the courses, deserve to be distinguished: one visible, the achieved goal of reducing the number of hours of the courses and adequate them to the speed of technological advance (Table 1); other invisible, the attitude change of the professor towards a pedagogical process now centered on the pupil, which is already happening through large pedagogical-political-didactic capacitation.

Engineering Courses (Year of the beginning)	Anterior Curriculums (Hours)	Proposal Curriculums (Hours)	Reduction (Hours)	% Of Reduction
Civil Engineering (1960)	4.530	3.750	- 780	- 17
Mechanical Engineering (1962)	4.650	3.540	- 1.110	- 24
Electrics Engineering (1962)	4020	3.600	- 420	- 11
Chemistry Engineering (1975)	4.485	3.690	- 795	- 18
Control and Automation Engineering (1994)	4.230	3.750	- 480	- 12
Compute Engineering (2002, new course)	- - -	3.390	- - -	- - -
Management Engineering (2003, new course)	- - -	3.580	- - -	- - -

TABLE 1
PROPOSAL OF CURRICULAR RESTRUCTURE OF GRADUATE ENGINEERING COURSES

So, this article consolidates the Proposal of Curricular Restructure of five Engineering Courses of FENG and the implantation of two new Courses. Based on the flexibility of this Restructure Proposal, we intend that the next cycles of curricular restructure do not occur this way, but that this process can be permanent from now on, making change be seen as a daily practice, and that the new paradigms are always placed to be overcome, for a better professional qualification and a more human formation.

General Information

The academic activities of the College of Engineering begin in 1960, constituting the second teaching institution of engineering to be founded in our State.

At the end of the 80's, PUCRS gave priority to some academic areas for the constitution of Excellence Centers. As a result of this policy, long term investments were done in various units of the institution, pointing out the policy of the teacher staff entitlement of the College of Engineering, in our country as well as in other ones.

In 1994, it is implanted the first Post-Graduating Program in Engineering, in the Electrical Engineering area, beginning the stricto sensu activities in mastership level. In 2001, it is implanted a second program of Post-Graduation, now in the area of Engineering and Technology of Materials. In both, the initiative adopted was the strategy of executing a perfect articulation among graduate courses, making it definitely possible for the research environment and all its benefits to achieve the students of these courses.

Through its 44 years of existence, the FENG promoted changes in the course offer and in the curricular modernization, searching permanently for the modernization of the teaching processes and an adequate vision of future. During this period, more than eleven thousand professionals of the various segments of engineering have graduated and have been contributing in an expressive way for the academic, technological and industrial development of the Country.

The last curricular alteration of the Engineering occurred in 1989, considering that since 1997 the FENG has been implementing improvement processes aiming for the modern implantation of curricular restructure.

Internal Scenery

As a manner of better founding the whole study and evaluation of the real situation of the FENG it was established as premise the necessity to rise a series of indicators, illustrated by the following example (Table2), that have become very important through the process. So, it was possible to conjecture highly positive aspects of institutional policy of capacitation adopted, according to the demands of an emergent Post-Graduate Program in Engineering.

Specialization Class	Number of each class	%	
Graduates	02	1,41	
Specialists	21	14,89	
M.Sc.	66	46,80	
Ph.D.	52	36,87	83,67
TOTAL	141	100	

TABLE 2
ENTITLEMENT OF THE TEACHING BODY OF FENG

So, The FENG based on its history and tradition and with many curricula implanted already previously, had got consciousness it was time to change, keeping its compromise towards society and thinking on the future, well-founded on an up-to-date base of data and according to an adequate planning. For such a thing, they reviewed the teaching methods, in a way to put, in the market, professionals with a technical and cultural baggage focused at the multifunctionality, being able to adapt themselves easily to a real revolution of ideas, concepts and values that have been punctuating the changes in the work world and in the quotidian of the companies. To achieve this objective, FENG believes that modernization could not be restricted only to the contents of the disciplines, but also to the capacitation and permanent improvement of its teaching body.

External Scenery

Taking as a reference the restructured courses that would be offered by FENG, it was searched in all the other institutions, with similar courses, data that could indicate the real context of vacancy offer and society demand. It was indicated, for each course in various Institutions: number of vacancies offered, demand for vacancy in the entrance examination and total number of hours of the respective course.

Project Presentation

Objective

In the preparation and implantation of the Curriculum Restructuring, the aim has been more than just constructing a new curriculum, a change of posture of FENG, of its teachers, managing board, as well as of its students. The present proposal constitutes a pedagogic restructuring in engineering, with the macro-objective of restructuring the curricula of the courses of the several modalities, with the following objectives:

- To capacitate engineers with skills to get integrated in the dynamics of a modern world, characterized by fast changes and progresses;
- To capacitate engineers with skills to act in the society and in the productive sector, starting from enterprising actions and contributing to the scientific and technological progress, as development agents;
- To constitute the inherent professional profiles to the several engineering modalities;

Justification

The contemporary society is experiencing moments of intense transformations due to the necessities to get compatible, to adapt or even to change values of a world order in transition, for new values of the so-called "Knowledge, Information and Automation Era."

Being the University the main institution to promote knowledge, facing a reality where information, the base of knowledge, is widespread in a variety of ways and available through broadcastings, information systems and nets, its forms of performance become questionable.

Nowadays the professional has to be prepared to face challenges, to be flexible, adaptable, creative, critical, capable to solve problems, to make decisions, to work in a team, to communicate well, but how to endow this professional of so many competences and skills? This is the imposed question.

The tonic of more philosophical than technical focus seems to permeate the debate over the engineering teaching in the transition to the coming century. Besides, there is the migration from production to services. A little over a decade ago, specialists of the Bureau of Labor Statistics, USA [2], already pointed to this economical transition, of the industrial activity to services. What is more outstanding is that, in the industrial sector, unemployment is more pronounced than in the production sector, that carries on, in spite of the reduction of the first one, due to the replacement of human work by automated processes and "robots."

Additionally, technology migrates [3]. American industrial companies aggressively seek and employ high quality engineering services of lower price, independently of domestic borders. It is essential, therefore, that any nation interested in counting on engineering professionals endowed with global category, develops and preserves national policies in this sense. This transition affects the engineers' job and, as a result, the capacitation and development of these professionals. The demands change in the preparation for new industrial activities and for the services, where also "new" technologies come in, connected, above all, to the computer science and its "marriage" to the communications.

New market conditions affect the engineer's capacitation. The alterations to promote are still object of important debate and they extend for a wide list. The several-sketched attempts still await definitive evaluation. But one aspect seems unquestionable: to assure the recruitment of young talents for the profession is fundamental for the transition. There is where the problem seems to be, if in highly developed countries, such as the United Kingdom, there are those who lament that it is not always possible to attract, for the engineering courses, "satisfactory share of the best and more talented", with much more reason it will happen in Brazil. Submitted to a unilateral "globalization", it is not surprising that the engineering courses are not so popular as they used to be when the Brazilian GDP grew up to 12% a year and the country was admired as the "world economical miracle." The high operational cost of the academic~~als~~ activities and the growing complexity of the scientific production force the university to ponder over the need of a new academic, political and administrative project to assure the viability of the private Institutions. Nowadays, the mission of proposing modern courses of engineering, of excellent capacitating level and, above all, attractive, in order to massively recruit the best talents, is added to the challenges already stated. Here lies one of the great purposes of rethinking the academic curricula. This is the context of the present time in which the education institutions massively are.

The examination of the curricula previous to those proposed reveals a conception of extreme rigidity resulting in courses with restrictive views of knowledge, specifying what the student should learn during the course, not even offering the possibility to enlarge the horizons and to acquire a critical view to allow the student to go beyond the specific aptitude of his or her professional field performance.

The curricula conceived from contents are formed with disciplines organized in grids where the levels stop the movements of verticality and horizontality. In consequence, they exhibit, almost always, excessive workloads and no rarely the fragmentation and the overlap of contents, whose interconnection is achieved through a rigid sequence of requirements. However, the articulation among the several programs is fragile due to the vulnerability that constitutes them, sustained by the extreme individualism of each teacher's view, which becomes the center of the teaching-learning process. Besides, there is a serious compromise in the university/job market relationship due to the fact that the capacitation practice is little articulated.

In this scenery, the discussions and reforms proposed for the adaptation and modernization of the courses of Engineering are many. As starting point, the difference in meaning of curriculum and curricular grid should be pointed. The curricular grid represents the group of disciplines of a course with their requirements, schedule, contents and workload. Curriculum is a much wider concept that can be enunciated as:

"The whole group of learning experiences that the student incorporates during the participative process of following, in an education institution, a program of studies coherently integrated."

The innovative curricular structures should confer an integrating and not fragmented view with emphasis in the ideas and in the creativity and not in the memorization. Therefore, such structures should be flexible, dynamic, of easy monitoring, giving options to the student, besides being characterized by: appropriate planning; teaching centered in the student and based in the results; multidisciplinary focus; motivation to work in a team; emphasis in solving problems; highlights to the consequences of the engineer's performance in the social and environmental aspect; to guide flexible professionals' capacitation and with capacity to answer quickly to changes; articulation with research and masters degree.

It was in that context, of deep concern with the future directions of the graduation teaching that the discussions that subsidized the reflection and the formulation of the proposal of Curricular Restructuring of FENG took place.

Organization and Planning of the Curriculum Restructuring Project

FENG, having as reference its Mission and Vision, opted to begin the process of curriculum restructuring starting from the establishment of a group of directing premises of the development of the same, by the creation of an adequate work methodology, of the strategies for the elaboration and formulation of the political-pedagogic project.

Mission of The University of Engineering

"To promote the teaching, research and extension directed to the engineers' capacitation and qualification, seeking the scientific and technological evolution to serve the demands of the society, according to the highest principles of the ethics and of the human relationships."

Vision of the University of Engineering

"To become a reference center in the national extent and of Mercosul, in five years, capacitating differentiated engineers, valuing thinking."

Market Research

It was accomplished with the following objectives:

- To identify the attributes that compose the engineer's profile, being previously taken into account the characteristics pointed by MEC;
- To identify the profile demanded by the job market for the professional engineers;
- To compare the results of the existenting professional engineer's profile versus the ideal profile demanded by the job market.

The research was developed in two stages: one of qualitative character and another of quantitative character. In the qualitative stage, the aim was to obtain information to aid in the confirmation of the characteristics concluded by MEC, regarding the professional engineer's profile.

In the quantitative stage, the objective previously mentioned was evaluated, through a structured questionnaire, obtaining the results through the analysis of the answers of a sample of engineers of each modality. The department teams compiled the answers and the results subsidized the construction of the professional profile of each modality of engineering of PUCRS.

The formation of the Professional Profile

The profiles from the professionals graduated in PUCRS/FENG does not form an input, but an output of the transformation process, from an strategic planning of the process that consider every involved variable of influence. The scenery that based all the curricula restructure involved:

- Curriculum guidelines for the engineering courses - MEC [5], ABENGE [4];
- Standard evaluation of FENG/PUCRS defined by MEC;
- Standard evaluation of FENG/PUCRS used by "clients" (potential students, professional market, academy);
- Actual needs and future inclinations of the professional market.

The analyses of the searches results evoked clear view of the variable needs, and allowed the development of FENG's strategic for building the desired professional profile.

The FENG's team worked on the development of each skill proposed by MEC in the area of general and specific knowledge from every engineering course, and stratification of the respective abilities and posture expected during the process of professional formation.

So far, from the results of the market search analyzed by the lights of national curriculum guidelines for engineering, the team along the other professors from FENG constitutes the primer profile of each department of the course that was consolidated in the end of this process. This work has been coming along within the partnership of the academic units involved in the formation of the engineers.

The formation of the Pedagogical Model

The references of the University complete the following aspects, which based the work to build the pedagogical model and it's basis:

- Prepare competent professionals, allowed to realize their jobs with sense of responsibility and solidarity;
- To promote the culture in the intellectual, artistic, physical, moral and spiritual areas, committed with the Christian values of the civilization as an instrument of the integral vocation of men.

The College of Engineering constituted a pedagogical project in agreement with actual inclinations, and provides ample internal discussions about guidelines questions of the teach-learning relations. This project drove a matureness in the needs of a paradigmatic change, allowing a sustainable growing to each segment of the College. In this way the pedagogical model of FENG has it's singularity, it has been validated to different courses. So ever, we have a general project witch the expected actions for it's development and for it's professional profile building are specific characteristics of the adopted postures in the specified department of the course.

What is in proposal is an approach based on the competence from both professional and citizen, with focus on the development of competences, skills and posture. Been an interactive element capable of build knowledge from a efficacious teach-learning relation progress with the professors, the student can now became a competent professional to work independent, with responsibility and creativity in the context in vigor, influencing on his own improvement to face the challenges of the changes.

Curricular Restructure Project of the School of Engineering

Professional Profile for the Egresses Students

We currently clearly observe alterations in the professional profile of engineers, because of changes in the opportunities of work, influence of new products, services and materials, and still incorporation of new technologies. Concepts such as inter or multidisciplinary, enterprising, total quality, and systematic planning are becoming more and more requested to the professionals in this area, always searching for a better understanding of the new paradigms of society.

Facing this fact, the National Commission of Curricular Guidelines in Engineering (ABENGE), stratified the attributes of this professional profile in COMPETENCES, ABILITIES, and ATTITUDES, which served as a tool for the FENG team to stratify a professional profile for its egresses students considering, besides the general and consistent character of engineering, the factors inherent to the modalities of the various courses.

Considering these guidelines, FENG, as the active agent of the process, is accompanying, reflecting and contributing to their success. In this way, it is reiterating a full rearrangement regarding the mentioned attributes, as well as working towards the generation of formative actions aiming at their consolidation in the preparation of its egresses students.

Pedagogic Model of the School of Engineering

The School of Engineering has begun its efforts concerning didactic-pedagogic models after a referential mark that came from a movement installed in 1998, involving the participation of both teachers and students. This movement has inspired a process of reanalyzing the teaching of engineering at PUCRS, leading to the construction of a version of the pedagogic process of the College of Engineering, attached to this document. Until now, we have kept the policy of technical and professional up to date, and still of teaching enabling and qualification. Concerning the didactic-pedagogic aspects, these have been a vocation of the managers of this entity, always searching for the qualification of its members.

In this context, FENG/PUCRS started working on the reformulation of its curriculum, including in this process a new discussion about the pedagogic model, which represents the spine of this project.

Teaching Enabling

Every innovatory project, when it comes to its implantation, needs minimal conditions to reassure its real and successful concreteness. In the construction of the teaching-learning process, the imposed conditions are the effective involvement of the teachers and the change in attitude. This leads to the need for enabling teachers in both didactic and technologic aspects.

Therefore, FENG has followed the path to the construction of a Teaching Enabling Program specifically to reach the peculiarities of this curricular restructure program.

Strategies of accomplishing the Curricular Proposal

Historically, the Engineering area has formed, together with Law and Medicine, the foundations above which life in society follows its course, organizes and preserves itself. The accelerated changes that characterize modernity, however, have reconfigured this tradition, either by incorporating new and specific demands or by establishing interfaces which were unthinkable so far or by the opening to new and promising opportunities of application of knowledge, maybe the synthesis of the "admirable scientific and technological new world" in which we live.

Nowadays, some areas of knowledge exercise a low appeal to medium level student's motivation, either for structural or for conjuncture reasons. This fact generates that the direction of the respective professional segments occurs in small segments and not infrequently suggested by "following the fashion". In this way, due to a cause-effect relationship, with a lower demand of market in certain area, there will be less professionals, less development, less absorption of technologies, a cycle that will repeat itself till the rupture or breakdown of some paradigm. In the case of Engineering, even in the magnificent times, the classic teaching has always been considered though and difficult. So, in a vision of ransom of the social and economical importance of the profession it is necessary to undertake actions, which are capable to revert the situation. Then we have a double mission, one of them including a natural change of culture that prevails in various segments of the profession in order to build more friendly interfaces and to conquer a greater involvement of the students and also the breakdown of traditional patterns in the teaching of Engineering.

In this scenario, more than ever, it is a duty to engineering managers to have a pro-active disposition in the search of viable alternatives to the self-sustainable development that results in initiatives that respond in a qualified way to the emergent demands of the new social configurations.

This search introduces various and complex challenges that unfold punctual questions of internal character to Institutions such as:

- Curricular (re) organization;
- Actualization of pedagogical practices;
- Revision of the academic relationships (students, teachers, researchers and managers)

We verify, then, the opportunity and the urgency of (re) thinking, in a solidary way, the philosophy and the politics that fortify our Mission and to define strategies that result in a valuation of the professional of Engineering who initiates his academic development willing to build his permanent and autonomous knowledge with the major goal of offering human, ethical and technical distinctive solutions to society, which includes the institution of positive and dynamic relations with the productive part of the country; and that consolidates in the increasing of human culture, open to new challenges, agile and competitive, marked for the constant technological renovation and grounded in permanent historical values.

The works of curricular restructure of the courses of engineering of FENG went on in these context. The discussions clearly were about such evidences and deserved the attention of the educators to the point that they influenced the pedagogical models of the various groups through the adoption of a new attitude of teaching and learning.

For the worthiness of the education, the educational action must be necessarily preceded by a reflection about human being and an analysis of the concrete way of life, of the concrete man that we want to educate, that is: who do we want to

help to be educated. If there is not such reflection about man there is the risk of the adoption of educative methods and ways of acting, which reduce man to the condition of an object, when his vocation is to be a subject and not an object, according Paulo Freire.

The proposal we proclaim is, by its own nature, mediated by a practical and theoretical process sustained by emancipation, autonomy and interactivity which is related to live the interactive classroom environment in which the teacher interrupt the tradition of speaking and dictating. He builds a set of territories to be explored by the students and disposes co-authorship and multiples connections, allowing that the student *to do it by himself*. The student, in the other hand, changes from a passive viewer to an actor being able to be an emitter and a receptor in the process of inter-understanding. So, the education may stop being a product to become a process of changing of actions that creates knowledge and not only reproduces it. This attitude encounters the needs of the professional market where there is no more exclusive privilege to the technical competence but also to the capacity of interpersonal relationship. On the other hand, we are acquainted with the evaluative process of the teaching conditions prescribed by **MEC**. We observe that one the distinguishing marks of the several editions of this exam is related to an identification of knowledge as a net, what addresses to the change of the methodological teaching proposal we present.

One of the main-stream questions, which is a common one in all segments in Engineering, refers to the professional approach in the various curriculum, since the beginning of the courses. There is a clear worry in conceiving course proposals in which the curriculum expresses a constructive process, which is integrated both horizontally and vertically abolishing the classical segmentation between the basic cycles and the professional ones. Such precaution renders actions that allow the involvement of the student in his professional formation since the admission in the university. It also reduces the accumulation of hours with activities in the classroom.

With respect to the disciplines concerning humanities, a joint proposal with the courses such as Theology, Philosophy, and Human Sciences aims to offer disciplines oriented to Engineering courses. This proposal is the result of a work which took place similarly to what had been done in the other unities involved in the formation of professionals in Engineering.

Considering the decisions of the University concerning the distance learning education, as well the considerable technological advances and paradigm change which are being developed at PUCRS and at FENG, aligned with the teaching proposal that we proclaim, it seems natural and presumed that they can also be developed in the virtual environment, even though partially, and also in a harmonic way with the presence activities.

Concerning the complementary activities, it is convenient to mention that the proposal involves the offer of a multiplicity of these activities, such as: monitorship, scientific and technical initiation with written production, participation in actualization courses and complement of contents, participation in scientific events, community work, technical visits, interchange with other institutions, non-curricular training.

In the various curriculum there are oriented activities in which the teacher acts effectively as a tutor in terms of supervising scientific initiation, training supervisor, integrator of knowledge and supervising the final papers.

The activities of the disciplines of the supervised training must be developed based on the concluded training, preferentially out of the University or inside its research laboratory and typically related to the professional activity.

For the activities developed in the discipline “Final Papers” there are expected group and individual meetings.

In the current scenario of the Engineering courses, the great amount of hours in classroom hampers the student the access to the work market and raises the price of his maintenance until graduation. The reduction of the amount of hours in classroom by itself doesn’t mean any benefit for student’s development. It is necessary to consider that this reduced time of the classes be overcome for a proposal of work that leads the student to an emancipative process. We understand that learning can only be accomplished if the student performs an active role by construction of his own knowledge with the orientation and participation of the teacher. It corroborates to the accomplishment of this program the Teaching Qualifying Program in the creation of Virtual Learning Environments which avails the students with hipermidiatic spaces for the autonomous construction of knowledge.

These considerations, together with the practical character of the technical activities of Engineering make it clear the adoption of the following typology of disciplines: theoretical, practical and theoretical-practical. For the theoretical disciplines there were adopted the maximum of 60 students per class. To better face this challenge and to reduce the number of desistance and reproof, mainly in the initial levels of the Engineering courses and to contribute with self-development of the students, there were adopted modulus lesser than 15, 20 and 30 students per group, in various disciplines where the activities would be unfeasible and counter-productive in the full modulus, admitting eventual rise of 10 per cent.

It is convenient to note that this project besides its didactical-pedagogical worthiness and major goals brings as an upgrade the expectation of strongly diminishing the evasion in the first levels of all Engineering courses and increase, for each curriculum, equivalence among disciplines of the old and new curriculum.

Concerning to the implementation of new curriculum, the goal is to develop them in a way that they can be practiced by the greatest number of students as possible and in a short space of time.

It is known that the major interest of students of Private Institutions of Education is the night school schedule, as they must conciliate work and study. In this context the idea is to benefit the night school schedules, locating the students from the sixth semester, including Saturdays morning during the ten semesters of the course. We understand that with an average of 24 credits per curricular level of the courses, as it is proposed here, the present proposition is viable.

Conclusions

The main contribution of this Curricular Restructure Project of the Engineering Courses of the College of Engineering of PUCRS, here reported, is related to the planning process of these activities (1999-2002) and to the experience achieved in its current phase of implantation (2003-2004).

The significance of the process remains outlined by the constant need for changes, which are considered necessary and fundamental, and a perspective of success will only be possible if there is an effective commitment of all the actors involved. Therefore, the management team had to clearly define the steps to be taken, although always with an idea of need for alterations and correction of the challenges initially traced, which in fact happened after the amplification of the discussion forum, where teachers and students were also included. The fact that, at the same time, there are profound changes going on regarding curriculum guidelines for Engineering Courses in the country, rendered it more important to overcome the difficulties in order to achieve the proposed innovation and the challenge of changing all the courses at the same time. The simultaneity had the objective, as previously commented, of constructing an identity for the College of Engineering leading to the acquisition of a differentiated position.

The main alteration, when we speak about innovation, is not simply linked to the reconstruction of the existing curricula or to the proposal of excellence and up to date contents in each area of knowledge, but to the profound change in the professor's attitude inside the classroom and towards the students, characterized by decades of immobility. The student becomes the center of the learning process, or at least a much more important actor, leaving the professor in a more tutorial position, contributing therefore to the student's search for autonomy and emancipation.

The implantation phase brought up interesting aspects, which were not uniquely related to the process of searching for changes and for the new. In a way, to implant an extensively debated and carefully planned project, brought along with it a glance to the future, to the new students who would enter the School of Engineering. However, the proposed goals also intended to overcome new frontiers. It was always desired that the proposed project reached a large part of the more than three thousand students of the College of Engineering, allowing the innovatory proposal of curricular alteration to amplify even more its results. Therefore, the work for a transition of the previous curriculum to the new one, now in phase of alteration, was a work of major proportions, involving the transference of more than sixty percent of the students to the new curriculum, an option taken exclusively by the students themselves, after the explanation of the new proposal by the management team, as a motivation strategy. The students that were approaching the end of the course had to conclude the course in the initial curriculum.

The initial results can already be evaluated positively considering various factors. Within two years of implantation, seven semesters of the new curriculum have already been implanted, motivating the transference of many registered students. The motivation and support policy towards the Teaching Enabling Program, where more than sixty five percent have participated in the courses offered, have guaranteed the proposed change regarding the attitude inside the classroom. The modification in the sequence of disciplines, allowing some professional disciplines to be offered already in the first semester, has led to a change in the relationship of new students with the university, with more maturity and, consequently, a significant reduction in evasion rates.

As commented in the beginning of this article, the objective of this process could not be measured only by the success of its parts, individually, phase of proposition and planning, phase of implantation, still in course, and current phase, where positive results are already being observed. Maybe the main differential achieved was the group of actions and the fact of focusing on a major proportion change, reaching all the courses simultaneously, both new students and already registered ones, and, most important, proposing a change in the professor's attitude.

A motivating factor has been the permanent need to evaluate the process and the fact that, between other educational institutions in Brazil, the College of Engineering of PUCRS has reached an outstanding position, frequently receiving invitations to expose its experience, not only for having proposed something new, but also for having had the courage to actually proceed with its implantation, bringing the future to the present in Engineering education.

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