Including Integrating Projects in Engineering Curricula

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Abstract: - This paper addresses the challenge of applying new pedagogical tools by reporting the experience of project-based learning implementation, begun in the Mechanical Engineering course at the University of Brasilia. Due to pre-existing social, political and ideological conditions in the institution and the consequent difficulties of performing structural changes in the course curriculum, no significant change as such was proposed in this work. An environment for developing interdisciplinary projects has been established, allowing for opportunities to construct technical and non-technical knowledge. The experiment was conceived from a proposal that foresaw the creation of three design engineering courses throughout the Mechanical Engineering curriculum which may be characterized in three steps. First, a set of subjects/courses was chosen according to the projects to be accomplished; the second step was characterized by projects whose topic was chosen in order to involve other courses at the Faculty of Technology; finally, the third step aims to encompass projects with a wider scope. The report concerns the period from 2007 to 2010 covering the first two steps of implementation. Aspects such as number of students involved, related courses and institutional support are also discussed.

Key-Words: - engineering curriculum, engineering education, project-based learning.

1 Introduction

For some time now the Ministry of Education, through its curricular guidelines has been signaling towards the need for undergraduate degree courses with flexible curricula, student-centered pedagogic approaches, emphasis on transdisciplinarity, social and political integration, environmental conscience and links between theory and practice, so as to allow the future professional to have contact with the professional reality during his/her educational process [1].

Several of these premises are also demanded in the job market, which also requires complementary abilities (soft skills) such as leadership, entrepreneurship, team work, good oral communication and writing capacity [2].

During the World Engineers Convention, WEC-2008, the initiative managing committee of INOVA Engineering launched a proposal for the Brazilian Program of Technological Acceleration in Engineering [3], a document that suggests measures for the implementation of specific actions from the federal government to unite companies and engineering schools in competitiveness and innovation, attributes inherent to technological training. The document is the result of a great concern for the lack of the so-called, complementary abilities or “soft skills”, and for the distortions in the engineering courses, especially, for the need to update curricular content.

A lot has been discussed in terms of implementing changes in the curriculum in order to assist those needs and mainly, in terms of how to educate engineers. Besides acquiring the technical, managerial and humanistic capacities and the necessary behavioral attitudes, engineers need to acquire continuous learning capabilities, and be constantly concerned about having a global outlook, without overlooking the dimension of regional and local problems. Having these goals in mind, several actions have been proposed.

On the new campuses (created after the curricular guidelines) the curriculum is more flexible and already takes into account contents and proposals towards this goal. However, as this is beyond the scope of the article, they will not be discussed in this here.

In already existing courses, changes are slower because curricular structures are more rigid, and most of these actions have a restricted character, with few effective results. The question raised is the following: "How should content be maintained that enables appropriate scientific and technological education and at the same time, builds an engineering curriculum tuned into the new paradigms of global education without increasing the time a student spends in the course?"

The present work will introduce a proposal being implemented in the Faculty of Technology (FT) at the University of Brasília (UnB). Initially the objectives of this proposal were included, in an interdisciplinary context, as explained by Vasconcelos [4], in which "methodology is applied based on participatory interaction that includes the construction and agreement of a common premise to a group of related knowledge fields". The common premise will be the development of an engineering project whose theme will be defined based on the demands of society, market, or the institution. The field of related knowledge is represented by courses (required or elective) involved in the project during the academic semester. Afterwards, other courses in the Faculty of Technology were included, and subsequently, the experience tended to a wider field, involving other knowledge areas in the University.

2 Background

The proposal of this paper had as a guiding approach the studies and works developed at the time of discussing the pedagogical projects for the Faculty of Technology courses. These discussions were motivated by the Curricular Reform Commission of FT.

One of the study groups concentrated on the elaboration of proposals for the implementation of synthesis and knowledge integration projects, problem based learning (PBL) type activities. Such activities, discussed in several meetings, were revealed to be essential resources to complement professional education. They contextualized the acquired knowledge into theoretical subjects, enabling social, economical and environmental approaches using transverse themes, or by simulating situations experienced in the work environment. It is presupposed that this is a way students benefit from favorable learning environments for developing abilities and competences, not usually frequent in subjects in curricular schedules.

Although some experiences already accomplished in the Mechanical Engineering course could be characterized as synthesis and knowledge integration activities, they had little reach and/or low regularity.

One of the conclusions from the discussion events promoted by FT was that it would be necessary to conduct regular experiments that would affect a whole class, and that should occur with some frequency during the course in order to have their efficacy proven.

With that in mind, some experiments were conducted in classes in the Mechanical Engineering Department, in the first and second semesters of 2007 and 2008, , with the support of the curricular reformulation commission from ENM (Mechanical Engineering Department) and some ENM teachers. The diagnosis of the first experiment contributed to the study and the elaboration of a teaching-learning procedure based on projects that were being researched by Santana [5, 6].

In this context, a plan to include synthesis and knowledge integration activities through the development of real projects was proposed to be included in the Educational Project of the Mechanical Engineering Course [7]. The document foresaw the creation of three mandatory subjects in order to grant credits to students that participate in the projects according to three different approaches: 1) emphasis in planning and in the organization of tasks for a collaborative work; 2) emphasis in the process of project development and 3) emphasis in the product project. These activities were forecasted in the curricular structure after the first semester and before the eighth semester.

3 Reference Models

The theoretic references were obtained from several publications dealing with implementing project-based learning approaches. These publications have contributed significantly in terms of methodology for developing the proposal and the steps towards implementation.

Various authors have been investigating this topic to research and implement new teaching-learning methods. The idea is that it may provide students with the opportunity for a more complete development by directing team projects towards independent learning while the teams look for solutions during the process of executing a project [9,10,11]. Sometimes these experiments may simulate situations in professional practice and interaction with the environment and society while also considering cultural, economic and political aspects.

Examples of some project-based learning models can be noted in literature: the project as an exercise that aims to apply knowledge and skills already acquired in a context familiar to the student. This type of project work is applied in a single subject [12]. The second type is based on the project work established in modules. In this model the project is more interdisciplinary and related to real world issues and can be integrated with internships in the industry environment [13, 14]. The third type of project substitutes a group of traditional courses for a single project [15].

The proposal presented and implemented here aligns itself with the BATEC ideas [16] so as to structure a procedure that gives to undergraduate students the opportunity to acquire and practice soft skills while providing technical skills simultaneously, without burdening the teachers, students and the curriculum. However, given the extent to which the experiment was replicated in the Mechanical Engineering Department, it was noted that this goal is not guaranteed. Students realized that the participation in the project involves time management and commitment. For teachers, when the commitment of the students was low, the result was not satisfactory. The additional effort in executing the activities related to the project led the students to request the insertion of a class into the curriculum. This way, a class would provide greater motivation to perform the project.

4 Proposal

The proposal consists of creating an environment for the development of interdisciplinary projects, allowing opportunities for the construction of technical and non-technical knowledge, and its application in real problems.

It is based on a group of actions and tasks established with the main objective of accomplishing synthesis activities and integration of knowledge throughout the engineering curriculum. These activities are associated with developing soft skills, such as teamwork, leadership and management required from the future professional. The first experiments were carried out indirectly, or without the need for altering the content of already existent classes. This was done through project-based learning, having as a reference the methodology which had been developed and tested in the Mechanical Engineering course in the Faculty of Technology at the University of Brasília. Such activities were denominated Integrating Projects.

The topics for the projects must be chosen according to research done with the public and private productive sectors so as to identify and characterize the needs that involve knowledge related to engineering activities.

To include the Integrating Projects in the course curriculum, three subjects were planned without specific content, totalling 105 hours activities. These activities must be planned alongside the definition of the project topics and include student meetings, student and teaching assistant meetings, work progress evaluations, technical talks and presentations, and technical visits to industries. Integrating Project 1 must have a focus on solving a problem with emphasis on planning, organizing tasks and teamwork; Integrating Project 2 should focus on solving a problem with emphasis on the process of project development; The Integrating Project 3 should focus on solving a problem with an emphasis on constructing a product prototype.

The courses are designed to be started in the second semester, in the fourth semester and in the sixth semester. They are not scheduled for the eighth semester because it is the period that internships are done. The proposal implementation can be characterized in three steps. In the first one, named the Initial Step, a set of subjects from the Mechanical Engineering curriculum or “target-subjects” were chosen according to the projects to be accomplished. Figure 1 shows an outline of the Initial Step, in which the Integrating Project was used to aggregate knowledge motivated on the curricular contents learned (technical or scientific), and to develop soft skills. These were stimulated during the project development process resulting from the applied methodology and collaborative work.

Teachers of target-subjects participate in the orientation, supervision and assessment of activities. One of them acts as the general coordinator of the Integrating Project, and the students execute the projects.

The applied methodology presupposes that the executive groups or project teams have their own norms of conduct, which consist of ethical and professional commitment codes and may act autonomously, assuming responsibility over decisions taken. Initially, the teams are formed by students from target-subjects coming from different semesters and by students from outside these subjects, as volunteers, all of them were mechanical engineering students. The members of the teams are chosen by the teacher coordinating the activity, based on common schedule availability among students.

The second step of the proposal implementation is characterized by projects whose topic is chosen in order to involve other FT courses. It began to be implemented in the second half of 2009. The target-subjects now could be chosen in other courses.

Finally, the third step aims to encompass projects with a wider scope. An activity regarding this objective is being executed in an experimental way with a group of eight students. The aspects related to availability are still in development and will not be dealt with in this work.

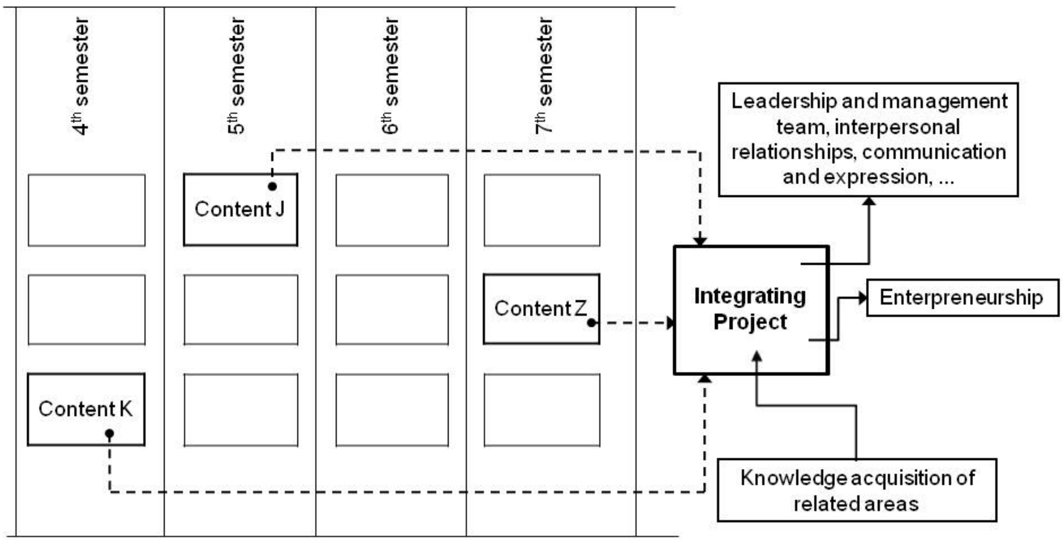

Figure 1. Initial Step of Integrating Project.

As a result of these actions, one may expect: a favorable environment for developing soft skills; student motivated due to their involvement in the solution of real problems; a greater interaction between universities and companies; an egress profile in accordance with the pedagogical project proposals in the Faculty of Technology courses; the incentive to research new methodologies for teaching engineering; the use of educational procedures that favor transdisciplinarity; the integration of different areas of knowledge; and finally the technical and didactic improvement of teachers and teaching assistants involved. Thus, this study aims at contributing along with other focuses to improving undergraduate teaching and learning.

5 Methodology

Construction of the methodology is focused on the use of a pedagogical strategy for teaching-learning, which uses the concept of projects. This includes life cycle development with work flows, structured documentation, identification of roles and responsibilities, supported by technological tools and an empirical evaluation of the project results.

Figure 2 shows the development process of Integrating Project courses. It covers the three basic steps of the method: pre-project, project and post-project. It also shows the project stage detailing its handed in work.

The pre-project stage takes place in a period that precedes the onset of the school semester. It consists of performing the plan of action (Student's Guide), by teachers and teaching assistants that will be presented to students at the beginning of the next step. This document consists of information about the objective to be reached, students involved in the project, the topic to be developed, the main milestones of the project, related subjects, assessment methods, spaces to be used, and the control points. In developing the plan of action the techniques of total quality management (TQM), called 5W1H were taken into account.

In the project stage of the methodology, a thematic project is executed by teams throughout the semester, over approximately 15 weeks. The students, teaching assistants and teachers take part in this stage. This stage is divided into five phases with defined goals for better management control, which constitute the life cycle of the project. The required documents, instruments and tools available in each phase of Integrating Project courses are

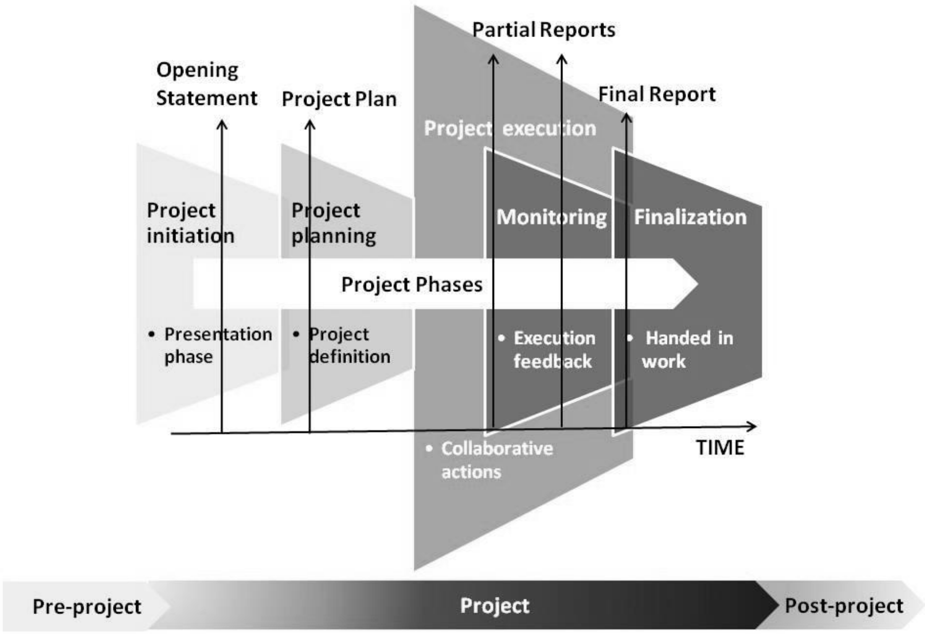

Figure 2. Adapted from [17]. Project phases for an Integrating Project course.

shown in Table 1. The sequence of related actions is shown in Table 2.

The phases of the project stages are explained below. Project initiation: this is related to basic activities - presentation of the work methodology, team arrangement, carrying out lectures on Project Management. In this phase the Plan of Action (the Student Guide) is presented by teachers, the Personal Identification and Availability form is filled in by the students (the teachers will use this information to organize the teams). The Term of Agreement (rules of conduct established by the team) and the Project Opening Statement (general information about the project and the team, deliverables, assumptions and constraints) are written by teams. The duration of this phase is three weeks.

Table 1. Documents, instruments and supporting tools related to project phases.

	PROJECT PHASES				
	Project initiation	**Project planning**	**Project execution**	**Monitoring**	**Finalization**
Documents	-Student's guide -Personal identification and availability - Term of Agreement by team -Project Opening Statement	-Project plan	-No documents	-Partial reports	-Final report
Instruments	-Dynamics of integration -Polls on various topics -Maturity assessment form	-Lectures on project management -Polls on various topics	-Dynamics of integration -Polls on various topics	-Soft skill assessment forms	-Soft skill forms - Maturity assessment form - Educational process assessment form
Supporting tools	e-learning tools (Moodle, dotProject, and other tools adopted by students)			-Peer review	-Peer review -Teacher Final Opinion

Project planning: this is the work teams prepare for the Project Plan. This plan aims at the definition, preparation, integration and coordination of all activities to be undertaken in the project. In this phase, a mini-course on control and project monitoring tools of is carried out. The duration of this phase is also three weeks.

Project execution: this is the work teams perform in collaborative actions and to complete the work specified in the Project Plan to fulfil the objectives and product deliveries. This phase involves the coordination of people and resources including the integration and implementation of project activities. The duration of this phase is seven weeks.

Monitoring: this is the verification of compliance by comparing the progress of the project with the Project Plan; identification of problems and adoption of corrective actions, if necessary, to control the implementation of the project. At this phase it is important to define the control points - meetings in which the teams present the progress of projects. The meetings are scheduled in the Student Guide, with the exception of one, which is reported 48 hours in advance. The follow-up takes place in parallel with the implementation.

Finalization: this is the completion of all formal activities with the final report delivery. In this phase a critical assessment is also made, both collectively as well as individually and involves analysis of the product, the process of implementation and the participation of the teams. The duration of this phase is one week.

Dynamic integrations and polls on various topics are provided during the phases: project initiation, project planning and project execution with the goals of integrating and motivating participants.

The third and final stage of the methodology is the post-project, which is characterized by data organization of experience, analysis of results and dissemination of final grades and the team classification. Only the teachers and monitors take part in this phase.

Templates for all documents and some other tools can be found in the work of Santana [6].

6 Implementation

The aspects that differentiate the proposal implemented in this work from those that have been related in literature as project-based learning are: the large number of students that can be involved, the size of teams, the different levels of knowledge of the participants - students come from different years - and the substantial team autonomy for performing the work - performance on demand. Some of these aspects are also the assumptions established by the Curricular Reform Commission of FT for deploying synthesis and integration activities in order to influence the educational profile of the Faculty of Technology engineering egresses [8, 18].

6.1 Initial Step

Experiments conducted in this phase were implemented in the form of virtual subjects except for the second half of 2008, when Integrating Project 1 was formalized as an elective class.

Table 2. Actions that characterize the project phases.

PROJECT PHASES	TEACHERS	STUDENTS
I. Project initiation	1. Class presentation	
	2. Provide Student's Guide	
	3. Distribute the Personal Identification and Availability form	4. Complete and deliver the Personal Identification and Availability form
	5. Define work teams	
	6. Register students/teams in DotProject program	7. Register the user in the Moodle system
	8. Provide the dynamics of integration	9. Participate in the dynamics of integration
	10. Provide the Term of Agreement	11. Complete and deliver the Term of Agreement
	12. Present the project topic	14. Deliver the Project Opening Statement
	13. Provide the Project Opening Statement	16. Participate in the lectures
	15. Provide the lectures on project management	
II. Project planning	17. Provide the document model for the Project Plan	18. Complete and deliver the Project Plan
III. Project execution	19. Orientate the students	20. Execute the Project Management Plan
IV. Monitoring	21. Perform the control points	22. Fill in the Educational Process Assessment form
		23. Present the project partial report
V. Finalization	24. Evaluate the final presentation of the teams	25. Present the final results
		26. Deliver the final report
		27. Fill in the Educational Process Assessment form

A virtual subject mentioned here means that classes were arranged within the Moodle environment with students enrolled in the target-subjects and there is no institutional recognition in this case. The projects were part of the evaluation of the target-subjects and no additional credits were imputed for them at this time, despite the workload allocated to students.

Presently, there is no way we may include mandatory credits in the curriculum of the engineering courses without a complete restructuring. This is due to limits on the number of credits required by the educational guidelines of the Ministry of Education.

Thus, an optional "free-time" subject was created, with 2 non-theoretical credits for the activity Integrating Project 1.

Table 3 shows a summary with main information related to the interventions done. The first one in 2007 was not well documented and organized. The methodology as presented was applied from the second semester of 2007 to the second semester of 2008.

Still considering Table 3, the number in brackets in the second column is related to the semester in which the course was offered. It should be noted that the engineering courses in Brazil are structured with an average of 10 semesters. Associating the knowledge levels with the number of semesters, one could say that the interventions covered two or more levels of knowledge, engaging one class at each level. In particular, the intervention performed in the second half of 2008 engaged two subjects from each knowledge level. The classes had between 25 and 40 students.

Table 3. Summary of interventions in Initial Step.

INTEGRATING PROJECT IMPLEMENTATION – INITIAL STEP			
SEMESTER & METHOD	**SUBJECTS**	**PROJECT TOPIC**	**STU NUM**
1st/2007 Virtual subject (mandatory)	-statics (3rd) -dynamics (4th) -mechanics of materials (5th) -hydro-pneumatic systems (7th)	-various	120
2nd/2007 Virtual subject (mandatory)	-thermodynamics (4th) -mechanical system project (8th)	-Stirling engine	72
1st/2008 Virtual subject (mandatory)	-machine design (7th) -thermodynamics (4th)	-hot forging press	68
2nd/2008 IP 1 (optional subject)	-thermodynamics (4th) -dynamics (4th) -hydro-pneumatic systems (7th) -machine design (7th)	-grain separator -pumping device	53
1st/2009 IP 2 Virtual subject (mandatory)	-machine design (7th) -thermal machines (5th)	-CNG compressor	80

The number in brackets relates to the semester in which the discipline is offered - the course has 10 semesters; STU NUM: Number of students enrolled.

In the first semester of 2009, all students had already passed through the experience and methodology needed to be adapted to follow the original proposal.

On account of this, the Integrating Project 2 activity is presented in an experimental way, as a virtual subject in the Moodle environment.

It is worth pointing out that these subjects are practical classes with no content; credits are attributed to tasks developed in relation to the project elaboration.

The main characteristic of this stage is the near total involvement of students in the classes. This was either due to mandatory participation - the project was part of the assessment of the discipline – or, in the case of the second half of 2008, owing to the weight of the project in the subject, even considering an optional participation.

Another feature is the size of the teams related to the number of target-subjects involved and the number of students in each subject. This number has fluctuated between 8 and 12 participants. The number of members can cause difficulties in work management and staff management due to the amount of members' commitment.

Besides the project development and tasks related to its follow up and control, lectures, mini-courses and motivational games (dynamics of integration) are applied to motivate and complement the formation.

The development of skills related to leadership and teamwork, professional relationships, communication, conflict management and the management of projects were found throughout the semester within the three replications (2nd half of 2007 to the 2nd half of 2008). Studies have continued to monitor the performance of these students in subsequent courses.

6.2 Second Step

This phase is characterized by projects whose topic is chosen in order to involve other courses of FT, and also, offering only elective subjects. Integrating Project 2 was formalized, granting 3 non-theoretical credits, for part-time attendance.

Table 4 shows a summary with main information related to the interventions done from the second half of 2009. The project is presented in the related courses and the students were not obligated to participate as before. Because of this, the number of students per project diminishes and the sizes of the teams are no longer related to the number of target-subjects involved and the number of students in each subject. It depends on the complexity of the project.

The modular robot project was only an exploratory study and the teams had four participants. The electrical vehicle project had a specific organization with a single team involving all the students divided into sub-groups.

Table 4. Summary of interventions in Second Step.

INTEGRATING PROJECT IMPLEMENTATION –SECOND PHASE			
SEMESTER & METHOD	SUBJECTS	PROJECT TOPIC	STUDENTS
2nd/2009 IP 1 (optional)	-dynamics -mechanics of materials -robotics	- modular robot	20
1st/2010 IP 1 (optional)	-machine design -electric machines -energy conversion	- electrical vehicle	23
2nd/2010 IP 2 (optional)	-machine design -mechanical materials -energy conversion	- electrical vehicle	30

The methodology explained before was maintained with few modifications: in Integrating Project 1 no partial reports are needed but only the final one. The monitoring is carried out based on presentations at the Control Points; in Integrating Project 2, the partial reports are required as well as the final one.

7 Assessment Methods

Individual assessments (IA), collective assessments (CA) and teacher final opinions (TO) were considered for the team member evaluation in the Integrating Project grade (IPG), after the oral presentation of project results (Eq. 1).

The elements considered in the project evaluation are related to internal aspects of teamwork such as creativity and originality, organization of activities, oral and written communication, professional behavior, and its technical, economic, social and environmental feasibility. The teacher final opinion is an average of the scores of all teachers involved in the process (one of the teachers is designated to assess only the non-technical aspects). This evaluation considers the evolution of the aspects mentioned, which are raised at control points, in the final presentation, and in the reports delivered during the experience.

Positive and negative stimuli are used in order to motivate students to participate in all activities. A binary system of assessment in which each activity or action brought, or each requested delivery, is punctuated with grades 0 or 10, is considered, not allowing late deliveries as those agreed to in the Student Guide and the Project Plan.

The grade given to the student consists of a weighted average:

$$IPG = (0.1\,IA) + (0.4\,CA) + (0.5\,TO) \qquad (1)$$

7.1 Self-assessment and peer review

These types of assessments are done through Soft Skill form. The aspects evaluated in the form are: team leadership, team management, communication in general, knowledge acquired in related areas, and entrepreneurship. Those topics are divided into sub-items detailed in [18].

The comparison between self-assessment and peer review provides information that allows educators to see if the goals are being met. This way, it is possible to perform corrections if necessary and to stimulate discussion about the results.

7.2 Assessment of the target-subjects

The grade obtained in the Integrating Project is considered part of the target-subject. The criterion for this is free, established by each teacher in the subject.

8 Development of Soft Skills

The best way to generate competence is to expose the student to contextualized activities that permit them to come forth - gradually and organized. Special attention should be given to the relevance of learning methodologies, which immerse students into an environment conducive to innovating and promoting direct contact with the world outside universities.

The way found to quantitatively assess the development of soft skills was through the comparison of data evolution in the Soft Skill form. This form was used by students for self and peer evaluation and also by professors to assess students.

9 Student Point of View

There is great resistance when the subject is change. Changing a teaching method may be complicated and in this specific case, it involves a cultural change. Research previously done with students from the Faculty of Technology [17] had already indicated that in general they consider that traditional teaching methods and evaluations work well and make better conditions possible for accompanying activities carried out during the course.

On the other hand, learning through projects, according to the very students involved, has offered gains in terms of applying specific knowledge in the area of engineering and knowledge in non-technical areas, necessary for developing and executing projects. This may be explained by the fact that students receive a solid theoretical education which also has shortcomings in terms of contextualization and mainly in application in the area of humanities. This situation may be observed through opinion evaluations done at the end of the project when the students described the learning experience as being very positive during the project, despite having recognized the need for greater effort in relation to the time spent working. Even difficulties regarding people management and team organization were considered as positive experiences in respect to their education.

Students opinions mentioned here were taken after the Initial Step. The main positive aspects related were: i) finding efficient methods for time management; ii) finding practical and feasible solutions for technical and non-technical problems that emerged during the project; iii) learning to deal with personal differences and resolving conflicts within the team; iv) employing content and techniques learned throughout the course as well as those offered through mini-courses during the execution of the project.

Among the difficulties reported on by the students were: i) the large number of students on the teams; ii) lack of support and little involvement from some participating teachers; iii) lack of physical and financial structure for developing prototypes.

Another question raised by those interviewed regarded the lack of interest on the part of some participants. A big problem when one does group work is to make sure that all of the members work and produce equally. This is a difficult task, when all of the members have a variety of other activities such as seminars, work, and tests to be done, and some more so than others. For this reason, many end up unmotivated and do not dedicate themselves sufficiently to the project and in consequence, make it difficult or even impossible for the team to have good results.

Finally students suggested that some of the projects developed could be used to the benefit of communities, others could favor the university, but a problem is run into that is typical of federal educational institutions in Brazil: the lack of sufficient financial resources for implementing and maintaining projects, principally when it comes to projects related to undergraduate courses. The hypothesis that a project will be utilized is motivation for a majority of students.

In experiences of this type, the work of the teachers should include constantly motivating the students in a manner that makes them realize the importance of project-based learning.

10 Conclusion

This paper shows a way to support project led education in engineering curricula regardless of the implementation of curricular reforms. At the same time, activities of synthesis and knowledge integration are introduced in accordance with the curriculum guidelines for engineering courses established by Ministry of Education in Brazil. These activities were considered very important to consolidate learning by the Faculty of Technology professors.

The application of knowledge learned in several subjects and independently will be demanded from participants for the development of engineering projects. These activities do not interfere in the target subjects or in the schedule, but they can be used as part of their assessment as an incentive to participate. The target subjects are those that teachers agreed to take part in, motivating their students to integrate the project teams.

It is important to emphasize that although it is a procedure that can be replicated for each semester, the action of performing a project is a unique experience. Moreover, achieving objectives or not is a result that requires more than scientific and technical skills.

In the Initial Step, each semester at least two courses were selected to be integrated into IP. Each course had at least 30 students. This large number of students had both advantages and disadvantages. On the positive side, with a larger number of groups there was a greater variety of solutions and options for developing the project. This became even more evident when it was considered that they were students with very different academic experiences. On the other hand, it required a greater effort to organize the groups, and to elaborate and evaluate activities during the execution of the project.

In order to involve students and professors from other courses of FT, from mid-2009, students were no longer obligated to participate in the Integrating Project, they have done it electively, motivated by its topic. It has been observed that the fact that the course was not a requirement decreased the reach that the project-based approach had in the first years of its implementation and its importance in shaping the profile of the student. This fact leads the authors to re-evaluate the application of large-scale interdisciplinary projects in spite of the good results obtained in relation to the development of technical and non-technical skills of the students.

About the lack of financial resources pointed by students, this problem is not impossible to be resolved: company sponsors could be sought for financing the execution of projects that are of interest to them as well as to the community. Another solution would be to associate the projects developed with extension projects and to obtain in this way the institutional support necessary and to even make it possible to participate in public biddings with resources for university extension. These solutions will be considered in the next step.

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