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1. Introduction

Problem resolution in Engineering and Experimental Sciences, as a research-oriented teaching methodology, is useful in cognitive-constructivist environments. This technique is reported in this chapter to show to the student the major phases of an Algebra course applied to typical situations of the syllabus, which have previously been characterized as completely open problems. The world today is characterized by rapid change. A number of factors necessitate an educational environment, significantly different. The current trend is that we are moving towards a learning society, and this involves a displacement towards a learner-centred education. There is also a change in the concept of continuing education, where the individual needs to be able to handle knowledge, update, select what is appropriate for a given context, to understand what has been learned so that it can be adapted to new, and rapidly changing, situations. Likewise, the change must be reflected in the assessment to the student, which should be focused on 'declarative knowledge' as a dominant reference. This paradigm shift should affect other features such as the approach of educational activities and teaching materials, which should lead to a variety of 'teaching situations' to encourage the student’s compromise (Savin-Baden, 2000).

Any situation can only be conceived as a problem to the extent that there is a recognition of it as such a problem, that is, it is unknown, and to the extent that, a priori, we do not have the solution: a situation for which there is no obvious solution. But, it is desirable that students learn to solve problems raised at the university level, starting from open, and of interest, statements which include aspects from Science, Technology and Society fields. Solving a problem is to find a path where there previously was not a known one, finding a way to a difficult situation, to overcome an obstacle, to achieve a goal that could not initially be reached. This technique is proposed to be applied to address an opened-statement problem, which will be the definition of the course project, each student has to raise in a course of Linear Algebra with competences in an Industrial Electronics Technical Engineering degree, where the aim is to consider the student’s meaningful learning. We analyze the possibilities of a course project based on the PBL methodology for teaching problem solving (Barrows, 2006): its strengths and its weaknesses are emphasized. In other words, we conceive the
possibility of proposing a vision for overcoming the teaching methods of problem solving in Science and Engineering, which in line with the model of learning as a research-oriented, leads to a methodological change in a way that the students arrive to be able to cope more successfully open-statement problems. The proposal is not characterized by dramatic changes in the structure of the education system but for qualitative changes in the teaching strategies used in the classroom, the activities proposed by the students and by the sequencing of conceptual and methodological contents.

The problem resolution by students (which are accustomed to implement the proposed model) features closely the characteristics of the 'scientific work' and increase its effectiveness as resolvents. The procedural knowledge involves declarative knowledge specific to the area, and at the same time, the acquisition of the declarative knowledge is a process of construction that makes implicit or explicit use of procedural knowledge. It is therefore reasonable to expect that a further development of those procedures could lead to a more comprehensive learning and greater efficiency in the resolution.

Fig. 1. The teaching methodologies.

2. The problem statement

The world today is characterized by rapid change. A number of factors such as globalization, the impact of information technology and communication, and the need for sponsoring and managing diversity necessitate an educational environment, significantly different. The current trend (associated with the European Higher Education Area -EHEA) is that we are moving towards a learning society, and this involves the displacement of an education that
focuses on education towards a learner-centred education. Interest in the development of expertise in educational programs corresponds to an approach to education primarily focused on the student and their ability to learn, requiring to him more prominence and more compromise (Albert, 2007). There is also a change in the concept of continuing education, where the individual needs to be able to handle knowledge, update, select what is appropriate for a given context, to understand what has been learned so that it can be adapted to new, and rapidly changing, situations. It will then need to reduce the use of class-present tasks and enhance the class-non-present tasks to 'teach to learn' so that the student can 'learning to learn' perceiving higher education as a further stage of 'learning over a lifetime' (long-life-learning) (Castillo and Polanco, 2007).

Clearly, the changing role of the teacher being the person who structured the learning process, the major player in education, as well as supervising the work of the students, whose knowledge he evaluated, in the vision centred in the student, the teacher is now a companion in the process of learning, which helps the studying to achieve certain competences. While the role of the teacher remains critical, it moves increasingly toward an advisor, guide and motivator (i.e., this is the well-known metaphor of the thesis director and the novel researcher) (Fig. 1).

Likewise, the change must be reflected in the assessment of the student, which should be focused on 'declarative knowledge' as a dominant reference, and often it only happens to include an assessment based on the skills, capabilities and processes closely related to work and to the activities that lead to the student’s progress (the need for continuous evaluation). Therefore, this paradigm shift should affect other aspects such as the approach of educational activities and teaching materials, which should lead to a variety of 'teaching situations' to encourage the student’s compromise. This leads to the unavoidable conclusion that the learning-teaching paradigm is changing (Fullan, 2002).

### 3. What does a problem mean?

Any situation can only be conceived as a problem to the extent that there is a recognition of it as such a problem, that is, it is unknown, and to the extent that, a priori, we do not have the solution: a situation for which there are no obvious solution. Accordingly, a problem can be defined as a situation such that there are no obvious solutions. But it is desirable that students learn to solve problems raised at the university level, starting from open, and of interest, statements which include aspects from CTS (Science, Technology and Society). The choice of problematic situations should be done so as to embody a challenge affordable by the students so that through interaction and the help of others, the student can participate in the learning process (Brockband & McGill, 2003)). Solving a problem is to find a path where there previously was not a known one, finding a way to a difficult situation, to overcome an obstacle, to achieve a goal that could not initially be reached.
This technique is proposed to be applied to address an opened-statement problem, which will be the definition of the course project, each student has to raise in a course of Linear Algebra (Figs. 2-3) with competences in an Industrial Electronics Technical Engineering grade, where the aim is to consider the student’s meaningful learning. The weight of the research work is important in monitoring the formative and additive assessment of the course: this is why special attention is devoted (Stake, 2004). To do so, students must apply the scientific method and the problem-solving methodology to develop the skills that are inherent. It is not an exclusive method, but one more training methodology, while in the strategic resources within the daily teaching practice implementation (McKernan, 1999; Fullan, 2002; Michavilla, 2006; Castillo and Polanco, 2007).

**Fig. 2. The syllabus of Mathematical Grounds (tasks-based).**

<table>
<thead>
<tr>
<th>THEMATIC UNIT</th>
<th>MATHEMATICAL GROUNDS II (LINEAR ALGEBRA) (1st course, 1st semester) (6.0 ECTS)</th>
<th>WEIGHT (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>FINITE DIMENSION VECTOR SPACES</td>
<td>10.00</td>
</tr>
<tr>
<td>2</td>
<td>MATRIX ALGEBRA</td>
<td>10.00</td>
</tr>
<tr>
<td>3</td>
<td>LINEAR EQUATION SYSTEMS</td>
<td>15.00</td>
</tr>
<tr>
<td>4</td>
<td>EUCLIDEAN VECTOR SPACES</td>
<td>20.00</td>
</tr>
<tr>
<td>5</td>
<td>SPECTRAL THEORY</td>
<td>10.00</td>
</tr>
<tr>
<td>6</td>
<td>Practical applications in the Mathematica programming environment by using algebraic and numerical techniques (5 two-hour practical sessions)</td>
<td>15.00</td>
</tr>
<tr>
<td>7</td>
<td>Research monographic work (cooperative/collaborative teams)</td>
<td>20.00</td>
</tr>
</tbody>
</table>

**Fig. 3. The syllabus of Mathematical Grounds (competences-based).**

<table>
<thead>
<tr>
<th>COMPETENCE</th>
<th>MATHEMATICAL GROUNDS II (LINEAR ALGEBRA) (6.0 ECTS)</th>
<th>NUMBER OF CRITERIA FOR MEASURABLE OUTCOMES</th>
<th>WEIGHT (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Significant knowledge of the mathematical contents from an algebraic and numerical approach with practical applications from engineering fields</td>
<td>3</td>
<td>15.00</td>
</tr>
<tr>
<td>2</td>
<td>Numerical and symbolic modelling of linear continuous time-invariant dynamic systems via some professional programming environment</td>
<td>2</td>
<td>10.00</td>
</tr>
<tr>
<td>3</td>
<td>Obtaining of valid (reasoned and justified) conclusions from the results by efficiently managing the worked data</td>
<td>8</td>
<td>40.00</td>
</tr>
<tr>
<td>4</td>
<td>Design, implementation and management of a research project which will be produced in a collaborative team; then an scientific report will must be presented</td>
<td>5</td>
<td>30.00</td>
</tr>
<tr>
<td>5</td>
<td>To establish strategies and mechanisms to improve the learning quality through significant trainings and NICTs by considering policies such as sustainability, thrift, ethics, human rights, diversity, … and so on</td>
<td>3</td>
<td>10.00</td>
</tr>
</tbody>
</table>
The learning methodology, that is suggested in the sequel, shows undergraduates develop the competences involved (Fig. 3), but a lot care must be considered.

4. Problem solving

The applied scientific method is based on a cognitive-constructivist (Osborne-Wittrock’s approach) concept of the learning environment (figures 4-5) to produce significant learning (Phillips, 1995; Wertz et al., 2005): (1) the appropriate definition of the problem under consideration, with a discussion of the problem interest raised in connection with the descriptors of the course subjects; (2) the adequate knowledge of the physical mechanisms, describing the process being worked; (3) the statement of the objectives of the study (qualitative analysis stage), as well as the detection of the conditions that define the problem; (4) the generation of hypotheses for creative speculation; (5) the search for a solution, developing different methodologies and strategies; (6) the contrast interpretation of the results obtained; (7) analyzing other possible extensions of the study, and (8) the development of the corresponding writing and speech, according to a particular pattern (for example, a scientific article). To fix the experience reported in this paper the photoelectric effect will be considered. Afterwards, some more examples will be provided as work references.

2007’s timing PBL is presented in Fig. 6 (detailed information is provided in figure 8). The students’ team carries out the diverse stages of the research coached by the professor. The PBL approach application in the Course Project consists of designing and implementing a
Research Project (namely, the photoelectric effect) as an open problem to work in teams, using the scientific method: a technological situation must be modelled to focus the descriptors, the resources and the algebraic methodologies of the syllabus. Also, the relationships with other subjects must be reflected as the competences are evolving while using the Deming’s wheel (PDCA; i.e., Plan-Do-Check-Act) work system. As a consequence, the following steps are taking into account:

Fig. 5. The process oriented research.

S1: The Course Project is enunciated as an open problem by the team: The photoelectric effect sets up that the minimum voltage \( V \) to make an electron to leave a surface is a function of the frequency \( \nu \) (Hz) of the incidental radiation and of a certain function \( \phi \), which is characteristic of each surface. Looking at the existing literature, one must select several experimental data to estimate the values of the constants \( h \) (Planck’s constant) and \( \phi \) so as to determine which such a surface is (Fig. 8).

S2: To take into account the PBL approach (Figs. 4, 5 and 7).

S3: To pose the problem via a matrix, vector or numerical modelling to establish the dependence between the existing variables \( eV_0 = h\nu - \phi \) being \( \nu > \nu_1 = \phi/h \) the minimum frequency. At the same time, the work hypotheses are established (Fig. 8).

S4: The theory key points must be revisited to have a good understanding: a concept map is usually provided with every unit as an information help.
A Course Project: An Overview from the PBL “as-Research-Oriented” Viewpoint

Research Project (namely, the photoelectric effect) as an open problem to work in teams, using the scientific method: a technological situation must be modelled to focus the descriptors, the resources and the algebraic methodologies of the syllabus. Also, the relationships with other subjects must be reflected as the competences are evolving while using the Deming's wheel (PDCA; i.e., Plan-Do-Check-Act) work system. As a consequence, the following steps are taking into account:

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**S2:** To take into account the PBL approach (Figs. 4, 5 and 7).

**S3:** To pose the problem via a matrix, vector or numerical modelling to establish the dependence between the existing variables \( \nu eV h, \nu, \phi \). At the same time, the work hypotheses are established (Fig. 8).

**S4:** The theory key points must be revisited to have a good understanding: a concept map is usually provided with every unit as an information help.

**Fig. 6. The Course Project definition.**

**Fig. 7. The PBL approach working concept.**

<table>
<thead>
<tr>
<th>Step</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>What do we understand about...? Clarification of terms - Building a common understanding</td>
</tr>
<tr>
<td>2</td>
<td>What are the questions, problems, fields of problems? (Hypothesis?) Which problems have to be tackled first to find a solution? Definition, Analysis, Weighting of the problems</td>
</tr>
<tr>
<td>3</td>
<td>Connecting with previous knowledge</td>
</tr>
<tr>
<td>4</td>
<td>What knowledge do we miss? Gap Analysis - Finding knowledge deficits</td>
</tr>
<tr>
<td>5</td>
<td>Specifying the learning targets, deriving the work packages and distributing them among students</td>
</tr>
<tr>
<td>6</td>
<td>Carrying out the work packages</td>
</tr>
<tr>
<td>7</td>
<td>Discussion of the solution and the its approach with an expert</td>
</tr>
</tbody>
</table>

**Fig. 8. Experimental data for the photoelectric effect.**

<table>
<thead>
<tr>
<th>( \nu ) (Hz x10^{-3})</th>
<th>56</th>
<th>70</th>
<th>79</th>
<th>83</th>
<th>102</th>
<th>120</th>
</tr>
</thead>
<tbody>
<tr>
<td>( V_0 ) (V)</td>
<td>0.05</td>
<td>1.00</td>
<td>1.40</td>
<td>1.74</td>
<td>2.43</td>
<td>3.00</td>
</tr>
</tbody>
</table>

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S5: How the student can be coached to reach a true mathematical comprehension in order to determine the concept structure and the relationships of the involved mathematical units? (Figs. 6, 7 and 9).

Fig. 9. Flow diagram of the Course Project implementation (formative and additive assessment in blue colour).

S6: Which are the student’s main difficulties? The PBL approach is an adequate tool to develop the problems, the algebraic descriptors usually pose: the vector space idea, different algebraic tools for numerical computation, situations where high dimensionality appears, systems with overdetermined data, the spectral theory to summarize systems up, the analysis of the physical systems response, …

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S7: To establish the connections with other units of the syllabus or with other subjects of the degree: a good tutoring (namely, facilitation) is basic to adequately coach the team.

S8: The problem solving is made by a using a computer to emphasize the results discussion and to look for the appropriate explanations. Here, several problems can be detected which are related to the team/student’s working way. Consequently, additional objectives must be defined and the corresponding activities implemented to solve these difficulties (Fig. 13).

S9: The team should look for other technical situations to compare with: electronic, mechanical, chemical, economic, biological, hydraulic, neurophysiological … models.

S10: The solution is reported as a scientific article and an oral presentation is compulsory. The report includes: (1) a graphical plot, (2) the data preparation, (3) the mathematical model of the information, (4) a solving proposal, (5) the algebraic and numerical methods that have been used, (6) the results preparation, (7) the results obtaining, (8) the results interpretation and discussions and (9) the coherence of the supplied data and the analysis of the errors achieved. A help template is provided to do it.

S11: The student’s opinion is essential: so that the team must write a short essay over the experience and each student must fulfill an opinion poll on the learning-teaching process. The following questions are suggested as a guide:

✓ Is the student satisfied?
✓ The student, gets a significant training in an efficient manner in order to acquire new competences, skills and/or procedural knowledge?
✓ Does he/she apply these new strategies in his/her curriculum in an appropriate way?
✓ The changes that succeed in the student’s learning-teaching process, do they improve the considered teaching system?

S12: The evaluation is inner and outer: at the beginning of the course the evaluation criteria are discussed with the students and some consensus is reached. Then, each team evaluates its work which is discussed with the professor in an interview (inner evaluation) and the remaining teams do evaluate the oral presentation, which must be given (outer evaluation) (see Figs. 9, 10 and 13).

There are many examples that can be used to develop the PBL approach to work in a Course Project at the University in a first course. Some examples (that can be coordinated with other subjects) are: the vibration analysis, the phase plane study, the approximation theory in a lot of environments –for instance, when tendencies are important, non-linear systems linearization, the discussion of the algebraic properties of (continuous time and discrete time) linear systems, … Those examples allow to follow the student’s progress (formative evaluation) and also to discuss his/her development (in the sense of evolution) (additive evaluation) from the measurable outcomes (Wolf, 1994; Stake, 2004).
5. Result discussion

If nothing is said, the results provided are for the 2007/08’s course. The mean time that a student has employed in the Project has been $t_{PFC} = 12.30$ hours (12%) (in class has been $t_p = 3.55$ hours (30%) and the self-work $t_{sp} = 8.75$ hours (70%)) (Fig. 9). Fig. 10 is the Gantt’s diagram of the Course Project timing during the semester (see Fig. 6). The students suggest in the individual reports that the initial project objectives are quite demanding, but the final questionnaire show great agreement.

During this time period each student has done 1.24 (2004/05), 2.38 (2005/06) and 1.98 hours (2007/08) of help session. The 96.34 % has said that the tutoring session is an important task but only the 63 % of the students has used it as a regular activity.

Evaluation results are quite interesting (Fig. 11). A lot of students take the Course Project with quite good results, although teams are not big (3 or 4 people per group) and many students don’t take the continuous evaluation (the causes are very diverse). There exist significant differences in 2004/05 and 2006/07 versus 2005/06 and 2007/08: the first ones correspond to

Fig. 10. The Gantt’s diagram of the Course Project timing.

Fig. 11. Result summary of the Course Project additive evaluation.
morning courses (more academic) and the second ones to evening courses (students usually are working and they require a more practical treatment).

The students’ opinion is going increasing every year. Results are quite good (Fig. 12) and they invite to use the PBL approach. However, these results can be improved, and the students can help in such a task.

<table>
<thead>
<tr>
<th>ITEM</th>
<th>POSITIVE ANSWER</th>
</tr>
</thead>
<tbody>
<tr>
<td>OBJECTIVES EXPLANATION</td>
<td>76%</td>
</tr>
<tr>
<td>FORMATIVE PROGRAM UNDERSTANDING</td>
<td>68%</td>
</tr>
<tr>
<td>COURSE PROJECT COMPETENCES</td>
<td>87%</td>
</tr>
<tr>
<td>SUPPLIED INFORMATION</td>
<td>78%</td>
</tr>
<tr>
<td>PROFESSOR’S HELP</td>
<td>89%</td>
</tr>
<tr>
<td>THE COURSE PROJECT IN THE SUBJECT</td>
<td>94%</td>
</tr>
<tr>
<td>HAS LEARNED TO WORK IN A TEAM?</td>
<td>75%</td>
</tr>
<tr>
<td>WORK ENVIRONMENT</td>
<td>96%</td>
</tr>
<tr>
<td>WOULD YOU WORK AGAIN WITH THIS PROFESSOR?</td>
<td>95%</td>
</tr>
<tr>
<td>GENERAL QUALIFICATION OF THE COURSE PROJECT</td>
<td>88%</td>
</tr>
<tr>
<td>PROFESSOR’S QUALIFICATION</td>
<td>87%</td>
</tr>
</tbody>
</table>

Fig. 12. Results of the 2007/08 student’s opinion questionnaire.

6. Facilitation

When developing a PBL Project course great care must be devoted to the tutoring task, above all in the first courses (namely, this is the case where strengthening work in basic sciences is called for (Shuman et al., 2005)); namely, focusing on improving the student’s communication (Hansen and Jensen, 2004). In this sense, facilitation must develop daily reflection: pre-session (to present a focus concerning group dynamics so that facilitative questions should be used to start reflection), ordinary supervision session (with timeouts to discuss focus and to play diverse roles) and post-session (to facilitate reflections on the focus). Furthermore, facilitation implies tutoring and supervision (sometimes, even control –see Figs. 9 and 10) to respond to student’s problems in terms of meta-skills. Several dimensions are taken into account: the intellectual dimension, the personal dimension, the social dimension, the practical dimension (with several viewpoints: providing support, encouraging independence, developing the interpersonal) and assessing research (formative assessment, creativity and originality, reliability and validity) (Light and Cox, 2001).

However, the teacher’s role must also be considered from a leadership point of view: from hierarchy/autocratic/consultative to autonomy/functional/contractual via cooperation/negotiation/consultative. This implies that the student/teacher relationships ought to include six dimensions: the planning dimension (goal-oriented, aims, ends and means), the meaning dimension (cognitive understanding of experience), the confronting dimension (raising awareness to individual and group resistance), the feeling dimension (addressing emotional competence and incompetence), the structuring dimension (methodology of structuring experiences) and the valuing dimension (creating a support climate that celebrates individuals) (Gregory, 2002; Savin-Baden, 2003; Tosey and Gregory, 2001). Fig. 13 reports some of the tasks that are considered during the facilitation process of the Project Course.
<table>
<thead>
<tr>
<th>ACTIVITY TO ASSESS</th>
<th>COMPETENCE</th>
<th>APTITUDE FOCUSED</th>
<th>QUESTION TO POSE/ APPROACH COVERED</th>
</tr>
</thead>
<tbody>
<tr>
<td>Looking for the best information in an optimum way</td>
<td>FA</td>
<td>C4</td>
<td>The individualization of the LTP: task assignment</td>
</tr>
<tr>
<td>Definition of the open problem based on the given standards</td>
<td>AA</td>
<td>C4</td>
<td>Student’s proactive participation and implication</td>
</tr>
<tr>
<td>Role playing in the team/group</td>
<td>FA</td>
<td>C5</td>
<td>Contribution to the cooperative spirit of the team/group</td>
</tr>
<tr>
<td>Forecasting of the difficulties which could come up/arise</td>
<td>FA</td>
<td>C5</td>
<td>Qualitative analysis of the solution found out</td>
</tr>
<tr>
<td>Look for values to settle the numeric problem down</td>
<td>FA</td>
<td>C4</td>
<td>Coordination and linking with other subjects of the degree</td>
</tr>
<tr>
<td>Resolution approach and formulation</td>
<td>FA</td>
<td>C5</td>
<td>Task arrangement</td>
</tr>
<tr>
<td>Result contrast related to the planned outcomes</td>
<td>AA</td>
<td>C4</td>
<td>Coherence between the obtained results and the theory applied</td>
</tr>
<tr>
<td>Analysis of the difficulties that have been encountered</td>
<td>FA</td>
<td>C4</td>
<td>Interesting contributions</td>
</tr>
<tr>
<td>Implementation computational costs</td>
<td>FA</td>
<td>C5</td>
<td>Result contrast</td>
</tr>
<tr>
<td>Teamwork applied methods</td>
<td>AA</td>
<td>C3</td>
<td>Self-assessment skills</td>
</tr>
<tr>
<td>Scientific report of the project experience</td>
<td>AA</td>
<td>C4</td>
<td>Helping the use of an appropriate structure for the project approach of the group</td>
</tr>
<tr>
<td>Oral presentation of the report</td>
<td>AA</td>
<td>C5</td>
<td>Coherence of the defence presented</td>
</tr>
<tr>
<td>Last interview for assessment</td>
<td>FA</td>
<td>C5</td>
<td>Use of the procedural knowledge related to the subject</td>
</tr>
<tr>
<td>Attitude in the facilitation and tutoring times</td>
<td>FA</td>
<td>C4</td>
<td>A more emphatic relationship between undergraduates/students and the teaching staff</td>
</tr>
</tbody>
</table>

References hooked up and constructed used
Time used to do the seeking
The way in which is declared the future implementation of the Course Project Adequate justification of the choice posed
Reasoning about the given role playing proposal in the group
Has the group productivity been followed? How? Which tools have been employed?
How can be interpreted the resolution of any linear system equation in an approximate manner?
Can be a qualitative analysis of the problem made?
How the chosen data can be disposed in order to apply the algebraic theory of the syllabus?
Which methodology type is applied?
How the work is distributed among the group members?
Is there any concept map about the implementation developed? A Gannt’s diagram about times and role playing has been presented?
The results looked for have been attained?
The values obtained, can be justified?
How have been solved the encountered difficulties?
How the resources used have been managed?
A problematic situation will be suggested (it will be a direct consequence of the project his/her group has worked?
How the chosen data can be disposed in order to apply the algebraic theory of the syllabus?
Which methodology type is applied?
How the work is distributed among the group members?
Is there any concept map about the implementation developed? A Gannt’s diagram about times and role playing has been presented?

Fig. 13. Some questions that are posed to students along the help/tutoring sessions (FA means formative assessment; AA stands for additive assessment).

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7. Conclusions

An application tour to a Problem-Based Learning approach has been reported. In contrast to other approaches, PBL not only emphasizes the work on the case study, self study and knowledge transfer among group members, but also the process of teamwork and the quality of the solution found by the students. With PBL an elaborate concept is presented; from the learning targets for our students to the marking all elements are well-coordinated. The aim of all the pedagogical efforts is to provide our students with decision-making and responsibility for their future vocational field. We analyze the possibilities of a course project based on the PBL methodology for teaching problem solving: its strengths and its weaknesses are emphasized. In other words, we conceive the possibility of proposing a vision for overcoming the teaching methods of problem solving in Science and Engineering, which in line with the model of learning as a research-oriented, leads to a methodological change in a way that the students arrive to be able to cope more successfully open-statement problems, for their educational level. The proposal is not characterized by dramatic changes in the structure of the education system but for qualitative changes in the teaching strategies used in the classroom, the activities proposed by the students and by the sequencing of conceptual and methodological contents. All this involves a series of changes at three levels: a) changes in the task, b) changes in the structure of the class, and c) changes in its operation.

The resolutions of problems by students accustomed to implement the proposed model, features closely the characteristics of the 'scientific work' and increase its effectiveness as resolvents. The procedural knowledge involves declarative knowledge specific to the area, and at the same time, the acquisition of the declarative knowledge is a process of construction that makes implicit or explicit use of procedural knowledge. It is therefore reasonable to expect that the further development of those procedures could lead to a more comprehensive learning and greater efficiency in the resolution. Since 2002 we have been working quite successfully with this student-centered method in our regular curricula and the enhancement is everyday in progress:

- Taking on personal responsibility for the learning process,
- Identifying the significance of previous knowledge,
- Cross-linking and integrating of learning and teaching contents,
- Dealing with literature and information,
- Experiencing, testing and internalizing a method to solve problems,
- Learning and working in teams,
- Experiencing and understanding team processes,
- Reflecting own behaviour in a team,
- Leading discussions on a high level, and so on.

8. Acknowledgements

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9. References


Since many decades Education Science and Technology has achieved tremendous recognition and has been applied to a variety of disciplines, mainly Curriculum development, methodology to develop e-learning systems and education management. Many efforts have been taken to improve knowledge of students, researchers, educationists in the field of computer science and engineering. Still many problems to increase their knowledge on daily basis so this book provides newly innovations and ideas in the field of computer science and engineering to face the new challenges of current and future centuries. Basically this book open platform for creative discussion for future and current technologies to adapt new challenges in education sector at different levels which are essential to understand for the students, researchers, academic personals and industry related people to enhance their capabilities to capture new ideas and provides valuable contribution to an international community.

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