INTRODUCTION

- Design methodology courses help the development of skills to approach and solve badly defined problems, common in every day work of design and operational engineers. This ability and knowledge to work with diffuse and non-structured problems is highly desirable.
- This paper shows how teaching of design methodology is treated in the Mechanical Engineering habilitation of Escola Politécnica - USP. There are two disciplines about this subject: Design Methodology I in fifth semester and Design Methodology II in seventh semester.
- The first one shows the basic concepts of design and students develop a project of a new product. The second one deals with the project management, and it is based on teamwork in groups with about fifteen to twenty students. They are submitted to several common difficulties in design process, for example: lack of information, unclear authority, open problems and others.
- The observed result was the increase of important skills for engineers: communication, people management, problem definitions, analysis, solution synthesis and research.

PROJECT METHODOLOGY I
Objective

Project Methodology I objectives can be classified in knowledge and skills:

KNOWLEDGE

- Introduction to engineering project and product development
- Project spiral and production and consumption cycle
- Value analysis in projects and techniques for new ideas generation
- Feasibility analysis
- Basic project, including: stability, sensibility and compatibility analysis.

SKILLS

- Team working
- Oral and written professional communication
- General research development, not only with academic purposes.

- **Other disciplines occurring in the same semester are: Solid Mechanics I; Materials for Mechanical Construction; Fluid Mechanics II; Thermodynamics I; Vibrations; Mechanism Project**

PROJECT METHODOLOGY I
Program

- The program of the discipline was composed by expositive classes for presentation of its theory and a team project involving Feasibility Analysis and Basic Project of a product.
- The book used as a support material for expositive classes is KAMINSKI (2002).
- The topics of production and consumption cycle, feasibility analysis and basic project follow ASIMOV (1962) orientation.
- On the other hand, Project Spiral, very relevant topic of the discipline, has been successfully used in Naval Engineering (EVANS, 1959).

PROJECT METHODOLOGY I
Program

- **Project teams are composed by five to eight undergraduates and their themes varies each year:**
  - In 2001, it was the development of a domestic ventilator
  - In 2002, an automotive cooling system, in 2003, a toy with movements controlled by the child
  - In 2004, a medical/hospital device for domiciliary usage.

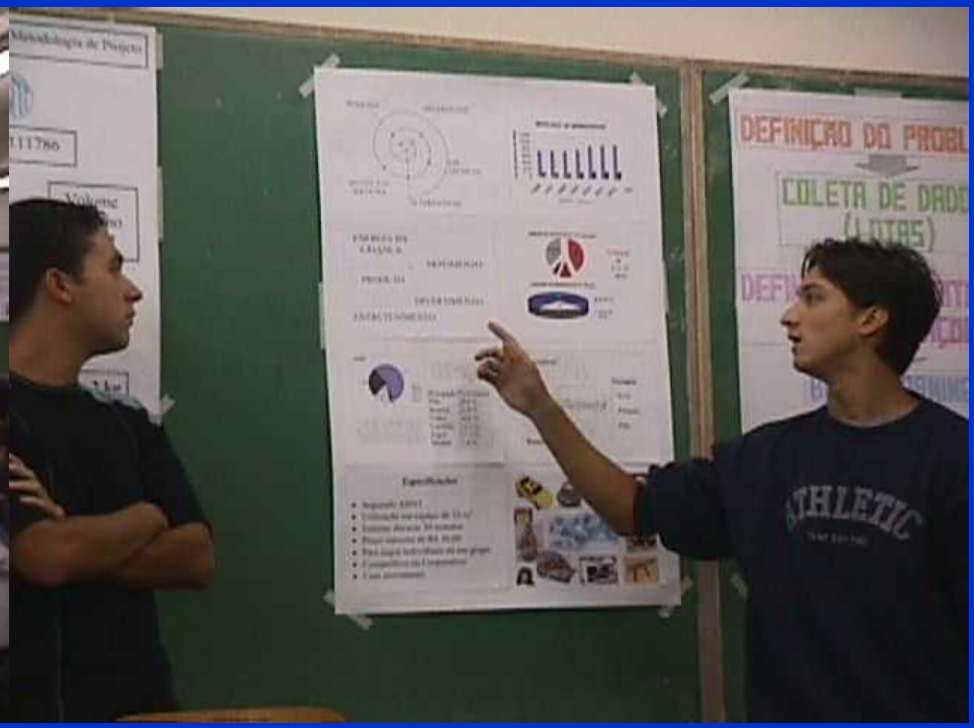
- **The main project characteristic is the absence of a defined structure, that means, an open problem, which is generally uncomfortable to be managed by students used to solving well defined structured problems, that most of times have a single solution.**
- **In the Feasibility Analysis, students are stimulated to begin with a real market or society need that must be identified and justified with collected information.**
- **Another recommendation for the development of the project is the most of the research must be done by visiting companies and interviewing professionals related to the product to be designed.**

PROJECT METHODOLOGY I
Program

Project follow up is done in specific classes in which each team presents to the professors all progresses obtained and difficulties faced to receive orientations for next steps.

Panel presentation in the discipline Project Methodology I

Poster presented in the panel of the discipline Project Methodology I



PROJECT METHODOLOGY I
Program

- Teams are supposed to prepare a preliminary project report containing the Feasibility Analysis. In the end of the semester, the Basic Project is prepared, also including a more detailed Feasibility Analysis.

- Grades consider the following issues: presentation, problem definition, development methodology, quality of alternatives presented and general presentation.

- Final evaluation is composed by grades attributed to each presentation, panels and reports.

- Besides, there are two written tests.

PROJECT METHODOLOGY I
Results

- It can be observed that the proposed activities are coherent with objectives of the discipline. The following issues must be emphasized:

  - A sensible improvement in oral and written presentation occurs in the second panel and in basic project.
  - The project proposal without a clear definition makes students uncomfortable because they are used to solving well-defined problems and following pre-determined structures (Hubka and Eder, 2003).
  - Topics integration occurs in two ways: by the contact with professors of other disciplines as consultants and by examples used by professors about projects under development in the semester.

PROJECT METHODOLOGY II
Objective

Project Methodology II objectives can also be classified in knowledge and skills:

KNOWLEDGE

- Project optimization.
- Project management. Planning and Organization.
- Quality in Projects. Quality systems in projects. Quality guarantee in projects.
- Forecasting and reliability analysis. Maintainability in project. Safety quantification.
- Project and environment. Ergonomics.
- Industrial property.

SKILLS

- Time management.
- Human and other resources management
- Research skills

- **Other disciplines occurring in the same semester are: Machine elements II; Thermodynamics II; Mechanical quantities measurement; Mass and heat transfers; Control and applications; Thermodynamics of compressible fluids and applications; Fluid-mechanical automation**

PROJECT METHODOLOGY II
Program

- Discipline program includes expositive classes for presentation of theory and a project of an enterprise.

- The expositive classes are supported by PMBOK (2000), provided to the students in the beginning of the discipline. More than fifteen students compose each team. The project scope must involve a real identified need and the results required are proportional to the number of people in the team, demanding organization and management of the team.

- Project follow up is done in specific classes in which each team individually presents to the professors all progresses obtained and difficulties faced to receive orientations for next steps.

- Evaluation is composed by grades for project follow up activities, reports and two written tests.

PROJECT METHODOLOGY II
Results

- There is an initial difficulty in the team organization with fifteen students or more that occurs in the first two weeks. After this period, the group develops tools for internal communication (all teams use “e-groups”) and tools for project integration.

- Another difficulty is the establishment of leaderships and hierarchies for team organization. All kinds of organization can be observed, from some with "positions and responsibilities" definition to informal ones. There is an odd leadership position avoided by students, sometimes the less adapted to leadership is nominated team leader, which harms the reach of project objectives. The best results were observed in groups that defined clearly the responsibilities of each element.

CONCLUSIONS

- The main contributions of Project Methodology I and II in Mechanical Engineering course is the involvement of subjective needs that must be converted in a well defined engineering problem.

- Engineering students generally receive clearly defined problems during their basic disciplines and instructions for development of experiments in labs. An open problem is more similar to professional reality.

- Sometimes, the information available is not enough or there is an excess of information. Dealing with this kind of problem creates an initial difficulty to students and provides benefits that will be noticed in their way to face problems.

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