

# Designing PBL scenarios for a course with integrated curriculum, team environment and use of technology

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## Principia PBL activities elements

### Principia program

Thought for freshman and sophomore years of engineering school, *Principia* is an educative model for engineering students which integrates the curriculum of basic sciences and basic courses of engineering. The main tools used in this program are problem based learning (PBL) and use of technology in classroom.

The model for construction of PBL activities includes the following dimensions:

- Environment
- Curriculum
- Framework
- Use of technology
- Development of formative objectives

### Stages of PBL activities

Three stages are constructed (two first to guaranteed the third, the PBL central activity):

- Knowledge acquirement
- Collaborative learning
- Problem

### Dimensions

| Levels | Levels | Levels | Levels | Levels |
|--------|--------|--------|--------|--------|
| N      | C      | F      | T      | F      |
| V      | U      | R      | E      | O      |
| I      | R      | A      | C      | R      |
| R      | I      | M      | H      | M      |
| O      | C      | E      | N      | A      |
| N      | W      | O      | S      | T      |
| M      | U      | O      | L      | I      |
| E      | L      | R      | M      | V      |
| N      | U      | K      | G      | E      |
| T      | M      | Y      | O      |        |

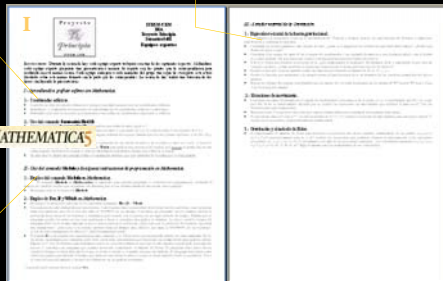
Abilities that may be developed:

- Teamwork
- Collaborative work
- Analysis and synthesis of information
- Identify and solve problems.
- Hardworking
- Use of technology

## Example of activity: object M-23041

Using *Mathematica* for rendering simulations

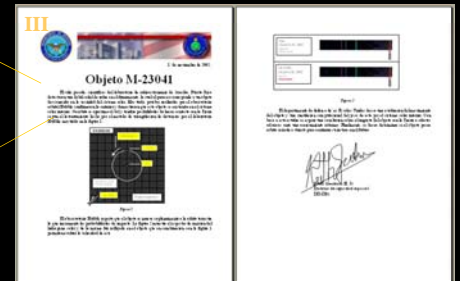
Relating contents with Physics: vector description of gravity




Integrating concepts and exchanging knowledge in an intermediate activity in advance of Problem Based Learning task: programming simulation of two bodies gravitational system

- Integrating:
- Mathematics
  - Physics
  - Programming

Problem Based Learning activity in which students will be simulate a three bodies gravitational system to establish if could be collision



In addition to curricula in each topic (vector calculus, gravitation and programming), students learn and integrate other themes: Doppler effect, Euler method in differential equations, dynamics.

Using *Mathematica* for programming numerical methods. Relating contents with Programming

## Stages of PBL activity

### STAGE I: Knowledge acquirement

#### Instructions and rules

**Teacher:** does not give the information, but gives orientation and feedback to each team.  
**Student:** each team may access the necessary sources of information.

#### Action elements

- Defined as an activity to develop competencies.
- Expert teams based in the ability of each student are conformed.

#### Way to work

Each team is divided to form expert teams conformed by elements of different teams.

#### Evaluation

Each expert team makes a presentation and is evaluated according to the activities specified in the outline.

### STAGE II: Collaborative Learning

**Teacher:** keeps the information and gives advice about the performance and amount of participation of each expert.

**Student:** Can't interact with other teams. Allows that each expert talks in each section of the activity.

- An applied activity is defined. It must allow the interaction and interchange of experiences from each student with his/her partners.

Base team joins to solve an intermediate activity where each expert contributes to team with individual knowledge.

Field evaluation (in what refers to efficiency and teamwork).

### STAGE III: Problem

**Teacher:** keeps the information. Watches the time and gives advice of the objective to the team.

**Student:** Can't interact with other teams and allows to each member participates equally.

- Problem that involves application of previous stages.
- Other contents within the analysis frame could be integrated.

The base team is oriented as a team to solve one more complex problem.

Evaluation is centered in a report in site that team prepares.

## Conclusions

The importance to create a consistent net of problems with the above dimensions allows developing sensitiveness and trust of student with respect the goal of each activity and the entire program. In addition, a net of problems under these considerations establish a frame of analysis and allows evaluate the recurrence to previous and future subjects. In this way the whole net is more important than the problem because it allows giving constant sense to PBL activity within the course.

Particularly using PBL activities within mathematics, physics and engineering courses, which include the use of computers as a tool, have not constituted a distortion to education at least in the students currently in the program. The evaluation of the students has been inside the global evaluation. The consistency of it with the results obtained is high.

