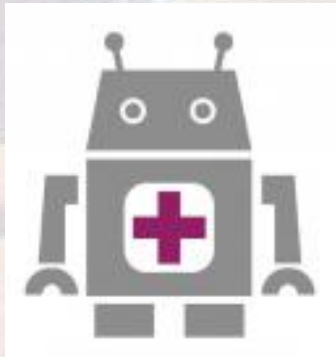


# Cad software to introduce robotic design process at school

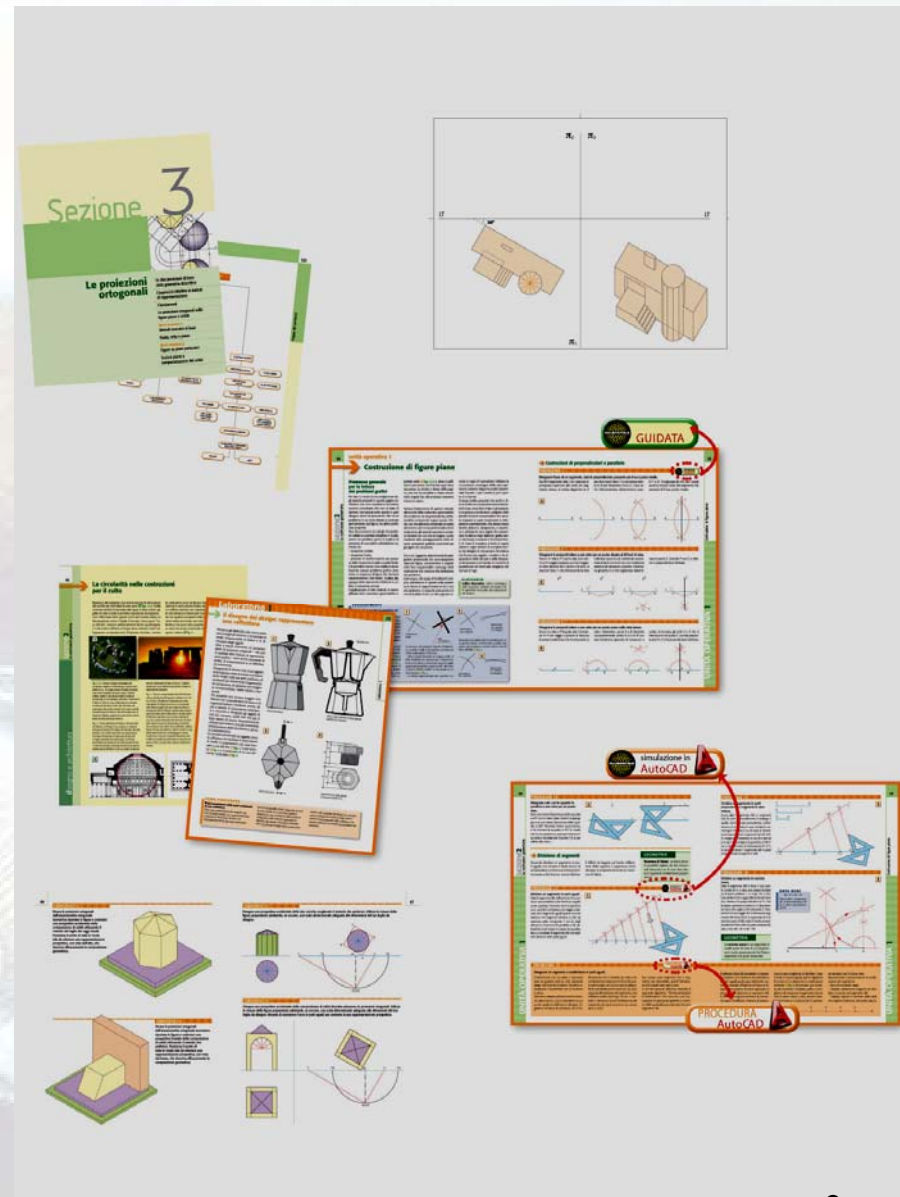


**Carlo Nati**

**[carlo.nati@istruzione.it](mailto:carlo.nati@istruzione.it)**

## School books:

images, charts, diagrams occupied a significant space within each chapter, combined more and more frequently with a CD-ROM or a web application that provide simulations and exercises to be used with the reference text.



It is a really deep “revolution” or if, even today, the cultural model is still based on the sheer learning of coded knowledge:



the teacher show something and the pupils look at the black/whiteboard!

Our hypothesis assumes that ICTs can constitute a higher pedagogic relevance if, by the use of them, we push the students to directly experiment learning paths of scientific or technologic type.



**Rocard report** - Improvements in science education should be brought about through new forms of pedagogy:  
the introduction of inquiry-based approaches in schools, actions for teachers training to IBSE, and the development of teachers' networks should be actively promoted and supported. .



**Rocard report** - Specific attention should be given to raising the participation of girls in key school science subjects and to increasing their self-confidence in science.



## Introduzione all'esperienza

**Our projects starts in 2004 with a path of action-research in collaboration with Prof. Colombi University of Bolzano and involved 5 Italian regions.**

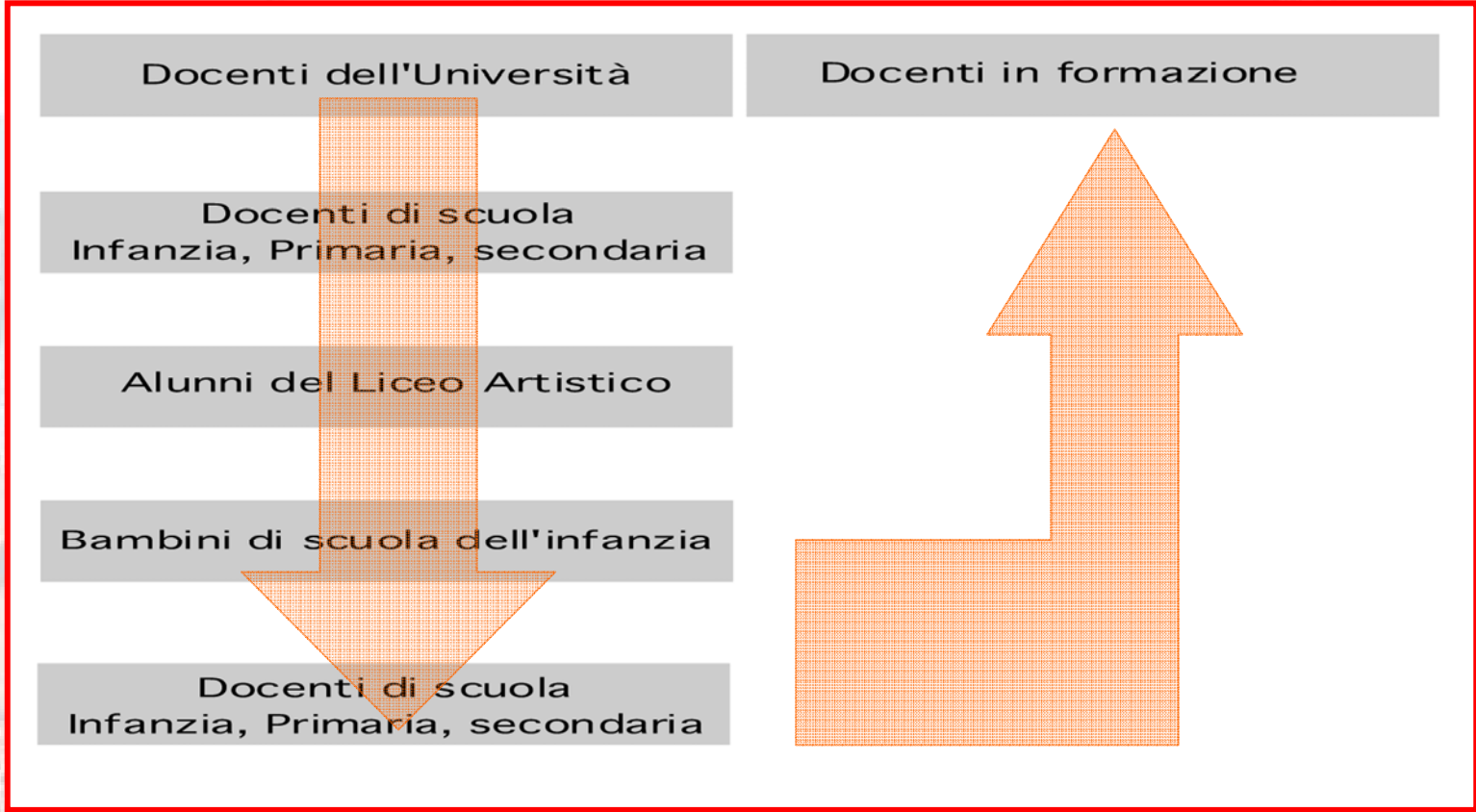


# Step 1: Latina, introductory meeting involved

**Nursery school, Primary school, secondary school**







## Step 2: operational testing space context



Liceo Artistico di Latina - classe 1° sez.D -

# Identification of the working groups

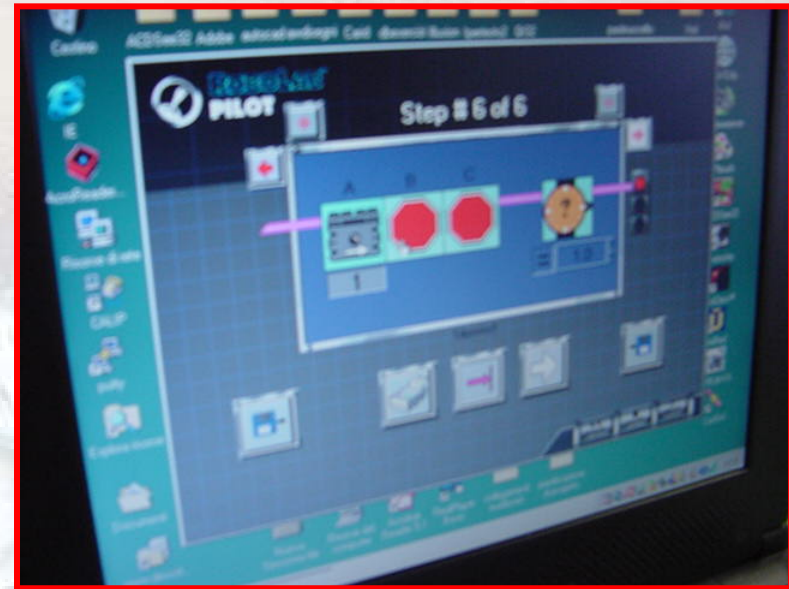


Constructing and programming Lego *robot*

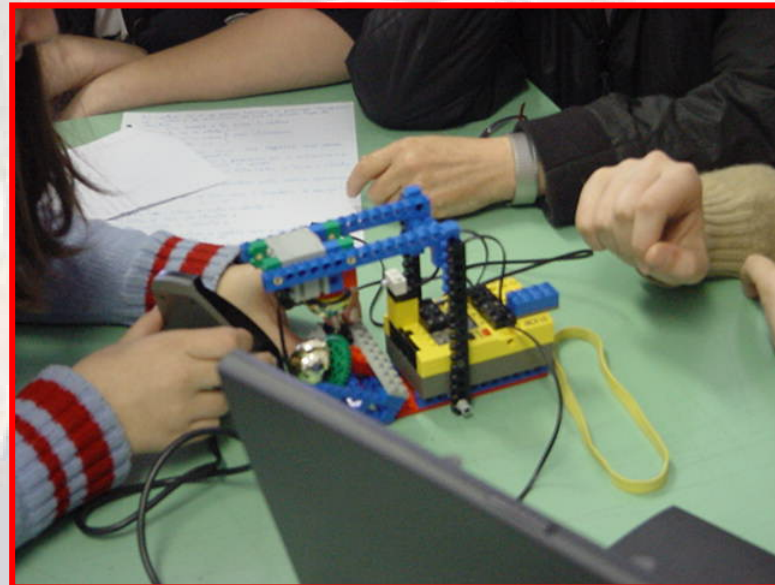
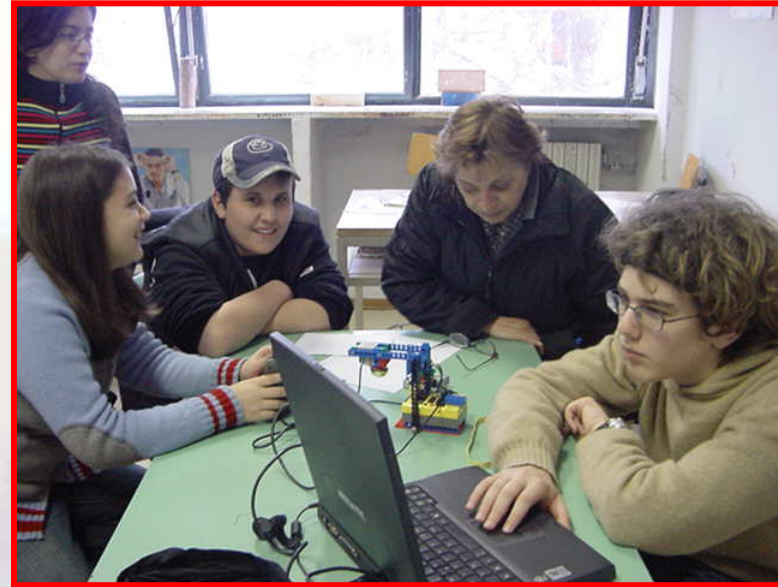


Design drawing

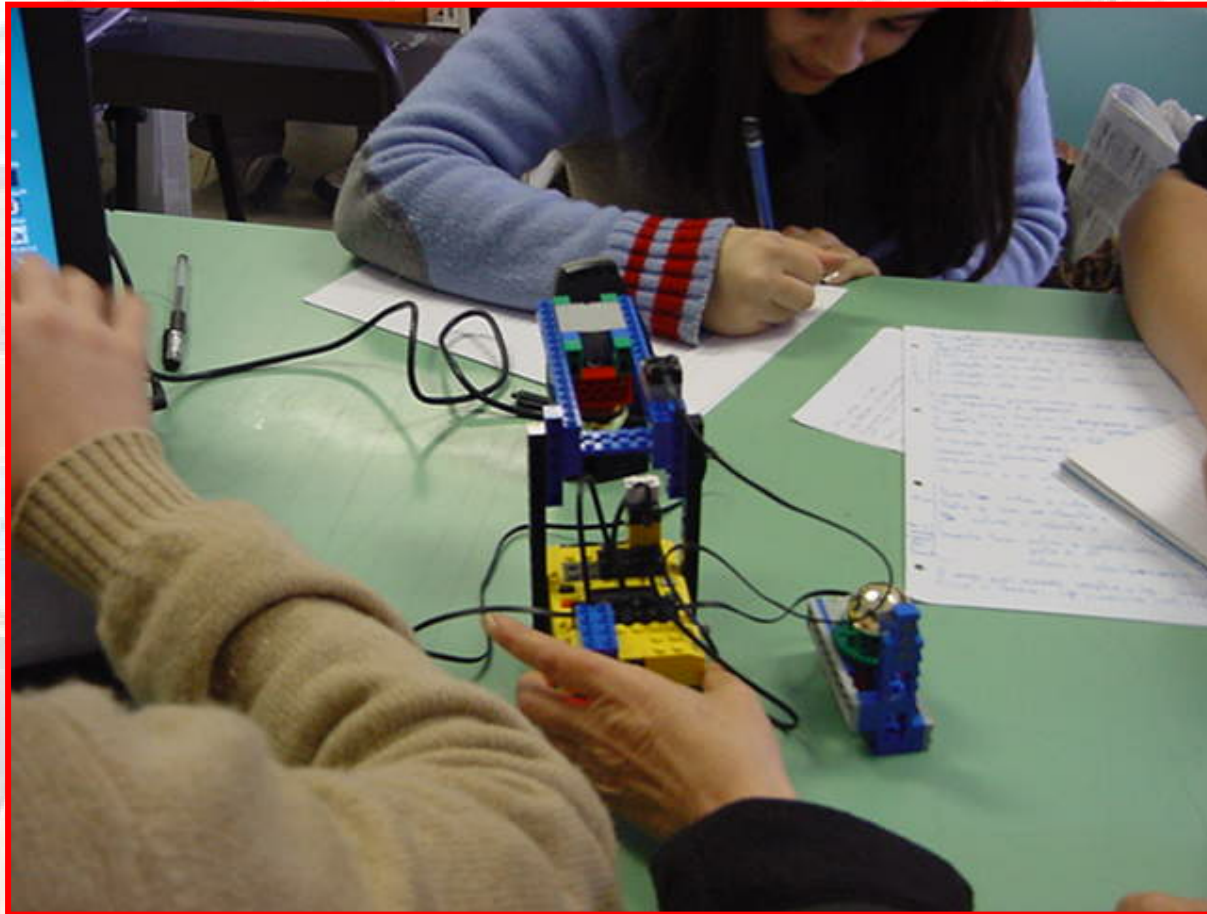
**the teacher explains the software**



## Direct testing of the robot



## Planning algorithms to interact with the robot



# Algorithms to interact with the Lego Robot

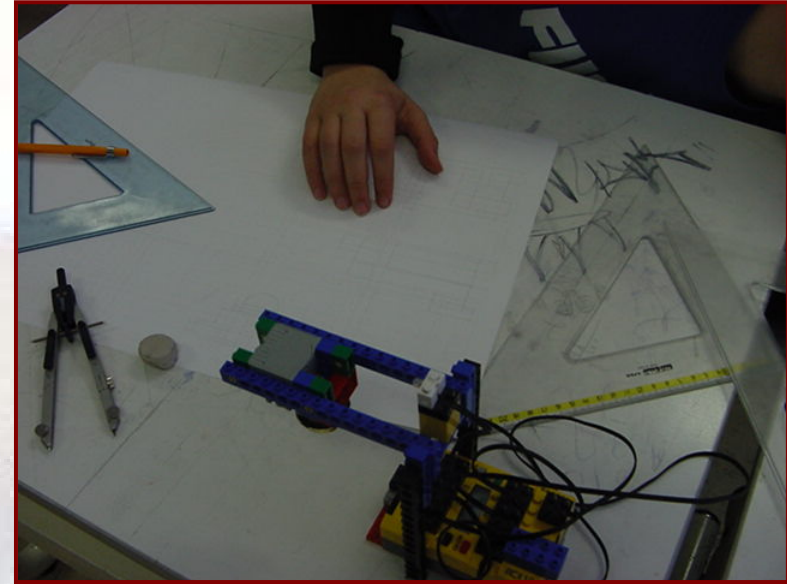
## Step 1 of 7.

- A: engine 1, counter-clockwise motion, speed 1
- B: light intensity 5
- C: engine 2, clockwise motion, speed 1
- D: if I switch on the contact sensor, then go from step 2 to step 7

## Step 2 of 7.

- A: engine 1, counter-clockwise motion, speed 4
- B: light off
- C: engine 2 off
- D: if I switch on the contact sensor, then go from step 3 to step 7

# Graphic representation of what they implemented





# PROBLEM SOLVING robot with wheels



## Step 3: Knowledge sharing



from secondary school to nursery school

## **Step 3: Knowledge sharing**



**from secondary school to nursery school**



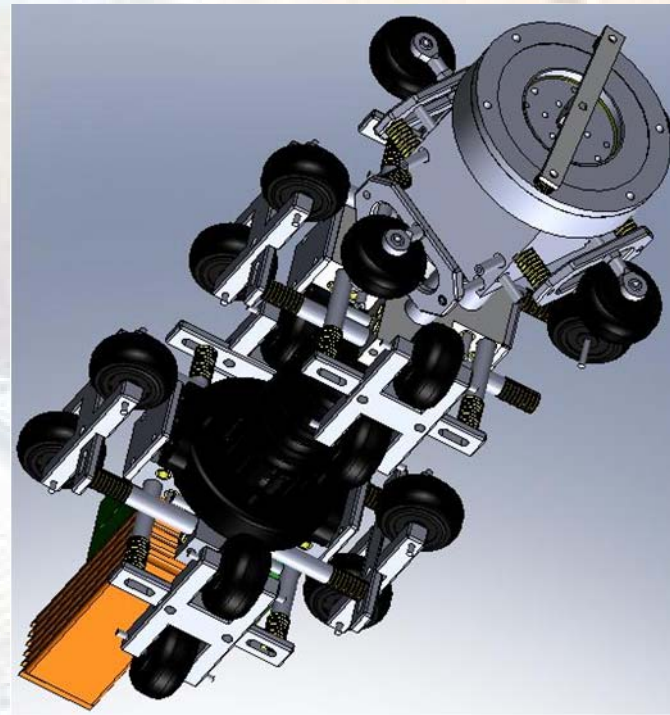
**Robotics in secondary school:  
age 14 -18**

**1) to develop disciplinary skills**

**2) to develop professional skills**

**Robotics to develop professional skills:**

**Technical/Professional schools  
Vocational education**



**ITIS Augusto Righi di Treviglio**

**Robotics to develop disciplinary or multi-disciplinary skills:**

**Art school for design**



**Art school for interior design: Latina, Italy**

## Drawings and design process

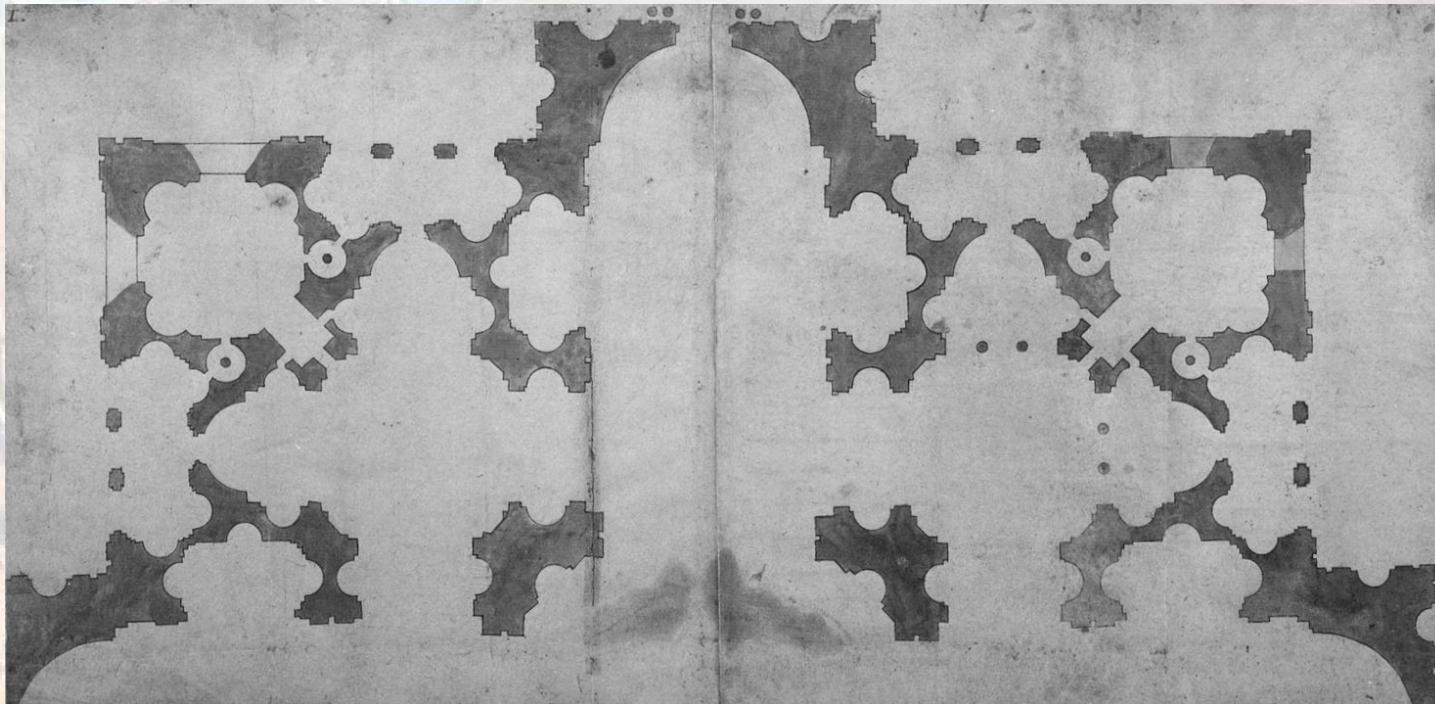
**Ortographic views:  
design drawing was used to represent the ideas**



**Forma urbis severiana: 203-211 AD  
Rappresentazioni di edifici in epoca romana**

The spirit of the times denotes the intellectual and cultural climate of a particular era:

*Drawing was strictly connected with culture and has changed its rules with the develop of society*



Donato Bramante: Pianta di S. Pietro: 1505 AD



## Perspective geometry

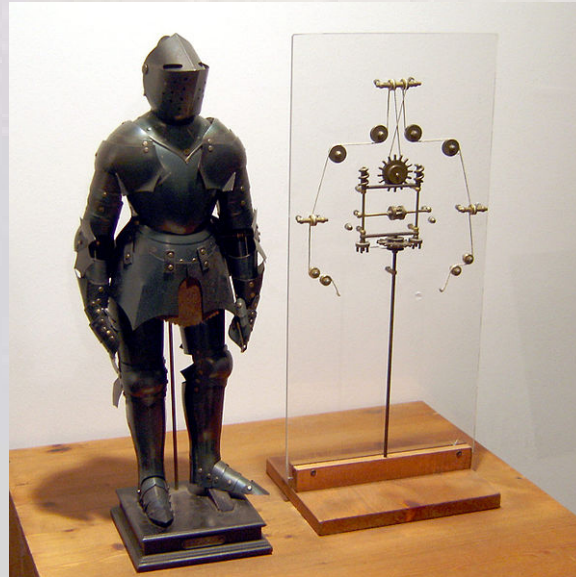
Perspective had a direct role in shaping Renaissance



Leonardo da Vinci: Adorazione dei magi – 1481 -

## Drawing (perspective) as a result of contemporary culture

From Leonardo to Galileo, toward the formalisation of the scientific method, graphic representation is closely connected with the project.



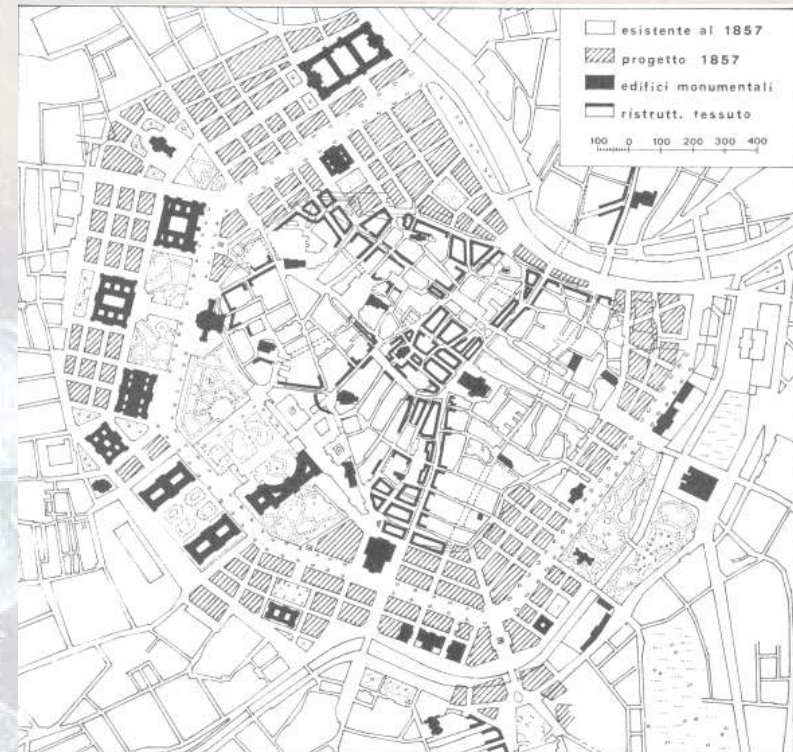
Model of Leonardo's robot with inner workings, as displayed in Berlin – 1495 -

# Drawing the city: the modern urban environment

New uses of technical drawings were able to plan what new ages ask to architects and engineers.



**Giovanni Battista Nolli:  
Pianta di Roma – 1748 -**



**Wien ringstrasse – 1857**

# The birth of industrial design

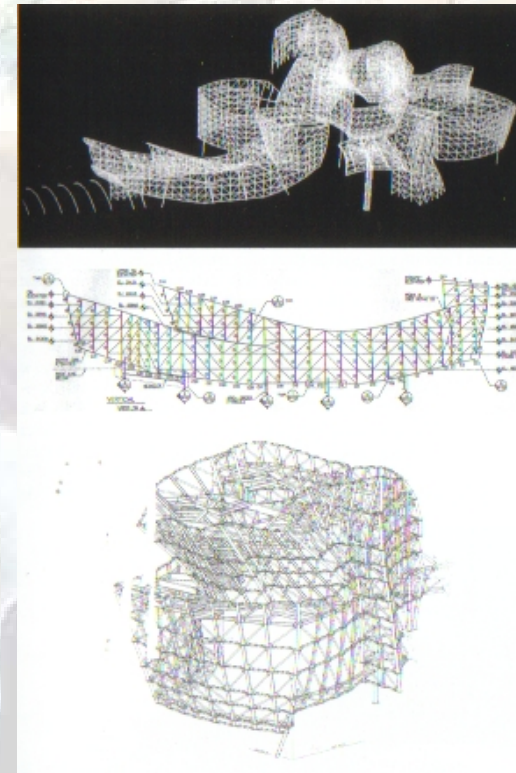


**BAUHAUS: 1919-1933**



**Technical drawing**, also known as **drafting**, is the act and discipline of composing plans that visually communicate how something functions or has to be constructed.

# Digital drawing: the new revolution



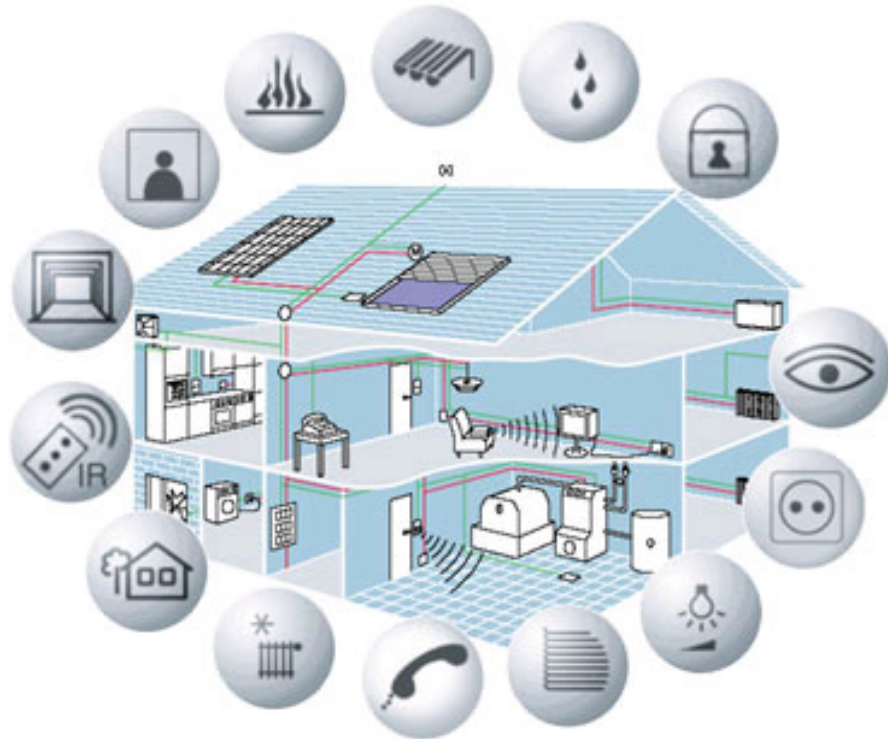
Digital drawing was a real revolution for people who has to manipulate an idea under construction

## Interior design and furnitures



Digital drawing has changed the way design projects has drawn and has changed the shape itself of the objects.

# Design drawing and domotics: new houses needs new way to represent plants into the buildings.



- ① Cavo **BUS** (12V) composto da 3 cavi di soli **0,5 mmq** ciascuno
- ② **Scatola derivazione** (alimentazione punti luce e pulsanti)

The word *domotics* means literally *home robotics*

**Other devices that have to deal with our area of interest**  
**Building and construction machines**



**Building and construction machines**



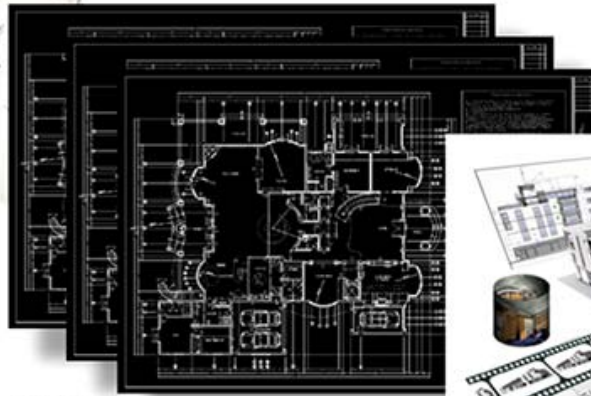
# PAPER, CAD, BIM

What is BIM

History 101



Paper



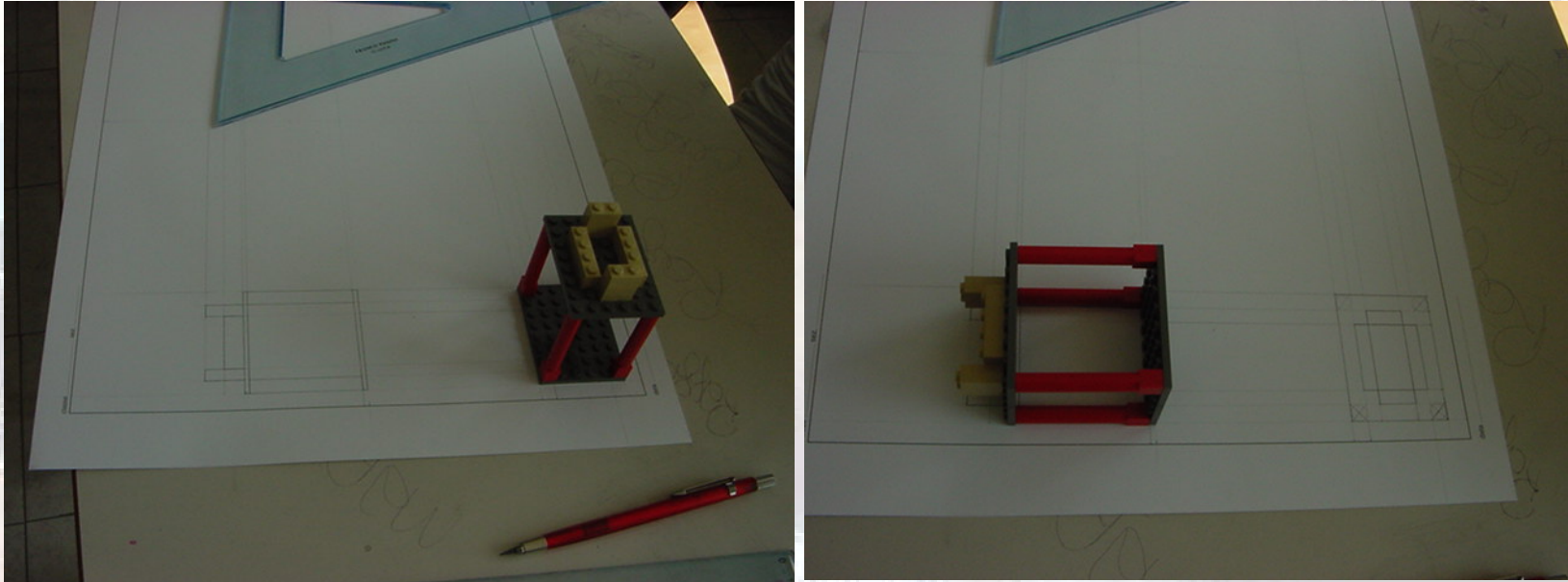
CAD



BIM

**At the moment, design drawing is moving from CAD to BIM: Building Information Modeling**

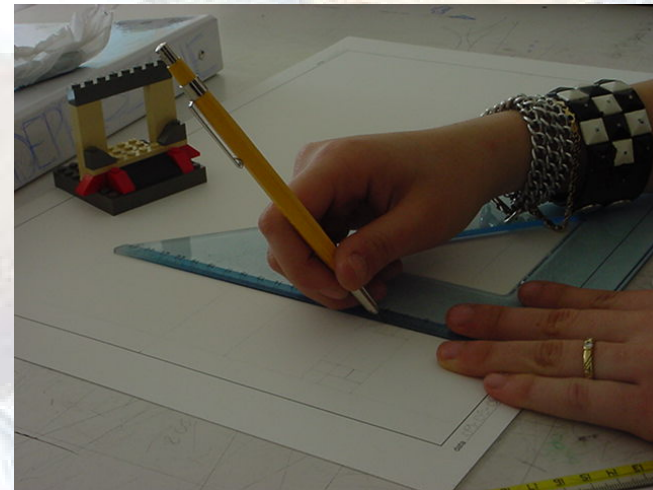
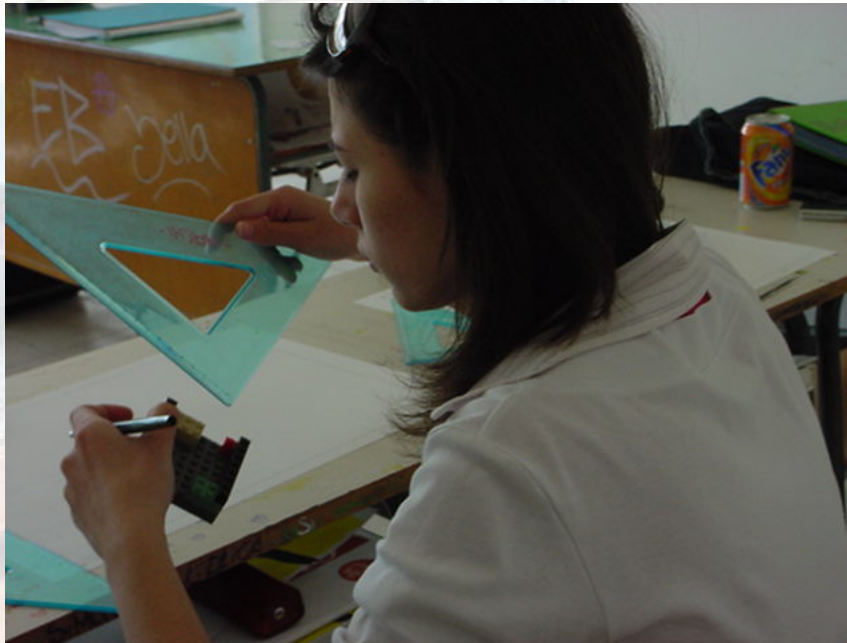
## **Disciplinary knowledge: the object and its graphical representation**



### **LEGO MODEL**

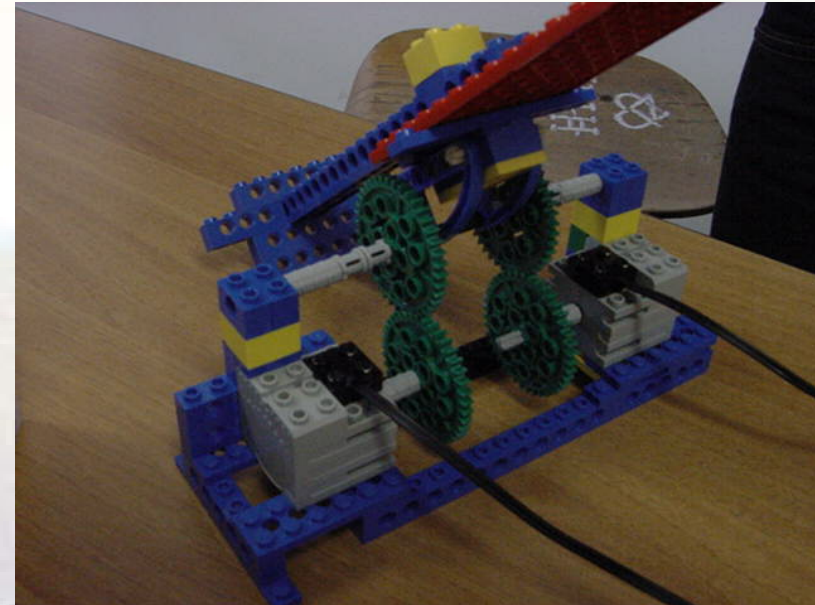
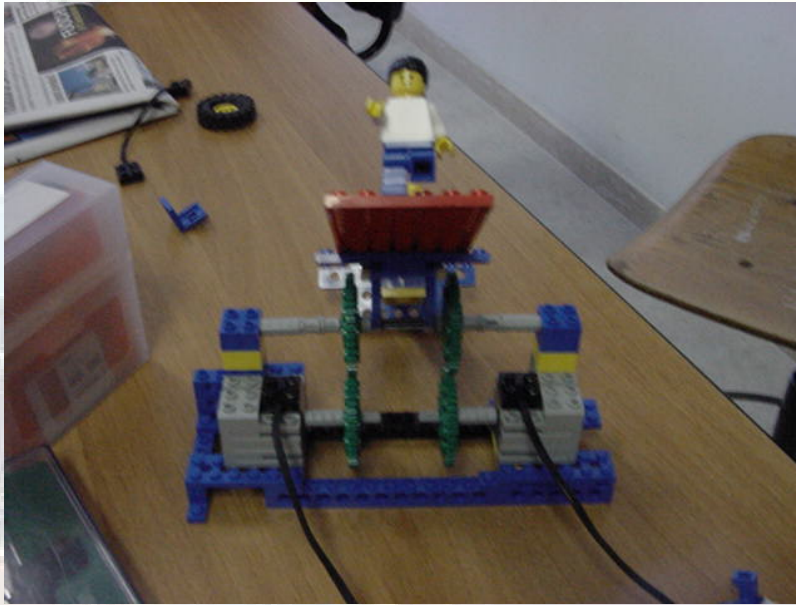
- to compare the graphical model and the real object
- to think about the scale of the drawing
- to think about the modularity of the elements

## Disciplinary knowledge: the object and its graphical representation



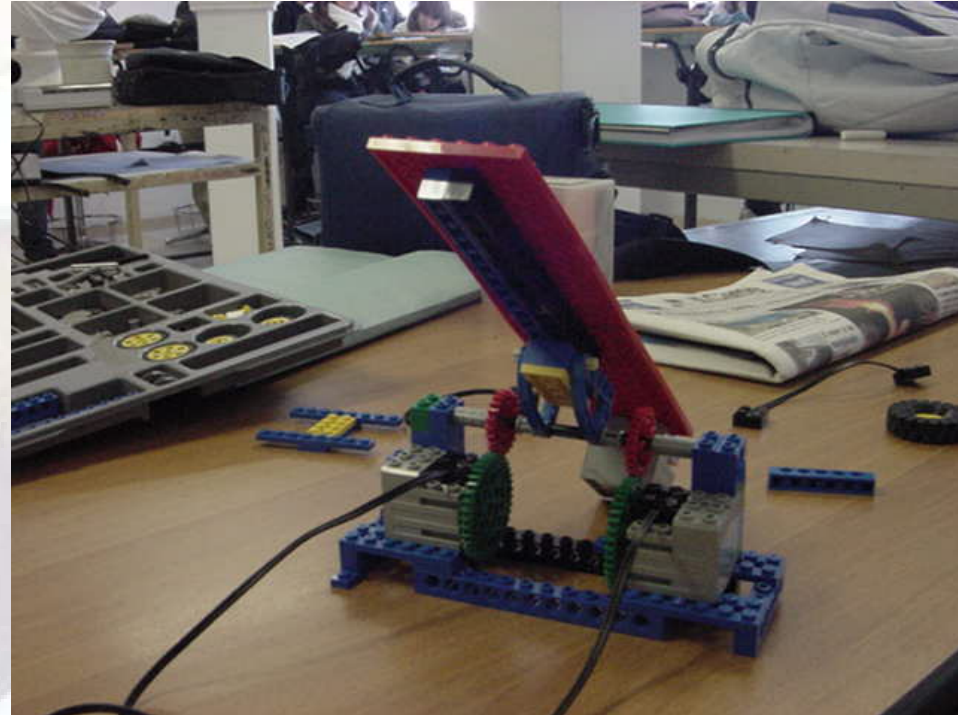
- to measure the object using different instruments

## Multi-Disciplinary knowledges



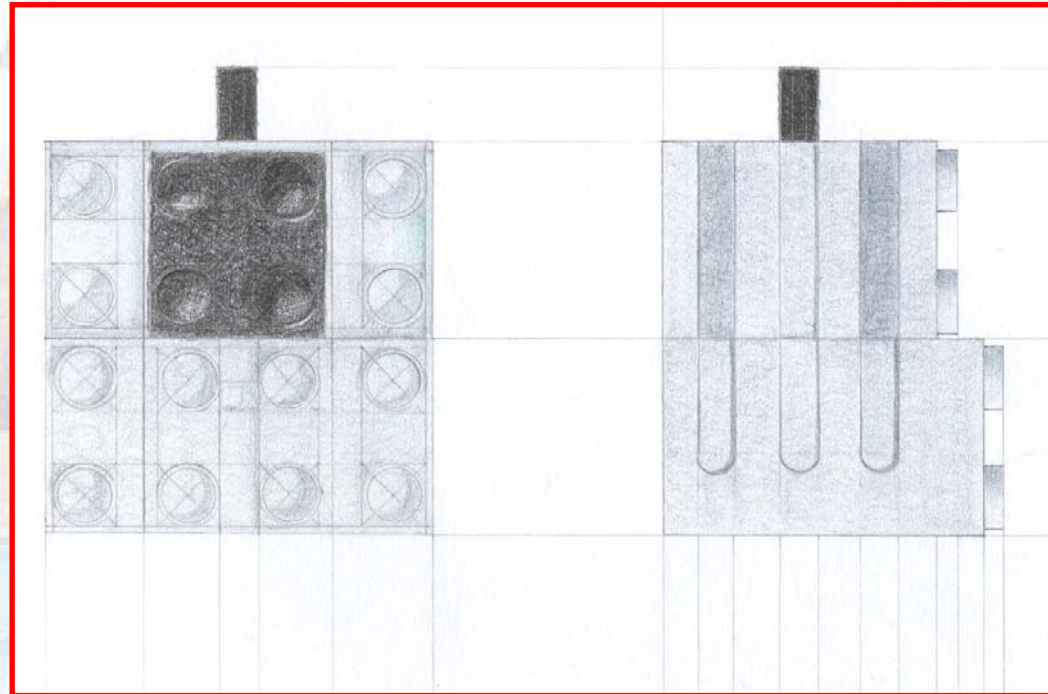
- Relationships between transmission of motion and dimension of the toothed wheels
- The weight of the elements and overload

## Multi-Disciplinary knowledges



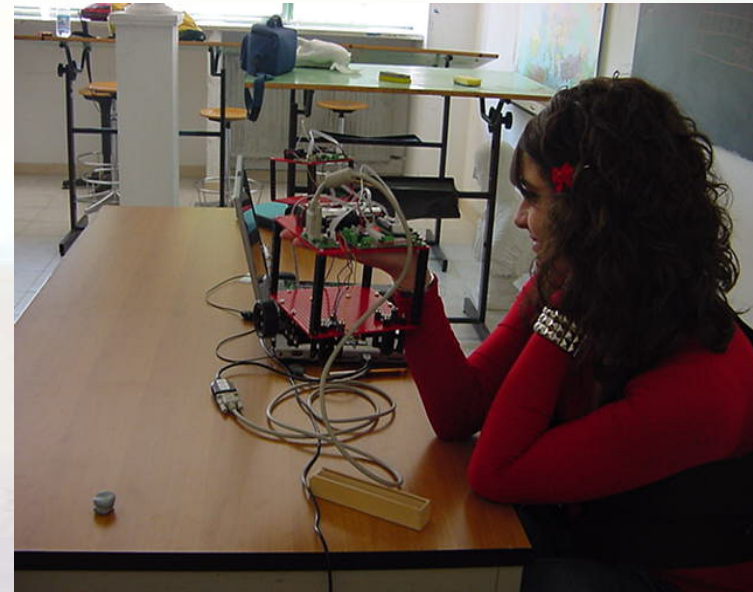
- Structure and length of the bascule element
- Inserting the touch sensor to activate / deactivate lifting

## Traditional design drawing: Lego electrical engine



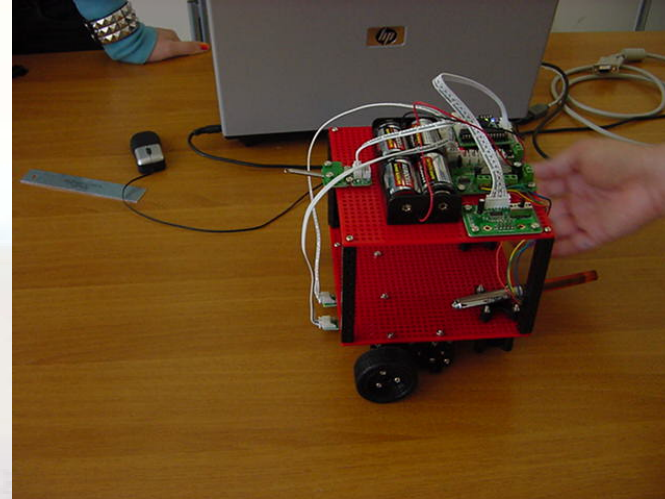
- to add color
- to add shadows

## Problem solving



- Issues about how to assemble elements
- Issues about understanding SW
- Issues about to simulate a behaviour
- Issues about to interact with the robot

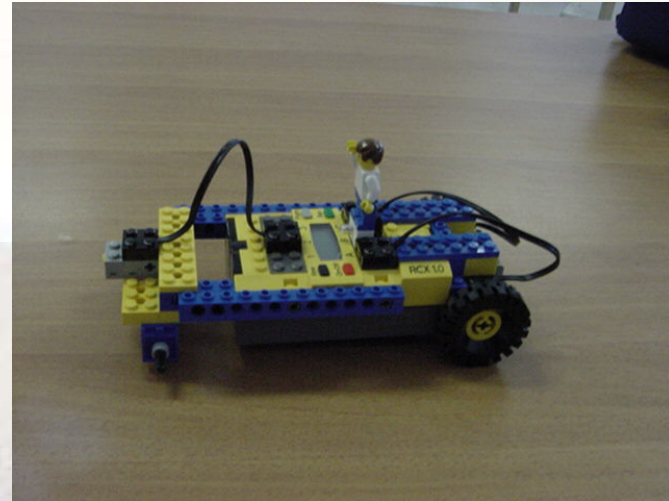
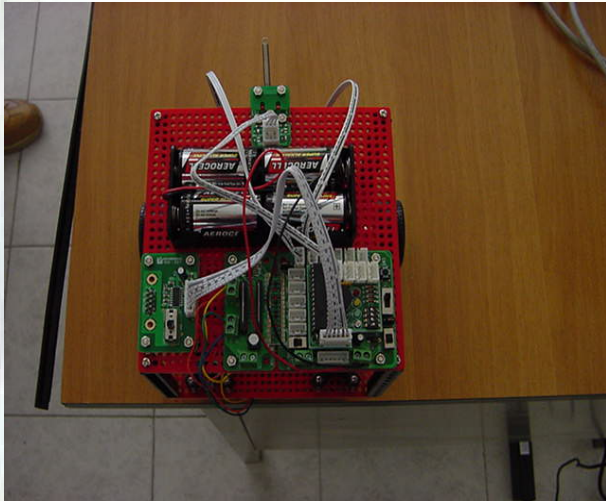
## Problem solving



- How to calculate speed cm/second
- How to measure an area (teacher desk)
- How to calculate time the robot need to reach the border
- How to plan a geometric path



## Analisi dei due robot



- Compare two different constructive system
- Compare softwares
- Compare the entyre environment

# Planning actios: how to represent a dynamic process-

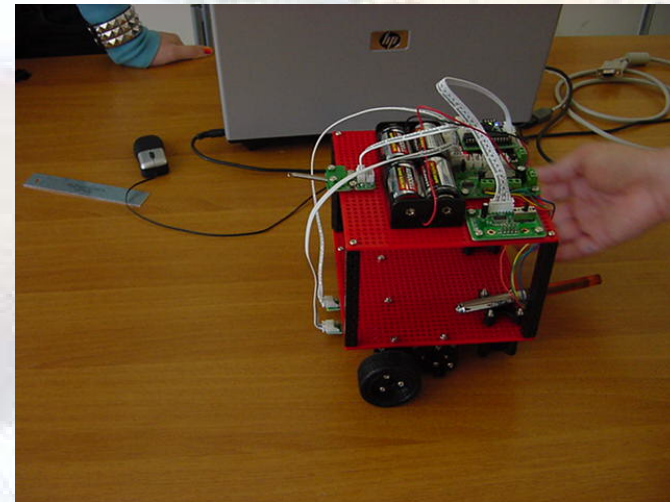
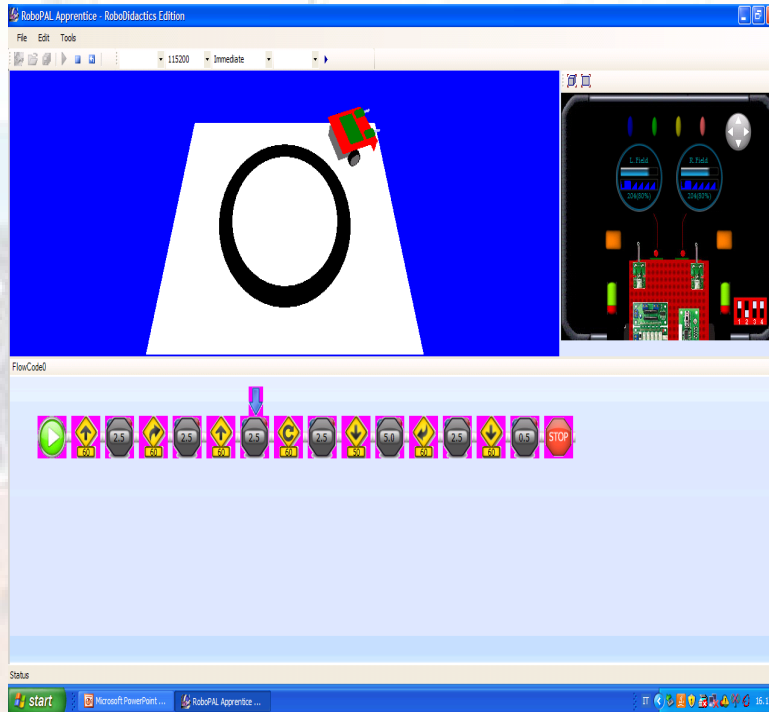
The screenshot displays the RoboPAL Apprentice software interface. The main workspace shows a red robot with two green wheels inside a circular arena. Below the arena, a sequence of traffic signs is shown, representing a dynamic process. The signs include a play button, a yellow diamond with a black border, a black octagon with a white border, a yellow diamond with a black border, a black octagon with a white border, a yellow diamond with a black border, a black octagon with a white border, a yellow diamond with a black border, a black octagon with a white border, a yellow diamond with a black border, a black octagon with a white border, a yellow diamond with a black border, a black octagon with a white border, and a yellow diamond with a black border.

semantic issues  
syntactic issues

– test n°1 – the drawing follow (or not) the formal algorith

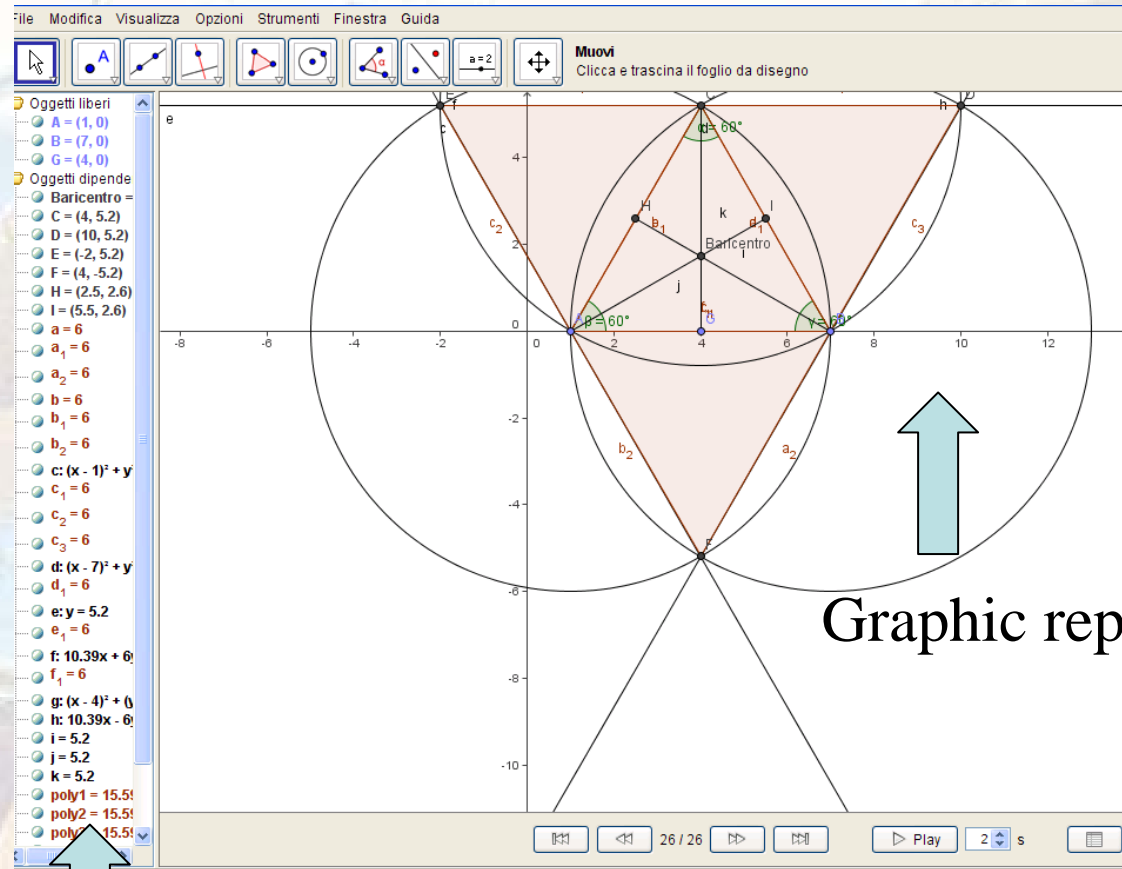
The screenshot displays the RoboPAL Apprentice software interface. The main window shows a blue environment with a white trapezoidal track containing a large black circle. A small red and green robot is positioned on the track. To the right, a detailed view of the robot's internal components is shown, including two motor fields labeled 'L. Field' and 'R. Field', each with a 20% battery indicator. Below the main window, a 'FlowCode0' sequence of commands is visible, consisting of a play button, a series of directional and speed commands (up, 2.5, right, 60, 2.5, up, 60, 2.5, right, 60, 2.5, down, 50, 5.0, right, 60, 2.5, down, 60, 0.5, and a STOP button), and a status bar at the bottom.

## Test n°2: the robot follow (or not) the formal algorytm-



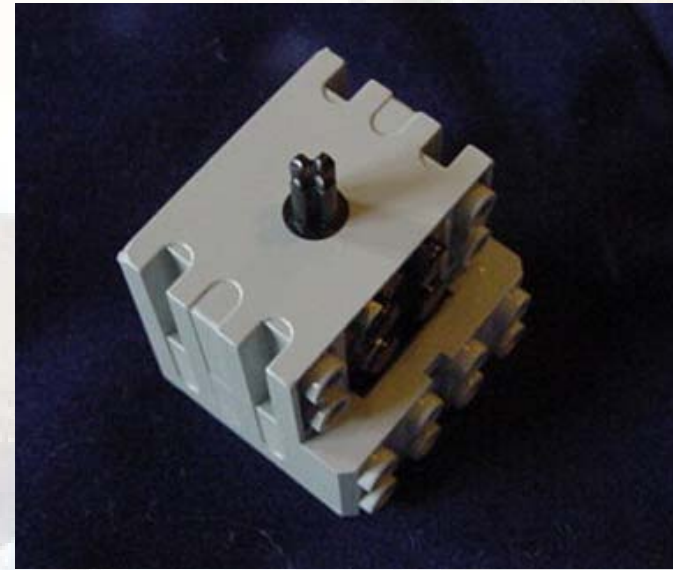
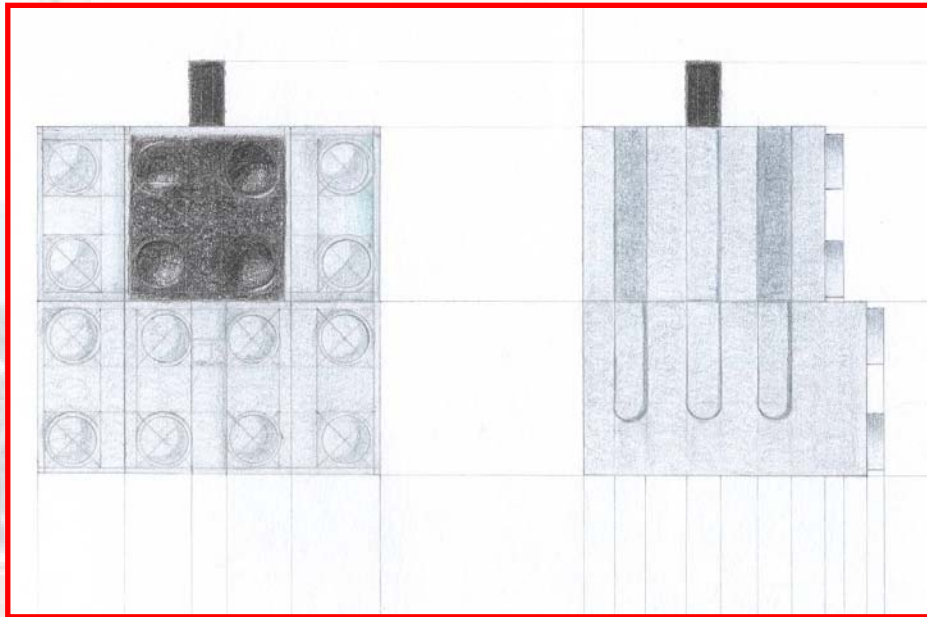
- Issues about comparing ideas with the real behaviour of the robot:
1. Compare theoretical model with reality
  2. Revise mistakes

# Geometric representation: Useful to take memory of a geometric process



Graphic representation

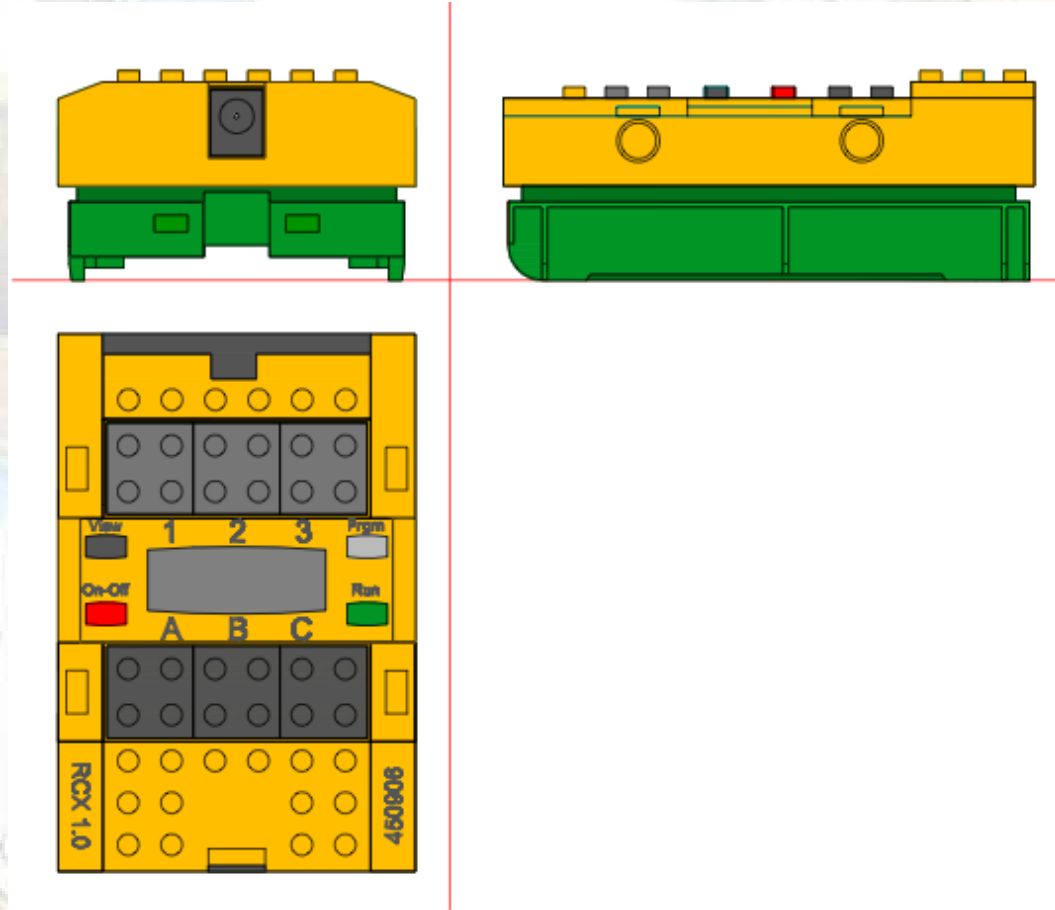
Formal representation



Graphic representation aims to imitate the real object

1. realize a graphic model – traditional tools or CAD
2. compare the model with the real object

# Graphic representation 2D software : AutoCAD



Technical drawing: 2D model – ortographic views -

## Graphic representation 3D modeling software : Blender



picture taken with a camera

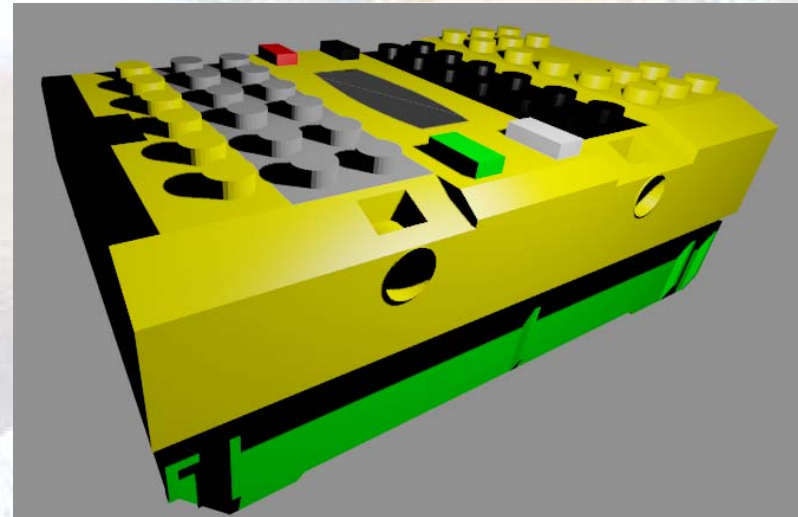
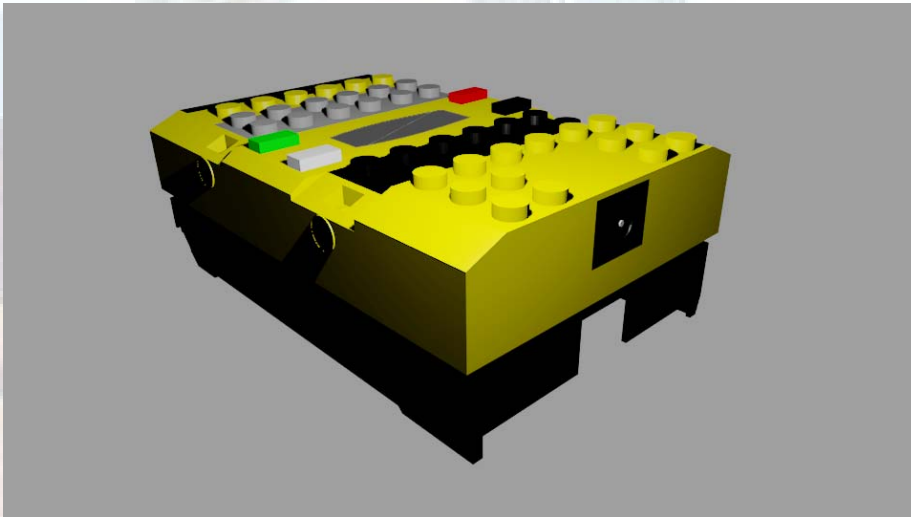


3D model

From a drawing that represent an object to a **simulation** of an object.



## 4D analysis of the model



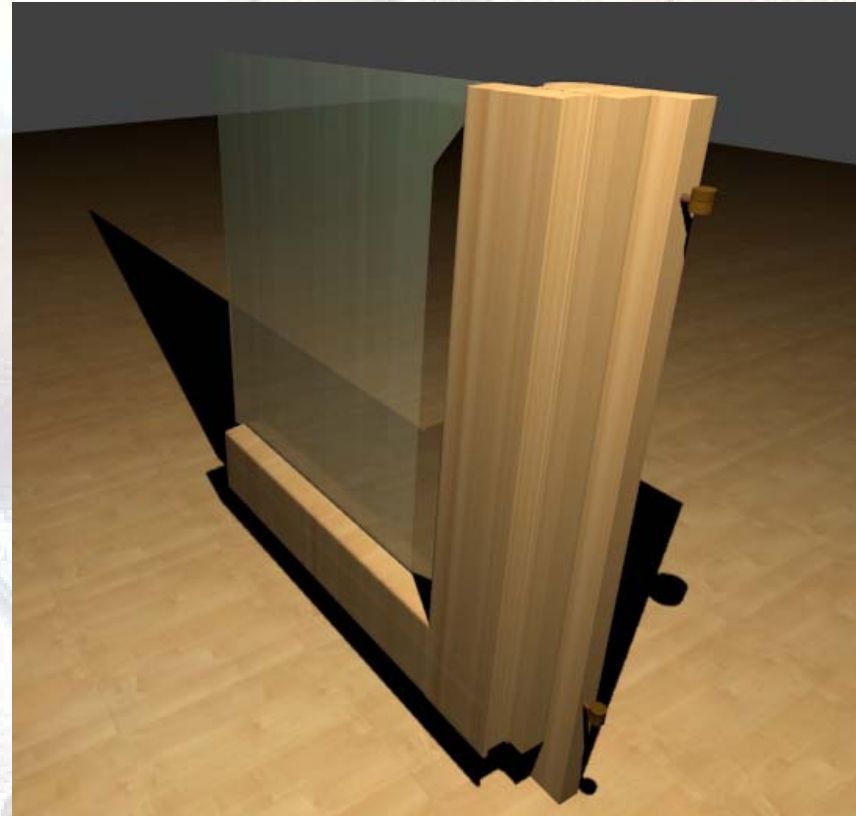
images from the same 3D object

From a drawing that represent an object to a **simulation** of an object

**3D modelling:  
Blender software - open source -**



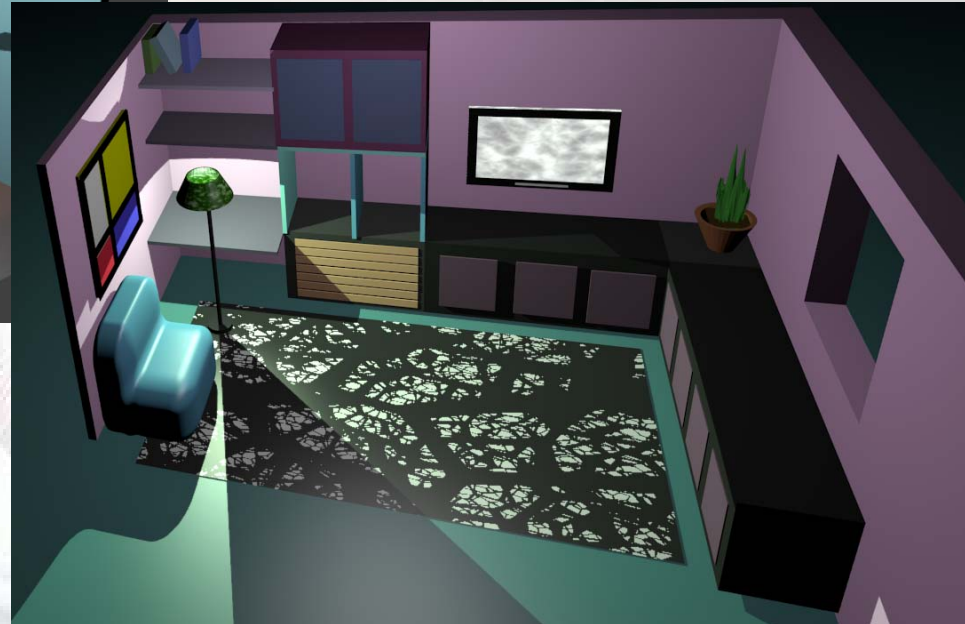
picture taken with a camera



3D model

From a drawing that represent an object to  
a **simulation** of an object

# 3D modelling: Blender software - open source -



Student's 3D models

## **DESIGN DRAWING AND ROBOTICS AT SCHOOL**

- Dynamic geometry software: Geogebra
- 2D drawing software : Progecad, AutoCAD...
- 3D drawing software: AutoCAD, Blender 3D...
- Robot platform
- Next year – BIM software – AUTODESK REVIT

# DESIGN DRAWING AND ROBOTICS AT SCHOOL

## EDUCATIONAL ISSUES

- Graphical representation/simulation of objects
- Formal representation of a dynamic process
- Simulation of a dynamic process – testing
- Introduce a methodology to plan toward the university

**THANK YOU**

