Cad software to introduce robotic design process at school

Carlo Nati

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.
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
Algorytms 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 development of society*.
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 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.

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
At the moment, design drawing is moving from CAD to BIM: Building Information Modeling
Disciplinary knowledge:
the object and its graphical representation

LEGGO 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 entire environment
Planning actions: how to represent a dynamic process-

semantic issues
syntactic issues
– test n°1 – the drawing follow (or not) the formal algorytm
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 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 represents 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

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
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