

THINK & BUILD BRIDGES

Linda Giannini ¹, Carlo Nati ²

Slide 2

We did not explain students (aged 3 to 16 years) what a bridge is, but we have been watching how they have built bridges, while playing, and what their idea of bridge was.

The survey upon the idea of bridge was also addressed to several adults of different nations, aged between 20 and 70+.

Among the materials used, plastic blocks, wood sticks, simulation software, 3D environments chat and Kit Lego Mindstorm.

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To involve in the "Build a bridge!" path classes of children from kindergarten, primary and secondary school, in addition to those of high school of art of Latina,

we proposed activities neglecting the initial study of what a bridge is, but that stress on the idea of bridge, its mental, physical and real representation, by models co-assembled, co-constructed by recycled material, simulation software and programmable Lego bricks.



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The idea on which the learning experience was based, tends to rely on experiential dimension that is often overlooked during daily activities, especially when it comes to technical and scientific phenomena which are kept in the abstract case studies contained in textbooks.

To directly experiment the problems associated with a bridge, we started the representation from the personal concept, to motivate students on the objective observation of items and – then - of physical phenomena related to its structure.



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Depending on the age of the students, different tools and models were used with the aim to extrapolate problems related to disciplines that allow a theoretical solution and a operational verification following an iterative sequence like this: theoretical model, verification of effectiveness of the model, new model revisited...



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Our activity had requested a longer time compared to the one initially forecasted by the group: from September 2007 to December 2007.

During the progress we collected the material produced by classes and documented it online [i] so to share it with other partners and with girls and boys of the several schools involved in the path. This is how our Think & build bridges was born!

[i] On line documentation [Teaching Science in Europe Pagina WEB.doc](#)

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Slide 8: childhood school

Girls and Boys 3-4-5 years old were involved from three different classes: one of the youngest ones who also uses ICT (in the normal school time) and the other two that proceed without the use of technology in teaching. Within these three classes the following students are enrolled and attending: about 70 girls/boys including two disabled and nine children having foreign parents: Chinese, Moroccans, Polish, Romanians, and Ukrainians.

The assigned problem, to find a solution, was, for instance:

"How can we move from one edge to another?"



[i] Bridges with various materials

<http://www.descrittiva.it/calip/0708/costruzioni/costruzioni.htm>

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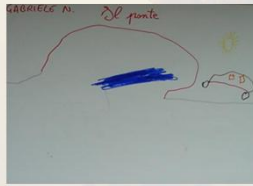
The bridges were constructed using wood sticks, lego bricks, joints [i], both within classrooms and outdoor and freely children have chosen whether to add towers, cars, animals soft toys, various characters.

Slide 9

As the time was passing by, we have noticed the increased stability of constructions, the variety of the solutions found to keep well balanced the parts.

Each discovery was then communicated to others, socialized, shared and again re-tested in small and large groups of girls/boys.

Together with the direct manipulative-practical experiences, individual interviews were proposed during which it was asked: "Do you know what a bridge is? If you know, can you describe it? And sketch it?"



*It serve us to pass with the car. Cars pass on the bridge.
Under the bridge there is water and if the car drop down it
get wet and broken.*

Slide 10

Along our way we met the free software Crayon Physics with which girls/boys 3 and 4 y. o. have been playing, virtually and empirically applying the laws of physics on PC.



Crayon Phisics free software
<http://www.kloonigames.com/crayon/>

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Among the virtual experiences, it is worth to mention the ones in ActiveWorlds, 3D chat. Girls and boys 3 and 4 years old searched for bridges in the virtual worlds, and their avatars crossed them, while partners from other countries offered their help to guide the children.



ActiveWorlds <http://www.activeworlds.com/>

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For the primary school the experience was done by children of third year; this choice was taken due to their intermediate level between the early childhood and the first degree secondary school. Moreover these children were already involved in earlier common projects.

The question we asked was: "When you think about a bridge, what story would you invent?" The stories were invented then read and told to childhood school children.



Sharing of stories of bridges: primary and childhood school

Slide 13

For the first degree of Italian secondary school we interviewed girls and boys from 11 to 14 years old. The question asked was the same: "Do you know what a bridge is? If you know, can you describe it? Can you sketch it?"

Obviously the graphical representations were different and so were the descriptions and the definitions. While with the younger children the main aspect was the one related to the experience, for the older ones other aspects were recalled: the social, the emotional, the metaphoric, the symbolic, the sentimental and the metaphysical ones.



Secondary schools: first degree (11-14 y.o.)

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These data appear more clearly in the answers from the girls and the boys of second degree (secondary school).

In our case the ones examined are the students from the first years of high school for arts. It appears more strongly the idea of the bridge as a link between abstract concepts.

A bridge is a chance between life and dead.


The bridge depends on people, it is link between people.

Secondary schools: second degree (14-19 y.o.)

Slide 15

Next slides show some disciplinary proposal related to bridges
Art history, technical drawing, history, physics, ICT....

few proposal of topics related to bridges

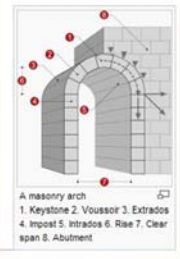


ROMA'S ROMAN BRIDGES

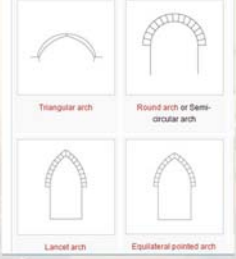
Secondary schools: Art history and Technical drawing

Slide 16

The Arch



A masonry arch
1. Keystone 2. Voussoir 3. Extrados
4. Intrafil 5. Intrafil 6. Rise 7. Clear span 8. Abutment

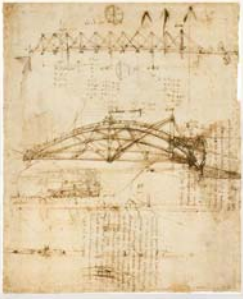



Triangular arch Round arch or Semi-circular arch
Lancet arch Equilateral pointed arch

Secondary schools: Art history and Technical drawing

Slide 17

Leonardo' bridges



Secondary schools: Art history and Technical drawing

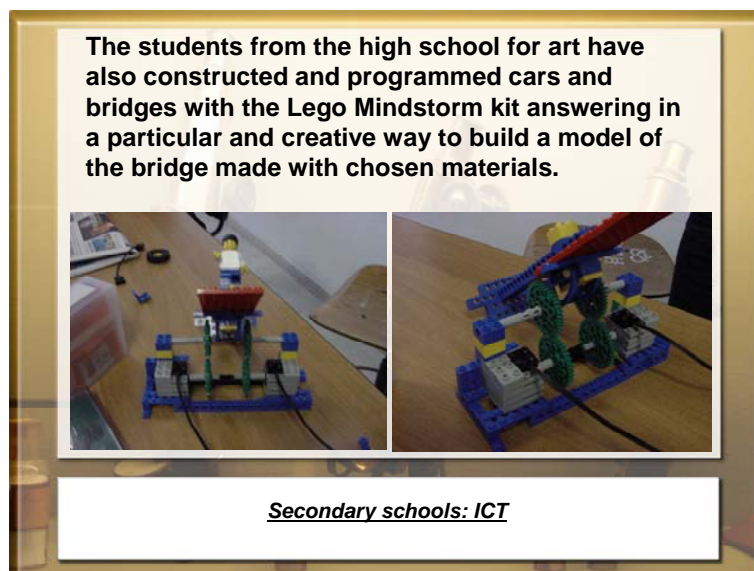
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Slide 19



Slide 20



At the beginning the production of robot bridges was not easy, but girls and boys did not give up and after comparisons, discussions, studies of algorithms, drawings, tries and errors, eventually they realized moving bridges perfectly running.

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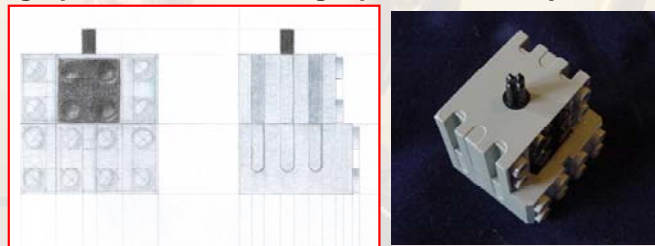
The structural issues related to the shape of the elements, the material and the power of electrical motors pushed the research for several possible solutions, and among them the best one was selected.



Secondary schools: ICT, physics

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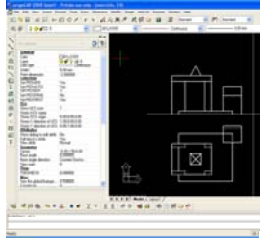
This means that a series of quality related parameters were adopted in a intuitive way and thanks to them it was possible to measure how good a solution was with reference to any kind of problem. Students were able to compare graphical models of single parts to real objects.



Secondary schools: ICT, technical drawing

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2D Digital Models and traditional graphical Models
Free Software : Progecad smart

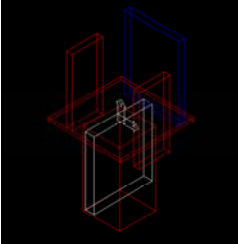
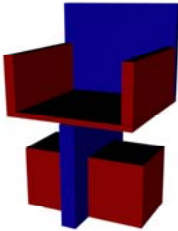


Semantic elements Syntactical elements

Secondary schools: ICT, technical drawing

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3D digital models
Free Software (Open Source) : Blender 3D

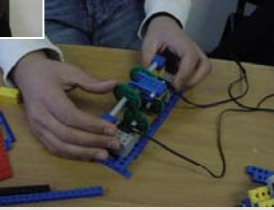
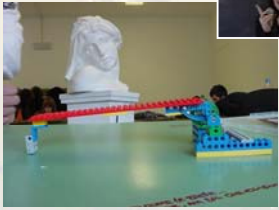



From the image to the model of an object

Secondary schools: ICT, technical drawing

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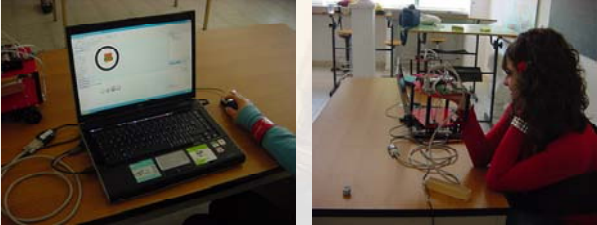
The structural issues related to the shape of the elements, the material and the power of electrical motors pushed the research for several possible solutions, and among them the best one was selected.



Secondary schools: ICT, phisic

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Part of the work was dedicated to rationalize these intuitions to make (through the observation of working conditions) a series of actions aiming to the solutions of the sub-problems present inside the general problem.



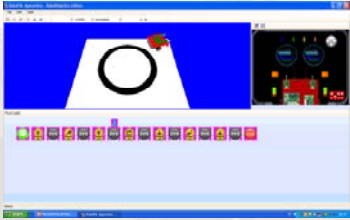
ROBOTECH AND SW ROBOPAL

Secondary schools: ICT, physics

To finalize the work, some main concepts were extended to other structures directly known by the students.

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After completing the mechanical and structural operations the programming algorithms were developed for horizontal rotation and the vertical lifting of the bridge (made of two spans, each moved by two motors).



Digital simulation of algorithms with roboPAL

Secondary schools: ICT, physics

Furthermore it was used Sodaplay¹, online simulation software that allows a game like approach to the abstractness of physics. By this software some bridge structures were created and then moved, and models were created and tested.

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We considered important to involve in this experience faraway adult people, through email, italian and not.

The survey was carried out during one week: 100 persons were contacted, 85 sent their answer back, and 56 allowed us to publish on line their answers.

Your age is in the range: __20/29 - __30/39 - __40/49 - __50/59 - __60/69 - __over 70

Your job/occupation is _____

What is a bridge for you? _____

If you want, you can write a very brief story and send us a drawing/picture/photograph of a bridge (not bound by copyright)

Do you authorize us to publish aforementioned data? Yes__ No__

Do you want your name be shown? Yes__ No__

Do you want your email address be shown? Yes__ No__

Secondary schools: ICT, phisics

The survey was carried out during one week: 100 persons were contacted, 85 sent their answer back, and 56 allowed us to publish on line their answers. Of the 56 people that gave their consent to the on line publication, 33 are women (23 italian, 10 not Italian); 24 men (16 Italian, 8 not Italian)²

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General summary

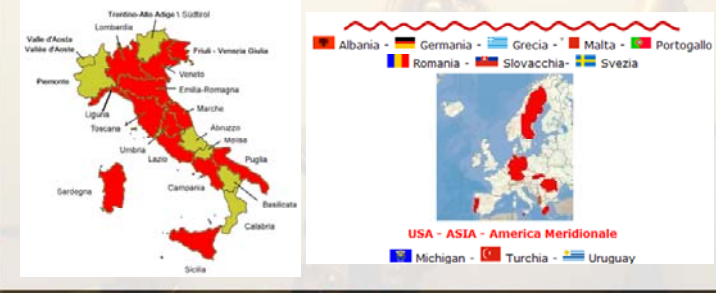
<http://www.descrittiva.it/calip/0708/Riepilogo-Generale.pdf>



Survey

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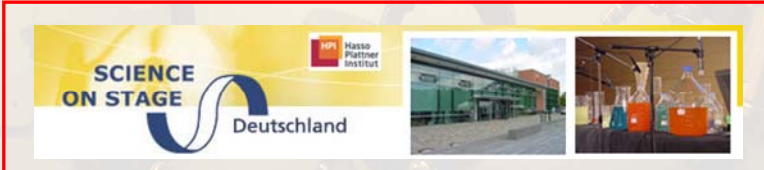
It was observed that for adult people the definition of bridge is often linked to direct and practical experiences (emotional, personal, work related), similarly to what was observed for children of childhood school.



Survey

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All the culled data, from the ones of the childhood school to the ones we received from adult people, are present on line and were shared with children, girls and boys, other teachers, and pupils' families through meetings both in small groups and in big conference in the school theater.



Linda Giannini e Carlo Nati
Berlin, -23/10/2008 -

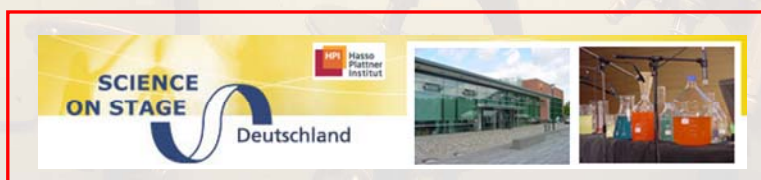
- . From the analysis and the comparison many new ideas came out and spontaneously students went on looking for pictures, news, stories related to bridges.

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There is no creativity in science or art or intellectual and sensible exercise in the soul, in the spirit, without collective perception of new strategies and rational models which induce to simultaneous and synergetic change between information and form in cultural, social, economical field.

Paolo Manzelli (2008)

University of Florence - department of chemistry -



Linda Giannini e Carlo Nati

Berlin, -23/10/2008 -

¹ Sodaplay <http://sodaplay.com/>

² General summary <http://www.descrittiva.it/calip/0708/Riepilogo-Generale.pdf>