

# THINK & BUILD BRIDGES

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**Abstract:** *"Think & build bridges" is a path which draws its origins from the project Teaching Science in Europe. 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.*

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.

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.

The scale ratio was subject to widespread use of key issues. 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 an operational verification following an iterative sequence like this: theoretical model, verification of effectiveness of the model, new model revisited...

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<sup>1</sup> 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.

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.

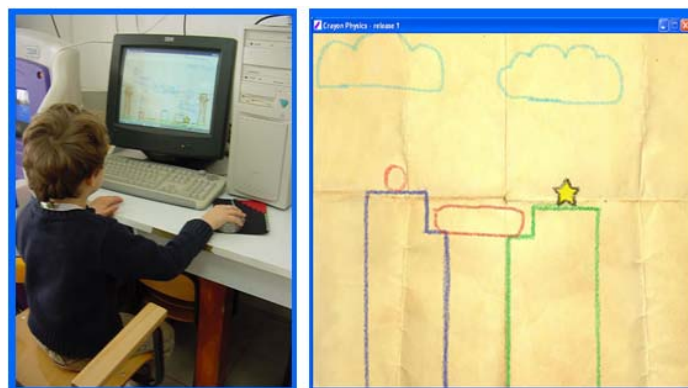
The assigned problem, to find a solution, was, for instance: "How can we move from one edge to another?" The bridges were constructed using wood sticks, lego bricks, joints<sup>2</sup>, both within classrooms and outdoor and freely children have chosen whether to add towers, cars, animals soft toys, various characters.



*Fig. 1 Girls and boys in the classroom and outdoor while experimenting bridges construction*

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<sup>3</sup> were proposed during which it was asked: "Do you know what a bridge is? If you know, can you describe it? And sketch it?"

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



*Fig. 2 Simulation, testing of mass, volume, levers and bridges*

Among the virtual experiences, it is worth to mention the ones in ActiveWorlds<sup>5</sup>, three-dimensional chat.





*Fig. 4 Sharing of stories of bridges, primary and childhood school*

For the first degree secondary school we interviewed girls and boys from 11 to 14 years old. The question asked was the same we asked to childhood school children: "Do you know what a bridge is? If you know, can you describe it? Can you sketch it?"<sup>8</sup>

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.



*Fig. 5 Some drawings of bridges made by girls and boys from first degree secondary schools*

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 life and death.

Suicide and death, obviously, are not to be understood as the desire to terminate one's own life, but the challenge, self affirmation, common characteristics of teen-age.



Fig. 6 Two examples of the representation of the challenge between the life and the death

<http://www.descrittiva.it/calip/0708/bridge-14-15.htm>

The students from the high school for art have also draught, constructed and programmed cars and bridges<sup>9</sup> with the Lego Mindstorm kit answering in a particular and creative way to “Build a model of the bridge made with chosen materials. Use an adequate scale”. 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.

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. 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.

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.

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).

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

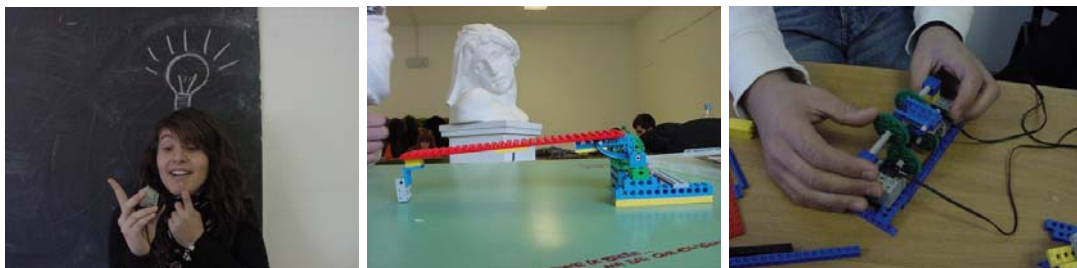


Fig. 7 Robot-bridges of the High School for Art

Furthermore it was used Sodaplay<sup>10</sup>, 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.

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.

From: Linda Giannini and Carlo Nati  
Subject: Build a bridge  
Date: Fri, 14 Dec 2007 16:46:07 +0100

Dear friends,

With reference to Teaching Science in Europe and to "Build a Bridge!", we request you to spend a little of your time to fill the following form. You can send back the filled form within December 21st 2007 to calip@mbox.panservice.it

Thanks for you kind cooperation and merry Christmas. Linda and Carlo

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\_\_

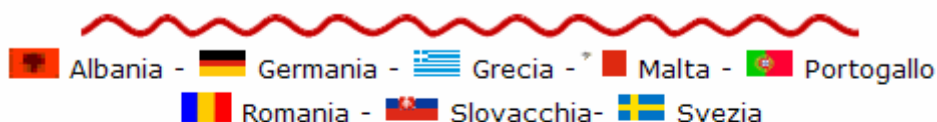
Do you want your email address be shown? Yes\_\_ No\_\_

*Fig. 8 English version of the distributed email*

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)<sup>11</sup>



*Here above it is highlighted in red the Italian regions from which we received answers.*



### USA - ASIA - America Meridionale



Answers of adults from non Italian countries

<http://www.descrittiva.it/calip/0708/ripartizione-FMpaesi-no-italy.pdf>

### Conclusions

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. From the analysis and the comparison many new ideas came out and spontaneously students went on looking for pictures, news, stories related to bridges. Moreover 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. Adults themselves restored the dimension of the game and of the tale. We finalize this path with a thought to our friend *Paolo Manzelli*<sup>12</sup> (2008)

*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 synergic change between information and form in cultural, social, economical field.*

### **Bibliography**

- (Ross, 2001) Ross D. (2001), Platone e la teoria delle idee, Il Mulino, Bologna 2001.  
(Giannini, 2004) "[Bambini reali mondi virtuali](#)"<sup>13</sup> - atti del convegno Didamatica 2004 Ferrara, pp. 187-198

<sup>1</sup> On line documentation [http://www.descrittiva.it/calip/0708/teaching\\_science\\_in\\_europe\\_II.htm](http://www.descrittiva.it/calip/0708/teaching_science_in_europe_II.htm)

<sup>2</sup> Bridges with various materials  
<http://www.descrittiva.it/calip/0708/costruzioni/costruzioni.htm>

<sup>3</sup> "Do you know what a bridge is? If you know, can you describe it? And sketch it?" interviews in Section G <http://www.descrittiva.it/calip/0708/bridge-3-4.htm> interviews in Section H <http://www.descrittiva.it/calip/0708/bridge-4.htm> interviews in Section I <http://www.descrittiva.it/calip/0708/bridge-5.htm>

<sup>4</sup> Crayon Phisics free software <http://www.kloonigames.com/crayon/>

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<sup>5</sup> ActiveWorlds <http://www.activeworlds.com/>

<sup>6</sup> "When you think about a bridge, what story would you invent?" interview with girls / boys in primary school <http://www.descrittiva.it/calip/0708/bridge-8.htm>

<sup>7</sup> The stories invented were then read and told to childhood school children

<http://www.descrittiva.it/calip/0708/lettura-storie/lettura-storie.htm>

<sup>8</sup> Interviews in the secondary school "Do you know what a bridge is? If you know, can you describe it? And sketch it?" <http://www.descrittiva.it/calip/0708/bridge-11-12.htm> -

<http://www.descrittiva.it/calip/0708/bridge-12.htm> - <http://www.descrittiva.it/calip/0708/bridge-12-14.htm>

<sup>9</sup> Robot bridges robots and machines

[http://www.descrittiva.it/calip/0708/ponte\\_carlo/ponte\\_carlo.htm](http://www.descrittiva.it/calip/0708/ponte_carlo/ponte_carlo.htm)

<sup>10</sup> Sodaplay <http://sodaplay.com/>

<sup>11</sup> General summary <http://www.descrittiva.it/calip/0708/Riepilogo-Generale.pdf>

<sup>12</sup> Paolo Manzelli - Director of LRE/EGO-CreaNet University of Florence - department of chemistry - polo scientifico 50019 -sesto f.no - <http://www.egocreanet.it/>

<sup>13</sup> Kids and virtual worlds

[http://www.descrittiva.it/calip/Bambini\\_reali\\_mondi\\_virtuali\\_Giannini.PDF](http://www.descrittiva.it/calip/Bambini_reali_mondi_virtuali_Giannini.PDF)