

Teaching to Teachers, Learning from Learners (Part 1)

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Abstract This poster, and the following included in this publication have been realized by the teachers attending the “TFA” School for secondary school teachers held at the Politecnico di Milano during the academic year 2012/2013. The work presented here refers to the results of the Laboratorio di Disegno e Rappresentazione Geometrica (literally *Drawing and Graphic Representation Studio*), a course dealing with the educational foundations of visual representation taught by the author mentioned above. The main focus was on the processes of teaching and learning Graphic Representation, on its use and on the support that this matter could give to the students in the field of Technology. We debated about the relationship between Reality and Representation and about the power of Graphic Representation as instrument of knowledge and invention. Basing on the activities really carried on in class, by the teachers with secondary school students, the poster summarizes and shows some fundamental concepts of Graphic Representation, especially the phenomenon of Projection/Section, which is the base of Projective and Descriptive Geometry, emphasizing the connection among experiment, experience and abstraction. The following comments are related to the corresponding figures in the poster.

1. Photography may be a good tool to introduce projection theories in the second year of a Secondary School class. A photo is a projection directly made with light, and this process can be understood and directly seen by building a pinhole camera made with a cardboard box and a frosted glass. The hole represents the projection center and the glass the projection plane. (Marco Gasparini)

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Poster Reality and Abstraction: observing physical light to understand geometric projections

2. Using a light source, an object made of balsa acetate sheets-coated and a model built with plexiglass dressed by white adhesive paper, it is possible to introduce the concept of orthogonal projections. Keep in mind that, by using primary colors, it is possible to explain that we project the entire object: it can be observed that the projection represents not only what we see but also what is behind and we do not see. (Federica Germano)
3. The perception of reality, in which we are immersed, is the result of a reconstructive process generated by our brain, controlled by genetic components, interactions between us and the environment around us and, last but not least, based on our knowledge and previous experiences. However, as humans, we are equipped with a binocular vision: just by looking at an object from different points of view, we are able to perceive its form and detailed characteristics. The shadow thrown by the object under observation can help to improve our perception, showing the hidden aspects. In the specific case where you want to go back to the real size of the object, as well as to its form, orthogonal projections are the most suitable technique for the detection of existing objects, and for the design and construction of new ones. In industrial design, the technique of orthogonal projections, has historically taken on significant importance, allowing different groups other than those who designed the work, to faithfully realize the project, as the designers have conceived. (Andrea Vicini)
4. A sequence of photographs to explain the concept of ideal point. The photos are always taken from the same angle and the center of projection moves away. We can observe that the projection rays become less and less oblique and it is easy to understand when the distance is infinite. (Francesca Antonelli)
5. Have we ever wondered what the figure from which the entire world of representation originates is? To *represent* means to graphically report what we observe. From the “point” begins the journey towards the representation of the straight line, the flat and the figures in two dimensions, the space and the three-dimensional figures, such as solids. (Cristina Caccia)
6. Photography is defined as “drawing with light”. Taking a photograph means turning reality into images catching light and shade. In an image, the compositional effect is due to the intertwining of self-shadows and shadows. The first ones fill the windows and mark the white part of the building with an alternating rhythm; the second ones are casting on the same wall and produce a pattern with an oblique structure that enlivens the composition with its different shades of grey. A photograph documents, it tells: in a word, it is life. What would we know without photography? (Mariamichela Di Carluccio)
7. It is possible to build a model that makes it clear to students how the visual rays shine on the volumes, taking advantage of little drawings of the object that you see in the real space. (Giuliano Gaudenzi)
8. Giving children the possibility of elaborating an image helps teachers to evaluate the abstraction level of the class and sensitize children to understand how we often see reality in a partial and approximate way. If we dedicate some time and attention to known shapes which are part of our environment and do

not elicit any particular emotion on us, we suddenly discover very interesting things. (Francesca Dordoni)

9. Can the *folding* process be a bridge between cognitive psychology and the didactics of geometrical representation? People reasoning on two different levels of thought have difficulty in understanding each other, and for a true, helpful relationship to establish, one of the two should perceive the other's reasoning. The teacher is like an engineer who tries to reach his own students' thoughts by building bridges. (Adriana Figurelli)
10. The aim of the lessons is to use photography to introduce secondary school's students to the perspective and projection-section concepts. They daily use a camera but they ignore its operating principles; during the course they build a pinhole camera to understand how two-dimensional images are created from the three-dimensional space. (Simone Mantovani)
11. The orthogonal projection method consists of drawing an object from more than one point of view, so that the actual proportions result preserved. The object to represent is projected on several levels, usually three and orthogonal between them. On each level a figure called view is obtained. This procedure comes from perspective projection, therefore the principle is clearly understandable by showing the example of a dark chamber (*camera obscura*). (Paolo Salvi)

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