

Interactive, Living and Vital Science

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ScienzaViva, a group of teachers, students, artisans and technicians, is doing in Italy an original work in the Informal Learning and Public Understanding of Physics and other Sciences. Starting from the mismatch existing in Science, in particular in Physics, among the experts, the simple students and the common people too, the group is deeply committed in connecting these parts. Its main actions are the direct production of exhibits and the experiential diffusion of scientific culture. With a genuine educative research, almost independent from the academic streams, ScienzaViva engages the people, being living and vital, similar to a *grassroots movement*. ScienzaViva spends the same vigour in the finding out the structural reasons of the old conflict between formal and informal learning attitudes, going back to the beginnings of the history of scientific facts.

1. Physics, students and common people

The title of this meeting, «Informal Learning and Public Understanding of Physics», really demonstrates that we are living a historical change in the conception of Physics and Science. It evokes in our minds that of the famous book of a great historian of Science, A. Koyré, «From the closed world to the infinite universe» [21] which, here, could be paraphrased as: «From the closed understanding to the universal sharing of Physics».

In fact, Physics is a difficult subject [22]. It's well known to the students, who pass through a hard selection, but to the common people too. A spirit of adaptation, stronger than in other fields, needs to study it. Without adaptation, nobody can go far. The sociologists say that this fact depends on the «paradigmatic» [23] nature of the scientists' schemes; the public opinion see it as a rigid initiation, which doesn't let alternatives: «This is Physics, take it or leave it». The social isolation of the group of the physicists in the society has been seen as the normal intellectual separation of the educated class from the public and it never has been a problem. School itself implicitly has justified it.

Since some decades, however, something is changed. The number of the physicists who get over the traditional boundaries and dialogue with the people is increased. Let's think to the Exploratorium founded in San Francisco by the physicist F. Oppenheimer and, about Italy, to the «Immaginario Scientifico» in Trieste and to the «Città della Scienza» in Naples created by P. Budinich and V. Silvestrini, both physicists. If we investigate about the origins of all the Science Center, we find out that they all have been created by similar initiatives.

It's true that the physicists', and generally the scientists' new attitude towards the common people is partially explained by the public origin of the funds of their researches, but it's also

[21] Koyré, A., 1957, *From the closed world to the infinite universe*, The John Hopkins Press, Baltimore [trad. it., 1984, «Dal mondo chiuso all'universo infinito», Feltrinelli, Milano

[22] K. W. Ford: «Guest comment: Is physics difficult?», *Am. J. Phys.*, Vol 57, n°10, oct. 1989, p. 872; S. Tobias: «Math anxiety and physics: some thoughts on learning 'difficult' subjects» in *Physics Today*, June 1985, p. 61-68

[23] T.S. Kuhn, *The structure of scientific revolutions*, University of Chicago Press, 1962

true that this attitude answers to the increasing request of science knowledge which comes from the people. Science and technology, in fact, have entered among the most important politic issues for the future of the mankind – let's think to the unsolved world energy problem.

In this changed landscape, we can distinguish still more the scientists and the teachers who try to show the natural phenomena and the scientific technologies in the most suitable ways for the popular sensibility. They now constitute a wide international movement which offers alternatives to the dry approach the major part of the people has been accustomed to. Their slogan is «putting science in the hands of the public» [24].

We refer to some specialists like Paul Doherty [25], invited to this meeting, and to other scientists like him that today are true professionals in this field of the communication. We also refer to *Dimension*, the magazine of the Association of Science Technology Centers (ASTC) [26] and to other publications of this area which show constantly their surprising exhibitions.

2. The popular education to science

Therefore, we can talk about a *popular education to science* or about a *public understanding of science*. Its approach is experiential, that is, the experience comes first and the theories and the formulas come afterwards. Such a conception inspires a new didactic technology: the interactive exhibits, big objects which invite the public to put the hands on them, without fear.

Using them, the common people interact with the physical variables of the shown phenomena and they can learn «in their own way». So, they have an alternative to the precedent «take it or leave it». Conceived this way, the learning is defined as informal. On the contrary, the formal learning is the typically related to school and university one and its conception are mostly hypothetical-deductive.

The validity of the distinction between informal and formal isn't completely foregone. Someone thinks that it's only a nominal distinction, because the informal learning, although essentially based on the direct experience, isn't less conceptual than the formal one. Their difference, they say, is not critically important for the educative purposes. The Exploratorium, for example, does not emphasize it very much [27].

According to others, on the contrary, the distinction is very effective because focuses the existence of a methodological contrast. A contrast which has become important in the modern society. The elimination of such a contrast constitutes one of the most prominent goals of the science educators in our time, as we know from the results of the meeting of Athens of the ECSITE, held two years ago: *Bridging the Gap between Formal and Informal Science Teaching*. However, we must observe that this operation come essentially from the

[24] G. Delacote, "Putting Science in the Hands of the Public" in *Science*, Vol 280, 26 June 1998, p. 2055-56

[25] P. Doherty is the *Co-Director Staff Physicist* of the Exploratorium Teacher Institute

[26] The ASTC (www.astc.org), Washington D.C., USA, now includes more than 400 institutions in 40 countries.

[27] We have perceived this position trough discussions with the members of the Exploratorium staff. Nevertheless the Exploratorium has part in the Center for Informal Learning and Schools (CILS) which has been funded in 2002 by the National Science Foundation. The Center supports research and develops leadership in the study of informal science learning and institutions, and their relationships to schools:

<http://www.exploratorium.com/cils/>.

world of the informal communication and depends on this point of view [28]. Moreover, we can't find analogous attempts produced by Schools. Nor by studies coming, for example, from Eastern Europe.

With regard to this, let's remember the recent institution in Europe of the PENCIL (Permanent European Resource Centre for Informal Learning) which aims to identify the reasons of the success that transforms the informal educative activities in innovative science teaching instruments. It involves 14 Science Centers and European museums and a university "Resource Centre" for the monitoring of the educative research.

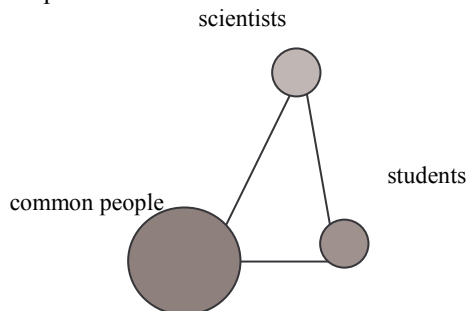
It's clear, therefore, that the theme of this meeting belongs under a more wide debate, focused on the nature of the aforesaid contrast, which needs to be composed in the best possible way.

3. ScienzaViva and the alliance between teachers and artisans

We contribute to this research trying to decode the main subjects that actually play a role in the abovementioned issues.

First of all let's consider the fact that the goals of the communication between «scientists» and «common people» are certainly different from the ones concerning the «scientists»-«students» educative relation, but let's ask ourselves: how much is great this difference? Are not the students in the group of the common people first that, after a long training, they are accepted into the scientific community? Or have we to consider the students as a different group, separate from their parents, their brothers and friends, who aren't oriented towards the profession of scientist?

If we put the students among the common people, we are devaluating very much the formative function of Schools. But if we consider them as a separated group, we attribute to Schools an «esoteric» and not yet acceptable function.



Our opinion, therefore, is that the most equilibrate response is to consider the students as citizens like the others, in a distinct position, but not completely separated from the society in which they live.

This way, the students are reached by the messages of both formal and informal scientific communications. These ones lie over with different intensity and efficacy, according to the situations.

In the Anglo-Saxon world, for example, they have almost the same importance, their interconnections are already active and the experiences are already been evaluated. Let's consider by the way what has been written in the several publications of the ASTC, of the

[28] J. Wellington, *Formal and informal learning in science: the role of the interactive centres*, Phys. Educ. **25** (1990), pp. 247-252; Hofstein A., Rosenfeld S., 1996, "Bridging the Gap Between Formal and Informal Science Learning", *Studies in Science Education*, 28, 87-112

British Interactive Group (BIG) and other American and European Institutions [²⁹]. So, we can see that - where the schools exploits by themselves the experiential pedagogy of the Science Centers and incorporate their most modern techniques - the two messages arrive to the students not in a cacophonous way. The general learning seems to be stronger and can be useful both to pursue scientific studies at the university and to the scientific consciousness and awareness, that is a right of all the citizens.

Instead, where the schools remains fastened to «book, chalk and blackboard» and leave to the Science Centers the task of offering the most exciting aspects of science, the effects on the comprehension of physics and science generally are contradictory. This is good neither for the young people nor for the society in which they live.

Italy, in a certain sense, lies in this last case. In fact in our country the formal and informal education haven't yet found the mutual recognition, differently from other European nations. Moreover, there are regional areas in which their convergence is favored and areas in which it is not, unfortunately. The factors that favor it are several: the presence of Science Centers, the single teachers and teachers associations' innovative vocation, the deep roots of local educative experiences, etc.

However, in our country, the two styles of education are more frequently in competition than in collaboration.

ScienzaViva [³⁰], the association that we represent, is therefore obliged to work on a difficult ground. This makes clear why it has chosen, as statutory aim, to improve the conditions of dialogue between the different parts. We believe to make it in an original way, taking our energies from uncommon motivations and experiences.

Our educative model is the Exploratorium of San Francisco, but the principal action fields are the schools, that is among the students and the teachers, and also the common people, that is between our students' parents, brothers and friends.

Our operative center is based in Calitri, a little town in the south of Italy, but it spreads towards all the directions of the country, giving concrete examples of experiential pedagogy in zones where they lacks. We built an exhibition of interactive scientific instruments, titled «The square wheels», that is in demand in all the country. It travels through the peninsula like the Tespi's Cart, and it's exhibited in the atriums of the schools, in the provincial museums and in the university buildings.

For making it, our association avails itself both of the funds of the Institutions who call us and of co-funds coming from the Italian Ministry of Instruction, University and Research. It's fundamental the cooperative contribution of our school, the IIS "Maffucci" of Calitri, and of the net of schools linked to it.

ScienzaViva proposes the learning through the use of the hands, following the lively artisan tradition of the place in which it's born. It can be briefly defined as the expression of the cultural «alliance» among teachers, artisans and technicians. A kind of alliance from which the didactic instruments come out, an alliance from which the natural phenomena become familiar to people as using their own hands. It proves how the scientific and technologic,

[²⁹] AA.VV., *What Research Says about Learning in Science Museums*, ASTC, 1990; S. Middlebrooks, *Preparing Tomorrow's Teachers: Preservice Partnership between Science Museums and Colleges*; ASTC, 1999; G.H. Hein, M. Alexander, *Museums, Places of Learning*, American Association of Museums, 1998, AA.VV., *An Invisible Infrastructure: Institutions of Informal Science Education*, Inverness Research Associates for the ASTC, 1996; *ASTC Dimensions*, Science Centers as Schools: Extending the Mission; Jan/Feb 2004; *ASTC Dimensions*, Active and Engaged: Science Centers as Schools and Informal Learning; Nov/Dec 2005

[³⁰] AA. VV., *Scienza Viva e Interattiva*, ScienzaViva, Tip. Pannisco, Calitri, 2004

formal and informal knowledge can be synthesized with a pedagogic efficacy. Without such a synthesis, we cannot solve the clashes of the Italian scientific education. Other Italian groups can't get analogous results because they aren't protagonist of the same constructive process. Some of them, in fact, prefer to buy their exhibits from international producers. Their instruments satisfy certainly the popular tasks for which they have been created, but they don't give to the public the idea that they can make it, with their hands, too. Some others propose a science made by «carton, adhesive tape and thumb-tacks», that is good in safe places like the schoolrooms and the libraries, but does not survive to the impact of the great public.

Our commitment consists of a series of enterprises: the autonomous production, by ourselves, of the interactive exhibits which we use both in the Schools and in Public Exhibitions; the introduction into the Schools of styles of learning which are coming from Science Centres; the identification of the theoretical dimensions of the hands-on activities we employ in teaching physics; the travelling scientific demonstrations, around the Italian regions, that involve «empirical knowledge» in addition to scientific rules and laws. Although guided by disciplinary purposes, many of these actions are led with the artisans' conceptions of manipulating materials and tools. The artisans are for us a precious source of knowledge, we consider them as «living treasures» because they are irreplaceable in the production of the exhibits. Moreover they give us a pedagogic model in which Science is structured on problems more than on apodictic statements, that you can learn at the university.

After all, we prefer being socially and intellectually independent from the Universities and the Big Science and more interested in the practice of common people and his difficulties of understanding Science.

4. The circulation of the scientific knowledge, the enthusiasm and the vitality of the educative message

ScienzaViva bases itself on the dedication of a little kernel of teachers of the schools of Calitri, with whom cooperate the other associates, among whom also some young students stand out: about thirty people on the whole. The fact that the Association is led by people who practice the school teaching as principal professional activity guarantees a constant curricular lecture of Science and not only the Science Centers' experiential lecture.

Our publications guarantee, moreover, a related to schools point of view which, as we said before, is hard to find out in the panorama of the publications on this topic.

Wendy Pollock, director of the research programs of the ASTC, wrote that the spirit of ScienzaViva is the typical one of the *grassroots movements* and furnishes awareness like those proposed by Paulo Freire [31]. What she has noted explains well the reason for which an unusual enthusiasm and an unexplainable falling in love for science is the first effect produced on the people by our actions.

In short, remembering the triangular figure that we described before, the aim that ScienzaViva pursues is to help the three subjects, shown there, to communicate among them, with a circular flux of reciprocal actions, a flux in which the liveliness and the cultural fertility are undoubted.

In fact, ScienzaViva testifies to the scientists and to the teachers how the students' needs can be understood. It offers to the public the spur to go further the variety of the shown phenomena, to arrive at least to perceive what a scientific theory is and how much the scientific knowledge is important for the future. Finally, it offers to the students, a part from

[31] *ibidem*

reserving them the best of the modern interactive technologies, the exciting experience of the explainers, that is to explain to their friends and parents the phenomena and the laws that they have learnt.

Who observes it with expert eye knows the skill of ScienzaViva of being a shining example of how a science center can be created by a school, or how a school can behave as a little science center.

Our science is living, vital and interactive.

Very much questions are still open for us, the same of the PENCIL's ones.

Another thorny subject is still open: the reduction of the number of the students of scientific subjects in the occidental nations.

A sort of lack of courage stops the students at the time of their definitive choices. One of the causes is certainly the fear induced by the university, because it seems that there a major intelligence is required.

In this case too, the PENCIL could give an answer, when it will be clear why who reaches the university studies undergoes an automatic and unjustified reduction of the experiential occasions. Why does the university student, therefore, lose the right to the perceptive approach through which he has been attracted towards the science?

ScienzaViva has already found a fundamental cause of this problem. The existence of a fracture inside the three hundred and more years of modern science that countered the baconian tradition (or experimental) and the mathematical tradition of science [³²].

An ancient and never joined fracture between the practical and the theoretic activity, between the artisans and the learned men. It explains the contradictory aspects of the scientific pedagogy that we have examined. For example, the fact that, generally, the theory has an intellectual charm that the practice hasn't. Does the alliance between teachers and artisans solder in part this fracture?

Is it an irreducible fracture? Is it linked to the cognitive modalities of the human mind? Or can we solve it in evolutionary terms, if the concept of evolution can be applied to science itself?

[³²] T.S. Kuhn, "Tradizioni matematiche e tradizioni sperimentali nello sviluppo delle scienze fisiche", in *La tensione essenziale*, Einaudi Paperbacks, Torino, 1985, pp.37-74