

## “Adotta scienza e arte nella tua classe”: The results of a successfully teaching project which combines science with art<sup>(\*)</sup>

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**Summary.** — The project called *Adotta scienza e arte nella tua classe* (“Adopt Science and Art in your class”), on the interconnection between science and art, has been addressed to the Italian secondary middle and high school involving more than 200 teachers and about 2200 students. The main purpose of this project is to make the young students aware of the strong link between science and art is a unique cultural and interdisciplinary occasion. To reach this goal, the Adotta project asked students to produce an artwork inspired by the interpretation of a quotation among a hundred commented quotes by physicists, mathematicians, scientist, writers, artists, accompanied by an original short sentence written by students themselves. More than 1000 artworks have been produced and collected in two galleries on Facebook. From their analysis emerges the students’ feeling about science, which is usually associated to human brain, based on mathematical laws and related to technological progress, but it is also a powerful tool that should be responsibly used. This project also valorizes teachers’ role in scientific education through activities that encourage students to recognize science in every aspect of their lives.

PACS 01.40. – Teaching methods and strategies.  
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### 1. – Introduction

The relationship between art and mathematics, art and science, can be recognized in the masterpieces of all times. The canon of harmony in the Greek architecture, based on the golden section, the Leonardo’s artistic and scientific work, the more conscious use

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of optics discoveries done by the Impressionists and the Pointillists, the digital art, the inspiration to the physical and mathematical theories of the multi-dimensions in some of the Dalí's works and the organization of the space-time in Escher paintings, are some examples of the link between science and art. Also the recent success of initiatives like the sonification of scientific data, the photographic exhibition — contests about detectors, machines and equipment located in the laboratories of CERN, show how art is, precisely for its natural link with science, one of the most effective tool for science dissemination among the general public [1, 2].

On this basis, the Laboratory Esplica—no profit, a cultural association engaged in the field of cultural and scientific formation and dissemination, has founded its concept of a project addressed to the secondary-school students.

The project called “Adopt Science and Art in your class” (shortened “Adotta project” in the following) was presented for the first time at the XI Aplimat International Conference, Bratislava 2012 [3] and its detailed description can be found in the paper of M. Torre [4]. In brief, the Adotta project leads the students to familiarise with the bond between science and art, providing the teachers with some tools to meditate on the similarities between artistic creativity and scientific process. The main tool is the document “100 +1 frasi famose sulla scienza” (100 +1 famous quotes on science) [5-7], a collection of famous quotations by scientists and artists, referenced and presented with an original comment. Another tool is the interactive collection of “78 + 10 biografie” (78 + 10 biographies), a file gathering about 400 links to the biographical references of the scientists and artists mentioned in the main document, selected taking into account the cultural levels of the students involved. The distinguishing feature of this file is the information on curious and fascinating aspects of the authors' stories which may result in the most didactically effective and long-lasting on the students' memory item and which make the document innovative, compared to the biographies usually found in textbooks.

Through an interdisciplinary work, the teachers provide the necessary educational support, while each student expresses his creativity producing a graphic work inspired by the chosen phrase, accompanying it with a personal comment on same quote. At a later stage the artworks enter two contests, one based on the public vote (“I like”) in the social networks and the other on the evaluation of an expert jury (scientists, researchers, artists, art critics) that will proclaim the final winners basing solely and unquestionably on judgments of an aesthetic and artistic character, as well as of their relevance and originality in the presentation of scientific topics.

The use of aphorisms as a tool for science dissemination has ancient historical origins [8,9]. Modern scientists as Galilei, Newton and Einstein often exploited the effectiveness of a short sentence to popularise mathematical-physical laws or to convey the sense of the scientific methods. This is due to the properties of quotes: they are synthetic, melodious, often ironic and can be instantly understood, arousing immediate emotion and stimulating reflection. In the Adotta project, aphorisms are the starting point to engage young students in a creative play on science. It is a way to capture students' interest, especially those who tend to reject any science. What motivates students more, is the challenge of competition and their will to win, then these activities are an effective way of teaching and learning science.

This introduction describes how the activities of the Adotta project meet the demands of curricular innovation as for the revision of the teaching-learning contents and methods in the field of the scientific disciplines at all school levels, also taking into account the new school contexts defined by the national guidelines for the first and the second cycle of education, where the school is called to realise the training in accordance to the students'

talents, in order to enhance their personal skills [10,11]. To reach these aims, the Italian school curricula ask the teachers to carry out an interdisciplinary teaching and base the assessment of the students' skills on their ability to make connections among the various disciplines. Extracurricular laboratorial works enable to experience didactical practices connect to new media. Activities that enhance creativity, as those proposed in the project, encourage to go beyond the habitual solutions, to formulate new questions, to overturn established processes, to look at the world from different points of view.

## 2. – Results

The first edition of Adotta project (school year 2012-2013) involved 39 educational institutes. The second edition has seen an increase of 67% of them, spread over the national territory, with more than 200 teachers and about 2200 students, producing more than 1000 artworks, collected in two galleries on Facebook: <http://tinyurl.com/okgu6ax> for middle and <http://tinyurl.com/owcpjz8> for high secondary school, where they have obtained about 20000 “I like”.

On the basis of the realised activities, an analysis on the effectiveness of the project, in terms of scientific thinking dissemination, can be performed: many artworks reveal the detailed work, on the interpretation and internalisation of the selected quote, made by students as well as the original artistic creation [12].

The document “100 +1 frasi famose sulla scienza” collects quotes from scientists, artists, philosophers and historians of science, on scientific or artistic themes; it is an atlas with various configurations, perspectives and maps for the teachers to get ideas and suggestions for the classroom activities of the project. Most of the quotes refer to modern physics (quantum mechanics and relativity), an essential content in teaching, followed by other physics-related topics as foundation of physics, mathematics, astrophysics, classical mechanics, electromechanics and other sciences (chemistry, biology).

In the first edition of the project 66% of the quotes have been selected by the students, a number which increased to 78% in the second edition. The favourite quote was “Numbers rule the universe”, attributed to Pythagoras of Samos (570 b.C.-475 b.C.). Scientists use mathematics as a tool to understand and model the world, and still today the role of this subject is discussed [13]. Young students easily see numbers around themselves, as written in the original short sentences which integrate the artworks: “Numbers, as Pythagoras asserted, give order to the universe and are necessary to understand it. But numbers allow us to have a human development, so they have given us happiness and amusement”, or “Laws, that explain natural events, are composed of numbers”, or “Everywhere, on my way, I find numbers” (fig. 1).

Other favourite quotes were “Time is what happens when nothing else does”, by R. P. Feynman and “When things get too complex, it sometimes makes sense to stop and to ask yourself: Have I asked the right question?”, by E. Bombieri [14]. This is due to the fact that time, questioning yourself and music are topics that young people know and live every day.

The Adotta project asked the students to produce an original artwork. These have been created in very different ways: made at home or in the classroom, created with traditional techniques or using digital software, some are low relief or ecofriendly handmade bags (fig. 2).

The strong link between science and art is visible in many pictures collected on the Facebook galleries. Although science and art were represented in two clearly different ways, they were considered as part of a whole. Figure 3 has been inspired by J. Cocteau's



Fig. 1. – An artwork inspired by Pythagoras' quote "Numbers rule the universe".



Fig. 2. – Example of artworks realised with different techniques: a freehand drawing, a digital design, a low relief and a handmade bag.

quote "Art is science made clear" [15]; science is associated to the human brain, able to create music, discover laws, develop new technologies, while art is related to the human heart, that paints all natural elements.

From the analysis of the pictures collected on the Facebook galleries it is possible to infer what the student feels about science. The crucial aspect of science regards its arousing questions in order to discover what lies beyond appearances, as shown in fig. 4 (left), a freehand drawing inspired by Bombieri's quote illustrated above. A simple orange hides a complex structure and, as the student commented, starting from a complex structure we can discover all the parts that compose it.

M. Planck asserted that "Science is only the progressive approach to the real world" [16], so science can give answers, it explains the universe through successive discoveries, just like it happens when combining many small pieces of a puzzle it is possible to reveal the laws governing the world, because nothing is at random, as the author of fig. 4 commented.

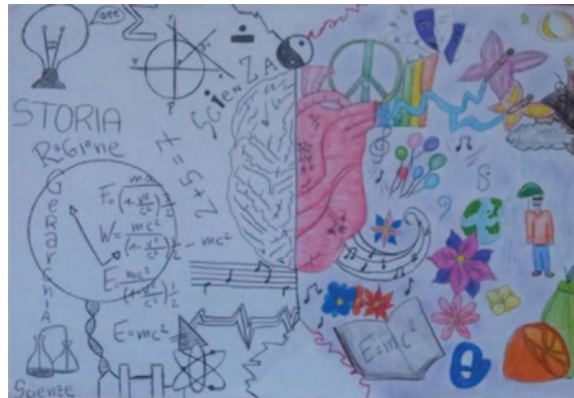


Fig. 3. – A freehand drawing inspired by J. Cocteau's quote "Art is science made clear".



Fig. 4. – On the left, an artwork inspired by Bombieri's quote "When things get too complex, it sometimes makes sense to stop and to ask yourself: Have I asked the right question?". On the right, a digital drawing based on M. Planck's quote "Science is only the progressive approach to the real world".

Science is based on mathematical laws, since "God does not play dice with the world", as declared by Einstein [17]. Drawing physical laws could be difficult but the author of fig. 5 (left) was able to depict a quantum-mechanics concept in a simple and very nice way, explaining that men on different sides indicate the position and momentum: they can never come out in the same shot.

Although characterised by numbers and formulas, science surprises as a coloured trail that comes out of a book and disperses in the world (fig. 5, right). A joyful and not boring science emerges in many artworks.

Science is also related to technological progress, a theoretical stairway that links Newton to Watson and Crick to Jobs (fig. 6, left), but it is also a powerful tool that should be responsibly used and men have to establish how to use what they have around, as asserted by the author of fig. 6 (right).

From this analysis it appears that, from the start of the classroom practices to the presentation of the artworks, the role of the teacher is central and crucial. The project valorizes the teacher's role in the formation of the students' cognitive processes: the teacher encourages them to behave as scientists in everyday life, helps them to recognize



Fig. 5. – On the left, a digital drawing inspired by Einstein’s quote “God does not play dice with the world”. On the right, an artwork based on M. Curie’s quote “A scientist in his laboratory is not only a technician: he is also a child placed before natural phenomena which impress him like a fairy tale”.



Fig. 6. – On the left, an artwork inspired by Newton’s quote “If I have seen further it is by standing on the shoulder of giants”. On the right, a drawing based on P. Curie’s quote “It can even be thought that radium could become very dangerous in criminal hands, and here the question can be raised whether mankind benefits from knowing the secrets of Nature, whether it is ready to profit from it or whether this knowledge will not be harmful for it”.

science not only in complex processes, but in every aspect of our lives and in our reflection on human existence, teaches them to draw conclusions from the phenomena critically observed.

Teachers play an important role in feeding the students’ desire for knowledge; the author of fig. 7 (left) affirms that the desire to know is the foundation of our existence. We must decide whether to feed this desire or let it die.

It is the opinion of C. Sagan that “Every kid starts out as a natural-born scientist, and then we beat it out of them. A few trickle through the system with their wonder and enthusiasm for science intact” [18]. Teachers can prevent the transformation of a girl dreaming to be a scientist in her childhood into one just caring for her appearance in her teens (fig. 7, right).

### 3. – Conclusions

The communicative strength of quotes and aphorisms on science by famous scientists, artists and writers is a universal value. Today, in Italian schools, the most difficult



Fig. 7. – On the left, an artwork inspired by M. Planck’s quote regarding science as a work based on new questions to solve. On the right, a drawing based on C. Sagan’s quote “Every kid starts out as a natural-born scientist, and then we beat it out of them. A few trickle through the system with their wonder and enthusiasm for science intact”.

objective for every teacher is to obtain the students’ attention in an original way: art is, for its natural appeal and its link with science, one of the most effective tools for the popularisation of science and for starting a cognitive process in the students.

During these three years, the Adotta project has been able to reach the defined goals:

- to promote and disseminate scientific thinking in the middle- and high-secondary-school students;
- to understand the link among scientific research, philosophy, historical situation;
- to disclose the enthusiasm which has characterised the scientists’ life, leading them to their discoveries, as a means for the students to identify themselves with them;
- to spread the awareness about the importance of science and technology for everyday life and for the future;
- to promote collaboration between teachers, not only via the interdisciplinary teaching practices at school, but also through inter-schools ancillary activities like: itinerant exhibits, thematic meetings in Skype, submission at conferences of co-written contributions about the Adotta experience and other educational subject.

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