MUSEOLOGIA SCIENTIFICA nuova serie • 10: 145-153 • 2016 ISSN 1123-265X

Comunicazione

Time and science. A co-creative project between schools and Pavia university museums

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ABSTRACT
The participation and subsequent funding by the Ministry of Education, Universities and Research (MIUR), of the project enabled the University of Pavia's Museum System, together with a number of infant, primary and secondary schools, to carry out various activities. The project "Time and Science" is one of many which, nearly since 2005, has variously engaged some of Pavia University's museums, the Department of Physics and a number of local educational institutions from schools to the university. Many of its characteristics have been retained this year too - the active involvement of museum staff, teachers and students, workshops and production activities, the wide use of the history of science and art history, the use of analogical reasoning, both within individual subjects and among subjects, as well as the attempt to create close ties between formal and informal education. The new elements of this project concerned work-related training and the participation of museums which had previously played a much more limited role. In addition, the final exhibition was mounted in enabled greater integration between museum artefacts and the work produced by the schools.

Key words:
educational projects, University museums, schools, time, birth, physics.

RIASSUNTO
Il tempo e la scienza. Un progetto co-creativo tra scuole e i Musei dell'università di Pavia.

Il tempo e la scienza. Un progetto co-creativo tra scuole e musei universitari pavesi. La partecipazione e il successivo finanziamento da parte del MIUR del progetto ha permesso al Sistema Museale dell'Università di Pavia e ad un certo numero di scuole di diverso ordine e grado di svolgere diverse attività. Il progetto "Il Tempo e la scienza" si inserisce in una serie di altri, che dal 2005 impegnano alcuni musei dell'università, il dipartimento di Fisica e alcune scuole del territorio. Molte le caratteristiche conservate anche quest'anno: il coinvolgimento attivo dello staff museale, degli insegnanti e degli alunni, la logica laboratoriale e produttiva, il forte utilizzo della storia della scienza e della storia dell'arte, il ricorso ad analogie, interne alle singole discipline ed esterne, tra discipline diverse, il forte legame al curriculum scolastico, il tentativo di una stretta unificazione tra educazione formale e informale. Le novità hanno riguardato l'alternanza scuola-lavoro, la partecipazione di musei e sezioni museali che in passato avevano avuto un ruolo limitato, la possibilità di disporre, per l'esposizione finale, che ha permesso una maggiore integrazione tra gli oggetti dei musei e i prodotti delle scuole.

Parole chiave:
progetti educativi, musei universitari, scuole, tempo, nascita, fisica.

GUIDING PRINCIPLES

Over 10 years ago, while putting on the major international exhibition "Albert Einstein, Chief Engineer of the Universe" (Bevilacqua & Renn, 2005), the history and teaching group of the Physics department of the University of Pavia began working closely with local schools of all levels. Over the course of a number of preliminary meetings it became clear that collaboration between the schools and museums needed to be planned jointly, and the areas of formal and informal learning needed to be integrated better. Starting from a subject that was historical and scientific, we began considering the teaching possibilities of interdisciplinary activities, particularly in the field of history of art. How were the history of science and the history of art used in this and subsequent projects? First and foremost through the scientific workshops run by museum staff and the artistic ones in schools. We also identified and developed several useful analogies for learning and remembering, as well as stimulating creativity. We then produced analogies to bridge the two disciplines, as well as enhance creativity and, above all, help identify models (Falomo Bernarduzzi et al., 2014; Falomo Bernarduzzi & Albanesi, 2015).

INITIAL STAGES OF THE PROJECT

Our co-creative project (Simon, 2010), named "Time and Science", began with a couple of meetings with the teachers, during which the theme was decided, requirements began to emerge and the first general objectives were agreed in relation to the age ranges of the pupils. The theme of time, proposed by one of the teachers at the first meeting, was greeted with approval from the other participants. The subject had often been mentioned in the previous year's project about cosmology, astronomy and gnomonics and had generated much discussion. Such a general subject was well suited to different age groups of students and to the collections of the three participating museums
• the Electrical Technology Museum, the Natural History Museum, and the Physics and Medicine sections of the history of Pavia University Museum.

UPDATE MEETINGS

A number of update meetings were held with teachers between the end of February and early March on:
• Time as a concept in the history of physics, an overview of some ways that "time" has been conceived and how they relate to some major scientific theories (Bevilacqua, 1984; Klein, 2008). How time is conceived is clear in three of them - Newtonian mechanics, special relativity and general relativity. The fourth, thermodynamics, is open to various interpretations, as is the fifth i.e. quantum mechanics. Time - and its negation - plays an important role in attempts to produce a quantum theory of relativity, such as loop quantum gravity (Rovelli, 2014).
Special consideration was given to the measurement of time and the search for ever more accurate clocks.
• Time and the evolution of the human species. Evolution can be defined as the accumulation of mutations which over time lead to significant changes in a living organism. Mutations in DNA provide variation that, over time, can give rise to changes in populations, which through natural selection and genetic drift, leads to the formation of new species. Thus, the living organisms of today are the result of an evolutionary process that began millions of years ago and which continues up to the present. Time is therefore an essential factor in evolution. *Homo sapiens* is also the result of this process and constitutes the latest stage of a journey in which successive elements have differentiated from each other over a long period (Piveteau, 1994). Through paleontology, phylogeny and the study of DNA we explore past time to locate the three-dimensionality of the human species. This concept takes into account how human groups in the past lived, how they adapted to changing environments, and how they behaved (Manzi, 2013). We can date back to between 5 and 6 million years ago the age in which the common ancestor of man and the African apes lived, to 3.5 million years ago, the appearance of the australopithecines and the ascent of the genus *Homo* to a million years later. When we refer to millions of years, we are referring back to a time in which a number of successive geological phenomena occurred, leading to the need for evolutionary adaptations. The first *Homo sapiens* appeared in sub-Saharan Africa eight thousand generations ago (about 200,000 years ago) as the Earth dried up further with the penultimate Quaternary glaciation (Cavalli Sforza & Pievani, 2013). Time becomes recent, closer and more tangible - it becomes prehistoric. The transition from prehistory to history to today is short, but the molecular clock does not stop and the human species continues to evolve.
• Time and birth. Time marks the formation of an embryo, and in the course of human history profound changes have affected the time of delivery. The teachers were shown some surgical instruments, historical images and photographs to illustrate how the time of birth has changed over the centuries, from the private sphere of the family, facilitated by the "mammana" (a sort of midwife, assisting both the mother and the new-born not only during the time of delivery but also through pregnancy and maternity) to a medicalized event involving obstetricians and surgeons (Grmek, 1993-1998; Cosmacini, 1997, 2003). We highlighted the techniques and ideas that have led to breakthroughs in medical history: the invention of forceps, Ignaz

Semmelweis' research into puerperal fever (Thorwald, 1958) and Edoardo Porro's caesarean-section technique developed in Pavia in 1876, which helped to drastically reduce the number of women dying in childbirth (Mazzarello, 2015). 2016 marks the 140th anniversary of this technique and some events during the spring under the auspices of Pavia University and the municipal council were linked to this theme. It was therefore thought useful to propose some ideas to schools for study and discussion to prepare for their possible participation in these initiatives.

• Time and communication. Here the project theme took on a historical and technological twist: artefacts from the museum collection were used to help pupils become aware of how technology has evolved to meet the ever increasing need to communicate quickly and securely, whatever the distance, as technological progress has steadily eroded the latter's relevance. Starting from the simple paradigm of sender - recipient - code - channel, "communication time" has shaped and is in turn shaped by the need to exchange information, which is at basis of social interaction.

• Time and art. The concept of "time" is a general and existential subject which has always been a part of religious, philosophical, scientific and, indeed, artistic thought. In Classical Greece, for example, art and sculpture in particular were able to reconcile the idea of time and philosophy - the time of being "which must be", and is therefore timeless - with the simplicity of the concept of linear and chronological time - discrete and measurable, which continues to be used to this day. The realistic figures in Greek sculpture portray men and heroes who express "their time" and at the same time become ideal models of form, according to timeless rules or "canons". Later, the Christian Middle Ages made a pointed distinction between the "time of man" (or the merchant) and the time of the Church and of God (Le Goff, 1977), splendidly translated into hagiographic paintings, in which the Gospel story follows the rhythms of the private sphere, based on the time of psychology and personality. In modern times, the French Impressionists captured the inadequacy of traditional painting and its "timeless" depiction. They sensed the unease of time that is radically evolving in the culture of "duration" (Bergson, 2004), in the perceived moment "en plein air", because science provided more persuasive ideas. This also means Einstein's concept of space and time which artists - not just Picasso - sometimes seem to prefigure and allude to, without really understanding it. In fact, this constant interchange between different disciplines, between art and science in general, arises from continuous references to meanings and allusions deriving from analogies between concepts, methods, and even images. The similarities feed off the construct of models and vice versa. The models interpret reality, they are hypotheses that would in time be replaced, but which are internally consistent. One such model is "representation in Western art", which stuck stubbornly to Euclid's postulates. However, it is not easy to get away from these models: contemporary art tends to entrust this possibility to happening, performance, not realizing that its escape route from the perspective model of traditional art has pushed it into the narrow confines of a narrative time that is chronologically older, because it is the same as that of classical theatre and sacred medieval representations!

CHOICE OF PATHWAY

After this stage, each teacher, or the teachers of each class (cf tab.1 for the list of schools involved), chose their pathways and the scientific and / or artistic workshops were decided in detail with each of them. Most of the classes, especially up to lower secondary level, followed both types of workshops, while the upper secondary schools chose different pathways. Art school pupils participated in the project through activities only related to figurative art, and workshops were held at school or in the museums, in the latter case as a work-related learning project.

Pupils from science- and classics-based schools took part in the science workshops and / or acted as explainers during the final exhibition, again as part of a work-related learning project. Integrated science and technical school pupils simulated the creation of a business enterprise linked to cultural heritage, participated in various types of scientific workshops, prepared exhibits, and acted as explainers of activities, which were again all part of work-related learning.

Schools involved in the project
Istituto Comprensivo di via Acerbi, Pavia: *- Scuola dell'Infanzia l'Aquilone, Pavia* *- Scuola dell'Infanzia San Genesio* *- Scuola Primaria Pascoli, Pavia*
Istituto Comprensivo di Corso Cavour, Pavia: *- Scuola Primana Carducci, Pavia*
Istituto Comprensivo di Via Scopoli, Pavia: *- Scuola dell'Infanzia Peter Pan, Pavia* *- Scuola Primana De Amicis, Pavia* *- Scuola Secondaria I grado Casorati*
Istituto Comprensivo di San Martino Siccomario: *- Scuola Primaria Mezzadra di Travacò Siccomario*
Istituto Comprensivo Carlo del Prete. Cassolnovo *- Scuola Secondaria I grado di Cassolnovo*
Altri Istituti: *- Istituto di Istruzione Superiore "A. Volta" Pavia* *- Istituto Superiore Statale "Taramelli-Foscolo", Pavia* *- ITIS e Liceo delle Scienze applicate "G. Cardano", Pavia* *- Istituto Superiore di II grado "A. Volta", Castel San Giovanni* *- Civica Scuola d'Arte AR.VI.MA, Pavia*

Tab. 1. Schools involved in the realization of the Time and Science exhibition.

EDUCATIONAL WORKSHOPS

The museum activities we ran in previous years demonstrated the wealth of educational ideas developed in close co-operation between schools and museums in which the connections made between art and science, between humanistic culture and scientific research proved very fruitful in educational terms. The presence of different school subjects continued this year too. It is characteristic of formal education at early schooling levels. The workshops conducted in the museum or in classroom activities, however, retained the methods and tools learned in the subject being taught. Applied workshops exemplified the concept of "time" from a scientific and historical perspective, based on the museum collections and through experiments and hands-on activities (how time is measured). In art, artists and artistic movements were approached by linking the definition of time with representational problems and schemas (in particular the relationship between space and time from medieval art to the avant-garde movements of Futurism and Dadaism).

All workshops made wide use of analogies and models, from the history of science and the history of art, devised by museum staff and teachers to encourage learning. These were constructed and completed together with students both within individual subjects and across subjects, especially science and art. Analogies were used with all age groups from infant school upwards. As our observations and other studies have shown, even very young children are able to make and use simple analogies successfully: "Encouraging basic relational thinking ... in preschool and kindergarten or early elementary may build a strong foundation for analogical reasoning in elementary school and beyond" (Vendetti et al., 2015, p.102). … "The fact that the neural structures for analogical reasoning are already in place by age 6, if not earlier, highlights the point that young children do not have a structural impediment to relational thinking. We propose that providing children with systematically guided experiences in using analogies will support the development of a strong reasoning system and promote a deep understanding of concepts across a broad range of disciplines" (Vendetti et al., 2015, p.104).

Some critical issues did emerge during the project concerning the marginal importance of the themes related to some museum collections with respect to school curricula and the peculiarity of their artefacts. One particular case was the theme related to the history of medicine, which requires great attention from participants so as not to offend the sensibilities of the public, especially minors. However, the work produced by the schools even on such delicate topics shows that further co-operation could offer more training opportunities for museum staff, through coaching of teachers and educators in workshops and creative events organized in the classroom. We observed in our project how subtle analogies between science and art help to enrich the encounter with the Museum. Analogies, similarities and associations between doing research and the act of creating often arise unexpectedly, striking a "chord" between two seemingly different fields. So in this year's project we started, and plan to develop, a special discussion and analysis "workshop", for school and museum staff, with the specific purpose of identifying "analogical pathways", common structures, schemas and patterns that can be shared across different subjects. This is because analogies do not manifest themselves when desired i.e. when a school group enters the museum. Only some associations can be imagined in advance. The value of analogies lies in their unpredictability. These "workshops in progress" for educators and museum staff could subsequently be opened up to students and museum visitors, to achieve really "productive" visits, in which museums form part of a "wider cultural ecosystem" (Zane, 2016).

SCIENTIFIC WORKSHOPS

The scientific workshops are always conducted in the museum, but in recent projects some have been continued in the classroom, with the support of museum staff. This has helped to better integrate formal and informal learning, and is appreciated both by teachers and pupils. In Physics, for example, two classes from the same comprehensive school chose the measurement of time as their topic. A large water clock was built in the Department of Physics workshop for the infant school, which helped to make time "linear". An activity was associated with each water level in the underlying cylinder, thus showing in a simple manner how one day is made up of a succession of moments that are repeated every day at the same "level" (fig. 1).

Fig. 1. A pupil marks the level corresponding to the activity of that moment.

Other activities conducted by the teacher on days, weeks and months, showed their cyclical nature and how we can switch from linear to circular time. A sand hourglass, built by the teacher, also enabled the children to "play" with the concept of duration. During its visit to the History of Pavia University museum (where different types of clocks are kept) and in museum workshops and at school, a fourth year primary school class observed several ways of measuring time developed over the centuries, from the sundial to the water clock, from the pendulum clock (a simple model was also realized in the Physics Department) to the quartz clock. At the end of the pathway the children made various drawings, and with the help of software, including *Stellarium*, they produced numerous images, which have been mounted in stop motion and can be seen at the Sistema Museale di Ateneo website: http://musei.unipv.eu/eventi-e-mostre/

As for Medicine, guided tours were organized linking the theme of "time and birth" with key turning points in the history of medicine (such as the development of the germ theory of infectious diseases, antisepsis, anaesthesia, the development of specific surgical techniques) which were dealt with not only from a biological perspective, at different embryo development stages, but also artistically, with representations of the theme of motherhood (fig. 2).

With regard to Natural History, two types of workshops were organized: one at the Natural History Museum, while the other was itinerant, and called "The Museum in a suitcase" because it is an experience which can be easily exported outside the institutional setting of the museum, in order to reach out to disadvantaged contexts, which are conditioned by social, physical or cognitive difficulties.

The museum's activities were chosen by infant and primary schools. With infant schools we tried to frame the concept of prehistoric time by presenting primitive man. One of the topics we focused on was cave paintings and the animals they represented, in order to contextualise prehistoric man in his environment. The children were able to touch some fossils and make drawings of some quaternary mammals in the museum (fig. 3). These concepts were then expanded on in the classroom and the children produced a 10-metre high painting inspired by the prehistoric carvings (fig. 4).

In the case of primary school children, we presented the main hominid species involved in the evolution of man and their salient characteristics. Subsequently, a few simple anthropometric measurements of skull models of *Australopithecus*, *Homo erectus*, *Homo neanderthalensis* and Cro-Magnon man were taken, and their skulls reproduced on a panel. Pupils used these real measurements to make "artistically evolved" drawings in class.

The Museum in a suitcase has been proposed to

Fig. 2. A painting on the theme of motherhood.

people that for different reasons were not able to visit the museum (like the Martinetti Foundation - Lega del Bene di Pavia, which assists disabled children, the primary and secondary schools of the pediatric hospital IRCCS San Matteo in Pavia and the Association of Parents B612).

The Museum in a suitcase project involved mixed groups of children, both in terms of age and in terms of previous knowledge about specific subjects. As a result, we began the workshops by screening a short video, which ran through the main stages of human evolution in a few minutes. Subsequently, we proposed engaging interactive activities through which the children were able to understand how the appearance and behaviour of our ancestors evolved into modern man. More specifically, we proposed the following activities:

1. a game about man and his distinctive traits, namely: the shape of the skull and brain, chest and internal organs, the structure of the hands and fingers, eyes and eyesight, teeth and chewing, ears and hearing, the pelvis and posture;
2. a fossil hunt through which individual children, or teams of several participants, looked for fossil bones and later rebuilt two Australopithecus and Neanderthal skeletons;
3. a game to study different skull models, by matching them with their respective species of hominids. This proved useful in encouraging the observation of some details and in understanding how the species evolved over time;
4. a game to match a few simple prehistoric objects and their uses: some examples were arrowheads, knives and scrapers;
5. making a simple characteristic prehistoric object such as a necklace of shells, a spear or a bow.

The Electrical Technology Museum was involved in two ways in the "Time and Science". Project - it was

Fig. 3. Pupils drawing at the museum.

both the "location" for the final exhibition, which was an integral part of the project, and the place in which the key theme was developed, by analysing, through artefacts, the evolution (over time) of communication technology.

Pupils who chose this pathway engaged with different means of communication from a historical and technological perspective. They ranged from the classic Morse telegraph system, through to phones using the Meucci and Bell systems as well as the telegraph, rotary dial telephone, the "smartphone" and e-mail. It became clear that the theme of *time* has a dual nature: on the one hand, there is the historical timeline of electrical communication, on the other, time is a resource in the act of communication, which gets faster and faster. More specifically, primary school pupils worked on the concept of communication in code by using a visual one in order to communicate with each other (fig. 5). Technical school pupils, instead, created two different communications-based exhibits: a historical one based on the theme of cryptography and on access to an original Enigma machine, which is part of the museum collection; the other using light optic fibres - the new information-carrying system.

FIGURATIVE ART WORKSHOPS

Many art workshops in schools are generally based on the spontaneous communicative and expressive capacities of children through their drawing and stereotypical representations (in infant schools and the early years of primary school), with appropriate guidance and extension over subsequent years from teachers who work to provide them with increasingly complex graphic/pictorial, technical and practical means of expression. This prepares them for an encounter with figurative art, particularly contemporary art, from a very early age. Pupils tend to be given selected, sophisticated visual models, on which to draw on as an "alphabet of signs" produced by artists, but which they can re-use to express themselves. The value of this image retrieval is once again analogical. Children are able to recognize the particular style of an artist through the signs that make up the work of art; they are able to connect the signs that "look alike" with their creator. They learn to appropriate them, copy them and re-use them for their visual stories. Actually, all figurative art history can be re-read as a great game of quotation and imitation, an assimilation of techniques and stylizations learned from external sources, as young pupils might have learned from their master in the art workshops of the past, and as children do today on the computer. These formal analogy games dramatically increase their expressive potential and facilitate their ability to "narrate" experiences also outside the world of art. This is what the pupils who explored the issue of time in our project were required to do. After visiting the science museums, taking part in scientific experiments, as well as learning about phenomena, events and personalities related to the definition of the concept of time, they "translated", imitated, revisited and

Fig. 4. The final drawing made by the pupils.

Fig. 5. Children using a visual code to communicate (see also the video at the "Sistema Museale di Ateneo" website: http://musei.unipv.eu/eventi-e-mostre/).

reinterpreted them in art workshops in their classes. Of course, this encounter with science can also take place through images. But a clear, equally rigorous approach, as well as precise indications are needed: reinterpreting an object exhibited in the Museum "in the manner of Picasso ..." requires a formal understanding of the great Spanish artist's style, characteristics which may suit an object "with a certain form", but not others. Many students from the "Istituto Superiore A.Volta" (an art school) of Pavia took part in a five day workshop (work-related learning) in the rooms made available by the Natural History Museum. The material on display in the museum, which varied in nature, was collected and reproduced. The theme of time remained in the background, as a starting point. Instead, the common denominator for many forms of creativity was mutation / transformation. As happens in design and styling, the forms of the objects selected from among the museum's display cabinets were reproduced, re-configured, stylized, and transformed into consumer objects and eventually collected and assembled under two sections: work "in the style of" J.M. Basquiat and J. Dubuffet, two masters of contemporary art. This time the analogies were many and sophisticated and, given the age of the pupils, expressed with greater awareness.

THE FINAL EXHIBITION

For the final exhibition some specific display cabinets were mounted in the temporary exhibition hall of the Electrical Technology Museum on the subject of "time and birth" in the history of medicine, which is closely connected to another pathway housed in the room, "evolutionary time". Indeed, walking upright determined changes in the shape of the pelvis, as a result of which, for the human species, childbirth became more difficult and painful and consequently also a social occasion in a woman's life, as she needed help and care. On display were surgical instruments such as forceps, obstetrical levers, syringes - which can be used for injecting medicines and, if necessary, to administer baptism to the child still in the mother's womb - sterilizers, manuals for midwives and anaesthetic equipment (fig. 6). The theme of motherhood was developed by art school pupils in two ways: the first mother / material - inspired by the maternal, generating power of the mother - where pupils created an artistic pathway which involved choosing, shaping and transforming different materials to express the concept of mother as a form and life-generating material based on their own personal experiences. The archetype of the Great Mother, the Feminine who possesses and conveys reason, emotion, intuition, as well as positive and negative feelings. After documenting themselves, the students had to search for, find and recognize this force within and around themselves and then transfer the images and feelings aroused by the powerful symbol of the Mother onto paper, canvas or other support. The work of each pupil brought out different aspects: protective and welcoming images, or threatening ones of the Terrible Mother. Infant school children produced "the rotating wheel of birth", which was conceived to narrate the fixed stages of gestation / formation and, at the same time, compare humans with plant and animal species.

As for "Time and evolution" the skeleton of a gorilla and a human were displayed in order to show the changes that occurred in achieving the erect position:

Fig. 6. A showcase on "Time and birth".

limb length, foot shape, the structure of the iliac blades as well as the pelvis and scapula. Comparison of the pelvis, which in humans becomes wider and flatter, reducing the space for the foetus to come out leads us back to "time and birth". Displayed on either side of this cabinet were several skull models of *Australopithecus afarensis*, *Homo erectus*, *Homo neanderthalensis* and *Homo sapiens* arranged to form an evolutionary pyramid. Other cabinets contained quaternary fossils of some common species of the time, such as the megaloceros, the cave bear, the mammoth and the steppe bison. Children from one infant school narrated one long story: ten metres of pictures and figures, where some museum exhibits were repeatedly drawn and mixed with signs taken from chronologically incongruent prehistoric/paleontological images, but associated analogically under the generic term of "prehistoric times". These included dinosaurs, Val Camonica rock carvings and some indistinguishable infantile drawings and, perhaps, a short cartoon strip. The dominant characteristic was more the concept of a "return to the distant past" than the rigour of scientific presentation. But the teachers know that "this is enough" ... A third-year primary school class presented the same subject by means of several skulls of *Homo habilis*, *Homo erectus* and *Homo sapiens* arranged chronologically in pop-art style. They won't forget their encounter with the topic!

The physics section was mounted in the Electrical Technology Museum and displayed not only a certain number of clocks taken from historical collections, but also the hands-on work produced for and by schools: a sundial, a water clock, pendulums made from various materials and of varying length, to show what a period of time depends on and to reflect on the subject of isochronism. In addition there was a Galileo-type water clock, which could precisely measure short time intervals by weighing the water which flowed out of a jar at a constant rate, as well as a simple pendulum clock with anchor escapement. Finally, a modern wristwatch was dismantled to show the oscillation frequency of a small quartz crystal. Reference to the universal coordinated timescale for Italy, which is generated by atomic clocks, was made through photographs provided by the Italian Institute for Metrology Research (INRIM). The work produced in the art workshops was placed alongside the scientific materials. Besides a short video on the history of clocks there was a graphic dream-like translation of the film "Labyrinth" by primary school children on a 10 metre long roll which sought to recoup and make internal time converge with external time; infant school children produced drawings on a large transparent sheet to represent movement, which is strictly connected with time, through overlapping images, and even self-portraits in the manner of Duchamp representing the rapid movement of the head, which almost turn into sculptures. An equatorial sundial and a grandfather clock were also decorated by primary school children. (fig. 7) A lower secondary school class worked on the project theme but basing itself on the history of classical electromagnetism, and also produced some explanatory videos.

The theme of "Time and communication" coincided with the organizing principle of the entire museum. So, instead of communication, a fifth-year primary school class chose another "big" museum theme by presenting exhibits alongside very small, intriguing experiments to show some sources of energy (wind and water) and how they are transformed into kinetic energy. They supported their work with some of Leonardo da Vinci's most famous drawings on the movement of water re-interpreted in the Futurist manner. Vinci's waves seem to murkily and repeatedly get agitated, like words in freedom, in the style of the dynamic rhetoric of Futurism.

Going back to the theme of communication, Futurism also inspired two first-year primary school classes, which communicated their own experiences in the style of Marinetti and, given the similarity between Morgenstern's open-mouth, closed-mouth fish ("The Night Song of the Fish") and the dot-dash of Morse code, sought to communicate, in their drawings, like the fish. An infant school artistically replicated a

Fig. 7. The physics section.

Fig. 8. Exhibits using optical fibers.

number of devices that have marked great changes in communication for children - books, the theatre, television and the tablet. An applied science high school and a technical school embarked on a complex, multi-subject pathway, and chose silk and its various uses over time for their main topic. The children presented a large number of activities at the exhibition, from the breeding of silkworms to dyeing scarves, from using "standard" optic fibres in communication to the study of new uses of silk protein such as in constructing optical fibres used especially in medicine (fig. 8).

FINAL REMARKS

The project involved 35 classes of 14 primary and secondary schools confirming the validity of the choice of the theme "Time and science". However, its general nature also led, in the climate of free thinking that typifies the project, to difficulties in identifying specific sub-topics and analogical models between science and art that would be useful in the various contexts. This set off a discussion which will need to be looked at in-depth with all participants in the course of this project and in future projects. Our work is not yet completed and will be further developed in the coming months through new insights and the involvement of new classes. Again at the end of this new phase the results will be presented on digital platforms and in a new exhibition.

ACKNOWLEDGEMENTS

A special thanks is due to all pupils, teachers and head teachers involved, that have participated with enthusiasm and creativity at all stages of the project. Last but not least thanks to: Nicola Basili, Alessandra Bonizzoni, Lea Cardinali, Patrizia Contardini, Roberto Galdi, Jessica Maffei, Michela Magliacani, Stefano Maretti, Paolo Mazzarello, Giorgio Mellerio, Edoardo Razzetti, Lucia Stefanini.

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Submitted: October 14th, 2016 - Accepted: October 30th, 2016
Published: December 16th, 2016