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Ideas and implementations of interactive didactics

– exhibitions, musea and science centres

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5.10. National Museum of Science, Daejeon, Korea¹

Our virtual travel over four continents we finish in Asia, in the National Science Museum of the Republic of Korea in Daejeon. This is second, after Seoul² science museum in Korea, placed almost in the geometrical centre of the Republic. Daejeon is a city of 1,5-million inhabitants, the capital of the Korean Silicon Valley. It hosts some 200 scientific and industrial research institutes. There are, among others, the laboratories of a multisector industrial giant „Samsung”³, employing in the whole Korea more than some 200,000 persons.

Korea is a country densely populated - 48 mln inhabitants over a territory of about 1/3 of Poland and highly industrialized – the growth rate in one of the highest in the world and the GNP *pro capite* was in 2010 almost twice as high as in Poland. Daejeon hosted in international Expo in 1993. The town is, similarly as many other in Korea, a mixture of the modernity and the traditional houses. Also the organization and arrangements in the National Science Centre in Dajeon recall this specificity of South Korea.

The National Science Museum is placed near to so-called government district, with four high buildings of the state administration, botanic garden (Arboretum) and two museums of arts. The park and museums host concerts, exhibitions and other events of the international importance. An open space of the park, filled by the modern architecture as well as the elements of the Korean tradition plays a special role in a country so densely populated as Korea. The streets leading to the science museum are surrounded by residential high scrapers and the entrance for pedestrians passes over a somewhat futuristic bridge, see photo 5.36b.

The Museum covers 16 ha area and the closed exhibition space amounts to over 21,000 sq. meters. The space, the nature and the architecture are the essential elements of the whole government-cultural district in Daejeon, see photo 5.36. The leading motto of Museum says “The harmony with science, nature, and man”. The diversity of the exhibitions confirms this.



Photo 5.36. The urban space and the architecture of the landscape as the elements of the science and culture centre in Daejeon: **a)** Museum of Arts in the government district; **b)** a hanging bridge leading from the government district to Expo i Science Museum pavilions on the other side of Gapcheon river; on the other side - residential buildings **c)** the overview of the National Science Museum in Daejeon (photo MK)

¹ Concept and implementation Maria Karwasz.

² The National Science Museum in Seoul was founded in 1945 and renovated after the war. As compared to the Museum in Daejeon it is characterized more by educational functions, as it can be noticed from the internet page <http://www.ssm.go.kr/v2/eng/sub30.asp> (15.09.2012). In Seoul majority of exhibitions develops questions of physics (energy, electricity, motion, acoustics, optics), differently than the much younger Museum in Daejeon.

³ Samsung corporation in 2012 launched, among other their products, a new model of the cell phone, exceeding in technical parameters the iPhone by Apple; at the same time Samsung was delivering 40% of electronic sub-components to iPads, including the central processor.



Photo 5.37. Using the *plain-air* in Science Museum in Daejeon: **a)** dinosaur park, a sundial to the left; **b)** playing with water; **c)** famous American fighter F-86 from the time of the Korean war (MK)

As compared to numerous museums described in this chapter (geological museum in Ontario, natural history museum in Bruxelles, paleontological museum in Bolca, Italy), and also the musea described in chapter VIII (Museum of Technology and Museum of Earth in Warsaw), the National Science Museum in Daejeon focuses in one place many different functions. Separate, spacious and modern pavilions are dedicated to these functions, with no predominant place for single objects but with their overall artistic arrangement – similarly to the museum in San Sebastian in Spain, but projected with a much bigger extension. The number of exhibition objects exceeds 4,000. Some of them are placed outside, see photo 5.37.

Social goals that the Science Museum in Daejeon performs are various – from the function of exhibitions, through historical collections, education, entertainment to the role of “nation-creation”. Therefore we will also find elements of the military museum – with a tank and an airplane from the times of the Korean war, for children – a park with dinosaurs’ sculptures and the waters games – smaller than those in Australian Questacon, but with really nice exhibits, see photo 5.37b.

The first of the four main sectors of the permanent exhibition in Museum in Daejeon is devoted to the history of science and technology in Korea. Particularly interesting is the collection of historical scientific instruments like sundials, an anemometer (wind speed), indicator of water level in the river, amount of rain (pluviometer) – all of them originate from the times of the Joseon dynasty (14th-19th century), see photo 5.38. In the outside exhibitions we find also a reconstruction of an astronomical observatory from 14th century.



Photo 5.38. Reconstruction of historical meteo instruments and sundials in Science Museum in Daejeon: **a)** water-level indicator from Cheonggye river; **b)** reconstruction of a portable sundial from 1437 done in bronze (7-times enlarged); **c)** sundial Angubuilgu invented at the beginning of 15th century – extremely interesting, concave configuration of the time indicator; **d)** anemometer – the direction and the speed of wind was shown by a pennant at the top of the column (photo MK)



Photo 5.39. Technological heritage of Korea: **a)** Historical Park in Daejeon: archive of printing matrices using *hanja* system; in spite of invention in 1446 of the own Korean alphabet using movable characters, educated classes for several centuries still used the alphabet of the Chinese origin; **b)** Science Museum in Daejeon: *hwacha*, i.e. a missile system invented in 1409 r. – it used to launch from 50 to 200 arrows at a distance of several hundreds meters, the arrows were propelled by gunpowder position below their tip; a catapult in the background (photo MK)

Both in Science Museum and in Historical Park in Daejeon, where the biggest archive of wooden print matrices in Korea is stored, the invention (prior to Gutenberg) of the movable print characters is stressed⁴. In one of the permanent pavilions of Science Museum reconstructions of military medieval machines are shown, see photo 5.39b. One can find there, among others, *hwacha* i.e. rocket-like arrow launcher – a kind of prototype for Soviet *katiusha* from the II World War. The arrows were propelled by gunpowder, which the recipe was re-discovered by Koreans at about 1374, in conditions of a technological embargo from China. *Hwacha* used to launch from 50 to 200 arrows at a distance of several hundred meters⁵.

The second part of the permanent exhibition is dedicated to the problems of modern science and technology. One can play there with futuristic automobiles supplied with hydrogen and photoelectrical cells, see photo 5.40. On a high scientific level, even if simply visually shown, is the discussion of the greenhouse effect – the complex Earth's energy balance is shown in details and possible consequences of the global warming are discussed, see photo 5.41a.



Photo 5.40. Travelling yesterday, today and tomorrow - the history, ecology and the futuristics are neighbouring in the pavilion of permanent exhibitions in Daejeon (photo MK)

⁴ Korean alphabet originates from Chinese and Japanese but in 1446 it underwent a radical reform. It consists of 24 movable fonts (12 vowels and 14 consonants), which sum-up to a kind of pictograms. .

⁵ In the same time in Europe the wars used to be solved by squads of archers. Particularly famous were English archers. The use of some tens of *hwacha* batteries was decisive in the defence of Korea against the Japanese invasion in 16th century.



Photo 5.41. Social competences in Science Museum in Daejeon: **a)** problems of the energy balance of Earth and the greenhouse effect. Even not knowing the Korean language the sequence of events from the bottom of 5.41a panel is clear: the rise of the number of inhabitants and the growing technological demand leads to intense use of fuel paleontological deposits what causes, in turn, the global warming effect and in consequence, for example, melting of the Arctic ice cover; **b)** photos of Nobel prize winners from 1903 and a short description of their achievements in the context of the type and the range of the nuclear radiation; **c)** a mock-up of the nuclear plant; to the right the scheme of uranium fission (photo MK)

Several other discussions on important questions of the contemporary civilisation have been undertaken in Daejeon Science Museum. They cover, for example, the problems of renewable energy sources, nuclear fission, deposition of nuclear waste, problems of urbanites, space flights and so on. The social importance of such discussions is extremely high. The exhibition instalments include different ways of narration – from posters, through interactive models (photo 5.41c), to descriptions installed on computer monitors.

„Immortal” in all science musea and exploratoria in the world is playing with physics. In Daejeon, in the adopted space, we will find several such games, but they are quite impressive in size and in the overall aesthetic impression. Two rolling-down instalments for billiard balls, in the pavilion of permanent exhibitions of Science and at the exhibition “Alive Science Center”, are great, similarly as in Australian Questacon and continue to fascinate all visitors, independently on their age (see photo 5.42b). Similarly of huge dimensions is the slinky spring⁶, which perfectly illustrates the perpendicular and longitudinal mechanical waves, see photo 5.42c.



Photo 5.42. Playing with physics in Daejeon: **a)** an interesting variation of the Newton’s cradle, so-called harmonic pendulum – balls hanging on wires of different length get into resonance only in some of the neighbours; **b)** super-size sliding-down instalment fo billiard balls; **c)** two huge slinky springs hanging beneath the ceiling allow experiments with perpendicular nad longitudinal mechanical waves. (photo MK)

⁶ See. A. Okoniewska i G. Karwasz, *Spings and waves*, [in:] G. Karwasz et al., *Physics and Toys*, CD-ROM, PAP, Słupsk 2005, http://dydaktyka.fizyka.umk.pl/zabawki1/files/mech/sprezyna_sch-en.html (15.09.2012).

Optics, as we show it in the chapter VII dedicated to numerous editions of our „Fiat Lux” exhibition, remains a pleasant subject of physics. In Daejeon we find several full-size classical experiments in optics: spherical and cylinder mirrors, telescopes, lenses in the configuration of binoculars, kaleidoscopes, stroboscopes, combinations of mirrors in 3D, games with light rays refracted in lenses or reflected from mirrors, optical illusions and son on, see photo 5.43. Some of these experiments resemble the exhibition on optics in La Villette Museum in Paris, but their arrangement is more aesthetic and interesting with no excessive explanations.



Photo 5.43. Playing with optics in Science Museum in Daejeon: **a)** this set-up of mirrors we call in our “Physics and Toys” a hair-dresser room⁷; **b)** cylinder convex and concave mirrors⁸; **c)** a head on the plate, or a kind of money-box of an illusionist⁹ (photo MK)

A separate space in the pavilion of permanent exhibitions is reserved for Earth in the Universe. The central place is occupied by a globe illuminated by a projector, which changes, depending on the image, into Jupiter, Mars, Sun. Big concave cylinder monitors in the edges of the room show the Solar system, the history of Universe from firsts moments after the Big Bang till the formation of stars. Stars and our Galaxy we find also on the black-ink coloured ceiling, see photo 5.44a. Interactive computer instalments describe in detail the Big Bang, the evolution of stars from the primordial matter, characteristic of stars, types of nebulae etc. Big models of planets, keeping their relative dimensions hang also in the main exhibition hall. The subjects of cosmos are discussed again in a separate building of planetarium.

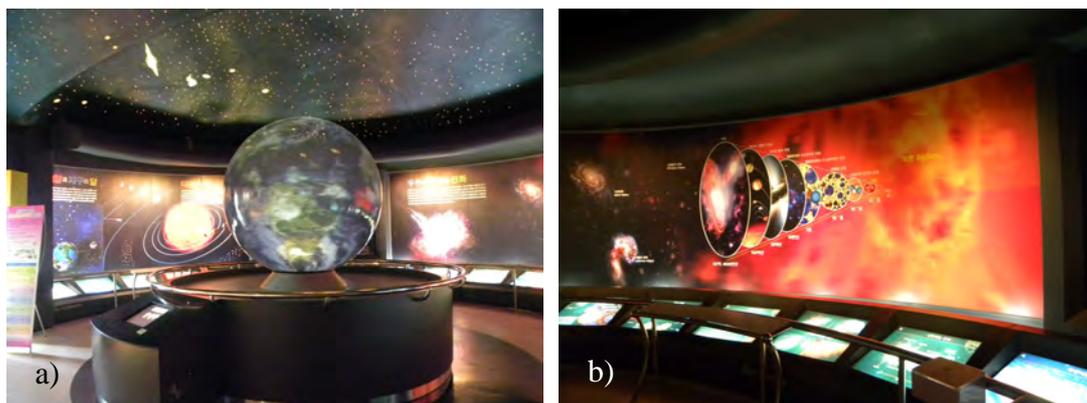


Photo 5.44. The structure and beginning of the Universe: **a)** the central sphere is, in reality, a monitor which changes into a chosen planet (Mars, Jupiter), satellite or Sun; black-ink ceiling is spotted with stars; **b)** interactive monitors describe in detail the history and the structure of Universe (photo MK)

⁷ See K. Hubisz i M. Brozis, *A hair-dresser room*, [in:] G. Karwasz et al., *Physics and Toys*, CD-ROM, PAP, Słupsk 2005, <http://dydaktyka.fizyka.umk.pl/zabawki1/files/optyka/fryzjer-en.html> (15.09.2012).

⁸ G. Karwasz, *A mirror for everything*, [in:] G. Karwasz i in., *Physics and Toys*, CD-ROM, PAP, Słupsk 2005, <http://dydaktyka.fizyka.umk.pl/zabawki1/files/optyka/lusterko-en.html> (15.09.2012).

⁹ G. Karwasz, T. Wróblewski, *Money-box for illusionist*, [w:] G. Karwasz i in., *Physics and Toys*, CD-ROM, PAP, Słupsk 2005, <http://dydaktyka.fizyka.umk.pl/zabawki1/files/optyka/skarbonka-en.html> (15.09.2012).



Photo 5.45. Elements of science history in Daejeon: **a)** paraphrasing the leaning tower in Pisa, with changed proportions between the levels, to illustrate the law of free-fall (distance proportional to the square of time; **b)** illustration of Kepler's laws – text, portrait, scheme and computer animations (photo MK).

Despite of the scientific character of the Museum in Daejeon several humanistic elements appear. This is for example the paraphrase of the famous campanile from 12th century in Piazza dei Miracoli in Pisa (so-called leaning tower). It reminds Galileo Galilei and the discovery of the uniform accelerated motion and also the place, where it was tested. A computer monitor illustrating the three Kepler's laws is mounted into the background with the scientist's portrait and with short descriptions, photo 5.45b.

The third part of permanent exhibitions is the museum of the natural history in its best, although short edition. We will find there a skeleton of a mammoth preserved in 80%, a skeleton of a whale, similar to that in Bruxelles and the reconstruction of *Triceratop* and *Tyrasonaurus Rex* skeletons. The exhibition, in spite of its laconic character extends well beyond the phenomenological dimension solely. The narration about the natural history is multi-weave. In cabinets on the walls main paleontological natural environments have been reconstructed. We have there an aquarium from Palaeozoic with exotic fish which lived at that epoch and in the neighbouring cabinet numerous relicts of non-questioned record-bearers of paleontological long-living – bottom trilobites, see photo 5.46b.



Photo 5.46. Travelling back in time of Earth's history: **a)** a mock-up of the Palaeozoic ocean; **b)** a real object – fossils of different types of trilobites, **c)** a didactical scheme – genealogical tree of dinosaurs (photo MK)

The solution adopted resembles that from the next room – space exploratorium (photo 5.44) – big monitors and posters on the surroundings and under - the detailed histories in interactive set-ups. So we have a dinosaur hatching from the egg, a battle between the herd of styracosauri, hunting of the tyrannosaurus etc. The virtual layer does not dominate anyhow, as under the monitors, the triceratops strolls and between its paws the eggs are deposited and Cenozoic trunks of trees stand-up. The additional explanations and mini-schemes are perfectly incorporated into the whole exhibition, see photo 5.47a.



Photo 5.47. Life on Earth: **a)** in Mesozoic – reconstruction of the triceratops’ skeleton and below its legs – the schemes, descriptions and the reconstruction of the environment; at lower consoles – interactive, computer-driven stories on dinosaurs; **b)** the nature today – reconstruction of the autumn forest; to the left – interactive puzzles on animals, e.g. „What does the deer like?” etc. (photo MK)

The *tête-à-tête* with nature serves also to developing children’s social competences, see photo 5.47b. In four angles of the room the natural environments of the four seasons have been reproduced. In a country densely populated and covered with rice fields the possibility to meet a tiger in the forest is faint. In the Museum one can stroke its fur (other animals as well) what is a wonderful plat also for blind visitors. One can peek into the lair of a mouse, feel the canines of a wolf, hear the rumbling of an owl etc. In the ornithological collection over 100 species of birds residential on Korean Peninsula or migrating there are shown.



Photo 5.48. Elements of the natural history museum in Daejeon: **a)** anthropology lesson – different forms of hominids; upper panels show their distribution and migrations; in lower cabinets copies of the remnants (mandibles, fragments of skulls) are shown etc.; **b)** lesson of geology: examples of minerals and their importance; the right panel shows the distribution of minerals forming the Earth’s crust: plagioclase, orthoclase, quartz, pyroxene, olivine; the scheme in the centre explains different forms of silicates, starting from the $(\text{SiO}_4)^{2-}$ group in tetragonal compound with cations Mg^+ or Fe^+ like in garnets, through alluminosilicates, e.g. of beryllium (i.e emerald), kaolin, mica etc. This knowledge exceeds even the level of the secondary school and sometimes is too difficult even for students of natural sciences, but important for the technology and science (photo MK)

The subject of anthropology, which we illustrated already on the example of Science Museum in Trento, Italy, is treated in Daejeon in a way somewhat nation-forming. Different species of hominids in accordance with international standards are shown, but their diffusion is shown only in South-East Asia. Similarly as for many other exhibitions, different objects

(copies of fragments of bones), reconstructions (postures) and computer-based schemes are highly complementary in narration, see photo 5.48a.

Information on geology, apart from classification of rocks and minerals that we have already shown, for example, in Ontario, Canada, in Daejeon allows to make a complete lesson at different levels of difficulty (even academic) on subjects like, soil stratifications (i.e. agriculture), processes of subduction in Earth's mantle and crust¹⁰ (geology), structures of silicates (material engineering), technical applications of rocks (architecture), see photo 5.48b.



Photo 5.49. Traditions and artefacts of Korean handcrafts: **a)** iron forging; **b)** traditional carillon with different than European pitch and harmony of the bells (photo MK)

The subject of the Korean cultural heritage comes back several times in the National Museum of Science in Daejeon. Traditional branches of crafts, like iron casting and blacksmithing, weaving, glass forming are shown in various ways: as mock-ups of processes, collections of materials and tools, ready products, and so on, see photo 5.49.



Photo 5.50. Centre of Advanced Science and Technology in Daejeon – an example of science-divulcation activities of research institutions: **a)** exposition of the Korean Institute of Astronomy and Space Sciences; **b)** exposition of the Institute of Mathematical Sciences (photo MK)

In Daejeon it happened possible to establish collaborations with numerous scientific institutions located in that city and the Science Museum¹¹. Exhibitions organized by research institutes occupy a separate, few-store pavilion in Expo area. In the Advanced Science & Technology Centre separate expositions show, for example, the Korean Institute of Standards and Science (KRISS), Korean Institute of Earth Sciences and Mineral Resources (KIGAM), Korean Institute of Oriental Medicine etc. see other examples on photos 5.50.

¹⁰ A similar scheme, but more complicated can be we will found in Earth's Museum in Warsaw.

¹¹ We recall that a Lack of such collaboration in Canberra between Questacon and CSIRO was one of the drawbacks listed in Australian government reports, see par. 5.3.

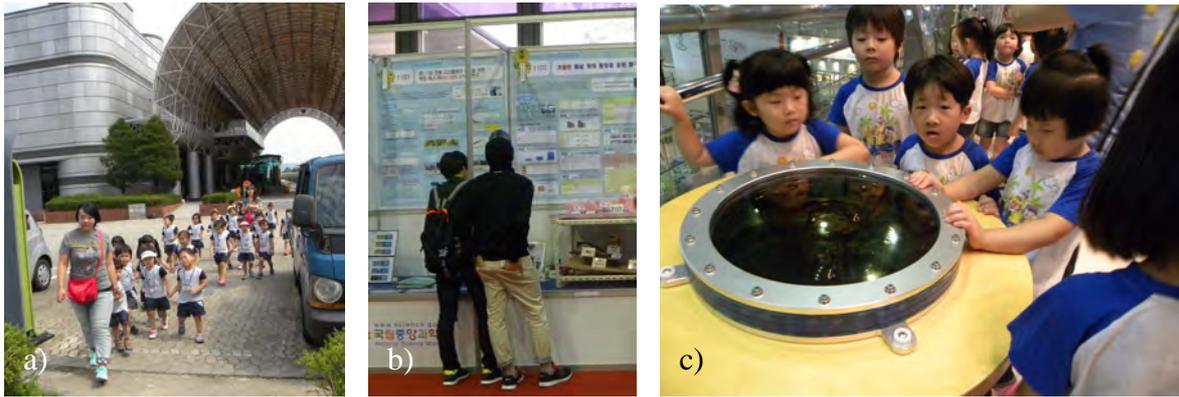


Photo 5.51. The addressees in National Science Museum in Daejeon: **a)** a fair good amount are the early-school groups; **b)** scientific posters – the results of a competition for students – attract the interest of secondary-school pupils; **c)** sometimes the visitors turn-out to be too young and/or the exhibit (the magnetic fluid in this case) too complicated or too little amusing (photo MK)

The richness of thematics discussed in the National Science Museum is impressive. We find there rooms dedicated to the traditional products and professions (like in Polish regional museums), interactive medical arrangements (similar to those introduced in the “Kopernik” Centre in Warsaw), botanic species, reconstruction of the national technological achievements (similar to the Leonardo da Vinci hall in Milan, Italy), elements of the museum of technology (like it is in the Palace of Culture and Science in Warsaw), collections of traditional musical instruments, many interactive instalments in physics and so on. A separate building in Daejeon is called “Biosphere” – it resembles a botanic garden. The two exhibitions in Science Park and in Expo area are connected by a train levitating on a magnetic suspensions (*maglev*).

Many different ways of communication with visitors are in use. We will find multimedia, cabinets with seeds, schemes of tidal electrical plants etc. Apart from interactive experiments in physics, cars operated by joysticks and computer-illustrated Kepler’s laws, we will find the natural size lister to experience the work of a countryman. The visitor steers this lister and the effect of the plough field is seen on the computer screen.

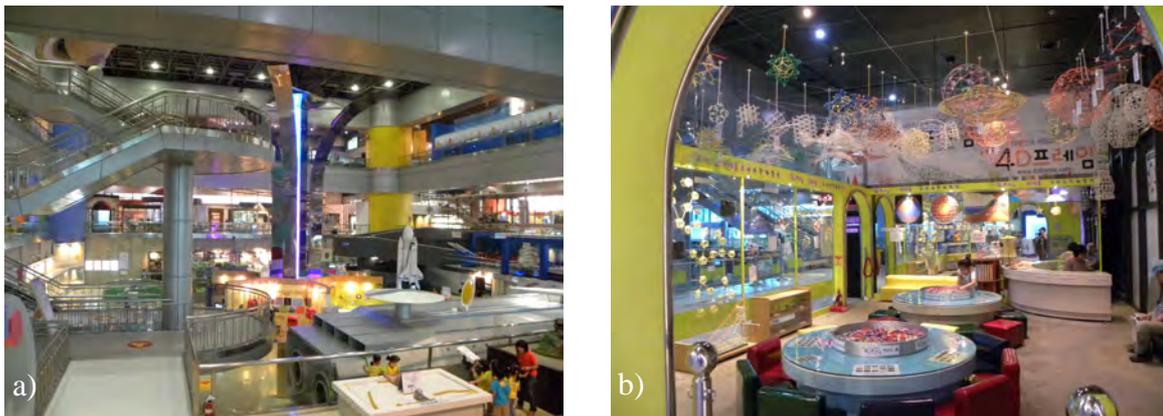


Photo 5.52. Architecture in the hall of permanent exhibitions in Science Museum in Daejeon: **a)** the space, shape, colour and light become essential elements to organize the discovery paths and visitors’ perception; the three-colour column in the middle symbolizes the three elements of the world – science, technology and humans; **b)** hall of mathematics – interactive games in the centre resemble island and the mathematical polygons under the ceiling seem to be candelabra (photo MK)

The Museum is under constant development – the pavilion of biosphere was opened in 2008, the exhibition on Space exploitation in 2009, the magnetic train between planetarium and the Centre of Advanced Technologies in 2010 and Science Alive Discovery Centre in 2011.