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School Workshops on Astronomy – an extracurricular activity for secondary school pupils

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Abstract. Interdisciplinary and egalitarian, the School Workshops on Astronomy have been being in their educational mission since 14 years. Here we present the concept, methods, and some example results of that educational technique.

Keywords. educational techniques, project method, hands-on activities

1. Hands-on astronomy

Hands-on activities are powerful educational tool based on a simple truth: if you do something yourself, you learn more and you learn faster. Keeping that in mind, we mixed the traditional approach to teaching with the project method to develop a genuine formula of teaching astronomy and science to secondary school pupils.

The School Workshops on Astronomy (SWA)† are a bi-annual event popularizing astronomy and other sciences, sparked off by Grzegorz Żakowicz, a teacher of physics at the XIII Lyceum in Wrocław (Poland). The SWA take place at the heart of the Izera Dark Sky Park in Poland, which is a perfect location for that kind of event. The staff members who are responsible for various educational activities that take place at SWA are astronomers from the University of Wrocław, teachers from high schools, and invited guest specialists. There have already been 23 editions of the School Workshops on Astronomy. The total number of pupils who took part in them exceeds 500.

The SWA focus on astronomical observations and hands-on activities during which pupils learn practical aspects of observing techniques which include orientation on the night sky with the help of sky maps and planispheres, assembling and using simple astronomical telescopes, performing visual or astrophotography observations, measuring brightness of the night sky to assess the level of light pollution, and presenting results of those observations in a form of reports.

Other workshops which build the SWA focus on providing pupils insight into fundamental physical laws, helping them to develop scientific thinking and the ability to formulate scientific predictions. A good example is an exercise in which the size of a crater made in sand by a small ball in a freefall can be extrapolated to the energies needed to form the real craters left by asteroids that hit our planet in the past (see Fig. 1). During that exercise, pupils learn that impact craters are the most common surface structure in the Solar System, and that they provide insights into the age and geology

† School Workshops on Astronomy http://www.swa.edu.pl

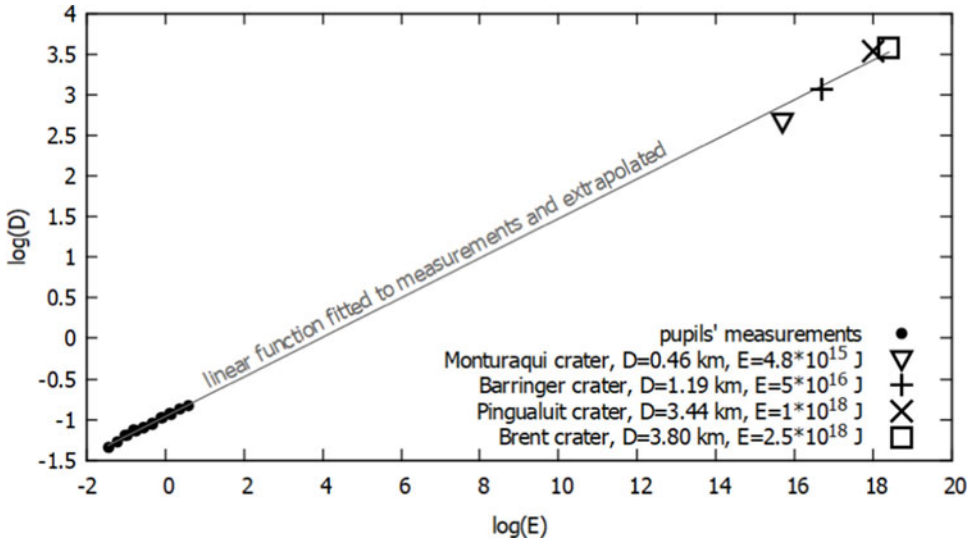

Figure 1. The relation between the diameter of the crater ($\log D$) produced as a result of an impact and the energy released in that event ($\log E$) obtained during one of the Workshops. Linear function was fitted to the measurements and extrapolated to real craters. The extrapolation fits well to a sample of four Earth craters which diameters and impact energy are known.

of the planetary body. Being able to see that a very simple experiment can lead to valid scientific reasoning helps pupils build their self-esteem, while the new knowledge gained during the exercises and lectures widens pupils' intellectual horizons. All that may lead them to choosing science for the future career which is the ultimate purpose of the SWA. Even if they will not become scientists or engineers, they can possess skills that are very useful in everyday life: critical, analytical, and rational thinking, problem-solving skills, forming evidence-based opinions, curiosity and open-mindedness, awareness of existence of cognitive biases, ability to work in a team and to share knowledge with others.

Astronomy is the main content of the SWA, but other sciences (physics, biology, geography, meteorology, geology, computer science, ect.) are also present. This inclusion allows the pupils to see connections between ideas across different disciplinary boundaries.

2. Education beyond curricula

Over the last hundred years, we witnessed many astronomical discoveries that significantly changed our understanding of the Universe. The advancement in astronomy induced also technological progress and, as a result of it, influences our everyday life. Eventually, science and technology became foundation of modern society and an intrinsic part of modern civilisation. Therefore, it is obvious that science (including astronomy) has to be part of school education. Surprisingly enough, over the last 20–30 years astronomy has been significantly reduced in education curricula in Poland, resulting in unsatisfactory level of astronomical knowledge among pupils and a renaissance of unscientific concepts, like astrology, in the society (see, e.g., Molenda–Żakowicz, *et al.* 2020).

Such a trend is very difficult to counteract from the position of individual teachers and educators. However, even little help is important and therefore, extracurricular activities like the School Workshops on Astronomy play crucial role in filling gaps in knowledge and understanding among pupils.

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