Heureka Project – for both Pupils and Teachers

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Abstract

Project Heureka at first concentrated on physics education for age group 12-15. Now it covers a broader scope, incorporates also high school teachers, inspires some improvements in pre-service training of physics teachers and helps to develop fruitful teachers-university partnership. In addition to general information on the project some concrete examples illustrating its “spirit” are presented: simple instruments created by children and students, some interesting variants of experiments developed at seminars with teachers, photos documenting activities at these seminars etc.

Introduction: the roots of the project

Heureka (or “Eureka”, in English) started about 12 years ago as an informal project of a small group of teachers and other people who were not satisfied with a traditional “transfer-of-knowledge” approach to teaching physics. The alternative approach they developed and refined seemed to work in practice – at least for age group 12-15 at which it was aimed at the beginning. (Some information about this stage of the project can be found in [1].) Still, for almost a decade the project involved just a few teachers. But it did not die and about 3 years ago (see e.g. [2]) it started to grow into a new and vital phase.

Recent scope and activities of Heureka

At present, Heureka has about 60-70 active participants: physics teachers from all types of schools, future physics teachers and people from university.

It comprises several connected “branches”:
• The actual teaching of physics “according to Heureka” at schools (now also for age groups 15+).
• Weekend seminars for teachers – new participants to Heureka.
• Weekly seminars for students – future physics teachers.
• Weekend seminars for “traditional participants”.
• Common activities (annual “conference”, a visit to CERN etc.). These also include related activities (“spring camps” etc.) described elsewhere.

Altogether it means more than 12 weekend seminars per year plus other activities.

2 The role of teachers

At many parts of Heureka seminars teachers are in the role of pupils. It does not mean they just “play to be pupils”. They really solve problems; try to discover why things work as they work etc. They are often confronted with somewhat nonstandard problems, situations and questions which cannot be answered by common textbook answers. But they do all this in a friendly atmosphere and in “a safe environment”.

This enables teachers really to feel as pupils – not to feel small but to experience practically how active a physics lesson can be, how it is possible to teach physics without traditional “lecturing” and how stimulating can be a communication between teacher and pupils. And, last but not least, very often it also enables them to clarify and better comprehend many points from various parts of physics.

The equally important role of teachers in Heureka project is a role of partners. They are partners for both each other and also for leaders of the project and participants coming from the university. The project has been successful in creating a community of its participants. Teachers involved in it discuss their problems, help each other and are not passive “objects of in-service training” but really active participants. As a result the project also helps to build and cultivate so needed teachers-university partnership.

By all this, hopefully, the participants improve also in their most natural role – and become better teachers appreciated by their pupils and students.

3 How pupils and teachers can enjoy physics

Here we very briefly illustrate how both pupils and teachers can be creative when they have an opportunity and are properly stimulated. The instruments constructed by pupils as their voluntary homework and the instruments and experiments build by teachers for Heureka seminars show clearly how their authors really enjoy “hands- and minds-on physics at work”, i.e. the physics they do themselves, the physics, with which they interact “by their own hands and minds”.

We can mention for example:
• Sandglass alarm clock invented by a 12-year-old pupil. Sand falls into a small bowl mounted at a lever. When
sufficient mass is accumulated the bowl with sand outbalances the weight at the other side, goes down and closes the contact. (Of course, the time is too short for a good sleep – it scarcely suffices for boiling a small egg – but the idea and construction is nice.)

- Bimetal switch. Also a construction of a 12-year-old pupil. Two connected thin stripes of different metals close a contact when placed e.g. to the flame of a candle. The boy did it with the help of his father but, as he stated: “I thought it out and my father helped me to do it”.
- Heron fountain from plastic bottles and hoses was built by one of the teachers participating at Heureka project as a “voluntary homework”.
- Various pumps (Archimedes screw and other) were constructed by teachers as a practical answer to a problem “how to help an old king to pump the water to his castle on the hill”.
- Interference of laser light on a plastic ruler was investigated by a group of teachers at one Heureka seminar. Started from interference on CD and an old LP record they arrived at the finding that when the angle between the ray and grid is small the grid can be coarser – and finally an ordinary plastic ruler can be used to measure the wavelength of laser light. (To be fair, it must be said that one of those teachers remembered there was a similar practical task in “Physics Olympiad” several years ago. But at Heureka seminar we solved the problem independently – and it was nice to discover afterwards further interesting information on web, for example that the same principle is used in monochromators of synchrotron radiation.)

There are other interesting constructions and instruments created by both pupils and teachers and experiments and small projects carried out at schools, at seminars and, in the last two years, at workshops at the “annual conference”. We plan to describe some of them also at English web pages of the project [4] in the future.

4 Some experiences

After more or less enthusiastic description we presented above, one natural question may arise: What proved to be worthwhile in the whole project?

The answers are, of course, perhaps similar to those one can find in analogous projects elsewhere. But it may be useful to try to summarize some experience.

Perhaps the most important point is that Heureka seems to work. Even though this was not confirmed by any formal and rigorous research up to now, the feedback from both pupils and teachers, the results of pupils and the mere fact that teachers come (and return) to Heureka seminars voluntarily and without any formal rewards persuades us that the project has something to offer.

Why does it work? One reason is that the project stimulates (and requires) active work. Pupils are not passive “objects of education” – and, in fact, Heureka independently arrived at many principles one can find in constructivist approach and other modern trends in science education. And an active work is also a basis of teachers’ participation at the seminars.

What else has proved to be worthwhile? Certainly a friendly atmosphere – also both in classrooms and at seminars. It does not mean that the education “according to Heureka” should be “too liberal” or that physics as a subject should be “just fun”. But it is important that, for example, children can express their hypothesis without being laughed at (see also [3]). Friendly atmosphere is also something much appreciated by teachers as a very important factor at the seminars. There is already mentioned factor closely related to it: a real partnership of all participants – organizers (including people from university), teachers from schools and future teachers. Opinions and experiences of all of them are valuable and bring new ideas, stimuli and inspiration.

To mention just another point: what proved to be fruitful are mutual contacts of all groups of participants. Teachers (“new participants”), future teachers and “traditional participants” do not form separate sets – they like to meet, interact, help and inspire each other.

And, of course, Heureka is not alone. It is a part (and sometimes a center) of a broader stream of activities aimed at pupils and students at schools, future teachers and physics teachers at schools.

Conclusions

Of course, our project is not unique in the world. But perhaps it can offer some inspiration. To get better idea about its aims, activities, atmosphere, results etc., you can look at web pages [4]. And, if interested, contact us.

We are (or at least try to be) open to new opinions, ideas and friends. And we hope that mutual contacts and exchange of experience may be useful perhaps not only for us.

References