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"Science is Beautiful" Students at Risk Develop Science and Technology Integrated Projects

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Abstract

UNICEF, the Institute for Educational Sciences and other partners in Romania have been carrying out an attendance campaign in order to diminish the dropout rate in poor areas in the country. One of the components of the campaign is a teacher training program the aim of which is to support teachers who work with students at high risk.

The trainees often think that students at risk have small chances to meet the curricular requirements. Moreover, science is perceived as one of the most difficult subjects due to its abstract nature and complicated assignments. The common mythology with the science teachers is that students at risk are a lost cause in their curricular area. Nevertheless, the training program consists in a series of activities to help teachers adopt new approaches to their subject by taking into account the students' needs as well as the situation in the community.

The training sessions bring about opportunities to shift from the common practice that is text-book-based towards a student-oriented approach. What does this approach mean? Instead of presenting chapters in a science book teachers are encouraged to plan and implement meaningful projects that highlight the conceptual network of the subject within discovery learning. Students are involved in practical assignments, quite often in integrated projects that also include Technology, which are relevant for their lives and family, for their school and for their community. All the projects are developed within the framework of the national curriculum and take place within the ordinary time-table. Teachers are encouraged to plan fieldwork in order to apply the projects in meaningful settings and develop real products. Under the teacher's supervision, students work in teams, each individual is valued and involved in the task.

These projects contribute to positive relationships among the teacher and the students. Gradually, the students' perception about school and their habit of failure change. The students become more confident and motivated while something special and meaningful results from their project-work. In the students' words "the science class is the most beautiful."

Our paper presents this project-work experience with examples of good practice as well as weaknesses.

1. A UNICEF project, a training program and support for students at risk

For the past two decades, Romania has been scoring rather low in the international studies that focus math and science (TIMSS, PISA) [3,4] and has one of the highest dropout rates in Europe [2]. Consequently, UNICEF, the Institute for Educational Sciences and some NGOs in Romania joined efforts to develop initiatives to support the acquisition of students at risk. After a number of small scale projects, a major attendance campaign was launched in 2010 that targeted students at high risk, teachers who work with them, the management of their schools, their parents and the local communities they belong to. Various activities took place in order to support these diverse target groups and to comply with the main aim of the campaign: diminish the dropout rate in the most disadvantaged communities. Among these activities we will further detail the objectives of the training program devised for the benefit of the teachers who work with students at risk. The teacher training focuses a *student at risk-based perspective* on the curricular provision that involves the identification of the level of attainment and the selection of learning tasks that are adapted to each student's level. The program promotes the contextualization of the curriculum in the sense that the competences listed in the official document are to be developed within activities that are meaningful for the students and are adequate in terms of their level of attainment. In other words, teachers are encouraged and assisted to shift from teaching a subject matter towards teaching students (at risk!), i.e. from a neutral, text-book approach towards a students' needs approach.

2. The routine of science teaching, the needs of the students and the progress in science and technology

Two main approaches characterize the tradition of science education in Romania. One is the highly theoretical, elite-oriented teaching. The teacher presents the highlights of a chapter in a science textbook/ reference material. This concerns the best students in a class, who always get the point of the teacher and handle quite easily generalizations and abstractions. They have no trouble in modelling and easily decoding a variety of models they are presented with. They have solid acquisitions and more often than once are the most talented in logical and mathematical abilities. The second approach values science experiments that are displayed by the teacher in order to point out a theoretical position. Often, these experiments do not have a practical impact, i.e. they have no meaning for the average student who in the beginning is curious about the experiment but soon loses interest for a "thing" that is pointless for daily life.

A number of consequences derive from these approaches:

- The teachers believe that science is difficult for most of the students and a stumbling block for students in disadvantaged communities – that is the latter are considered unfit for solid scientific training (they lack the discipline of study and moreover they skip classes).
- Students are bored by scientific topics which seem totally separated from daily life and needs.
- Both students and teachers develop unhealthy relationships that stem in frustration.
- Students at risk abandon science study since it is unpractical and largely disconnected from their survival patterns

If science is to make a difference in schools that belong to disadvantaged communities then the study should shift towards a practical outcome. The interesting thing about this statement is that in the knowledge domain that are external to schools this is exactly the path of evolution. Technical problems call for a scientific breakthrough. A new discovery brings about new technological solutions and a tangible impact on people's lives that result in socio-economical progress. This expands the need for new technological results that press on a change of the scientific paradigm. And the cycle of a scientific breakthrough is reiterated. If we are to mirror in education this model of development that engage the interdependence of science and technology in the development of human knowledge we have to admit that the two main approaches that we mentioned above are insufficient and rather superficial [1].

The classroom observations that we carried out in the schools involved in the attendance campaign as well as the discussions with the teachers highlight that students dislike science if it is taught in the traditional way and they consider that Physics, Chemistry, Biology, Geography are useless and very difficult to understand. Teachers are very often in the situation of not having an answer to a rather legitimate question: *What do I need this* (i.e. the scientific topic today!) *for*? The question is difficult yet not impossible to being addressed. The teacher training program tried to offer a few perspectives in looking for possible answers:

A number of reference points underline our approach:

- Science activities respect the official curriculum in order to have a basis for equal opportunities and a good preparation for the future exams.
- The scientific topics are presented/ explored/ developed within project work that involves the work of all the students.
- Project activities are carried out solely within the official timetable
- Projects are needed in the community, in school, in the family or in a personal way – no project is useless!
- The planning of the project can involve a team of teachers with the technology teacher as a possible partner in order to offer an even more practical side to students' work.
- The outcomes of the projects are valued in various ways including being on sale in a community fair
- The products ought to support the understanding of various science concepts, develop basic competences in science and technology.

3. Some examples of good practice from the school year 2013-2014

We present some successful projects that were carried out by students at risk from disadvantaged communities under the supervision of their science teachers during the previous school year (which actually was our first year when we experimented an "applied science" section within the teacher training program..

3.1. Geography project in a rural school in the NW of Romania (Bihor county)

The villagers cut down trees from the hills behind the houses. Not long afterwards the soil started to give way and threaten the families. The teacher helped students to question the situation and look for solutions. Planting trees seemed the best alternative. Students participate in the project with enthusiasm and better understanding of the phenomenon they witnessed. Sometimes parents also joined the students' effort. The project started in the spring 2014 and is still on. The pictures below show the "before " situation as well as various stages of the project (Fig. 1-6).

Fig. 1, 2 – *The hill after the trees were cut down*

Fig. 3,4,5 – *Students in the early stages of the project*

The project focused the following curricular provision:

a. In terms of competences: explore the importance of the environment for people and society, identify solutions to protect the environment, identify ways to plan space for sustainable development
b. In terms of knowledge: the preservation and the protection of the environment, soil – types of soil, vegetation

Fig.6 – *Planting a tree*

3.2 Biology project in a rural school in the eastern part of Romania (Vaslui County)

The project aimed at growing a vegetable garden in the school yard so that the 5 graders get a first hand experience on germination and systematic observation on the plants cycle of life. The benefits of the projects are the following:

- The students explore the curricular provision in meaningful activities: they observe, carry out agricultural activities, explore the plant growing. The teacher and the students discuss each activity and its outcomes. They learn about the plants and their features. They mark each lot with the common and latin name of the plant.
- The garden makes the school yard more beautiful and useful
- The products are sold in the village market

- The students enjoy what they do, become more motivated and they do not even think of skipping biology classes
- The children work in teams and develop cooperative skills.


Fig. 7-8 *The 5 graders start the project*


Fig. 9-10 *The students plant the vegetables and mark the lots.*


Fig. 11-12 *The plants grow and the students have fresh produce*

3.3 Primary education science project in a rural school in the NE of Romania (Suceava County)

The four graders help the poorest child in the class to grow a vegetable garden in front of her home since there is no suitable room for a garden in the school yard.

The project gathered the family members, the primary teacher and the four graders who had the initiative (see Fig. 13-14).


Fig. 13-14 *working together in the garden*

The students actually played while planting in the garden of their colleague. The experience was joyful, full of memorable science activities but, above all, was an excellent lesson of civics – students who do not belong to well off families understood the greater need of another family. In the words of the teacher: "We went there for a vegetable garden and we developed a garden of learning and good behavior, generosity, modesty, humility".

3.4 Chemistry project in a rural school in southern Romania (Calarasi county)

8 grade students explore a variety of products that ordinarily are to be found in the kitchen: baking powder, eggs, bleech, onion, orange essence, lemon juice. They choose some items and take them to the chemistry lab in order to test the pH.

Fig. 15 – *Testing the PH*

The students order the various substances on the pH scale by means of the order of intensity of blue and red on the markers. They learn by doing how to establish and order the pH of a substance.

The hands-on activity helped the 8 graders forget about the ordinarily "dull" chemistry class and note its impact in daily life and its presence "even in the kitchen".

4. Brief conclusions

Our exchange of experiences within the teacher training program show that a student-centered perspective in the science class is not only possible in disadvantaged schools but also highly stimulating for the students' learning acquisition. Science becomes a pleasurable experience and brings about all sorts of profit – including material one. Students are thrilled to become involved in the project and there is no way they might think to skip classes. In most of the situations they devote more time to project work than the one scheduled in the official timetable. In the terms of one of the participant students,**"Science is beautiful".**

Within the current academic year we continue the teacher education program and we try to improve activities in the schools were no steps have been taken so far for the shift towards a student-oriented perspective in science study in disadvantaged schools.

References

[1] Constantin, Rodica et al. (2012) Resources for teachers who work with students at risk (in Romanian), UNICEF
[2] Sarivan, L (2010), Reversing the Spiral down in *Revista de Pedagogie* 4/ 2010
[3] www.pisa.org
[4] www.timssandpirls.bc.edu