

## Setting up a Scientific School Project as a Method of Increasing Students' Motivation for Studying Natural Sciences and Ecology

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### Abstract

*The paper reports the experiment of a team from the National Aprilov High School to increase the motivation of students interested mainly in the humanities for the natural science subjects through the development of a school project.*

*The aim of the project entitled "Science from Granny's Chest Drawers" is to build a bridge between present days' science and technology and the history of Bulgarian crafts of the mid and the late 19<sup>th</sup> century. The old technology of braiding and dyeing woolen threads is interpreted attractively and unconventionally on modern scientific level. The project activities include the use of the authentic "chark" equipment for braiding woolen threads. It has been restored to the way it looked in the 19<sup>th</sup> century when it was used. Woolen threads are coloured with natural dyes obtained from plants and herbs gathered by the project participants. A small model of the wool-braiding workshop shows how the equipment works driven by the mechanical force of water.*

### 1. Introduction

In recent years there has been a worldwide tendency towards a decline in young people's interest in natural sciences. It assumes alarming proportions in our country particularly. Evidence for such claim is based on the comparative research of the level of Bulgarian students' knowledge of the subject and their European peers. The increasing use of modern educational technologies calls for a new approach to teaching cultural and educational context of natural sciences and ecology. New pedagogic methods and practices aim to sustain students' interest in natural sciences.

Running school projects in the cultural and educational field of "Natural Sciences and Ecology", designed for Bulgarian high school education, can also help explaining natural phenomena and their unity. The interdisciplinary approach will convey a global understanding of natural processes and phenomena. It is of great significance to young people for gaining sound knowledge, skills and competences as well as for developing environmental attitude expressed in ecology-friendly social behaviour.

### 2. Scientific project as a method of increasing students' motivation for studying natural sciences and ecology

"Science from Grandmother's Drawer" project has been developed over the period 2011-2012 in Aprilov National High School – Gabrovo. Fifteen students, age 16 to 18, together with their teachers in physics, chemistry and biology participated in the project. The idea of the project was born by the necessity to acquaint our students, especially interested in humanitarian sciences such as history, literature, foreign languages, art, with the boundless world of natural sciences. Our goal was to show to the students how attractive these sciences can be and to provoke scientific quests of long-known empirical knowledge.

#### 2.1 Project development components

Project development includes some obligatory components:

- identifying a problem and formulating the objective, the tasks and the theme of the project
- recruiting a team to develop the project
- defining the target group
- raising funds for the project budget

- finding partners to develop the project with
- carrying out all project activities planned
- providing the target group with the project results
- entering various competitions to present the results of the project

The need to generate motivation in students for the subjects of physics, chemistry, biology and ecology has identified the problem and the theme of the project "Science from Granny's Chest Drawers". The aim of the project is to build a bridge between present days' science and technology and the history of Bulgarian crafts of the mid and late 19<sup>th</sup> century. The tasks performed to achieve that goal are as follows:

1. Learning about the crafts of braiding and dyeing woolen threads, and interpreting old technologies on modern scientific level.
2. Braiding of woolen threads with the use of an old-time equipment called "chark".
3. Project activities

The target group includes students and teachers from the National Aprilov High School and the population of Gabrovo town.

The most difficult part of project development seems to be funds raising. To find sponsors in a situation of an economic crisis and complete disregard of private businesses for children's creative development is extremely hard. The money needed for the implementation of the project was endowed by sponsors and through students' charity campaign.

A partner of the project is the "Etar" ethnographic open-air museum. Without its assistance, the project would be difficult to carry out.

Students found the specific project-related activities particularly appealing:

- interpreting wool as a natural animal polymer, getting familiar with its structure, composition and properties; learning how to spin wool into threads using a distaff and a spindle and to twist and wind the threads onto a spool by means of a spinning wheel.
- exploring the technology of braiding wool threads with specially designed device called "chark"; studying the laws of physics that allow driving the parts of the device [1,2]
- learning about the colouring properties of plants; gathering herbs, such as marigold, nettle, sumac (*Rhus cotinus*), sunflower, walnut leaves, peach leaves, etc. and studying their chemical composition and colouring substance in particular [4]
- exploring the old technology of dyeing wool with natural plant extracts after treating it with alum, blue and green vitriol to achieve a diversity of colours [5,6]
- making items of variously coloured wool threads, such as bracelets, wall decorations, etc.
- learning about the mechanical force of water that causes the wool-spinning equipment to work; producing a small model of the workshop for braiding wool threads
- putting on a play to show how the processes of dyeing and braiding woolen threads relate to science
- making multi-media presentation in addition to the play and posters for the Festival of Science
- building a website of the project: [www.projectsosnag.uni.me](http://www.projectsosnag.uni.me)

## 2.2 Project's content

During our work, the following parts of the project took shape: Granny Had Been Spinning, The Heart of the Chark, Dyes from the Nature, The Rainbow Kingdom, and From the Wheel to School. *In the first part*, Granny Had Been Spinning, the students got acquainted with the types of threads, and especially with wool as a biopolymer of animal origin. The content and structure of the woolen thread were thoroughly researched, as well as the physical and mechanical properties that determine its usage. In the chemical properties an emphasis was put on the methods of wool dyeing and the possibilities for having chemical bonds between the fiber and the dyeing substance. The technology of wool spinning (forming of threads) with distaff and spinning wheel was researched and tested by the students participating in the project. The latter were encouraged by their physics teacher to describe scientifically the movement of the spindle and the spinning wheel. Consequently, the students learned about the spinning of a solid body around its axis as well as about circular movements. *The second part* of the project is the one most closely related to the history of our town and its advancement as a centre of crafts during the Bulgarian Revival. In this part the process of knitting the "gaytan" with the help of a special cog wheel mechanism called a "chark" is studied. The students showed great interest for this craft as working with the chark is quite fascinating. The whole

technology of gaytan knitting was studied – from winding the yarn on the spools with the help of a spinning wheel (“chekrak”) (fig.1), threading the slips and then arranging them on the chark and setting it in motion with the power of water. The students first knitted a gaytan in a unique gaytan workshop in the museum “Etar” and afterwards they restored an old chark from the museum fund (fig.2).



Fig.1. Winding the yarn on the spools with the help of a spinning wheel (“chekrak”)



Fig.2. Knitting “gaytan” with the help of a special cog wheel mechanism called a “chark”

It was used in the production of more gaytan which was to be dyed in the next part of the project. The students examined the movement of the bobbins of the chark and discovered that the uniqueness comes from the alternation of reciprocating and rotational motion, which they explained with the laws of the solid body. The movement of the slips on the chark inspired some of the project participants, and they reproduced it with a compelling dance. The high productivity of the chark comes from the fact that the machine is powered by water via a horizontal water wheel. The ingenuity of the Gabrovian, capable of “entrapping” the power of water for their own use shows the presence of the required knowledge, skills and entrepreneurship. During the Bulgarian Revival charks were forged and gaytans were knitted in Gabrovo, spreading the glory of the craftsmen all over Europe.



Fig.3. Dyeing of gaytans using natural dye, extracted from herbs

The dyeing of the gaytans was done using natural dye, extracted mainly from plants and herbs. The participants in the project researched which plants are suitable for obtaining colors similar to those of the rainbow and collected them. They carefully examined the process of extracting the colorant from the plant and the process of dyeing (fig.3). The different solutions used for treating the woollen thread before dyeing were studied. The painted gaytans were used to create decorative panels, bracelets and other hand decorations. While studying the technology of dyeing the students updated their

knowledge of the visible light spectrum and the reason for which we see color in nature.

*The last part* of the project includes making a small scale model of the gaytan workshop and dyeing workshop which are in Architectural Ethnographic museum “Etar”. The headline “From the wheel to school” shows the integral link between education, vocational learning and manufacture. While travelling through Europe to sell gaytans, the Gabrovian realized the need of investing in the education of his own children “so that they are better educated than him and thus working with greater ease”. And so in 1835 with the invaluable help of the philanthropist Aprilov, the first secular Bulgarian school was founded, which later became the first Bulgarian high school – Aprilov High School. It was namely the descendants of these Gabrovians who implemented the project, unraveling some of the scientific facts on which the treasures from “Granny’s Dower Chest” are founded.

The results of the project were presented at the “Science on Stage” National Festival’ 2012 (fig.4) and then at Festival fair (Fig.5). The spectacle was awarded to attend International Festival “Science on stage”, 2013 in Germany.



Fig.4. Young artists present a spectacle, based on the project results during the National festival “Science on stage” – 2012.



Fig.5. The stand of the project attracted the interest of the Festival fair visitors

They were shown in an attractive way putting on a play and setting up display stands for all students and teachers from the National Aprilov High School and for the public at the town hall.

### 3. Scientific project outcome

The final outcome of the project has been identified as positive with regard to students’ attitude towards natural sciences and motivation to learn.

Students:

- developed ability to deal with scientific literature independently and applied what they had learnt to making multimedia products and posters;
- extended their knowledge of chemistry, which helped them acquire skills necessary to explore and practise old traditional crafts;
- demonstrated artistic abilities to put on a play, give multimedia presentation, build a website, colour wool with plant dyes, make items of decoration, etc.
- became aware of how beneficial modern science is to interpreting processes and technologies of the past used for crafts works
- appreciated the importance of natural sciences for everyday life in the past and in the present as well
- directed their energies and enthusiasm to carrying out something useful to them, to their peers and to the whole society
- changed their own and their peers’ attitude into ecology-friendly behaviour
- learnt how to work in a team
- made good friendships
- developed deeper interest in natural sciences
- attributed to stirring up their classmates’ interest in natural sciences and ecology
- learnt how to appear in public giving presentation of the results of their work

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- acquired knowledge, skills and competences that will benefit their future development

The development of the project “Science from Granny’s Chest Drawers” proved to be a good practice in the National Aprilov High School, Gabrovo, and a successful method of enhancing students’ motivation and altering their attitude towards natural sciences and ecology.

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