

## More Heads Are Better Than One: Making Teaching/ Learning Science More Appealing to Students

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### Abstract

*The article is a study based on the research findings of the Goerudio science education project, which has been implemented in seven European countries, as part of a European funded project in the framework of the Lifelong Learning Programme – Transversal Programme – Key Activity 4 Multilateral Project. The project focuses on science and its new role in our society: science has become a necessary part of one's future personal development. The project created a strong learning community across Europe made up of teachers and students, who were involved in the project research and its development from the very beginning. The project research is based on the comments posted by the project participants (teachers and students). The article analyses teachers and students' difficulties encountered when learning and teaching science and highlights the most effective projects and experiences available at European level in the field. The findings identify and select innovative practices which could enhance students' motivation to learn science. Results have shown that an inquiry-based, interactive and amusing approach relying on both traditional and state-of-the-art teaching methods makes science more appealing and accessible.*

### 1. Introduction

The article is based on a study focused on the Goerudio project, funded by the European Commission within the Lifelong Learning Programme – Transversal Programme – Key Activity 4 Multilateral Project, as applied in organizations and schools from seven European countries: Bulgaria, Italy, Latvia, Poland, Romania, Slovakia and Spain. The project's innovative idea lies in today's challenging advance of science and technology and supports teachers and students across Europe to work together in order to identify, select and share the best practices which will make science more appealing to students [1].

### 2. The Goerudio project and its learning community

The main aim of the project is to create a learning community of European teachers and students whose main task is to raise students' interest and stimulate their motivation to study science [2].

The need to create a learning community is rooted in the new complex demands that our world places on teachers and students who find themselves unprepared for these challenges. Students need to be able to manage their own learning, communicate and work with people from diverse cultural backgrounds and cope with complex issues which schools do not currently prepare for. The solution proposed so far is the learning community where all members contribute to the development of collective knowledge, resulting in both collective and individual growth. Education based on learning communities is supported by three arguments [3]:

- -the social-constructivist argument holds that people learn best when they are involved in the knowledge-construction process supported in the surrounding community.
- -the learning-to-learn argument: children will learn to read and write if the adults they admire read and write. Given the demands of the new society which requires workers to learn new skills on the job children will develop learning skills by joining a "learning club."

- -the multi-cultural argument: the world is becoming more and more complex and diverse requiring people to interact and work with people from different cultural backgrounds. Education must prepare its students to live and work with cultural diversity by providing a learning environment that fosters students' abilities to work and learn with other people.

In a learning community students learn to respect other students' contributions and differences and to be assertive and stand up for their own ideas. A learning community accepts failures and holds that failure is part of taking risks, but leads to more learning if the community knows how to learn from its mistakes. In a learning community students depend on each other's contributions in order to achieve a common task, which generates respect for the other student and increases self-esteem. In a learning community everything that is known or acquired by individuals is shared within the community, so that everybody has equal access to and profits from the collective gains of the community. Negotiation lies at the centre of all processes. It is perceived as necessary for finding better solutions or understandings [3]. At the moment the community is made up of 35 European schools, which means that 70 science teachers (2 teachers per school) and 100 students have been involved directly and actively in the project research and development from the very beginning of the project [1].

### **3. Research methodology**

Research was based on the observations collected from comments posted on the project platform by the learning community created (teachers of science and technology and students from seven European countries). Each country was supposed to contribute 50 comments to the platform, on problems encountered when teaching science subjects and their solutions.

The problems identified were common across European schools: teachers' lack of time, reduced number of classes allotted in the curriculum, students not having the necessary basic knowledge, students' inability to link science with life, students' lack of autonomy and learning skills, lack of appropriate teaching aids and unsuitable laboratories [4]. On the other hand students related most of their poor performance during science classes to teachers' complex performance: from teachers' voice, enthusiasm, experience or personality to teaching methods, communication skills, inability to create good atmosphere or rapport with students or text books used.

The present article focuses on the solutions to the above-mentioned problems, envisaged by the teachers in the seven countries participating in the project. The analysis of teachers' contribution to the Goerudio platform took into account the number of posts they uploaded. The analysis of the content of the comments relied on a coding system that distinguished the linguistic clauses (an idea representing an event, a process, a condition etc) within the same post.

### **4. Results: analysis of the teachers' contribution to the Goerudio platform**

There were 356 posts in all and 656 linguistic clauses (ideas/solutions). Some posts focused on one linguistic unit (solution) whereas other posts highlighted two or three linguistic units. Most solutions encouraged the use of experiments and modern technology, team work, new interactive methods based on scientific enquiry and problem solving, games or field trips with a view to making science subjects more attractive and accessible to students [4].

In general, doing experiments seems to be by far the most popular solution given by teachers although this rating may vary from country to country (33 % Italy and Spain, 25 % Bulgaria and Romania, 12 % Slovakia and 9 % Poland and Latvia). Comments appreciated experiments as they provided teachers with vivid and convincing means to clarify ideas and introduce new concepts, familiarize students with scientific processes, stir students' interest or having a memorable impact on students by actively involving them. Experiments pave the way for new interactive methods based on scientific enquiry and problem solving and link abstract concepts to practice and real life. "Experiments will certainly help to motivate pupils because they gain students' interest in science (...). Students work better when they have opportunities to discover certain facts, phenomena and laws of nature by themselves." - teacher, Romania. "Experiments engage students in the activities. They provide excellent opportunities for learning by doing." - teacher, Slovakia.

The next ranked solution within the general classification (30 %) was the use of ICT in classes (22 % Slovakia, 18 % Italy, Latvia and Poland, 17 % Spain, 12 % Bulgaria and Romania). Modern technology is perceived to enhance students' motivation by making science classes more attractive and challenging. "A conceptual understanding of geometry calls for mental imagination; it requires teachers to help students visualize figures and shapes. Electronic applets on trigonometric functions present functions in a dynamic, interactive and visual form. The students are enthusiastically involved in the organized learning activities.. they get plenty of data which initiate discussions." - teacher, Poland. "Interactive whiteboards make the learning environment more interesting and accessible to students." - teacher, Latvia.

Group/ team work was another solution which ranked 15 % in the posts (17 % Bulgaria, Poland, and Romania, 12 % Latvia, 7 % Italy and Slovakia, 3 % Spain). The value that group work adds to learning and students' personal development is highly appreciated: improved time management, interrelation and communication skills and self-esteem. "I agree that group working is a good way to fill some gaps. I use this method the lesson before a written test and I see that it helps to clear many students' ideas and give them more self-confidence." - teacher, Italy. "They learn how to help each other in order to accomplish their tasks. They learn to listen and negotiate; they learn to be patient and pay attention to what is happening around them." - teacher, Romania

Teachers also said that games make a solid solution (6 %) to enhance students' interest in science and technology or defuse tension caused by inability to understand abstract concepts (10 % Poland, 7 % Spain, 6 % Bulgaria and Romania, 4 % Italy, 1 % Latvia and Slovakia). "It is important to get your students' interest right from the beginning. The use of "games" certainly releases a tense atmosphere in the classroom especially if students do not like Math." - teacher, Slovakia. "Ludic activity is an important instrument to attain both comprehension and willingness to study a subject." - teacher, Italy. Sometimes when other means fail to raise students' interest and stimulate their participation in science classes it is their creativity (4% in the general rating) that teachers resort to in order to make science appealing and comprehensible. Activities vary and make their classification impossible showing that teachers' creativity and dedication have no limits (13 % Bulgaria, 8% Poland and Romania, 7% Slovakia, 6 % Latvia and Italy, 2 % Spain). The most creative example is a teacher's explanation of Markovnikov's rule: "The molecule of propene is presented by 9 students where every student plays the role of one of the atoms. In organic compounds the carbon is always 4-valent so the 4 legs of the students are the free four possible links. The children who play the role of the hydrogen atom use just one of their arms and put behind their back the other one."

Field trips got 3 % of teachers' posts by providing students with opportunities to link theory with practice and school with the world of work. "I have tried to raise my students' interest in science by inviting former students... now scientists... Students felt that an expert in the classroom would help to put the subject into context and make classroom activities more exciting. - teacher, Romania. "I think that personal visits to organic farms and active experiential learning are prerequisites to increase the interest in science subjects. Science gets very close to normal life through personal experience."- teacher, Slovakia.

2 % of teachers favoured the stories behind all inventions: "Students enjoy this form of teaching while having fun....I find this kind of approach very useful... In fact, teenagers like to listen to stories about science, scientists and important discoveries."- teacher, Slovakia. "It is also a way to let them know how different lives and conditions of scientists and people were in the past centuries." - teacher, Italy. "...when it comes to stories students would listen for hours. This is also a good introduction to more abstract concepts as it creates atmosphere and definitely stirs students' interest in the topic. There are also life lessons to extract and debate..." - teacher, Romania.

## 5. Future stages

The new online learning community reviewed and commented on solutions suggested in the posts so that they will be implemented by other teachers. The community has also identified and reviewed 210 projects. The projects selected by the new learning community focus on innovative practices for scientific issues taught in a more interactive and attractive way as well as innovative teaching methods based on students' autonomy in managing their own learning process. In the next stage the community will prepare and then post their own materials to be reviewed and improved by all its members.

## 6. Conclusions

The research has shown that, in the countries considered, teachers are highly motivated in cooperating with teachers across Europe in order to stimulate students' interest in learning science. The idea of creating a community of teachers and students working together to exchange ideas and overcome difficulties is totally new and proves to be the best solution to the existing situation, which is too challenging and all-encompassing to be solved individually. Success depends on cooperation as well as on empowering students to manage their own learning process.

## References

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