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STIMULATING STUDENTS' MOTIVATION TO LEARN SCIENCE

Case study

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Abstract

The article is based on the findings of the Goerudio project which has been implemented by the EuroEd Foundation Iasi. The study focuses on the main factors responsible for students' passivity and suggests innovative solutions in order to enhance students' motivation to study science. Project participants, students, teachers and experts alike, have been engaged in applied research and development since the very beginning. Traditional and state-of-the-art teaching methods promoted by European projects have been taken into account. A solid learning community encouraging a new learning environment has been created through national and international interaction and communication. Its main ambition is to devise the necessary tools to enable learners to get a better understanding of the scientific subjects.

Introduction

The article is a study based on the Goerudio project, whose method is being applied by the EuroEd Foundation Iasi, Romania. The project is funded by the European Commission within the Lifelong Learning Programme – Transversal Programme – Key Activity 4 Multilateral Project. The innovative method encourages both teachers of science and their students across Europe to work together in order to identify, select and share innovative practices to make science more appealing to students. The focus of the project on stimulating students to learn science

is in line with current trends and research-based best practices in science education (Gallenstein N., 2005). Teaching and learning science in schools is vital nowadays. Science influences our daily lives. Science teaches people how to think critically about any subject. It is part of our lives (Colibaba A., 2014).

The Goerudio project objectives

The aim of the project is to create a learning community of European teachers and students whose main task is to carry out a common analysis and reflection on how to stimulate students' motivation to learn science. As a result, the most effective projects and experiences available at European level in the field are considered (http://goerudio.pixel-online).

- Science teachers and students analyse the teaching and learning of scientific issues and experiences, in order to identify and understand the main difficulties encountered when learning or teaching science.
- Science teachers across Europe try to raise students' interest and stimulate their motivation to study science by sharing their most effective experiences and promoting an inquiry based, interactive and amusing approach to the understanding of science.
- The project creates a learning network among teachers and students from several European countries and institutions, willing to develop and exploit a new approach to science teaching and learning. School science is no longer perceived as a set of information to be memorized but as a necessary part of one's future personal development.

The Goerudio project research

1. Goerudio project target groups

There have been five schools from seven countries participating in the project, which means 35 schools in all. A total of 70 science teachers (2 teachers per school) and 100 students have participated in the project activities. What is characteristic of the Goerudio project is that both target groups of the project have been involved directly and actively in the project research and development from the very beginning of the project.

2. Research methodology

The project research regarding learning science is based on the observations gathered from comments posted by the project participants (teachers and students).

The teachers were asked to describe problems when teaching as well as the solutions and methods used to overcome them and stimulate students' interest in science. The students had to write about their difficulties in learning science and also describe their achievements and give the reasons for their achievements as well. The experiences have been posted on the Portal of the project. The present paper has categorized and analyzed the participants' posts. There have been 70 teachers' posts and 100 students' posts.

3.Students' posts on their problems and achievements while learning science

In terms of the problems encountered and achievements accomplished while studying science the high majority of students related their problems as well as their achievements to their teachers' performance seen in its complexity.

-voice: "She has a sharp monotonous voice as if students were at the cinema." "He was speaking loudly but he was not shouting."

-strictness or lenience: "He was too strict."

-enthusiasm and experience: "He was like a robot." "He didn't know how to teach."

-fun/ dynamic personality: "Nothing happened." "We appreciated our teacher's sense of humour."

-creativity: "Studying physics with my teacher helped me visualise and understand physical properties because he compared everything with real life. He was so creative! For instance, he compared the forces of movement to a boy who is pulling a sled or throwing a stone. He always told everything with a touch of humour, so it was easier to remember; creative teachers are able to appeal to students."

-communication and ability to create and develop good relationships with their students: "My teacher supported and encouraged us." "In lower secondary school I studied chemistry with a charismatic teacher who managed to keep us focused and interested in chemistry by giving us simple explanations of complicated ideas and by doing numerous experiments. I would say that we learned with pleasure, as a respect for the way she spoke with us and treated us, always smiling, but always applying the rules without comments."

-patience: "If I do not understand something in class, I ask the teacher and she begins to explain everything in detail and shows and provides examples."

-language used: "Sometimes teachers explain in a very sophisticated way, even though most students do not understand or they move on to a new lesson using concepts that weren't previously explained."

-fast rhythm: "I couldn't follow what he was saying; there were lots of things happening at the same time."

-too much information: "I can't take it in. It is too much for me."

-teaching techniques: "too much focus on the theoretical part: he teaches us lots of formulas." "His methods are based on memorization." "She does not know how to capture students' attention." "My first

approach to Maths was wonderful thanks to an extraordinary teacher. He had a teaching method which was unusual for primary school: he pushed us to solve difficult problems but he knew how to make us solve them. He taught us how to be very proud of ourselves."

The students also mentioned the teaching techniques used as leading to learning problems because they did not address all learning styles: "the teacher did not help me visualize what she was talking about; thus, it was too abstract for me."

Some posts were related to the teaching material used: "She uses only the textbook, with no experiments, no connection with real life" but there are also a lot of comments such as: "He always uses a variety of materials - the interactive whiteboard, the internet, books, newspapers."

The students' posts are also related to the textbooks used at school: "The textbook is inadequate, presenting the content in a way that is not attractive, bad layout, lack of graphics, and the language is difficult to understand."

Some of the posts stated that schools do not have the necessary equipment so that students cannot do experiments which could help them understand the concepts.

There have been a few posts which held that students' attendance is important in learning science: "I have a good teacher but there is a huge difference whether I miss a lesson or I'm there in the class!"

The general attitude of the teacher towards students and their subject and the methods used are perceived as essential in influencing students' preferences for a particular subject.

4. Teachers' posts on their problems when teaching science to students

The high majority of teachers related their problems to lack of time: "not enough time, not many classes in the curriculum," or "a reduced number of chemistry lessons in vocational secondary schools."

Lots of posts commented on students not having the necessary basic knowledge when they enter high school: "The students come from lower secondary schools without the basic knowledge of physics. No wonder they are scared of formulas."

35 % of the teachers complained about students' inability to link science with life: "They perceive physics only as a school subject. It is necessary for them to understand that almost everything that is happening around us and in us is physics, from breathing to death."

There were also posts on students' lack of autonomy and learning skills: "They do not realize that the molecules drawn on their textbook or on a blackboard have a three-dimensional structure." "Students especially have trouble understanding the micro processes (e.g., the cell) and the processes related to the hidden phenomena within the earth." "Students learn mechanically." "Many students are not used to systematic studying and fragmentary knowledge does not cover the entire complexity of the subject." "Experiments sometimes help them understand the process of the reaction better. However, they do not spend time on revising what was done during the classes."

25 % of the teachers mentioned the lack of appropriate teaching aids and unsuitable laboratories for students as a problem they have to cope with.

12 % of posts focus on the excessive number of students in a class.

The research analysis showed a few comments on the difficulties teachers encountered when asking students to apply the theoretical concepts into practice, "which could enable students to visualize the phenomenon taught, see its link with reality and its usefulness."

5. Students' solutions

Doing experiments, which link theory with practice and teach students how to observe and extract the essentials from their observations comes first in the solutions suggested by students: 38 % of students appreciated experiments for making science accessible, memorable and interesting. "I had great success in Chemistry and Science when we started to combine the teaching classes with the Laboratory. Balancing classes and labs, theory and practice is always worth it". "I have noticed that most students complain about science as being too hard and too abstract but nobody complains about experiments, which are also part of science. It goes without saying that experiments are fun, appealing and they all stir our imagination and curiosity. When we first started chemistry and flickered through the textbook I got really scared. There were lots of formulas and definitions and very abstract terms. I didn't understand a thing. It was our teacher who made it very accessible through a lot of experiments". "Science can be difficult but experiments can make it fun. We once had a lot of fun and we learned a lot by making a tornado!" "Experiments make science more accessible and more memorable. The experiment we did once with Epsom salts dissolved in a cup of beer is a very good example. Our teacher asked us to observe what happens and take notes. I still remember the beautiful crystals we saw the next day after the experiment."

The use of ICT is highly appreciated by 32 % of students because it enables them to visualize, explore, imagine or even virtually implement the theoretical aspects. Most posts stated that the use of ICT makes classes interactive and pleasant. They are given feedback on the spot and can interact with peers and

teachers from other countries as well. “Computer has helped us visualize abstract geometrical concepts. There are three programmes which enable us to see the geometrical structures. Geometry is made more concrete; this method also works on our ability to imagine and visualize things. Since our math teacher started teaching by using the multimedia whiteboard, mathematics has become more interesting and more understandable. If I can see a visualization of a problem it becomes immediately clear.” “Geometry was a foreign language to me; I looked at the drawings and graphics and I didn’t understand a thing. They didn’t look like the objects in reality. Then our teacher had a fabulous idea and one day he used the computer. We were able to see the objects in space and even play with them virtually. Everything became clear and much easier.” “I realized that I learn better when we use the interactive whiteboard.”

16 % of students suggested working in groups during classes as a possible solution to increase their interest in science. Group work can have positive impact on students’ learning and attitude. “I think that the group work in math greatly helps me learn. When each member of a group helps with what he/she knows, it is easier to reach the final result.” “My colleagues help me a lot; they explain things in a very simple way that I understand everything.” “I really like working in groups because we help each other.”

8 % of students added field trips to their solutions. Field trips are memorable: they stick in students’ mind for a long time. Good field trips provide participants with first-hand experience and can stir their interest and increase their engagement in science. “I really liked the visit to the factory which produced electronic components; it was some years ago! It was very interesting. We saw how robots joined all the parts to make the product. The whole process! The truth is that I would have never imagined all that. I learned a lot. That is how I started liking science.” “A few months ago I visited a museum which showed what schools were like in the past. It was very interesting to see what school was like in the past and the limited resources they had, and then compare it to our school. The purpose of the visit was to observe what resources students had when doing math and sciences and what materials they used. I noticed that generally school is the same, but the methods have changed a lot. It was a very interesting experience because it allowed me to share experiences with my family, especially my grandfather and my teachers and colleagues. Afterwards I did some research to find more things about our education in the past. It was fascinating.”

Learning through games is another solution proposed by 4 % of students because it creates a relaxing atmosphere and often students feel challenged by their teacher’s creativity: “I really like math, because our teacher often asks us to apply what we have learned by playing a game. One such task was to organize a birthday party for one of our classmates. We set the rules which had to be observed. These rules were related to calculations and safety. We had to work a little. We used a lot of my math when we organized the party. We had fun and we also understood how useful math is in life”.

There were a few posts (2 %) which supported the idea of going to science clubs: “Participating in a physics club gave me a new insight into Physics. I even bought a textbook for university students in general physics so that I could study many things that we have no time for during lessons. In the club we do experiments, make models and comment on theories which explain the phenomena. It is very interesting.”

6. Teachers’ solutions

40 % of the posts favoured experiments as the best solution. Experiments have always been appreciated for their action-oriented demonstration and students’ initiation in scientific techniques. They not only impart information but also train in the basic scientific processes. Students are asked to make predictions, observe, and reflect on their observations. Experiments can be used to introduce or clarify ideas.

“Students have difficulty understanding how a chemical reaction takes place and how a change in the combination of atoms forms different molecules. I did an experiment which highlighted a redox reaction that ends with a sublimation of the iodine, resulting in a purple cloud. I like this experience because it is easy to perform, and has a quick evolution. This is what the majority of students need, because their attention doesn't last very long. In addition it is colorful, that means extra attention on behalf of the students and possibly increased motivation because they try to understand why it happens. Some students are not very motivated because they can't follow things that last too long.”

“Sensory experiences are fun and raise students’ awareness about their senses. They are easy to do and frustration free. All pupils understand the message of the lesson as it is rooted in the concrete reality.”

“I have always tried to start from enjoyable simple things: experiments which open doors to students. Experiments also build up relationships between teachers and students.” “Students enjoy this form of teaching while having fun. They like doing experiments and finding the connections to theory by themselves. They can better remember and imagine different types of mixtures and later apply them to other examples.” “Doing experiments ensures the success of a lesson. It stirs interest, engages students and makes everything memorable.” “A simple

experiment is one of the best ways to motivate your students and raise their curiosity. Make each demonstration look like a mystery: it is the magic of chemistry. Later in the course, when you are teaching the topic illustrated by the demo, remind them of the demo. Students will remember and make the connection between the lesson and the demo, enhancing their understanding of the topic."

"As I have already said experiments appeal to students because they are accessible and intriguing and because students are involved in carrying them out. They are not passive; they feel responsible for what they are doing. They know that if they follow the instructions correctly, they will witness something interesting happen. Experiments are fun, raise a lot of questions, help students find answers and make science accessible".

The use of modern technology definitely makes classes more challenging and stimulates students' motivation to learn (30 % of posts). "The use of these programs catches the interest of the students, because they can build molecules, foreseeing and then confirming molecular geometry, and, above all, they can play with their colleagues, competing in finding the right geometry."

" It goes without saying that taking advantage of the benefits of the new technology makes a class more interesting. PPT presentations are more colorful and sometimes an image speaks volumes. I also use PPT presentations in my classes and I often ask students to contribute to them as well or even have their own PPT presentations."

According to 15 % of teachers' posts work group helps students develop skills that are increasingly important in the professional world: plan and manage time, give and receive feedback, develop communication skills, delegate roles and responsibilities, share diverse perspectives, assume responsibility, find their voice in relation to their peers. Positive group experiences contribute to student learning, retention and overall college success.

"In the process of learning, teamwork is essential and in certain contexts, better results than other methods such as individual work are obtained. Group work can optimize resources, improve student motivation, can be a time saver and helps students share knowledge and experiences."

"As regards the exchange of information between different groups, this is desirable and necessary because the same experiment carried out by two different groups allows the analysis of the results from different points of view."

"Working in groups is fun for most students, when trying to solve problems, do experiments, and work on projects with other students. The social interaction can get them excited about things in the classroom and students can motivate one another to reach a goal. Teachers need to ensure that groups are balanced and fair, however, so that some students aren't doing more work than others."

6 % of teachers added games as a solution to stimulate students to learn.

"The use of games in the learning process is always a motivating experience. In fact, in the learning process in early childhood education is done through the use of play as an educational resource. Games attract and hold students' attention, increase interest in the subject and reinforce concepts in a funny way."

"During the game the students not only practise certain formulas but they learn a lot of things about group collaboration and decision making."

Creative solutions to raise students' interest were also among the teachers' posts (4 %). The most creative example is the way one of the teachers explained Markovnikov's rule to his students: "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 will play the role of the hydrogen atom will use just one of their arms and put behind their back the other one."

Field trips were the topic of 3 % of teachers' posts because they provide students with opportunities to consolidate the knowledge acquired during the science classes. Students are not only cognitively but also emotionally involved and challenged. Field trips connect school with the world of work and show students how theory is applied in real life.

Students are not only cognitively but also emotionally involved and challenged.

"The visit to the Botanical gardens raised students' interest in the subject. They showed a desire to deepen their knowledge of exotic plants by reading guides and watching nature films. They also suggested that I could prepare contest on exotic plants for them."

2 % of teachers agreed that another solution lies in telling the stories which are hidden behind all inventions: "I know when it comes to stories - students would listen for hours. This is also a good introduction to more abstract concepts; it creates atmosphere and definitely stirs students' interest in the topic. There are also life lessons to extract and debate..."

New developments

The new online learning community will select and vote for the most suitable solutions suggested in the posts so that they will be implemented by other teachers. The project partners have also used the

project Compendia, the Databases EVE and ADAM and their network of contacts to identify and review at least 30 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. The most innovative practices and innovative teaching methods which will be voted by the new learning community as the most successful ones will be tested within the community and then posted on the site.

Conclusions

The research has identified the problems that students and teachers encountered when learning and teaching science. Solutions meant to address these difficulties have also been highlighted. Success depends on using the best techniques and methods as well as solutions which will empower students to be managers of their own learning process. The strong learning community where students and teachers have the opportunity to discuss and find solutions will definitely stimulate science learning and will promote the most effective and interactive approaches to the teaching and learning of scientific issues.

Reference

[1] Colibaba A.C., Colibaba S., Colibaba C.L., Gheorghiu I. 2014 - Goerudio: an innovative solution to enhance motivation to teach and learn science, The Future of Education Conference Proceedings

[2] Gallenstein N., 2005 - Engaging young children in science and mathematics, Journal of Elementary Science Education, 17, 27-41

[3] http://goerudio.pixel-online (30.10.2014)