

Chemistry is All Around Network

Workshop on "Students' Motivation to learn Chemistry"

Athens, Greece, 22 September 2012

Minutes

Participants

The workshop was coordinated by the Project manager Dr. Dionysios Koulougliotis. The following 16 people participated in the workshop:

1. Vachliotis Theodoros (Teacher) from 2nd Lykeio Irakliou Attikis
2. Karachaliou Ioanna (Teacher) from 3rd Lyceum of Koropi
3. Doumkou Fotini (Teacher) from Primary School of Kampos-Zakynthos "Panagiotis Chiotis"
4. Paschalidou Katerina (Scientific Expert) from University of Athens
5. Mylona Anastasia (Teacher) from 2nd Experimental Lyceum of Athens
6. Salta Katerina (Teacher) from 2nd Experimental Lyceum of Athens
7. Tsechpenakis Sakis (Teacher) from Mykonos Upper Secondary School
8. Kordatos Konstantinos (Scientific Expert) from National Technical University of Athens
9. Niki Rapti (Teacher) from 5th Geniko Lykeio Petroupolis
10. Kalachanis Vasileios (Teacher) from 127th Primary School of Athens
11. Charizanos Panagiotis (Teacher) from Primary School of Kampos-Zakynthos "Panagiotis Chiotis"
12. Ireiotou Effimia (Scientific Expert) from TEI of Ionian Islands
13. Kappatos Stamatios (Teacher) from 1st EPA.L. Schimatariou
14. Korfios Vagelis (Teacher) from 3rd Lykeio of Korydallos
15. Sanakis Ioannis (Scientific Expert) from NCSR "DEMOKRITOS"
16. Nikolopoulos Dimitrios (Scientific Expert) from TEI of Piraeus.

Minutes

9.00 – 9.30

The participants were welcomed to the workshop by the project manager (Dr. Koulougliotis) and subsequently they were asked to divide in four groups of four people each so that each group contains one or two scientific experts. The following four groups were made: Group 1 containing participants 1-4 of the above list, Group 2 containing participants 5-8 of the above list, Group 3 containing participants 9-12 of the above group and Group 4 containing participants 13-16 of the above group. Subsequently participants were given a maximum of one minute each to present themselves to everybody. Finally, the project manager made a short (ca 15 min) presentation of the project (Context, Aims, Main Activities, Results reached so far, Anticipated results)

9.30 – 10.45

In this part of the workshop, there was a discussion on the content of the database. All participants had already been asked to search thoroughly through the portal database and make two comments on either papers/publications/teaching resources. All participants had already completed this task and were familiar with the content of the portal. So they were given a specific amount of time (ca 25-30 minutes) to freely interact with the other members of their group and discuss the contents of the database. At the end of this free interaction, each group was asked to present the main conclusions of their in-between discussion via one spokesperson for a maximum period of 10 minutes. Here are the main conclusions reached by each separate group:

- a) Group 1:

The papers and publications we examined, present the following factors that could affect the motivation of students to learn and study chemistry: a) the themes. Students want to learn about things which are related with their everyday life and which show the usefulness of chemistry. b) the personality of the teacher c) the job opportunities and the potential for a successful professional career, d) the teaching methods and strategies. In respect with the resources, first of all the Greek ones are very carefully chosen and they contain themes/tools (like videos) that could enhance motivation. However, the use of videos is not the solution to everything. There are also good Greek resources that are very useful for the teacher to organize his class more effectively and which they do not contain some “impressive” element. Some of the foreign teaching resources we checked were of very good quality and could increase motivation. Special reference is made to “The periodic table of videos” and “Food Education”. In general, we find this site useful and we are glad that it exists. We are planning to use it systematically in the teaching praxis and in order to get information on the latest trends of educational research.

b) Group 2

One of the most interesting things we read and with which we all agree is that unlike other physical sciences, chemistry is missing a “catchphrase” (slogan) that could incorporate in a few words, what it is about and in this way motivate the average student to get interested in it.

Regarding the teaching resources, we found some that were really very interesting and useful for the teacher, like an Irish site which was integrating the whole chemistry curriculum of lower secondary school. We do believe that it is important for the teacher to have the possibility to use ICT resources which are as complete as possible, and which offer several links and possibilities. However, we also stepped into resources that were too difficult to use because they needed downloading too much material which was not always functioning and of course this can be very discouraging for motivation. Some resources were pay-per-view and we consider this also a negative aspect.

In respect with the Greek sites, there were some that we liked very much and we appreciated the fact that at least the ones we checked were functioning and did not need downloading anything special.

Finally, we would like to point out that some publications’ reviews were written in the national languages of the respective countries with no translation possibility in English. In addition, in some of the papers the translation in English was a Google translation which usually makes very little sense.

c) Group 3

The papers and publications we read and reviewed gave importance to the following aspects of chemistry education: a) students need to get actively involved in different learning activities taking place outside the traditional classroom like in museums, exhibitions etc. (Italy), b) modern lectures and attendance of impressive experiments (Czech Republic) and c) curriculum design and job opportunities (Ireland).

The Irish example of student motivation towards chemistry not increasing despite the increased funding in infrastructure is very interesting. This paradox is attributed to the unwillingness of students to act as “experimentalists” or “explorers” and in addition to a not-well designed educational system that undermines the chemistry course for entering tertiary education institutions.

The abstract concepts and the need of math knowledge seem to create difficulties to students of other countries as well besides our own. A change to a more collaborative teaching approach is proposed. In respect with the teaching resources, we also found the site “Food Education” a good children’s encyclopedia on nutrition and a useful tool.

We believe that “acting like magicians” in order to attract students’ interest has its limitations. It is simply not enough for maintaining motivation. At some point we also need to move to the molecular nature of matter. Regarding the Greek teaching resources, we believe that they are often stuck to simulation. However, there exist some Greek resources which go beyond that and give more lively information.

d) Group 4



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Regarding the papers and publications we found interesting the Italian paper on the connection of science with movies and science fiction. We consider this is a good teaching proposal for helping students to understand the difference between science and science fiction in an attractive way. Another publication related with the Nuffield system is also interesting because of its finding that the more developed a country is the less popular science becomes among students. The necessity of introducing chemistry to students before they reach the age of 14 and the need for the best teachers to actually teach in class are proposed as necessary steps.

Another interesting approach for increasing motivation is related with the assessment system which could be adapted so that the acquired lab skills are actually evaluated (Irish example).

We also found striking similarities between the Greek and Bulgarian reality in the area of strategic planning and policy in chemistry (and science) education. In both countries, the teaching approach tends to be very academic, all types of students are treated in the same manner, the exams are very difficult, the teachers' training is usually not enough.

Regarding the teaching resources we pointed out one resource from Portugal (The Chemistry of things) which we consider that it could increase students' motivation because it relates chemistry with everyday life materials. Another interesting teaching resource was a successful TV series by Nobel Laureate Roald Hoffman. It is important however to keep in mind that research makes very fast advancements and some of the videos in this series provide outdated information.

10.45 – 11.00

In this part of the workshop, the project manager made a short presentation of the recent research bibliography related to factors that influence in general student motivation to learn. This presentation was made in order to introduce the participants to the next session of the workshop.

11.00 – 12.00

In this part of the workshop, the aim was to try and analyse the current situation in Greece in respect with students' motivation to learn chemistry, by taking into account the personal experiences of the participants. The participants were asked to discuss their personal experiences with the other group members for a set amount of time. Subsequently, each group was asked to present the main conclusions of their in-between discussion via one spokesperson for a maximum period of 10 minutes. Here are the main conclusions reached by each separate group:

a) Group 2

We found out that students at University (Department of Chemical Engineering) have different motives than secondary school students. University students either start with strong intrinsic motivation to learn or they tend to develop it as the years go by. Very few students quit the degree. University students tend to have a higher degree of self-regulation. This means that they have the ability to set goals and do their best to achieve them.

Passing into secondary education, we all agreed that the motives of students can be more easily influenced, the further away they are from taking decisions about their professional future and from preparing for the national exams for entering higher education institutions. The students who are in upper secondary school (16-18 years old) have usually chosen an orientation. Chemistry is a prerequisite only for health and medicine. The students who do not have this orientation are already psychologically very distant from chemistry and it is very hard to get motivated to learn anything related to it.

Our experiences also show that family plays an important role in the creation and development of motives to learn. The family environment can cultivate a specific learning culture and value system and help the child develop special interests. Finally, we have all noted that the economic crisis of the last few years has made students more responsible and more apt to develop their own motivation to learn.

a) Group 3

We first need to note that the teacher is a central figure in the process of students' motivation. The teacher can exert a large influence on the students by constant encouragement, by convincing them that they can do well



in chemistry. Especially in the young ages (up to 15-16 years) the teacher can largely influence motivation via his personality, personal paradigm and teaching approach.

Even in tertiary education, the motivation of students can be largely enhanced (or the opposite) via the paradigm of the professor. Students tend to be indifferent towards the subject and fear that they will not be able to perform well. When they realize for example that they can perform a simple experiment on their own, they can really “take off” and develop their own intrinsic motivational structure.

In secondary school, students do not know what chemistry is about, they consider it difficult and they need to be convinced that it is important for their lives. In fact, starting from primary education we need to note that the word “chemistry” is never mentioned in the curriculum even though the pupils are taught different chemical phenomena (like for example the water cycle). This makes the subject of chemistry very unfamiliar to the pupils who will subsequently become secondary school students.

Finally, we also note that students can get motivated when they are given the possibility to work in a team for the completion of a specific project.

a) Group 4

In our team we discussed a lot the issue of the teachers’ role in affecting students’ motivation. In several cases, teachers themselves have very low expectations from their students and they are not interested in motivating them. Another interesting issue is that there is often a battle between older and younger teachers in the sense that the former do not think positively of the efforts the latter do for applying a new teaching approach that could potentially increase student motivation.

In tertiary education, professors are often not very interested in motivating students to engage in the learning process. However, we agree that university students can evolve with the guidance of their professor to independently motivated learners. From our experience with Ph.D. students in research centers we note that they usually belong to two categories: a) the ones who have strong intrinsic motivation for research and b) the ones with a “utilitarian” approach, who are interested in getting a Ph. D. degree in order to gain some additional bonus points in their search for getting a permanent job in the public sector.

Another issue that we have noted from our experience is that it is perhaps easy to act like a magician and attract students’ attention with an impressive experiment. However, it is not as easy to motivate them to go one step further and make an effort to understand chemistry in more depth.

We note also that especially in upper secondary school, students are very often interested only in their grades. This poses a major obstacle for creating intrinsic motivation to learn.

a) Group 1

We will start our discussion on the motives by using a bottom-up approach. In primary school, children do not come with preconceived ideas and the teacher may have the possibility to affect their interests in a large degree. In lower secondary school, children are still young and their interests could still be shaped up by the teachers, however I doubt that we as teachers do the best we can in this direction. At this level, students indulge in rote learning. Once they reach upper secondary school (16 years old) they have already made their choice to either follow a path that will necessarily involve chemistry (health and medicine) or a path in which they can avoid the chemistry exam for entering tertiary education. Students consider chemistry to be difficult, they have fear for problem solving and for using math and they avoid it. I personally find great difficulty in motivating them to learn chemistry no matter what I do (experiments, ICT etc).

Another teacher from the group expressed the opinion that teachers hold the largest responsibility for changing the picture. The teacher has to take into account the students’ needs and try to reinforce their self confidence. Chemistry has a symbolic language that can be really intimidating for the students. Physics has much less of this problem.

At University, students fall into different categories. There are those who are intrinsically very independent and highly motivated. There are those who feel they entered a faculty that was not their first choice and they are not really motivated to learn. Finally, there is a category of students who get a second degree or who are older in age because for different reasons they had interrupted their studies. These students are usually very

motivated to learn chemistry. Finally, experience shows that all student types exhibit a large enthusiasm working in the lab for doing an experiment they find interesting (making aspirin).

As a group, we agree on the fact that every educational level “does” something wrong that is then transferred to the next one and also magnified.

12.30 – 13.00

Right after the coffee break, we asked participants to discuss as a group and propose different chemistry themes which, in their opinion, could be used in the teaching praxis for enhancing student motivations. We asked from each time to right down on their proposals. The participants proposed several themes some of which are the following: Food and nutrition, chemistry of the exercise, doping control, forensic chemistry, chemistry and the art of painting, biofuels, drug design, wine chemistry, waste management methods, polymers, environmental chemistry (air and water pollution, ozone layer etc), biological phenomena (osmosis, proteins etc).

13.00 – 14.00

In this part of the workshop, the aim was to try and make proposals for overcoming the problem of lack of student motivation to learn chemistry. The participants were asked to discuss freely within their group for a set amount of time. Subsequently, each group was asked to present the main conclusions of their in-between discussion via one spokesperson for a maximum period of 10 minutes. Here are the main conclusions reached by each separate group:

a) Group 3

Our team believes that actions should be taken at three different directions, namely students, teachers and curriculum. In regard with the students, it is necessary for them (and for the general public) to get informed and understand what chemistry is about. More time should be available for active participation of the students in the educational process especially via the lab work. Students' self-efficacy and self-regulation should be built up. It is important that students get substantial feedback on their homework, so that they can learn from their mistakes and improve their skills. Student evaluation via quizzes, tests etc should also be done by following the philosophy of improving. In addition, it is useful that we also make use of the historical aspect of chemistry so that students get an idea of how knowledge is being conquered and how ideas evolve in science. In the direction of the teachers, we believe that teachers need to be given the possibility for constant training. We need to get informed on the latest advancements in the science of chemistry and on the most recent findings in educational research. It would be nice if the Universities could be more connected with the educational process in secondary education for example by giving the possibility to the students and their teachers to visit an organized research lab, attend some real research experiments, etc.

Finally, the curriculum should be designed so that it advances the general level of knowledge. The chemistry curriculum should avoid repetitions. The curriculum content is not very big but it is not very interesting for the student. It should be enriched with new themes. A specific timeslot for chemistry laboratory should be put in the weekly course program.

a) Group 4

We discussed about the performance of laboratory experiments with the method of guided inquiry. Students should be given the possibility to take their own measurements, do the data analysis, write their own reports and also make a short presentation on what they did. The use of new technologies can also be very helpful for example videos, simulations, etc.

The curriculum should be centrally designed from the policy makers by taking into account the needs of all the educational levels.

Teachers' training is a central issue and special care has to be taken. It has to be done by teachers who are themselves in service and have experience in applying new teaching methods (ICT based) in a real classroom with average students. Teachers need to develop their own intrinsic motives and acquire the necessary skills so that they feel confident enough to use new teaching tools and teaching strategies. We also believe that the

organization of teaching sessions on a voluntary basis outside the official school program could be helpful for both students and teachers.

Finally, we believe that the opening of the school in the society could enhance students' motivation. Students should be given the possibility to present themselves the results of a completed project to the public (parents, friends, etc.)

a) Group 1

Starting from primary school we believe that chemistry themes should be included in the curriculum from the smaller classes. These themes should point out the presence of chemistry in everyday life. Young pupils should take a taste of chemistry from early on.

We believe that lower secondary school (12-15 years old) is very critical. We tend to "lose" the students at this level. Chemistry is usually taught in a very academic manner. It would be preferable that at lower secondary school students get more involved in projects and lab experimentation and not necessarily so much with "academic chemistry". In addition, we propose the periodical establishment of chemistry happenings and chemistry competitions in a local scale, so that it does not require a large organizational effort.

In regard with the curriculum, we also believe that it should have a few major goals that are served in all educational levels.

Finally regarding teachers' training, we wish to point out that it should be goal-oriented and aiming at facilitating the work of the teacher. In addition, it is necessary that the implementation of the new teaching methods is rigorously checked. In other words, the teachers should be facilitated but also have the responsibility to prove that they actually put the new teaching methods in practice.

a) Group 2

The curriculum should be designed with the same philosophy for all educational levels. In addition, education in the upper secondary school should be disconnected from the examination system for entrance in a university faculty. In lower secondary school, the chemistry laboratory should be obligatory and be included separately in the timetable. In addition, the analogy of 27 students per teacher in a chemistry laboratory is very large. The teacher's motivation to actually teach lab techniques diminishes.

In regard with the teachers, measures have to be taken for creating and maintaining their motivation. Financial motives and an objective evaluation system are necessary. Our society tends to constantly devalue the role of the teacher. As also pointed out by the previous group, the system should find effective ways to check whether a specific teacher or school unit actually implements new teaching methods. Unfortunately, what usually happens is that because the system does not have efficient control mechanisms, it just does not provide any motives or facilitation to the teacher. In this way, a conscientious teacher is not given the possibility to prove the quality of his/her work and he/she totally loses motivation to continue trying.

In reference to the connection between tertiary and secondary education we think that several efforts are made in this direction and that it should be done in a more organized way.

Finally, we would like again to point out the importance of us chemists to build our image in society. Chemistry does miss a specific slogan or "catchphrase" that identifies what it is about. In this way, it tends to remain alienated from the general public.

14.00 – 14.30

In this part of the workshop the participants filled in the project evaluation questionnaires. Some general concluding remarks were made by the project manager. It was pointed out that a lot of issues were pointed out during the workshop. All the material collected will be used as effectively as possible for the production of the first national report.