



518300-LLP-2011-IT-COMENIUS-CNW

Motivation of Bulgarian Students' to Study Chemistry: Problems and Solutions



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Motivation of Bulgarian Students' to Study Chemistry: Problems and Solutions

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Abstract

Recent years have seen the subsiding interest in sciences, including Chemistry, among young people. In general, the cause of this negative tendency has not been clearly defined. To a certain extent it may be due to the transition of the society toward a different political and social system. Another possible cause is the globalization and its impact on the educational process. Chemistry is regarded as tough science by young and adult learners. The teaching content of most school courses in chemistry add their finishing touch to the entire picture. Disproportionate informational input, too much theorization and systematic ignoring of laboratory experiments in chemistry have discouraged a great number of students who would otherwise direct their interest to this particular subject. Last but not least is the lack of whatever prospects for those who would venture in making a career in chemistry.

This report presents the main results from the activities carried out during the first year of Chemistry is all around Network Project and dedicated to the problem of student's motivation to learn scientific subjects and particularly Chemistry. Through the view-point of Chemistry school teachers with rich professional experience, representing different types of Bulgarian secondary schools, experts in Chemistry education, scientists in Chemistry, researchers in philosophy of Chemistry, science mediators and policy makers in natural sciences education, the main obstacles to students' motivation to learn Chemistry are analyzed. Based on reviews of large number of publications, national and from the other Project partners, general approaches to improve the teaching-learning process and to motivate students to study Chemistry are formulated. Practical instruments and interactive teaching resources for implementation of these approaches to improve the motivation of students to learn Chemistry are proposed.

1. Introduction to the National Situation

1.1. Bulgarian school education system: main features

Structure. Schooling in Bulgaria includes training and education of students from grade one to twelve and is carried out in the following basic types of school:

According to the way of funding:

- state schools – these are funded from the government budget through the institutional budget allocations of the Ministry of Education, Youth and Science or some other Ministries or government bodies;
- municipal schools – they are funded from the municipality budgets;



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- private schools which according to the provisions of the law are not funded through budgetary instruments.

According to the level of education offered they are:

grade schools: Grade education is carried out in two stages (primary and elementary) and respectively:

- Primary stage involves: primary schools /I-IV grade/; elementary schools /I-VIII grade/; secondary comprehensive schools /I-XII grade/; schools of arts and special purpose schools.
- Elementary stage involves: grade schools /V-VIII grade/; secondary comprehensive schools /I-XII grade/; schools of arts, vocational schools; sports schools; special schools.

Secondary school: Secondary education is carried out in high schools, profiled high schools /VIII-XII grade/, vocational schools, special schools and schools of arts.

According to the content of training:

- comprehensive schools;
- vocational schools;
- special schools.

Training is carried out at above type of schools. Vocational colleges are also included in this list as they offer training after secondary school graduation [1,2].

Present status of Bulgarian school system. Total number of schools in the country at the beginning of 2011/2012 school year amounts to 5164 of which: comprehensive schools – 2166 and vocational – 477. The number of primary schools (I –IV grade) where Chemistry is not included as subject taught in education curricula is 156 only. Fig. 1 illustrates a tendency of schools' number reduction during last few years because of:

- Demographic crisis and decreasing number of children;
- Reformation of Bulgarian education system as sequence.

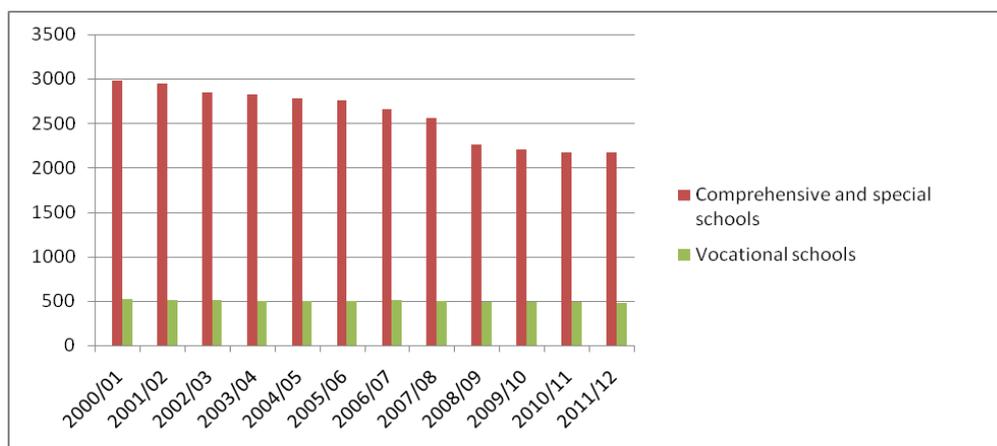


Fig.1. Number of Bulgarian schools including secondary ones

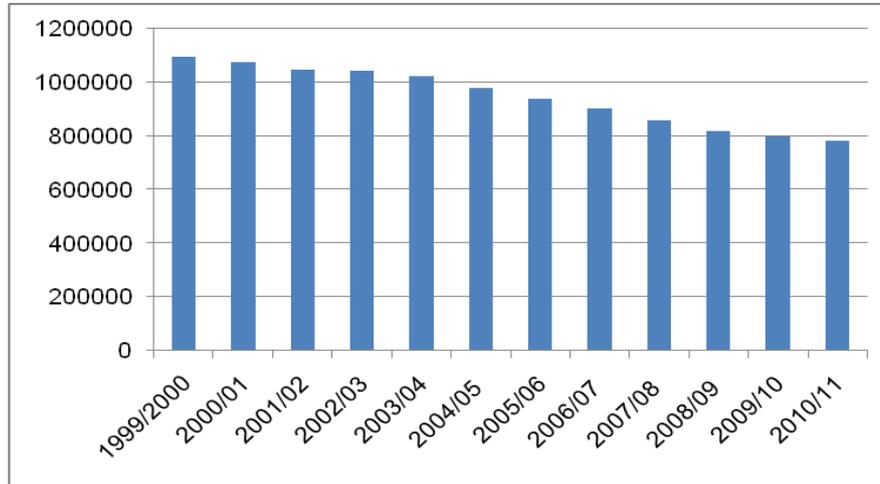


Fig.2. Number of students in Bulgarian schools for the period 2000-2011

Negative tendencies in Bulgarian political, economical and social development during last 20 years influenced negatively particularly the education system. As a result the total number of students in Bulgarian schools has decreased year by year (Fig.2).

Another negative result was increasing of the number of children dropped out the school system. Even the last few years their number is slightly reduced, it is still considerable (Fig.3). For 2011 the average percentage of young people age 18 – 24 dropped out the school is 12,8% (20,1% for the small towns and 23,4% for villages) [3,4].

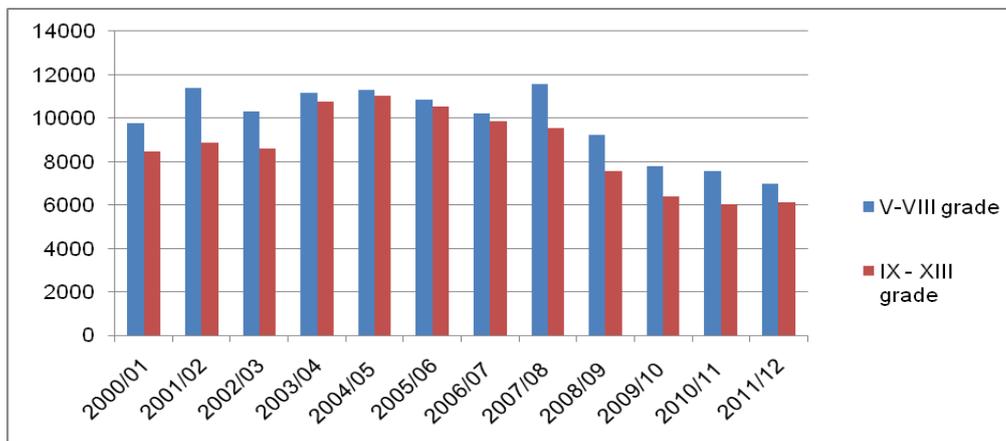


Fig.3. Number of students, dropped out from the lower and upper secondary schools (2000-2011)

Till 2011 main reasons to drop out the school have been considered to be:

- social status and luck of finances;
- going abroad;
- lack of wish (mainly for ethnic minorities)

Last inquiry performed by the Ministry of Education, Youth and Science shows another important reason marked by the students dropped out: lack of interest and motivation caused by the way of teaching and the quality of educational content.

Contemporary school system analysis indicates the following positives and negatives affecting directly the quality of education and the students' motivation:

Positives:

- Relatively well developed network of schools which guarantees comparatively decent access to education
- New model of funding based on unified expense rates for the support of one school child
- Relatively well developed system for providing access to education – free transportation; free course books and study aids for all school students from grade 1 to grade 7; e-based study contents; special purpose program for additional work with
- Low and high performers.
- Programs for upgrading of the necessary school equipment.
- System staffed by teachers with university degrees.

Negatives:

- Large disproportions in the quality of education offered by schools across the country,
- A considerable number of unschooled students and drop-outs at school age
- Insufficient financing;
- Tight centralization and lack of autonomy for educational institutions which renders them unable to follow their own school policies.
- Poor practical orientation of training and study contents which do not correspond to the contemporary needs of young people; low level of utilizing modern teaching methods.
- Unified approach to learning and educational processes disregarding the individual needs and gifts of students.
- Outdated system for vocational training and poor contacts with business.
- Underrated educational role of Bulgarian school.
- Underdeveloped forms of life-long learning.
- Inadequate upgrading of school facilities and equipment

Possibilities for further development of the educational system:

- Development of integrated learning content and enhancement of practical applicability of training and its orientation to concrete practical outcomes.
- Development of complete and effective system for introducing, sustaining and rewarding qualification of pedagogical specialists and adoption of career development system
- Improvement of vocational training quality and provision of conditions for more effective connections with business.
- Granting greater autonomy to educational institutions which allows for development and implementation of their own school policies.
- Enhancement of both effectiveness and appeal of the learning process and school environment.

Main Possible obstacles and negative tendencies in effecting this development were defined to be:

- Widening of the gap of disproportion in education quality observed at individual schools.
- Rise of illiteracy percentage among young people.
- Considerable number of unschooled and dropped out students mainly from ethnic minorities which results in their ousting from the process of worthwhile social realization.
- Low interest in opting for potential teaching career which results in aging pedagogical staff and inadequate number of young highly qualified and well motivated specialists at school; feminization of teaching profession.
- Poor appeal of vocational training and learning, lack of qualified specialists and low level of manifested interest on behalf of business [5]

National policy in the field of school education presented by the Ministry of Education, Youth and Science is oriented toward the following main directions:

- Achieving high quality of education;
- Ensuring equal access to education and opening up the education system.



- Development of conditions for implementation of the educational concepts "Lifelong learning" and motivation of young people for continuous education.
- Incentives young people in the development and implementation of sector policies;

Conversion of Bulgaria In the medium term Country in which knowledge and innovation are the drivers of the economy [3].

The general national strategy is based on the following crucial documents:

- Programme for Development of Education, Science and youth policies in Bulgaria 2008-2013;
- National programme for Development of School education 2006: 2015;
- National strategy for lifelong learning (LLL) for the period 2008: 2013.

As a step for realization of this strategy the list of major priorities for secondary education in 2012 includes also the following:

- Considerable decrease of the number of drop-outs. Both national and regional policies have focused on providing free transportation, text books and food plus developing a wider scope of extra curricula activities;
- Sustainable school network;
- Improvement of the quality of educational process, modification of syllabi and curricula and their rendition made relevant to the specific requirements of each age group during schooling;
- Improvement of professional qualification of teaching staff. About 43 thousand teachers are due to pass professional appraisal and qualification courses;
- The new Pre-school and School Education Act that has been developed by the Ministry of Education and Science passed and is due to be enforced in the school year 2012/2013.

1.2. Science education in Bulgarian secondary schools

An essential feature of modern school education in Bulgaria is the fact that it is directed towards the abilities of the average student. In the existing traditional class-lessons system not enough attention is paid, and suitable forms and approaches are missing, in the work with poor performers and children of smaller learning capabilities or, on the other hand, with students with well expressed capabilities and talents in different fields of science and arts. All these processes are taking place against the background of overall international drop of interest in natural sciences at the expense of the larger interest in humanities and social sciences [5].

Teachers in natural sciences are facing some challenges affecting the students' motivation also:

- The educative content of the relevant subjects is difficult to learn and is frequently presented in the incomprehensible, far-fetched language of the existing textbooks.
- Lack of actual inter - subject connections in the operative textbooks in the cultural-educational area "Natural sciences" which contribute to the comprehensive acquisition of knowledge about the natural processes and phenomena on behalf of the young people;
- Work with students having humanitarian interests and skills, who are well acquainted with the modern technologies, but not educated in the smaller classes to the necessary degree which would enable them to make logical reasoning and deductions [6-8].

Based on deep analysis of the contemporary situation, the following main reasons for the present state of science education and in the country have been drawn by experts [9]:

- Lack of precise vision and policy concerning the volume and quality of knowledge (theory and practice) at the different education levels on behalf of the Ministry for education.
- Shortage of financing for the educational and scientific institutions for modernization of the material base and for use of modern equipment.
- Insufficient motivation of the learners, the teachers, firm leadership for life long learning;
- Lack of synchrony between the specialists in information technologies who could work out interactive education and demonstration materials and the teachers who could present the corresponding tasks and education contents with the aid of these materials.

Student motivation to study natural science can be intrinsic and extrinsic. Intrinsic motivation arises from the interest in, inquisitiveness and disposition towards natural science subjects. However, it can also be

stimulated by situations which spark interest and create desire to acquire knowledge. Scientists say that there is extrinsic motivation when the incentive for performing given activities is external, for example getting rewards, high marks, etc. Interest is closely linked to intrinsic motivation though these two concepts do not overlap. Researchers distinguish individual and situational interest [10]. Situational interest can be excited by means of assignments in real-life situations, interactive methods, discussions of mass media news, involvement in research activities, etc. [11-13]. For instance, in chemistry an experiment has not only a cognitive function but it plays a key role in increasing the interest and motivation of students as well. If students are only passive observers, i.e. if they do not plan and do experiments independently, the motivation function cannot be performed [14].

Unlike the individual interest, the situational one is considerably affected by the characteristics of the learning environment and the assignments to be completed [10]. In this sense, the establishment of a constructivist classroom and the ability of the teacher to apply constructivist approaches have a great impact. The research of the learning environment in Bulgarian schools shows that we have a mixed type of learning: traditional with some constructivist elements. However, the teachers are willing to use different constructivist methods [15-20].

Student motivation to learn requires the provision of concrete expectations – both teachers and students have to be aware of what students are supposed to know, what they are expected to do, how they will be assessed and what will be the consequences of their success. Students' failure is often a result of ill-defined requirements toward them thus demotivating them to further learn. Providing feedback is also an important condition: information about the results of positive efforts is of great importance for student motivation to learn and can play the role of an incentive.

To arouse interest in natural science and to increase the motivation of students to study it, some key competences in the area of science and technology are needed to be built and developed.

The willingness to apply the things learnt in a variety of everyday situations is a basic component of a positive attitude. The subjects related to natural science provide a lot of possibilities for acquiring key competences in real-life situations that are interesting for students. Key competences underlie in the general guidelines of the curricula reform in all countries, including Bulgaria. It is believed that this is a way to outline the benefits of the scientific knowledge and to avoid the acquisition of pure theoretical knowledge by learning and reproducing facts.

Key competences are included in a decomposed form in the National standards of learning content and the curricula. In the National standards the learning content is presented in a more general form, and it is related to a separate educational degree. In the curricula the learning content is decomposed to the lowest level, and it is respectively described in details for each grade. Within the updated National standards and the new curricula which are being developed at the moment and are supposed to be approved in the nearest future a special emphasis is placed on key competences.

Each subject allows the acquisition of certain elements of the key competences in compliance with its learning content and teaching methods. Key competences can be gradually acquired by studying all subjects and completing all grades.

The development of the key competences underlying in the National standards and the curricula depends on the work of the teachers, the use of up-to-date interactive methods, team work, problem solving in real-life situations, etc. All these can be actual prerequisites that can increase the motivation and interest of students in natural science, in particular in chemistry.

Within nontraditional competitions and Olympiads, based on team work, key competences are assessed (joint work on assignments simulating real-life situations) rather than individual achievements of participants. Such competitions are: the National competition for key competences in natural science [21] and the European Union Science Olympiad [22]. Observations show that these events develop strong interest in natural science in the participants (students under 16).

2. Setting up of the Network

Based on the specific features of Bulgarian education system and science education in school, in order to fulfil the main project aim and in accordance with the specific objectives for realization of this aim, national network has been created. The network combines two categories of educational institutions for the exchange and comparison of experiences and knowledge in science education (Chemistry education):

- Secondary schools with different profile of education according to the structure of Bulgarian school education system. Because the number of classes and the educational content in Chemistry, defined by the Ministry of Education, Youth and Science are different depending on the school profile, the recruiting strategy was built onto two supporting points: first - to cover all types of school secondary schools where Chemistry is a part of the education curricula; second:



to combine schools profiled in natural science education with these ones specialized in ICTs education (technical education) and that way to find the best approach in Chemistry teaching applying modern internet-based technologies.

Five state upper secondary schools have been invited to join the network: 1 National school in Natural sciences and Mathematics; 1 vocational school in Chemical technologies; 2 vocational high schools of Electronics; 1 Mechano-electrotechnical High school. All schools chosen are responsible for education of students 14: 18 ages.

Ten secondary school teachers (2 from each school) in Chemistry have been involved into project activities. The reasons to choose them were: school teachers are the main target group of the project; the chemistry school teachers are real participants in the process of education and are responsible for the quality of chemical knowledge.

Since secondary school students are the final "user" of the project results and knowledge, gained by the teaching approaches and teaching materials resulted from the Project activities, they have been chosen as a group supporting teachers in their Project activities. The students' group includes more than 200 students, age range 14 – 19, with Chemistry included as a taught subject in their Curricula.

- State institutions responsible for development and implementation of science education policy, universities. The strategy in recruiting the group was to cover with competent opinion and evaluation every stage of the chemistry education process: planning, strategy and approaches of chemistry teaching (implementation of ICT- based teaching materials and attractive way to present the chemical science in classes), improvement of teachers' approaches and the relation "teacher-students" in order to involve students as active participants and enhance their motivation. Following institutions become part of the national project network: Sofia University, Plovdiv University, Research Laboratory of Chemistry education & Philosophy of Chemistry - Sofia; Regional Inspectorate of Education – Gabrovo. Every institution is represented by expert - among them people working in the field of chemistry education, scientists in Chemistry, researchers in philosophy of Chemistry, science mediators, policy makers in natural sciences education. The expert group includes: 2 professors and scientists, working in Research Laboratory of Chemistry education & Philosophy of Chemistry (Sofia University) with rich experience in methodology of science education, Internal and external assessment of students' achievement, evaluation of scientific content standards and programs, ICT science education, etc.; 1 university professor (Plovdiv University) working in the field of Organic Chemistry and Molecular biology; 1 young researcher, working in the field of bio-analytical chemistry and as popular science communicator on radio, TV and on stage; 1 Chief expert in Natural sciences and Ecology from Regional Inspectorate of Education – Gabrovo, who is responsible for the organization, implementation and control of national educational policy in natural sciences, particularly Chemistry, Biology and Environmental protection within the regional frame of secondary schools.

Profile of people forming the national work group by gender, age and years of experience shows the following:

- the number of women is 11 versus 4 men – in fact it is in accordance with the tendency of "feminization" of Bulgarian school education;
- teachers and experts cover all age categories (fig.4). The largest part is the category of older than 45 years, followed by the category of 36 – 45 years old

The last fact guarantees adequate professional experience - more than 15 years for 60% of people involved and 10 -15 years for another 25 % (fig.5).

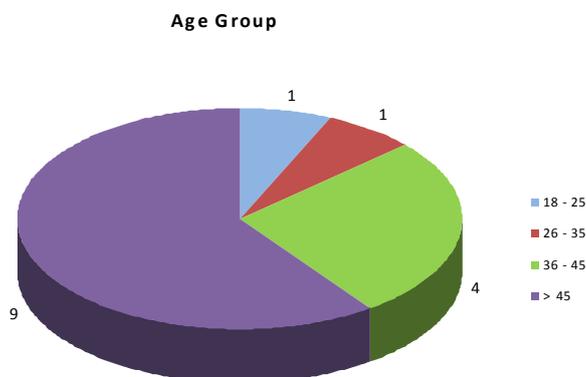


Fig.4. Age distribution of teachers and experts involved in National work group

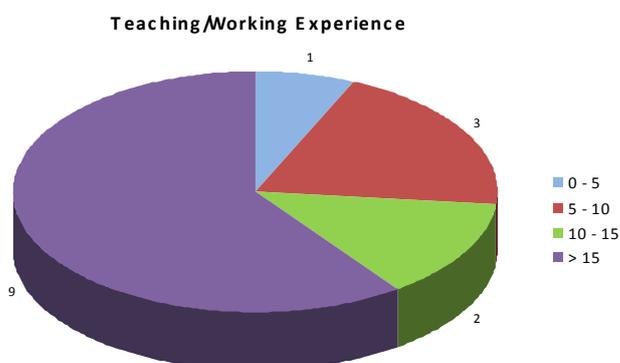


Fig.5. Distribution of teachers and experts according to the years of experience

There are also relatively young people, with less professional experience, but they are very useful working as a “corrector” during the development of Project activities and analyses of the results because of the missing of the routine and the view point closer to the students’ one.

3. Main obstacles to students’ motivation to study Chemistry

As a part of the fundamental education Chemistry learning in Bulgarian schools starts in the primary school, continues in the secondary for a period of 2 - 3 years depending on the profile of the school and finishes in the university degree where (with the exception of the specialized universities) it is taught/studied for one semester [1].

According to secondary school Chemistry teachers following factors in Chemistry teaching and learning are responsible for the quality of education:

- Academic style of course book content which is difficult to understand for students - Course and reference books in Chemistry abound in theorizing which encumbers the students and gives them poor motivation. This tendency is sustainable both at grade and high schools. Knowledge should be grounded on and oriented to practical experience;
- Depreciated material base and insufficient modern equipment – the lack of proper equipment is one of the most serious problems related with the study of Chemistry;
- No willingness and motivation to study;
- Lack of specialized literature written in easy to comprehend language for students who learn Chemistry;
- Not enough training courses for teachers related to the interactive methods of teaching Chemistry [23].

The process of teaching Chemistry at secondary school level is accompanied with a number of additional difficulties and unsettled problems as:

- Insufficient lab equipment and base;
- The number of Chemistry classes is insufficient at school and, as the usual practice is, there is no time for lab exercises;
- Large classes with no possibility to be divided into groups during lab exercises; There are no possibilities for normally conducted lab exercises and ensuing progress check;
- Too large lesson units- students are unable to extract the most relevant information;
- Students are inadequately capable to cull textual information, read charts, diagrams, graphs and chemical equations.

These factors make up an overall understanding among school students that Chemistry is an unintelligible and sophisticated science. Young people are poorly motivated for learning Chemistry. During the project activities publications and articles on students' motivation, available on the project website as "POPUCH - Popularization of Chemistry", "Students' motivation to learn chemistry: the greek case", "The problems of chemistry and science teaching in Spain", "CERP – chemistry", "Students' motivation in secondary school chemistry teaching using common life tasks", "The motivation of students to learn Chemistry," etc. have been reviewed and commented by teachers and experts. The analyses of the current situation and available publications related to the problems of Chemistry school education allowed to formulate some general approaches to improve the teaching-learning process and to motivate students to study Chemistry:

- Improvement the organization of the educational process: making explanations in easy to understand language and support them with practical exercises; involving students in scientific activities at school with their teachers, but also outside school (i.e. at universities or companies and organized by researchers and experts);
- Developing tools and alternative teaching material to be used by teachers; novel innovative methods of training are to be introduced relying heavily on ICT;
- Providing continuous training to chemistry teachers;
- Development of conditions for self-realization of young people - young people should be offered clearly defined prospects for self realization and professional progress.

Supporting initiatives in the field of Chemistry education at national level are:

- Festival of Bulgarian education - It is an event held annually and a place for public presentation of educational institutions, to search and create new contacts and partnerships with NGOs, businesses, other educational institutions, media; the festival creates area for interaction between different educational institutions, students and business;
- National Contest in Chemistry and Environment Protection: it is an annual competition of high school students (grades 9-12) from all secondary schools in Bulgaria and aims at verifying the quality of education in chemistry and the environmental protection. It also allows for comparison between different training schools and is a natural place for the exchange of new approaches to training students in Chemistry and environmental protection;
- National Educational Portal - Bulgarian Ministry of Education, Youth and Science developed National Educational Portal - the first serious step in creation of a large national system for e-learning of scientific subjects in Bulgarian high schools, including Chemistry. The Portal is addressed to high school and Universities teachers, lecturers and students, people interested in e-learning and education in general. On-line lessons facilitate educational process by transferring it to the homes of potential learners allowing both students and teachers to avail of the needed information at any time and place. The very process of learning is substantially modified; the recipient is no longer trying to cram lesson facts from the teacher, but invests his/her time during classes in assimilating the underlying principles. This in turn enables individual students to create their own framework within which to prioritize and arrange all facts. Among the top advantages of the portal is its interactivity. There have been developed textbook contents for subjects included in the curricula for all grades from grade 3 to grade 12 plus the subject "Chemistry and environmental protection".

4. Analysis of Teaching Resources

Twenty online available teaching resources and materials to teach Chemistry have been collected and reviewed by teachers and experts. As the number of really suitable for school education, with high quality of scientific information interactive materials at national level was small, some teaching products from other countries were reviewed also.

Analysis of the teaching resources by their type, level of knowledge proposed, and etc. gives information, which in combination with the scientific content could be helpful to evaluate each of the resources related to its pedagogical value for the purposes of Chemistry education. In some cases the total number is more than 20 because some of the resources could be related to more than one category. By type of product the teaching resources could be classified as: online courses: 5; downloadable software: 4; web sites: 6; downloadable materials: 10. By the level of knowledge proposed 7 of them are suitable for basic education, 14 for medium and 1: for advanced level of education (student applying for Medical universities after the secondary school level).

According to target group the teaching resources cover all school levels starting from the primary school: 2, continuing with lower secondary school: 10 and finally upper secondary school: 14. The analysis shows clearly that the largest number of the resources serves for the purposes of the secondary school education. There is a lack of attractive interactive materials, written in simple, understandable "Chemical" language, suitable for pupils (Primary school level), when the basic learning skills and interest in science are created.

Considering the pedagogical approach of the teaching resources they cover all pedagogical instruments except "Modeling": 7 of them are suitable for cooperative learning, 2: for problem solving, 3: for peer education, 4: for experimental learning and 5: for other pedagogical approaches (discussion, home schooling, self-education).

The information gained during the searching and reviewing process shows that the largest number of teaching materials available on-line relates to problems of General chemistry which is logically having in mind that more of these problems are part of the Chemistry education content for secondary school education. Following the mentioned tendency, 12 of the reviewed resources offers knowledge on fundamental chemistry. After General Chemistry the most exploited scientific area is Environment and sustainability: 8 resources offer education and training in Environmental sciences. Seven resources are oriented to Life chemistry, : 4 to Food science and 1 is related to Material Science.

According to the professional opinion of teachers and experts one of the best examples for interactive teaching material in natural sciences, including Chemistry at national level is the website "Uchase" (fig.7). The resource could be classified as website, online course and downloadable material at the same time. It was created with the tutorial support of chemistry teacher in Aprilov National High school, directly involved in project activities.

The website www.ucha.se [24] is an educational environment with the aim of making studying a pleasant and fun activity. A leading section of the website is a collection of educational chemistry videos covering the official school program. The videos are completely free of charge and presented with intriguing narratives. The website step by step becomes an indispensable resource for preparation of students, helping them study, revise, catch up and test their knowledge in the field. The main goal of www.ucha.se is not to be just a collection of educational videos, but to be a dynamic place, where students go, study, interact with others and leave with increased motivation. Therefore, the website contains a live chat, where students discuss different topics and help one another. More specific questions are discussed also in the video sections, where the more experienced participants offer their assistance. It is not a secret that many books present the material not very attractively, which often demotivates students. The videos on the website are interesting and motivational, which explains the big interest in the website.

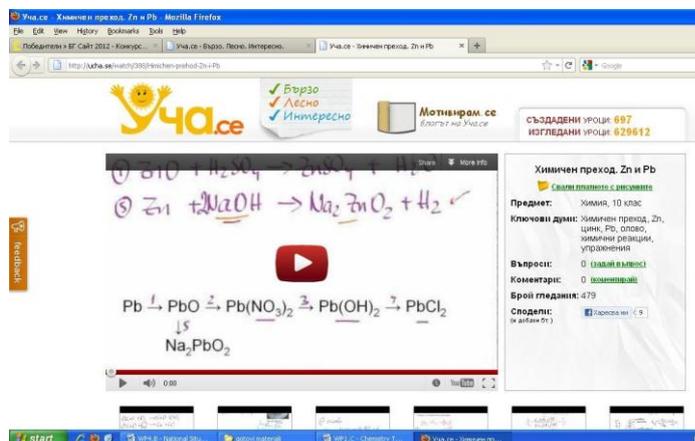


Fig.7. Homepage of the website www.ucha.se



Fig.8. The website prize from the competition BG SITE 2012

The main advantage of the chemistry videos is that they are narrated in a friendly and popular among students style. Every process and system are explained by visual demonstrations – pictures, schemes, figures, as the main goal is to always look for the logic behind them and avoid ineffective learning by heart. The main idea of every video is to boost the interest of the students. This is often achieved by linking the concepts to everyday life.

Another big advantage of the website is the possibility to discuss the topics presented in the videos. Questions and comments can be easily posted, which are then answered by people with more knowledge – teachers, other students, parents. The answers can be rated, which allows for sorting out the best answers from the rest. The main page of the website has also a live chat, which turns the website into a social environment, where visitors go, study, help one another, discuss different topics and make new friendships.

The pedagogical value of the website is indisputable as it offers an innovative way of teaching, bringing the school lessons as close as possible to the students

- Proof for the high pedagogical value of the resource is the facts that for around 6 months the videos have been seen more than 150 000 times.
- The website has been awarded by the jury of “BG SITE- 2012 in pixels” competition to be the best Bulgarian website in the category “Education and science” for 2012 (Fig.8). The “BG Site” competition is one of the most prestigious competitions for webs in Bulgaria and this year was its 13th edition.

Chemistry teaching resources highly evaluated by teachers and experts offers National Education Portal [25]. The portal design and educational content have been developed by the Consortium Lexis with the financial support of Bulgarian Ministry of Education Youth and Science. The consortium is an association of the two leading Bulgarian companies in the field of ICTs and information systems - combining the traditions of the Bulgarian school education with high technologies they contribute to the modernization and development of the Bulgarian educational system. In the field of Chemistry education the website offers interactive online lessons including material from the 7th, 8th, 9th, 10th and 12th grade - compulsory and specialized training. The lessons are prepared very professionally, in details, interactive and interesting. They give a great opportunity for easy accepting and understanding the material and possibility to check knowledge.

As Chemistry is an experimental science, skills related to monitoring, planning and implementation of chemical experiments are very important. Chemistry will be more understandable if students have the opportunity to conduct laboratory practice sessions on their computers at school or at home. **Virtual** chemical laboratory [26] is an interactive teaching resource, which enables practical training of large classes. Students have also the opportunity to test their knowledge and skills in an unconventional and entertaining way. The site allows teachers to simultaneously monitor virtual experiments and test

students' knowledge. By using the resource, students acquire basic knowledge about working in a chemical laboratory.

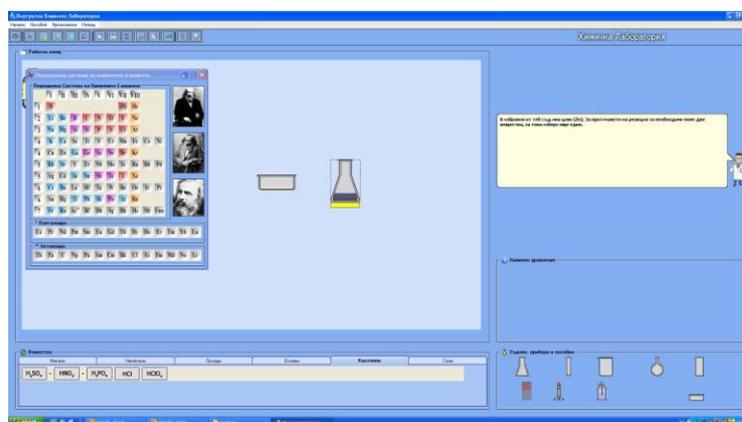


Fig.9. Virtual chemical laboratory

The proposed site is consistent with the Chemistry curriculum for seventh grade, where the basics of this subject are taught and a good mastery of the material is a prerequisite for successful performance in the coming years of training. This is the age when it is most important to create interest in the chemical science and using the site contributes to that. Besides due to their universal character, separate components would be of great use to older students (solubility table, periodic system) The program can be of assistance to teachers in their laboratory classes or it could be used by students independently at home. Parts of the program can be used in the assessment of the students' achievement.

5. Workshop

Workshop, dedicated to the motivation of students to study Chemistry was held on 21.09.2012 in the conference room of the University Library of the Technical University of Gabrovo. It was attended by teachers of Chemistry - representatives of all schools – associated partners of the Technical University - Gabrovo, as well as representatives of universities and organizations as experts.

The meeting took place in accordance to the previously agreed agenda, which included: introduction of participants; presentation on "Chemistry is all around Network" Project (goals, objectives, ongoing and future activities); presentation of reviews and opinions for the posts of the project partners concerning students' motivation for learning chemistry and discussion "Motivation - How to achieve it?"; Presentation of reviews and opinions for the educational interactive materials for teaching chemistry, followed by discussion "Using interactive forms of education as a tool to increase students' motivation for learning chemistry; final remarks and conclusions.

The workshop was organized in two sessions. During the first session the goals and objectives of the project achieved so far, the expected outcomes, and the future activities to be performed as well as the commitment of teachers and experts in them were presented to the participants by the Project contact person.

Through short presentations teachers and experts presented their views on the publications and articles on students' motivation, available on the project website (fig.6). Special attention was paid to some of them dedicated to innovative and implemented practically in school Chemistry education like "POPUCH - Popularization of Chemistry", "Students 'motivation to learn chemistry: the Greek case", "The problems of chemistry and science teaching in Spain", " CERP - chemistry ", "Students motivation in secondary school chemistry teaching using common life tasks ", " The motivation of students to learn Chemistry " etc.



Fig.6. Experts and school teachers presented their opinion about publications related to student's motivation and interactive teaching resources

The publications were commented and analyzed based on the expertise and the professional experience of participants during the discussion "Motivation - How to achieve it?". Both two groups of participants came to some common conclusions related to student's motivation to learn Chemistry:

- To be the process of teaching and training successful, students must become its focal point – that is the best way to motivate them.
- In order to motivate students to do something, the teacher has to grab their attention. In this respect the personality of the teacher is of great importance;
- Demonstrations are of great help to visualization of the chemical phenomena and lessons - the important thing is that they should not only be attractive, but also should define their relationship with practice and life. So the teacher should take the role of science communicator.
- Inclusion of the science in the process of teaching Chemistry at school is another way to attract students' attention and motivate them - the e-magazine CERP is a fine example of that. The variety of information offered by the magazine online would stimulate the students to go further into Chemistry and would stimulate their inquisitive and innovative spirit
- interesting and effective approach to involve students in the learning process (presented in "POPUCH - Popularization of Chemistry") is bringing chemistry to them through the work of outstanding students as researchers in the laboratory, after which they are included in the delivery of lessons and serve as "ambassadors" of chemical science among their classmates. This is a way for them to be active participants in the learning process, which motivates them to study chemistry at school.
- Tasks related to practice help to increase students' interest in the subject. That is why the topics for discussion in class and the homework must stimulate students' interest – this will make students more active in class, which will finally lead to a better grasp and assimilation of the scientific content.
- Problem, concerning especially the Bulgarian young people, is their limited chance to succeed on the labour market - the Business is the missing part which fails to close the cycle "school – university – career" so one can hardly talk about students' motivation to learn Chemistry.

During the second part of the workshop the teachers and the experts shared their opinions on interactive teaching materials on Chemistry available at the portal of the project and their relevance to the increasing of students' interest in Chemistry: ChemsKetch 12 software, Chemoffice, Chemistry demos and activities for science 9 and 10, 50 Really Cool Online Tools for Science Teachers, A Química das coisas (The Chemistry of Things), ArgusLab, P-net – interactive simulations, Interactive Periodic System (University of Nottingham) etc.

Topic of the subsequent discussion was the use of interactive materials in the process of teaching as a tool to stimulate students' interest and increase their motivation to study Chemistry.

During the discussions the participants in the meeting summarized that:

- to be an ICT - based product useful and to be used in class, it is necessary to be user-friendly, to provide sufficient scientific information in accessible and attractive way to the student (based on ChemsSketch 12 software, Chemistry demos and activities for science 9 and 10 etc.);
- to use interactive materials in class requires both time and proper equipment - the actual state of affairs in many Bulgarian schools, however, would limit its use as a textbook in class due to lack of computers, the time constraints of lesson periods and the different level the students have in English (based on ArgusLab, Interactive Periodic System, 50 Really Cool Online Tools for Science Teachers etc.);
- major disadvantage of present day Chemistry teaching is the extremely theorized course, which makes the subject incomprehensible and discouraging for students. It is necessary the offered knowledge to be supported by a real use in life and practice (based on A Química das coisas)

Among the ICTs based interactive teaching materials on Chemistry available at the portal of the project the most successful, suitable for direct application in classes and relevant to the increasing of students' interest in Chemistry were matched to be ChemsSketch 12 software, Chemoffice, Chemistry demos and activities for science 9 and 10, 50 Really Cool Online Tools for Science Teachers, A Química das coisas (The Chemistry of Things), ArgusLab, P-net – interactive simulations, Interactive Periodic System (University of Nottingham) etc. For example:

- ChemsSketch 12 software, Chemistry demos and activities for science 9 and 10, Chemoffice - the products are useful and could be used in class, user-friendly and provides sufficient scientific information in accessible and attractive way to the student;
- ArgusLab - the software tools are manageable for students of secondary schools; via the product the learning of Chemistry is just fascinating;
- Interactive Periodic System, 50 Really Cool Online Tools for Science Teachers - to use interactive materials in class requires both time and proper equipment - the actual state of affairs in many Bulgarian schools, however, would limit its use as a textbook in class due to lack of computers, the time constraints of lesson periods and the different level the students have in English (based on);
- A Química das coisas - the material is extremely useful as it introduces the application of chemistry in life. The understandable language, the looks of the presenter and the appropriate duration of the episodes (about 15 minutes), make the material interesting for students. The product is innovative not only for schooling, but can be used by people of different ages who are interested in chemistry in the world around us.

After the discussions the participants in the meeting agreed on the following:

1. Motivation is an important factor in the learning process, as the teacher facilitates and underpins students' desire to acquire new knowledge. Key factors in the motivation of students are the teacher's qualifications, character, temperament, qualities, approach and attitude to the students.

2. The main reasons for the lack of motivation for learning chemistry can be identified as follows:

- Material is theorized;
- Lessons are monotonous and uninteresting;
- Knowledge is not practical and useful;
- Lack of understanding of the material and hence difficulty in learning it;
- Lack of laboratory facilities and possibilities for the visualization of processes, etc.

3. Possible ways to increase students' motivation could be:

- provoking students' interest by using more user-friendly and interesting materials, and solving practical problems associated with phenomena of everyday life;
- a more interesting and effective presentation of the material via multimedia lessons, games and exercises;
- teaching to become a positive emotion for students;
- Illustrate the material to its practical realization through industrial tours and visits to companies;

- A change in the teaching approach designed to encourage practical work on the problems of motivation, project work and networking.
4. Innovative approach for the practical implementation of these guidelines can be multimedia products developed based on the modern Internet.

Suitable for teaching, are these web - based materials that have been developed in a simple scientific language, do not hinder students in using them, allow independent teamwork and enrich the theoretical knowledge and practical skills of the students. Examples include products such ArgusLab, Chemoffice, 50 Really Cool Online Tools for Science Teachers, A Química das coisas (The Chemistry of Things) etc.

6 Conclusions

1. Negative tendency of Bulgarian school education nowadays is the lack of interest among young people in scientific issues. Among them Chemistry is recognised as one of the most problematic and difficult subjects. It suffers from a permanently growing unpopularity due to some negative trends which are well expressed in Bulgarian education system:

- Academic style of course book content which is difficult to understand for students - course and reference books in Chemistry are theorized which demotivates the students. This tendency is sustainable both at grade and high schools;
- Material taught is not oriented to practice;
- Not enough training courses for teachers related to the interactive methods of teaching chemistry;
- Lack of synchrony between the specialists in information technologies who could work out interactive education and demonstration materials for visualization of difficult for demonstration "alive" of chemical processes and the teachers in chemistry who could present the corresponding tasks and education contents with the aid of these materials;
- Depreciated material base and insufficient modern equipment – the lack of proper equipment is one of the most serious problems related with the study of Chemistry.

As a result students are poorly motivated for learning Chemistry - most of them perceive Chemistry as a complicated and incomprehensible subject, filled with formulae, mathematic expressions and long inapprehensible terms.

2. Based on the analyses of the current situation possible approaches to improve the teaching-learning process and to motivate students to study Chemistry could be formulated as:

- Improvement the organization of the educational process: making explanations in easy to understand language and support them with practical exercises; provoking students' interest by using more user-friendly and interesting materials, and solving practical problems associated with phenomena of everyday life; involving students in scientific activities at school with their teachers, but also outside school (i.e. at universities or companies and organized by researchers and experts);
- Developing tools and alternative teaching material to be used by teachers; novel innovative methods of training are to be introduced relying heavily on ICT;
- Providing continuous training to chemistry teachers in order to change the teaching approach and to encourage practical work on the problems of motivation, project work and networking;
- Development of conditions for self-realization of young people - young people should be offered clearly defined prospects for self realization and professional progress.

3. Effective tool for the practical implementation of these approaches can be multimedia products developed based on the modern Internet - technologies that allow linking the skills and interests of today's web: generation to Chemistry curriculum, updated with the achievements of science in this area.



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