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Students' Motivation to Learn Chemistry – Polish Scene

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Abstract

Despite the subject the students are studying at school or university, motivation is a key element of their education and plays a crucial role in the success of the overall teaching-learning process. There are two kinds of motivation. Intrinsic motivation occurs when people are internally motivated to do something because it either brings them pleasure, they think it is important, or they feel that what they are learning is significant. Extrinsic motivation comes into play when a student is compelled to do something or act a certain way because of external factors. The article presents the results of research concerning the students' intrinsic and extrinsic motivation for learning chemistry in Poland.

Introduction

Over the last two centuries, chemistry has changed our daily lives more than any other of the sciences. Chemistry has made our world more colourful, more efficient, more reliable and safer. Pharmaceuticals, cosmetics, toiletries and body care products, airbags and brake fluid – they are all chemical products. Of all the natural sciences, this is the only one to have given rise to an entire industry – more and more people are currently employed in the chemical industry. At the same time, however, no other science is connected with more bad emotions, refusal and anxiety across wide sectors of society. No wonder that chemistry has always been the struggle for some students in Poland. Students either love the subject or hate it, but according to research carried out, the latter group is far in majority. Perhaps we can begin to understand student disaffection with science in general and with chemistry in particular if we examine briefly the questions: What motivates students to want to learn? What are the barriers to their wanting to learn chemistry? What intellectual talents enable students to learn advanced level concepts? What are the barriers that prevent students from learning chemistry? Although definitive answers to questions such as these are at present beyond the knowledge and understanding of even the most advanced thinkers in educational psychology it is possible to gain some insight into the areas responsible for changing the situation.

As all instructors know, students will learn what they want to learn, and if they really wanted to learn chemistry we will not be able to keep them out of our classes and laboratories. If students felt; for example, that learning chemistry would give them enough additional understanding of and control the forces that affect their lives, if they believed it would make their lives more exciting and fulfilling, if they thought it would develop their talents and abilities or if they were reasonably certain it would result in not only good grades but a feeling of accomplishment, they would learn it--and most would enjoy doing so.

Unfortunately, for large numbers of young people the rewards in learning chemistry are perceived as simply not worth the effort. For many, chemistry is seen as a difficult, remote subject, one that requires special intellectual talents to learn and one that neither they nor the vast majority of the public needs to comprehend in order to live a happy productive life. They often are reinforced in this belief by guidance counsellors and teachers in non-science disciplines. Even many of those planning careers in professions requiring chemistry doubt that the effort they exert to learn it will pay off.

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One kind of motivation influencing the process of learning new things is the motivation to learn in general. It is based on the concept that a student treats learning as a way of self-developing; improving competences and gaining significant knowledge of a certain subject. As it was mentioned earlier intrinsic motivation plays a crucial role in the didactic process. Of course, it can be shaped and developed by external factors e.g. by choosing specific teaching methods and defining forms of teacher-student interaction. However, it must not be forgotten that each student is an individual and it is worth pointing out each requires a set of different motivating strategies. That is why, motivating students to learn any subject, and chemistry in particular, requires from the teacher a great deal of flexibility, observation, consequence, patience and effort. Managing students motivation is undoubtedly a long, time-consuming and responsible process, which should be realised in practice after first diagnosing students needs, capabilities, getting to know their learning styles and ways of motivation. In the whole learning process there is a great need to shape enquiry-oriented interests students might have and it is logical that the way a chemistry lesson is conducted can either positively encourage students for further learning or discourage them permanently. One of the methods applied, can be directing students attention and the whole learning process towards practical knowledge, by showing them the usefulness and usability of the taught concepts in real life. Once the knowledge is relevant to students interests it will be automatically more digestible. The fact that chemistry has such an impact on present life and society works as a facilitator as it should be much easier to visualise chemical processes around us in the chemistry lesson. According to the new Core Curriculum (compliant with regulations of the Educational Reform in Poland) Chemistry is an obligatory school subject in Junior-Secondary Schools (3 years of study) and Senior Secondary Schools (2-3 years of study), i.e. for students aged 13-19. Primary schools in Poland treat chemistry as one of the natural sciences and do not distinguish it as a single, separate subject.

Research in Junior Secondary Schools

For the purpose of the paper a sample research was carried out among students of 1 school at the Junior-Secondary Level. 48 students of class I (16 students), class II (15 students), and class III (17 students) - more or less equally girls and boys- were asked about their opinions about chemistry in general and the motivating factors which help them learn the subject. Their questionnaires tackled three thematic questions:

- Individual motivation to learn chemistry
- Teacher's role (if any) in motivating students to learn chemistry
- Ways of rewarding their efforts in chemistry

The results were the following: for 75% of all questioned students the most important motivating factor to learn chemistry was to get good grades. For two thirds of students of the first class this is the most key issue. Class II students were less motivated in this issue and they mainly learn chemistry because they have to and because they are forced by their parents to do so. Generally speaking, it occurred that only 8% of students 'feel internal need' to learn, and only 7% like learning in general. However, despite the lack of intrinsic motivation, 36% of interviewed students want to 'learn more' and broaden their horizons. According to research, students of class I are really interested in learning chemistry because they are curious of the chemical processes, whereas more than a half Class III students are aware of the importance of chemistry in their life in the future. A lot of them justified their opinions by saying that knowledge of chemistry might be useful in Senior Secondary School, University or if they decide to become a doctor, vet or pharmacist.

As far as the teacher's role in motivating students is concerned, the majority of students (65%) claim that the teacher plays a crucial role in acquiring knowledge of the subject. Students pinpointed such issues as experimenting, explaining difficult concepts, visualising and showing demonstrations as well as adding additional material supporting a regular coursebook with online materials, presentations or visits to chemical plants. According to majority of students, it is mainly teacher's responsibility to interest students with the

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subject and his or her personality is master factor, too. Patience, smile and a good sense of humour were among a few characteristics students mentioned, when interviewed. However, more than a half of class I students claimed they 'learn for themselves, not for the teacher or because of the teacher' and that it does not matter what the teacher does in the class.

For the majority of the students the motivating factor is the possibility of correcting and improving any mark, even a good grade for the better one; and the teacher's ability to explain even complicated concepts in an easy, digestible way. Many students pinpointed defining and setting learning objectives in the lesson as crucial, as well as explaining usability of chemistry in real/ future life. For Class I students spoken or written appraisals and teacher's assistance in general are of great importance, whereas for older students they do not play any role at all. Class II students learn mainly because the teacher gives them frequent tests and quizzes. When students were asked what reward they obtain for good results at school, more than a half of them mentioned parents' approval; "pocket money" is distributed only to 10% of respondents. Nice holidays, a new bike or a computer game can be treated as a form of 'money rewards' and 14% of students admit to that kind of reward type. 13% of students do not get any rewards for their learning. Self-assurance, satisfaction and the awareness of the gained knowledge are for sure true examples of intrinsic motivation and they have been identified with almost 27% of students of junior secondary schools.

Conclusions of the research

According to the research carried out in this school, intrinsic motivation related to sheer will to learn something, broadening horizons and deepening knowledge is less important for students than external motivation full of approval from the teacher or parents and the possibility of receiving good or better grades. The role of the teacher in students' learning chemistry is restricted rather to making students aware of the significant role of the chemistry in life, by showing this branch of science in context and explaining its usability in society.

Possible Solutions – Teaching Chemistry in Context

Coursebook

Without any doubt, school Curriculum and Syllabus should be adapted to students needs, interests and abilities, and still be compliant with requirements of the Ministry of Education. Organising material in the students course books has a great impact on students and either facilitate or minimize students' want to learn more than it is expected. Theoretical concepts discourage less apt students even before they start doing their tasks. A good coursebook should be richly illustrated, clear and student friendly. Experiments and demonstrations should cover most of the content and should allow students' to apply their own initiative and creativity in context. It should arouse students imagination and stimulate their logical and critical thinking. Learning by doing approach, visualised by accompanied DVDs and online references would do the trick and popularize chemistry among young people. Below there is a sample of coursebook material organised in a 'more digestible' way.

1. The Air We Breathe
2. Protecting the Ozone Layer
3. The Chemistry of Global Warming
4. Energy, Chemistry, and Society
5. The Water We Drink
6. Neutralizing the Threat of Acid Rain
7. The Fires of Nuclear Fission
8. Energy from Electron Transfer
9. The World of Plastics and Polymers

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10. Manipulating Molecules and Designing Drugs
11. Nutrition: Food for Thought
12. Genetic Engineering and the Chemistry of Heredity

Teacher and Methodologies

According to the research teachers' role plays a crucial role in motivating students to study scientific subjects. There is a lot they can do to stimulate their students progress and will to develop further. First of all, they need to be inspiring and enthusiastic for their students. Young people should see the real human in front of them, with feelings and characteristics like patience, understanding and ability to explain even difficult concepts in simple language. Methods and techniques applied in the classroom are of significant importance. Under the Polish educational reforms teaching and learning activities are expected to be learner-centre, involve learning by doing, and have students engaged in learning activities that involve authentic learning. This is taken to mean students learn by engaging problem-solving activities that integrate with questions and problems in daily life. Authentic learning involves "learning knowledge and skills in contexts that reflect the way the knowledge will be useful in real life". Teachers need to design activities in which "students can integrate needed knowledge, skills and attitudes, coordinate individual skills that comprise a complex task and transfer their school learning to life, or work settings". There are four types of authentic learning:

1. the activity involves real-world problems;
2. open-ended inquiry, thinking skills, and metacognition;
3. to discourse and social learning; and
4. selected topic that learners' interested.

A professional teacher should identify identify seven indications of authentic learning in their classroom:

1. student centred learning;
2. accessing of multiple resources beyond the school;
3. students as scientific apprentices;
4. the opportunity to gather original data;
5. lifelong learning beyond the assignment;
6. authentic assessment of process product and performance;
7. team collaboration

The changes in the educational reform were conducted in order to allow Polish science and chemistry students to develop student-centred learning processes based on inquiry-based learning. Students are to design the experimental procedure themselves, and this seems to help them gain a better understanding of the process of scientific inquiry. This is in marked contrast to the 'normal' situation for teaching chemical kinetics in Poland, which more often simply involves following laboratory instruction or watching teacher demonstrations. The use of small group discussions also seems to reinforce the socially negotiated nature of scientific knowledge; more consistent with more holistic views of the nature of science and genuine inquiry-based learning.

A key feature needed to move students from passive to active learning is the use of the POE strategy (Prediction-Observation-Explanation), along with small group discussions. Most students are able to explain changes to the rate of a chemical reaction based on kinetic theory, and drew upon energy and particle theory to explain changes in rates of reaction. They understand how to conduct experiments, and the notion of investigating variables by changing each separately, while maintaining the others constant. They also have a better understanding of chemical kinetics, and are able to explain the changes in the rate of a chemical reaction, and also developed a better conceptual understanding of chemical kinetics. One intention of this new type of experiment is to relate the laboratory classes to daily life, since the chemicals used in the experiments

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are, sometimes, not purchased from a chemical company. This also introduced an element of student choice, with respect to research design and the conduct of the experiment.

To facilitate learning students should be involved in more 'open-ended-type' activities. It is intended that this approach allows the students to construct their knowledge by actually conducting authentic scientific work. This includes the following:

1. Asking relevant problems concerning the phenomena that students have observed;
2. Formulating a hypothesis that is in alignment with the suggested problems;
3. Choosing an appropriate problem for further investigation;
4. Conducting a suitable experiment in order to investigate this problem (including prediction, observations, and explanation);
5. Analyzing the findings and arriving at conclusions;
6. Sharing the ideas between their classmates.

The role of Higher Education Institutions and Chemical Industry

Polish Universities and Polytechnics are very active in supporting schools with various kinds of activities and events intended to popularize chemistry among young people. Series of lectures, workshops and seminars are organised both at university campuses or at schools, depending on the type and topic of the event. Professors and academics frequently visit schools, too (especially at senior secondary level) to familiarize students with their educational offer and promote chemistry in general. Some schools organise regular trips and excursions to chemical plants, research laboratories, sewage treatment, water purification stations etc.)

Summary

All the material presented above seeks to help students learn chemistry better and to enjoy their learning but fostering an active-learning environment. The driving force behind the interventions was a desire to develop learner-centred instruction that is consistent with the aims of the Polish science curriculum. As such the interventions consisted on hands on activities, such as laboratory work, collaborative group learning, argumentation and analogy. As a result of the reform specific pedagogies are going to be applied in classrooms or laboratories (at any level of schooling), and the research findings point to some gains in terms of learning. There is reasonable evidence that learning outcomes are enhanced.

And the final touch, at some point Polish authorities will need to consider the match between the desire for more active learning in the classroom or laboratory, and the nature of the assessment regime. As it is observed, assessment drives teacher and student behaviour and if there is miss-match between the assessment processes and pedagogies, the assessment regime wins every time.

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