'…A PHARMACIST COMES TO A CHEMIST…' – AN EXAMPLE OF CONTEXT BASED LEARNING

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Introduction

Curricula of chemistry thought at university level do not refer enough to authentic questions which inflame students and which they may meet in the professional life. On the contrary in Context - Based Learning (CBL) teachers choose real-life situations to show the application of chemistry. This rise motivation and enthusiasm of our students and provides a starting point of development for chemical concepts and competencies. Teaching chemistry within an applied context is gaining in popularity in many countries [1-4]. There is a vast number of possible contexts which can be used in chemistry teaching and learning process: environmental, industrial, forensic, analytical, and pharmaceutical.

CBL is included in wider conception called Problem Based Learning (PBL), which also takes into account that problems are encountered before all relevant knowledge has been acquired. Many studies have argued that problem – based learning makes students more engaged in learning because they feel they are empowered to have an impact on the outcome of the investigation. PBL offers students an obvious answer to the questions 'why do we need to learn this?' and 'what does what I am doing in school have to do with anything in the real world?'[5].

PBL (and CBL) in analytical chemistry is not a new concept e.g. in the 1960s, Herbert Laitinen (USA) began focusing undergraduate analytical chemistry curriculum development on problem solving [6]. Recently, Simon Belt (UK) has developed problem solving case studies for students of analytical chemistry courses [7].

The problem

The course of Analytical Chemistry (Part Two – Instrumental Analysis) at Jagiellonian University, Faculty of Chemistry consists of 10 different exercises. Each of them concerns different analytical instrumental problem. The goal of one of these exercises is to acquaint students with basics of the electro analytical techniques and detection of titration equivalence point.

Usually this kind of exercise 'brings no smile on students' faces' as they do not understand that in the simplicity and straightforward form of this kind of experiments lies the essential knowledge and practical skills needed to become a good chemist. In order to change that approach some innovation to the course should be introduced.

New approach

The quality of teachers' work can be always verified by the students' progress in understanding and solving given problems. Such approach involves constant research on new methods of teaching targeted at the maximization of this effect. These can be accomplished by formal, metrological, organisational or technical efforts. Unquestionably, one of the most vital elements of such work is usage of very widely understood students stimulating techniques, far from didactical conservatism, cognitive eclecticism or tiresome scholasticism.

Undoubtedly the simplest way of achieving this goal is to introduce the concept of solving a real-live scientific problems into academic courses. These problems must be characterized by probability so to induce genuine student involvement in planning its solving.

Exercise project

The new exercise plan consists of five stages, all described bellow and depicted on Fig.1.

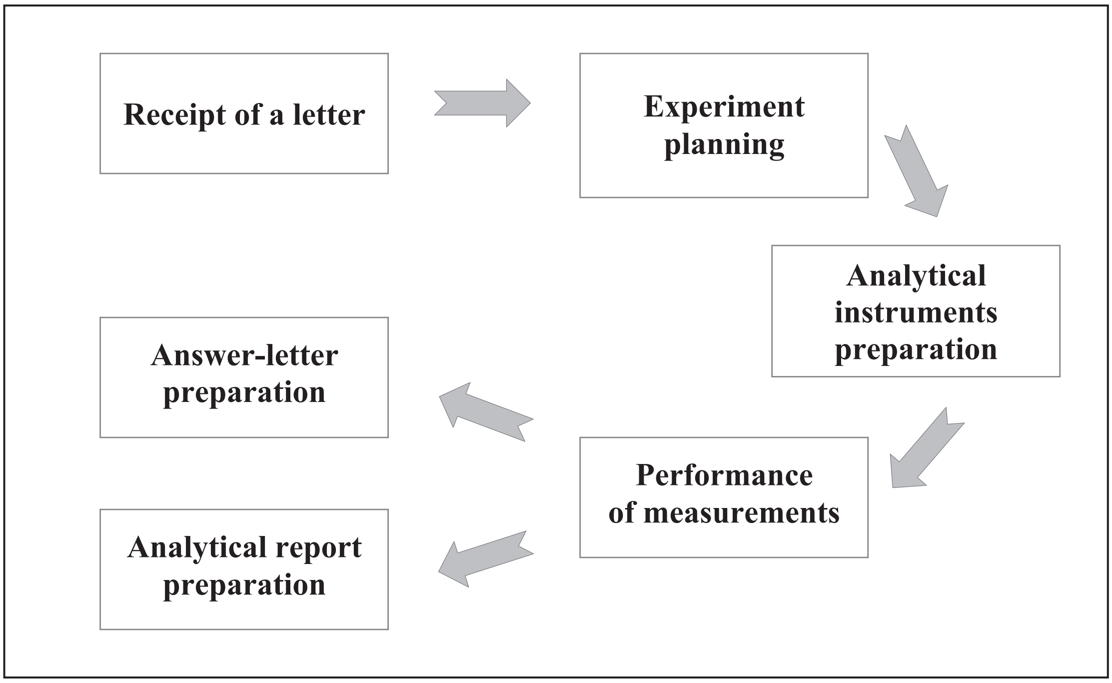

Fig. 1. Plan of the new approach

At the begging of the exercise students receive a letter and a bottle of iodine tincture form a pharmacist for testing. In this letter they are asked to check the concentration of iodine in iodine tincture and juxtapose their results with provide current norm.

At the second stage students are asked to plan experiments. Firstly they need to check the available equipment in the laboratory which involves recognising different analytical instruments. Than, basing on their theoretical knowledge, they decide which techniques and tools should be used.

After that decision all automatic and semiautomatic devices must be checked in order to make any accident impossible and ensure that the operational principles are fully understood by all. Moreover, at this stage, students performing an exercise are asked to build a simple electrochemical devices based on electrical shames (Fig.2) from provided:

- battery (1);
- volt-meter (2);
- amperometer (3);
- electrodes (4);
- potentiometer;
- some cables with connectors.

The idea is similar to that of building Lego® constructions. From this elements more than three different devices can be assembled.

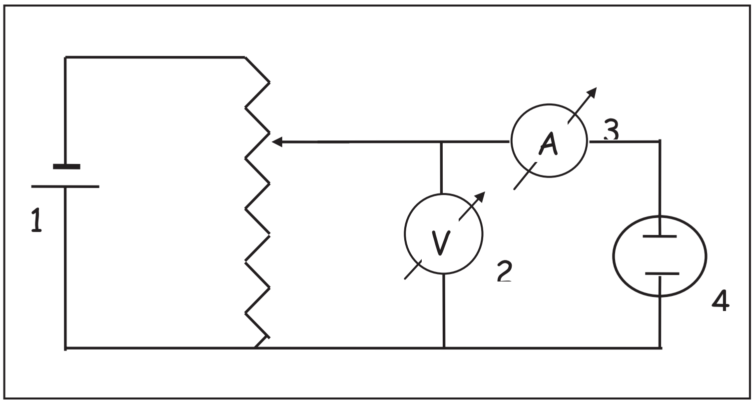

Fig. 2. An example an electrical shames

The next stage consists of performing exercise itself and collecting the vital data. That requires not only students' focused attention but also keep teacher alert as some small accidents may occur at this moment. Moreover it is important to ensure that all of the gain, printed or written information is properly labelled and described in the lab-book, so that no chaos is introduced and it is easer, for students, to write a proper and comprehensible analytical reports at home.

As a final stage students must write two documents. One of them is typical analytical report similar to the ones they are very familiar with (e.g. they came across it during inorganic chemistry or physical chemistry laboratories) and therefore it is a very common task. The second document is a letter. It should be an answer for the question given at the begging of the experiment. Because for most of the students it is a novelty, it intrigues them and gives opportunity to "show off".

Advantages and few disadvantages

Advantages:

- work conditions and tasks similar to real life problems;
- possibility of soft skills development;
- growth of (even poor) students attendance and interest during exercise;
- increase of cooperation within the student group;
- decrease of routine in teachers work.

Disadvantages:
- problems caused by performing different teaching method than cook-book chemistry;
- uncertainty that students dislike very much;
- poor communicational skills could be frustrating in putting everything together in the process of solving such problems.

Conclusions

Example of „Teaching and learning in context" described above is a verified in practice way to activate a group of students in order to solve not a trivial problem. This activity engages students' ingeniousness, withdraws an excess of often abused didactics and employs elements of intellectual games.

The task given to the students is a mundane analytical chemistry problem consisting of instrumental measurement of concentration of iodine in pharmaceutical product such as iodine tincture. Methods used for solving given problem and ways of analysing collected data depends in great manner on student' choice. That concerns for example students independence in constructing simple sets for electrochemical measurements based only on shames.

Not so typical, but nevertheless, very efficient element of this task is the need for students to write an answer to the letter given at the beginning of the classes. This, is a real life letter written by a pharmacist, owner of a drug store. The answer letter produced by students verifies their communication skills - formulating direct answers and proper conclusions about performed experiments and collected analytical data.

The above mentioned example is one of many that can be found when attending university courses such as the Analytical Chemistry (Part Two - Instrumental Analysis) at the Jagiellonian University, for instance: a coin composition analysis to prove its authenticity (ASA), soil composition analysis in order to detect pollution (ASA), drugs quality check (TLC) etc.

In one word all this effort is for students, to make links between different subject areas, do develop higher order thinking skills and so called key skills (team working, decision making, problem solving, communication, presentation etc.) and to strengthen self-directed learning.

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