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INCREASING STUDENTS' INTEREST IN CHEMISTRY WITH CONTEXT-BASED APPROACHES FOR CONTROL AND ASSESSMENT IN THE ENGLISH LANGUAGE PROGRAM AT MEDICAL UNIVERSITY IN VARNA

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Abstract. In the Department of Chemistry, University of Varna, Bulgaria, students of the English language course are thought for 5 years. There was a need for adaptation of chemistry curriculum to the needs and requirements of the new students. Recognizing that a graduate in chemistry has knowledge that is necessary for understanding of chemical principles applied in further study subjects, a context- based approach is used in chemistry practice and lectures. Increasing the students' interest to chemistry as a preclinical discipline aims to motivate their curiosity and help them learn. Based on the Bloom's taxonomy we suggest the students 6 types of tasks for the laboratory and seminar works. We use the tasks for control as well as for assessment. Using a well-known guideline, students perform the seminar and practical work and get used to follow instructions, an approach often used in the physicians' practice. The topic "Amino acids" is proposed as an example how the experimental procedure is compared to a clinical procedure.

Keywords: English language course, context-based approaches, tasks for control and assessment, guideline for performing seminar and practical works

Introduction

Varna Medical University was established as a Higher Medical Institute in 1960. The university diplomas are recognized in all EU countries.

For 5 years the Department of Chemistry[1)] have been thought students in English language program. The different nation's origin, chemistry and language knowledge provided a curriculum adaptation for the needs of the new students.

Chemistry is taught in 60 hours lectures and 45 hours practice and seminars which are divided in two semesters.

Chemistry is now taught in the first year of academic study - winter and summer semesters. Graduate in chemistry has knowledge that is necessary for understanding of chemical principles applied in further study subjects. General and inorganic chemistry provides students with understanding of solution properties, principles and techniques for qualitative, quantitative and instrumental analysis, acids, bases, buffer solutions and basic physic-chemical laws.

Organic chemistry enables students to become familiar with compounds and reactions taking part in metabolism and organic compounds that have importance in toxicology.

Seminars and laboratory practices are complementary to chemistry lectures. The knowledge of general, inorganic and organic chemistry is thoroughly practiced during chemistry seminars. This is accomplished with discussions on different topics, solving problems and naturally performing chemical experiments. Students have to evaluate and comment their results at the end of the class.

Managing students' interest to chemistry

Motivation drives the process of starting and continuing learning. Relevance refers to activities that give the students satisfaction and meet their needs, including the chance to achieve personal learning goals. In order to capture students' attention and activate their motivation to learn, teachers must consider the relevance of each topic. Then they can connect science with students' interests, personal lives, societal issues, cultural backgrounds, and other school subjects (Staver, 2007).

Science is an inspiring process of discovery that helps satisfy the natural curiosity with which we are all born. Unfortunately, traditional instruction that misrepresents science as a body of facts to be memorized can deaden students' spirit of inquiry.[2)]

Fortunately, fostering such understandings needn't require reorganizing the entire curriculum. Simple shifts in how content and activities are approached can make a big difference in overcoming student misconceptions and building more accurate views of the process of science. Educational research supports the following strategies for teaching about the scientific endeavor: *Make it explicit:* Key concepts regarding the nature and process of science should be explicitly and independently emphasized. Engaging in inquiry and studying the history of science are most helpful when the nature-of-science concepts they exemplify are explicitly drawn out in discussion and interactions; *Help them reflect*: Throughout instruction, students should be encouraged to examine, test, and revise their ideas about what science is and how it works; *Give it context, again and again*: Key concepts about the nature and process of science should be revisited in multiple contexts throughout the year, allowing students to see how they apply to real-world situations.

Maintaining students' interest to the preclinical disciplines is important for saving

their motivation for learning. Unfortunately well-known questions from high school chemistry " Why do we learn this? " and " What do we need this for?" can still be heard in students' classes. The lack of systematic knowledge and skills to students in science, which they demonstrate in different situations in practice and life outside of school and the perishable nature of this knowledge, proves that there is a rift between teaching and learning in the form in which they are traditionally implemented. One way to handle this problem is the use of different contexts of science as a starting point for the development of scientific knowledge (Gendjova, 2012). Therefore we should not forget that Science Education is not only of interests to specialists of different didactics, but also to all professors. In many universities before starting their academic work all new assisting professors and teachers should graduate a course of pedagogy (didactics, etc.). Aim of the university professors at medical schools is not only mastering the theoretical foundations of the structure and reactivity of the compounds, but also a developing in the future physician a skill of prompt transfer of the acquired knowledge in appropriate situation. Namely in the second professors in advance must be considered the context of chemical knowledge and offer students assignments in which they themselves will see the relationship of chemistry to their real professional life.

We have the idea to combine and integrate topics from other science's disciplines in order to give much more attention to the teaching, and hence the medical students' learning process. Biochemistry, pathology, pharmacology and clinical medicine are just a portion of the list of disciplines which are based on chemistry. Fig. 1 represents the correlation between different preclinical disciplines - Chemistry, Biochemistry and Physiology.

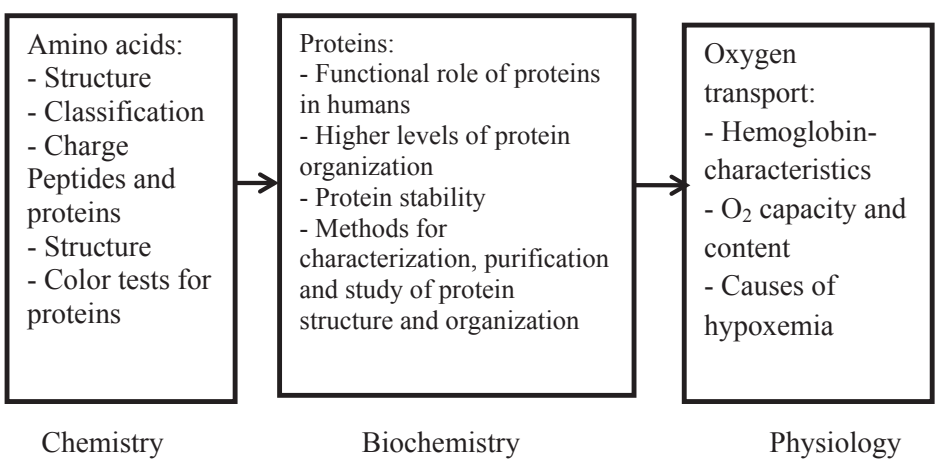


Fig. 1. Correlation between different medical disciplines

To enhance this situation we have also adapted the chemical curriculum to the specific interests of the students of medicine and dental medicine including use and application of important for medical and dental medical practice substances and techniques (Makedonski et al., 2013a).

The topic "Testing for cations and anions" contains tabled information about importance of ions in human body; students comment hypothetical situations and find out how to handle them. At the end of the class students determine the presence of some ions in biological samples (Fig. 2).

A.1. Test for calcium ion, Ca^{2+}

Place 1 ml of 0.1M $CaCl_2$ in three test tubes. In the first one adds 10 drops of 0.1M NaOH. Look for the formation of an amorphous white precipitate. Record the color of the precipitate. The net equation for the reaction is :

$$Ca^{2+} + OH^- \leftrightarrow Ca(OH)_2\downarrow$$

In the second test tube add few drops of $NaCO_3$ until a crystalline white precipitate is formed. Heat the test tube. A CO_2 evaporates from the system. The product of the reaction is soluble in HCl and in diluted CH_3COOH. Record your observation

$$Ca^{2+} + CO_3^{2-} \leftrightarrow CaCO_3 \xrightarrow{t^\circ} CaO\downarrow + CO_2\uparrow + H_2O$$

C. Testing a Biological Sample (Concrement) for Some Cations and Anions

Your task is to test a solution containing a concrement made from salt composed of different anions. From your test results, you can identify the presence of certain anions. For example, if you found that in the anion tests you got the same result as for Cl^-, then the anion in your concrement sample would be Cl^-.

C.1. Take a small portion of your concrement sample and tests it (separately) for the presence of carbonates, oxalates and phosphates with the specific reaction described above.

Fig. 2. Topic "Testing for cations and anions"

Context-based approaches for control and assessment

Kotzé (2003) cites assessment as an encompassing concept that is associated with concepts like measurement, evaluation, testing, standards and criteria. Context-based assessment models use open, interpretive items that describe scenarios of real life events in which scientific concepts are embedded. The assessment tasks require of students to

use scientific knowledge to interpret and explain occurrences in real world situations presented in the questions. The assumption is that if students succeed in providing a scientifically sound answer to a context-based question then they have understood the scientific concepts embedded in the questions (Ahmed & Pollitt, 2007).

Not only is there a call for more inclusive assessment models, but there is also a need to recognise the importance of students' and teachers' perceptions about assessment practices and formats. Perceptions about classroom processes of teaching and learning held by teachers and students affect implementation of new reforms in curricula and assessment in significant ways (Aschbacher, 1991). These perceptions influence and maintain students' motivation in preparing, performing and persevering with tasks they see as important, useful and of value in their learning, development of skills and achievement (Ames & Archer, 1998).

The success of context-based teaching has been observed not only in students' increased enthusiasm and motivation but also in the delivery of content in chemistry (Belt et al., 2005). Belt et al. (2005) conducted a case study in the United Kingdom in which students were introduced to thermodynamics and kinetics. Students were required to identify fuel sources for a hypothetical newly established city through interpreting and evaluating a variety of physical chemistry data. Students were also expected to develop and use a variety of skills relating to group work, such as communication, organisation, problem-solving and critical thinking. All this work culminated in oral presentations and reports by the students. Students were, in addition, asked to indicate their perceived level of difficulty with regard to the tasks.Participating students appreciated studying Chemistry within an applied context and felt that the approach could lead to the development of their subject knowledge and their perception of its relevance. Some students expressed a perceived increased confidence in approaching problem-solving in the future. A number of students found the calculations in tasks challenging until they realised a familiar method to use in the calculations. Further difficulties reported by students were: working out how to approach the task, knowing where to start with the task, understanding what was asked, as well as deciphering each task to know which bits of information to use (but were fine once that was done).

Context-based assessment in our practice

In this paper we summarize the types of problems we use for assessment during practical exercises and those for tests and final exam. Our research in this area provided information about the possible function of assessment in promoting students' learning as a direct outcome of engaging in assessment tasks.

This promotion of learning was in addition to the mastery of subject content by students from revision exercises and practice of the skill of answering assessment

questions. It is clear that assessment activities could also serve as learning activities during which students could develop new knowledge and skills.[3)]

For example control and application of the knowledge during class or for revision are achieved with following task (Fig. 3).

A ceruloplasmin test (which tests the copper level in blood) was ordered for a patient with following signs and symptoms:

– Anemia
– Nausea, abdominal pain
– Jaundice
– Fatigue etc.

Lab Tests Online

University Medical Center, Dept. of Pathology 02/14/2012
Varna
10:05

Doe, Mr. John Q.

Patient ID:
Ordering MD: Smith, Peter MD
PT medications: multivitamins

Specimen collected: 2/10/2012 14:30
Specimen : Serum, Urine

Test name	Patient's Result	Ref. Range
Free serum copper	1,2	1.6-2.4 µmol/L
Total copper	8	10-22 µmol/L
Serum ceruloplasmin	2,4	2.83-5.50 µmol/L
24-hour urine copper	0,2	0.3-0.8 µmol

1. Examine the results and prescribe e diet for this patient.
2. Order a procedure for investigating the presence of copper in a concrement

Fig. 3. Example task for control and application of knowledge

In our work with students of English language program, we have prepared different types of tasks, both for the laboratory and seminar work, semester tests (colloquiums)

and final exams. This is how we cope with differences in pre-linguistic and chemical knowledge of the students. Tasks can be classified as follows taking into account the new Bloom's taxonomy[4)] (Table 1).

Table. 1. Classification of tasks according Bloom's taxonomy

<table>
<tr><th>Art of the task according Bloom</th><th>Tasks for laboratory and seminar work</th><th>Tasks for semester and final tests</th></tr>
<tr><td rowspan="2">Tasks for reproducing and remembering the information</td><td>Pre-lab Study Questions
1. What is the difference between a water-soluble vitamin and a fat-soluble one?
2. What is the metabolic role of vitamin C?
3. What foods contain large quantities of vitamin C?
4. What disease is associated wit ha diet lacking in vitamin C?</td><td rowspan="2">Draw with chemical structures maleic and fumaric acids. Identify the one that is a metabolite in citric acid cycle.</td></tr>
<tr><td>A lipid necessary for the blood clotting is ……
a. cephalin b. lecithin c. sphingomyelin d. leukotriene</td></tr>
<tr><td>Tasks for understanding the information</td><td><u>E. Alkaloids</u>
<table><tr><th>Alkaloid</th><th>States of matter</th><th>Solubility</th><th>Chemical Properties</th><th>Physiological Application</th><th>Medical Application</th></tr><tr><td>Nicotine</td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>Quinine</td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>Atropine</td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>Morphine</td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>Caffeine</td><td></td><td></td><td></td><td></td><td></td></tr></table></td><td>What is the chemical structure of salicylic acid? Draw the chemical structures of three derivatives that are used in medicine.</td></tr>
<tr><td></td><td>An ion(s) necessary for the formation of bones and teeth is/are …
An ion(s) necessary for the formation of hemoglobin is/are …
The principal extra cellular positive ion is … .
The principal intracellular cation is … .</td><td>Serological test is made to detect serum antibodies that appear specifically in association with certain diseases. A veronal solution (mixture of barbituric acid+ sodium barbiturate; pH=7.28-7.64) is used as a diluent and/or stabilizer. For experimental purposes a certain quantity of strong acid/base is added to the solution and little change in pH occurs.</td></tr>
</table>

		Is veronal solution a buffer? Which of the characteristics described above helped you to make the conclusion.
Tasks for applying the information	How many grams of glucose and water are required to prepare 750 g of 5.3 % (w/w) glucose solution? An intoxicated driver has a 0.2 v/v % alcohol in his blood. How much alcohol is contained in the total 6 L of blood for this individual? A person who consumes 800 ml of wine, which is 12 % (v/v) alcohol, has drunk how many milliliters of alcohol? Количеството на кръвта в организма е около 6,5 % от теглото на човека. The label on the shampoo claims that it is pH balanced. What do you think 'pH balanced' means? A glasss of orange juice has $[H_3O^+]= 2 \times 10^{-4}$ M. What is the pH of the orange juice?	Butyl ethanoate has a sweet smell of bananas. Write an equation for the formation of butyl ethanoate and explain the process.
	Your task is to test a solution containing a concrement made from salt composed of different anions. From your test results, you can identify the presence of certain anions. For example, if you found that in the anion tests you got the same result as for Cl-, then the anion in your concrement sample would be Cl^-. Take a small portion of your concrement sample and tests it (separately) for the presence of carbonates, oxalates and phosphates with the specific reaction described above.	
	Why is milk given to someone who accidentally ingests a heavy metal ion such as silver or mercury?	
Tasks for analyzing the information	Based on your knowledge for the carbonic-acid-bicarbonate buffer, draw the buffer curve for the acetic acid-sodium acetate buffer	Draw and describe the buffer curve for the bicarbonate buffer
	In the lab three fixatives are present- formalin, ethanol and acetic acid. Compare their properties as fixatives and give examples of samples that can be preserved with them.	Draw the chemical equation for the formation of the glycerophospholipid α-cephalin (phosphatidylethanolamine). Identify the main components of the compound.

Tasks for evaluating	You are supposed to prescribe a shampoo to a patient with seborrhea. Appraise which of the following shampoos are suitable for this disease and why! Explain the action of the active ingredient to the patient. Shampoo 1 : Water, Ketoconazole, Water, Sodium Laureth Sulfate etc. Shampoo 2: Water, Ammonium Lauryl Sulfate, Panthenol, Citric Acid; Shampoo 3: Water, Salicylic Acid, Water, Cocamidopropyl Betaine Shampoo 4: Water, Sodium laureth sulfate, sodium chloride, sodium benzoate Shampoo 5: Water (Aqua), Sodium Laureth Sulfate, Punica Granatum extract, Glycol Stearate; -
Tasks for creating	Denaturation of a protein occurs when certain conditions or agents disrupt the bonds that hold - together the secondary or tertiary structures of a protein. Perform an experimental procedure that illustrates the process of denaturation.

There were some limitations in development of assignments for evaluating and creating (Fig. 4) and it took not only time, but also expertise expansion. At last we decided to use this assignment as a project task, which students should prepare for the end of school year.

In the case of pentobarbital (a weak acid) overdose the urine should be made more alkaline with sodium bicarbonate injection and in this way to increase drug excretion.

The effect of pH change on tubular re-absorption can be predicted by consideration of drug pKa according to the Henderson-Hesselbalch equation.

Fig. 4. Assignment for evaluating and creating

Our program ensures that all students: (i) obtain hands-on experience with modern scientific instrumentation; (ii) enhance their ability to communicate knowledge inside and outside the classroom; (iii) receive mentorship from faculty with extensive real-world work experience.

Adaptation the didactic structure of the chemistry practice using a guideline

In order to improve clinical practice, the Committee for Practice Guidelines charges groups of European experts with the task of creating recommendations and guidelines for clinical practice. These recommendations and guidelines clarify areas of consensus and disagreement, allowing distribution of the best possible guidance to practicing physicians.

Guidelines aim to present all the relevant evidence on a particular clinical issue in order to help physicians to weigh the benefits and risks of a particular diagnostic or therapeutic

procedure. They should be helpful in everyday clinical medical decision-making[5].

Getting used to the work with guidelines may be hard if you don't have an experience with it. Chemistry laboratory work is organized and always follows the rules of a guideline. The steps they have to follow are always the same. Here is an example.

Topic Amino Acids (Makedonski et al., 2013b)

1. Students' work starts with filling out the Report sheet. Pre-Lab Study questions are answered and discussed.

Report Sheet-Lab 14
Student Name……..... Date:……..…
Student Group: ..... Instructor signature……...

Pre-lab Study Questions
1. What are the functional groups in all amino acids?
2. How does an R group determine if an amino acid is acidic, basic or nonpolar?

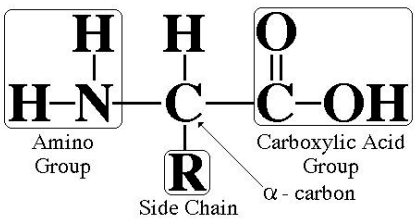
2. Goals of the practice are discussed first:

Goals:
- Use R groups to determine if an amino acid will be acidic, basic, or neutral; hydrophobic or hydrophilic
- Identify the structural pattern of proteins.
- Observe the denaturation of proteins
- Use chemical test to identify proteins and amino acids

3. The theory concerning the topic is discussed, usually students are in previous separated in groups and all the groups present their part of the text.

Discussion:
A. Amino acids
In our body, amino acids are used to build tissues, enzymes, skin, and hair. About half of the naturally occurring amino acids, the essential amino acids, must be obtained from the proteins in the diet because the body cannot synthesize them.

Amino acids are similar in structure because each has an amino group (-NH2) and a carboxylic acid group (-COOH). Individual amino acids have different organic groups (R group) attached to the alpha carbon atom. Variations in the R-groups determine whether an amino acid is hydrophilic or hydrophobic, and acidic, base, or neutral.



Amino Acids Characteristic Titration Curves
Titration curves of amino acids are very useful for identification. As you can see in the example for glycine shown below, a simple amino acid has two dissociation steps corresponding to loss of H+ from the acidic carboxyl group at low pH followed by loss of H+ from the more basic amino group at high pH. …

B. Peptide Bonds
A dipeptide forms when two amino acids bond together. A peptide (or amide) bond forms between the carboxylic acid of one amino acid and the amino group of the next amino acid with the loss of H2O. …

C. Structure of Proteins
When many amino acids are joined by peptide bonds they make a polypeptide. If more than 50 amino acids are in the peptide chain, it is usually considered to be protein. Proteins make up many important features in the body including skin, muscle, cartilage, hair, fingernails, enzymes and hormones. …

D. Denaturation of Proteins
Denaturation of a protein occurs when certain conditions or agents disrupt the bonds that hold together the secondary or tertiary structures of a protein. Proteins are denatured with heat, acid, base, ethanol, tannic acid, and heavy metal ions (silver, lead, and mercury). …

E. Color Tests for Proteins
Certain tests give color products with amino acids, peptides, and/or proteins. The results of the test can be used to detect certain groups or type of bonds within proteins or amino acids **Biuret test**: The biuret test is positive for a peptide or protein with two or more peptide bonds. …

4. The experimental procedures are explained by the instructor and students get ready for work

Experimental Procedures
A. Amino Acids
A.1. Using your textbook draws structures of glycerin and alanine. Convert the alanine model to a model of serine. Indicate whether each of the amino acids would be hydrophobic or hydrophilic. …
A.5**. Titration:** Place a sample of 25 ml glycine into a 100 ml beaker. Place the beaker on the stirring hotplate, add a magnetic stir bar, and begin gentle stirrin. …

B. Peptide Bonds
B.1. Using your textbook make models of glycine and serine. Form the dipeptides glycylserine and serylglycine. Draw each of their structures. …

C. Structure of Proteins
C.1. Know how to make a peptide bond from different amino acids. Be aware of protein Structure. …

D. Denaturation of Proteins
A fresh egg albumin solution can be prepared by mixing the white from one egg with 200 ml of water and filtering the mixture through cheesecloth into a beaker. …

E. Color Tests for Proteins
E.1. **Biuret test:** In three separate test tubes, place 1 ml of solution of glycine, alanine , egg albumin. To each sample, add 1 ml of 10 % NaOH and stir. Then add 2-3 drops of biuret reagent (5% $CuSO_4$), and stir. Record …

5. Following the instructions students perform the experiment. Meanwhile questions concerning the results of the experiment are answered.

A5. Titration Curve of Glycine
Record all your results from the above experiment in the following chart:

Point	Volume NaOH	pH
1	0	
2	3	
…		
17	50	

Plot pH versus ml of NaOH solution added. Use pH as the dependent variable (Y-axis) and ml
of NaOH as the independent variable (X-axis)….
…

D. Denaturation of Proteins

Treatment	Observation of egg albumin	Explanation
D.1 Heat		
D.2 Acid		
D.3 Base		
D.4 Alcohol		
D.5 Heavy metal ions		

Questions and Problems
Q.1. Why is heat and alcohol used to disinfect medical equipment?

E. Color Tests for Proteins

Observation of Color tests			
Sample	E.1. Biuret	E.2 Ninhydrin	E.3 Xantoproteic
Glycine			
Alanine			
Egg albumin			

Questions and Problems
Q.5. After working with HNO_3, a student notices that she had a yellow spot on her hand.
What might be the reason?
…

The experimental procedure itself is complementary to the procedures physicians have to follow in certain cases. Use of imperative mood is preferred.

Place a sample of 25 ml glycine into a 100 ml beaker. Place the beaker on the stirring hotplate, add a magnetic stir bar, and begin gentle stirring. Clamp the pH electrode to the ring stand with the tip submerged in the solution in the 100 ml beaker. Be sure the electrode is clear of the magnetic stir bar. Record the initial pH of your solution and the initial reading of your buret filled with 0.1 M NaOH (which should be 0.0 mL). … Continue this procedure until you reach pH 11.0 or have used 50 mL of NaOH solution. Write all your result in a table.	When measuring blood pressure, care should be taken to: Allow the patient to sit for several minutes in a quiet room before beginning blood pressure measurements. Take at least two measurements spaced by 1-2 min, and additional measurements if the first two are quite different. Use a standard bladder … Have the cuff at the heart level, whatever the position of the patient. Use phase I and V Korotkoff sounds to identify systolic and diastolic blood pressure, respectively Measure blood pressure in both arm at first visit to detect possible differences … Measure blood pressure 1 and 5 min after assumption of the standing position in elderly subjects, … Measure heart rate by pulse palpation (30 s) after the second measurement in the sitting position.[6)]

Perspective work

The context-based approach for control and assessment of chemical knowledge is applied in 2012/2013 academic year. These results and the results of 2013/2014 academic year about the change of students' interest and progress will be analyzed in a further

study. Development and implementation of context-based approach in all topics related to medical sciences is planned.

NOTES

1. http://www.mu-varna.bg/BG/Structure/Pharmacy/Pages/KatedrapoHimiq.aspx
2. http://undsci.berkeley.edu/teaching/
3. http://etd.uwc.ac.za/usrfiles/modules/etd/docs/etd_gen8Srv25Nme4_9855_1259928262.pdf
4. http://ww2.odu.edu/educ/roverbau/Bloom/blooms_taxonomy.htm
5. http://www.escardio.org/guidelines-surveys/esc-guidelines/about/Pages/presentation.aspx
6. http://www.dableducational.org/pdfs/esh_esc_guideline2003.pdf

REFERENCES

Ahmed, A.& Pollitt, A. (2007). Improving the quality of contextualized questions: an experimental investigation of focus. *Assessment Education: Principles, Policy & Practice, 14*, 201-232.

Ames, C. & Archer, J. (1988). Achievement goals in the classroom: students' learning strategies and motivation processes. *J. Educ. Psychology, 3*, 260-267.

Aschbacher, P.R. (1991). Performance assessment: state activity, interest and concerns. *Appl. Measurement Educ.*, *4*, 275-288.

Belt, S.T., Leisvik, M.J., Hyde, A.J. & Overton, T.L. (2005). Using a context-based approach to undergraduate chemistry teaching – a case study for introductory physical chemistry. *Chemistry Education: Research & Practice*, *6*, 166-179.

Gendjova, A. (2012). Chemistry education in context: challenges for prospective teachers. *Chemistry, 21,* 807-817 [In Bulgarian].

Kotzé, G.S. (2003). The duality of coding assessment information. *South African J. Education, 23*, 338-344.

Makedonski, L., Peteva Z., Peycheva K. & Stancheva M. (2013a). Laboratory manual for teaching medical chemistry in English language course for the students of medicine and dental medicine. *JAHR(Croatia), 4*(7), 427-438).

Makedonski, L, Peycheva, K. & Stancheva, M. (2013b). *Laboratory manual for general and organic chemistry,* Varna: Steno.

Staver, J.R. (2007). *Teaching science.* Geneva: Educational Academy of Education.

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