The European Proceedings of
Social & Behavioural Sciences
EpSBS

Future Academy

ISSN: 2357-1330

http://dx.doi.org/10.15405/epsbs.2018.02.106

RPTSS 2017
International Conference on Research Paradigms Transformation in Social Sciences

MODULAR TRAINING OF GENERAL CHEMISTRY

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Abstract

Modular teaching is a novel approach, which integrates basic science - General Chemistry with a medical profile in the form of a module. The integrative-modular technology that was introduced at the Chemistry Department of the Siberian State Medical University (SSMU) for the study of general chemistry has shown high efficiency of the successful mastering of the subject.

To design educational programs the paradigm of training was exchanged to the paradigm of productive exercises with greater independence of students who become designers of their own knowledge, professional and universal competences.

The developed integrative course is professionally oriented to solve future clinical problems. For the implementation of this technology, a new teaching and methodical complex has been created. The following technologies are most often used during training: informative-developmental, interactive and practice-centered, contextual training, team work, games etc., developmental, task-oriented and learner-centered technologies. The article describes the use of combination of academic and innovative methods and technologies of training.

At present, the offered training materials on General Chemistry are being adapted for students taking bilingual training. General feedback obtained from the students showed that all of them felt that modular training was a more interesting and useful teaching learning experience than conventional teaching.

Keywords: Integrative training, invariant and variable components, adsorption.

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Corresponding Author: I.A. Perederina
Selection and peer-review under responsibility of the Organizing Committee of the conference
eISSN: 2357-1330

1. Introduction

Chemistry is a fundamental science and a tool for learning about and investigating living systems. Therefore regardless of their specialization, students should master ideas, laws, and methods of this science (as cited in Coyne, 1974; Gutwill, 2001; Kozma, 1985).

Chemical disciplines are closely connected with other fundamental and clinical disciplines. The Chemistry Department of Siberian State Medical University has introduced the concept of integrative and modular developmental training for the 1st year students within the chemistry training program when teaching general chemistry, inorganic chemistry, and physical and colloidal chemistry during the first semester.

2. Problem Statement

Well known traditional approaches are not always effective in the current training environment. The volume of information increases every year and thus new tools should be offered providing the prompt transfer and effective acquisition of knowledge. Students attend libraries less and search for information mostly in the Internet. When mastering materials available electronically students lose logical links in the information and their interest goes down.

3. Research Questions

The task of the university teacher is to direct skills and interests of the students towards cognitive activity using modern training technologies when learning the discipline.

4. Purpose of the Study

When implementing the integrative and modular concept during training in order to enhance the level of knowledge in medical students, the Chemistry Department of SSMU developed training materials for teachers and students. They include working programs for compulsory and elective training of students from General Medicine, Pediatrics Departments and Stomatological Unit of General Medicine Department as well as training materials for programs' implementation consisting of the following textbooks:

1. Collection of exercises in chemistry (Perederina, Galaktionova & Bystrova, 2011),
2. Practical training in general chemistry for students of General Medicine and Pediatrics Departments (Yusubov, 2010),
3. Test cases in chemistry. General and inorganic chemistry (Perederina, Tveryakova, Galaktionova & Yusubov, 2013),
4. Surface phenomena (Olishevets, Tveryakova, Kuznetsova & Timofeeva, 2014).

Collection of chemistry exercises of the medico-chemical content occupies a special place among offered training materials (Egorova & Kovalenko, 2006). The collection of exercises includes questions and exercises on the following aspects of chemistry training program: chemical thermodynamics, properties of solutions, equilibrium and processes in solutions, physical chemistry of

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surface phenomena, disperse systems and solutions of high molecular compounds. It is aimed for students' active using theoretical and factual materials, working out general skills to solve tasks of various types, including combined ones, basing on chemical laws and quantitative parameters. Each part of the exercise book is provided with a theoretical introduction needed in order to revise the most important aspects of the issue being studied. It contains detail solutions for standard exercises and questions and exercise to be completed by students themselves. The reference materials required for exercises are presented in the annex.

The content block of this discipline consists of two components: compulsory and variable, the latter include an elective training course.

The compulsory component containing the elements of chemical knowledge (basic chemical laws, chemical theories etc) is mandatory for medical students regardless of their specialization.

Nowadays a student graduating from university should have a good command of natural science when planning an experiment and summarizing data. The graduate should have sound knowledge of professional problems and be aware of professional duties. Besides, he also should understand the need in the *continuous self-tuition*.

The competency-based approach, recommended by the teaching standard when compiling training programs, is based on the replacement of the teaching paradigm to the paradigm of productive learning providing greater independence of students who become the designers of their own knowledge, professional and universal competencies (Belomestnova, 2009; as cited in Anthony, 1998).

In order to plan and implement such approach, the Chemical Department of SSMU uses combinations of various teaching methods and technologies. Chemistry teaching traditions at several departments and courses allow simultaneous working out of problem, modular, developmental, critical thinking etc. technologies, some of them are positioned as innovative ones.

Since testing of the acquired knowledge is traditionally performed through individual tests (Perederina et al., 2013), then assessment of the acquired competencies as preparedness to apply knowledge, skills and experience for solution of professional tasks can be done only through practical activities of the graduate - doctor, pharmacist, medical biologists.

The modern information environment requires new qualities of thinking. Therefore, the within educational paradigm pursuing sustainable development, discussed at Earth Summit in Rio in 1992, there is a task to develop new thinking and new skills required for living in the unpredictable future. The student can do it only by himself, hence it should put him in the center of training and the teacher is to be a partner supporting him.

At present, in order to increase efficiency of self tuition among students, the Chemistry Department of SSMU has developed and successfully used training materials for the disciplines of Chemistry and Chemistry of Biologically Active Compounds for the 1st year students of General Medicine and Pediatrics Departments.

For example, the Handbook of Practical Training on General Chemistry for Students of General Medicine and Pediatrics Departments (Yusubov, 2010) includes materials on classic and contemporary methods of chemical analysis. This handbook contains numerous practical exercises and case studies which help students to prepare for experimental activities. Each laboratory-based exercise is of clear

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training and research character enriching the experience of practical creative activities of students.

Tests for General and Inorganic Chemistry (Perederina et al., 2013) assist teachers and students when evaluating the ability to analyze and compare theoretical and practical materials from various parts of the chemistry course.

The Handbook on Surface phenomena (Olishevets et al., 2014) describes the use of achievements of physical and colloid chemistry in practical testing of living being functions and medicine. Materials presented in this handbook are related to biology, anatomy, biochemistry, pharmacology, normal and pathologic physiology, hygiene and other clinical disciplines.

Additionally, a handbook is being prepared for publishing basing on reports of the students - winners of the Annual Conference on Chemistry of Biogenous Elements and their Compounds, conducted by the Chemistry Department.

5. Research Methods

Teaching chemistry includes lectures, practical and laboratory-based training. The teacher can choose the traditional model of materials presentation or use new teaching technologies. The following technologies are most often used during training by Chemistry Department of SSMU: informative-developmental, interactive and practice-centered, contextual training, team work, games etc., developmental and task-oriented and learner-centered technologies.

In order to implement contextual education during teaching, the teacher organizes the dynamic teaching model: from lectures through games to professional activities.

Aiming at using knowledge for professional duties, the lecturer formulates tasks considering the future specialization of the student. The teacher selects the specific factual materials and offers a relevant format of training.

The innovative training uses project-based technologies in the students' teamwork (as cited in Anthony, 1998; Belt, Leisvik, Hyde, Overton, 2005). When conducting practical training in the game format, first of all, the specific tasks are formulated which are relevant to the students' specialization. Thus, students - future practicing doctors are offered the game on using thermodynamic calculations when investigating N_2O transformation into toxic products when used as an anaesthetic component, which imitates the real professional medical activities, and students acquire experience of solving tasks distributing responsibilities among team members. There is a training game for students of Pharmacy Department on Thermodynamic evaluation of oxidative threats when synthesizing medications (Kaletina, Efremenko, Zakharova & Cherkasova, 1990; McMurry & Peterson, 2014; Bespal'ko, 1989).

The *variable component* for students of General Medicine Department, presented by the profession-oriented materials reflects the specific medical profile.

The variable component includes elective training course on Chemistry of Biologically Active Compounds. It contains numerous functions and tasks aimed to provide efficient learning of certain chemical topics and assists in mastering adjacent subjects on the inter-disciplinary basis (e.g., biochemistry, physiology, pharmacology etc.) and supports the continuity of the profession-oriented training.

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6. Findings

This training course provides fundamental knowledge of general chemistry in medical students, development of intellectual skills and logic for the further mastering of clinical disciplines and raises students' awareness of the value of chemistry for future professional medical activities.

The approximate algorithm for mastering the training module on adsorption equilibrium and process is as follows:

- theoretical training is implemented through working with handbooks, text of lectures, guidelines (Perederina et al., 2011; Gutwill, 2001; Yusubov, 2010).
- the training quality is assessed by students themselves when performing tests in Adsorption Equilibrium in the collection of tests (Bespal'ko, 1989).
- practical training includes laboratory-based work, for instance, Unmixing of Novocaine and Anaesthesinum by Thin-Layer Chromatography. (Yusubov, 2010).
- further deeper learning of this subject is possible when reading the handbook (Perederina et al., 2011), describing the use of achievements of physical and colloid chemistry in practical research of living beings in medicine. For example, use of adsorption techniques in medicine - Hemosorption - adsorption technique of blood purification. The handbook (Olishevets et al., 2014) describes the unique properties of nanomaterials and biological nanoobjects. The students' conference is conducted to evaluate the results of the elective training course.

At present, the offered training materials on General Chemistry are being adapted for students taking bilingual training. The practical training on experimental activities has been already successfully piloted for English-speaking students. Lectures and practical classes include elements of the exercise book. The «Problem solving workbook» is planned to be developed.

Having completed this integrative training course, students can successfully resolve any clinical tasks in future. Profession-oriented knowledge is well summarized and perceived by students, forms a basis for clinical thinking, is important for practical medicine, and assists in solving theoretical and clinical tasks.

7. Conclusion

The offered and implemented training technology and training materials provide training of competitive and professionally mobile specialists with creative thinking using their knowledge in their professional activities in order to meet the current demands in research and production.

The forms of training described above implemented by the Chemistry Department for the 1st year students of General Medicine and Pediatrics Departments are only a fragment of training activities of the specialists of the Chemistry Department, which celebrated its 135th anniversary in 2013. Teachers of Chemistry Department of SSMU carefully keep and transfer traditions of classic academic education of medical students and as a team occupy the outstanding position in current innovative training strategies and technologies.

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