

Artículo de investigación

Teaching “oil and gas chemistry” through an interactive approach

Enseñar “química del petróleo y el gas” a través de un enfoque interactivo
Ensinar “química de petróleo e gás” por meio de uma abordagem interativa

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Abstract

In the article, the author examines the theoretical issues of the problem of the quality of chemical training of students at an oil and gas university. The author shows that the discipline “Oil and Gas Chemistry” is the discipline of the basic part of the main professional educational program of the specialty “Oil and Gas Business” at Tyumen Industrial University, therefore, the success of a specialist in this field will largely depend on the quality of chemical training. But due to the prevailing circumstances in which the study time is 51 hours per semester, it is not enough for effective learning, therefore, the question of effectively, methodically correct organization of the educational process of chemical training of future specialists remains relevant.

The article provides a brief overview of some of the interactive methods, its advantages and the possibility of using in the classroom. The author conducted a detailed review of the scientific literature on this topic, showed the widespread use of this method in the study of various disciplines.

Base of the research: Department of Natural Sciences and Humanities, the Branch of IUT in Surgut. The interactive lecture method was used as an interactive teaching approach. In the article it is shown that the use of such a method in the educational process in the study of oil and gas chemistry at the university allows to increase the motivation to study the subject, to develop self-organization and self-education students' skills.

Keywords: Chemical training, Oil and Gas Chemistry, Oil and Gas Business, prevailing circumstances, self-organization, self-education.

Resumen

En el artículo, el autor examina las cuestiones teóricas del problema de la calidad de la capacitación química de los estudiantes en una universidad de petróleo y gas. El autor muestra que la disciplina “Química de petróleo y gas” es la disciplina de la parte básica del principal programa educativo profesional de la especialidad “Negocio de petróleo y gas” en la Universidad Industrial de Tyumen; por lo tanto, el éxito de un especialista en este campo depende en gran medida de la calidad del entrenamiento químico. Pero debido a las circunstancias prevalecientes en las cuales el tiempo de estudio es de 51 horas por semestre, no es suficiente para un aprendizaje efectivo, por lo tanto, la cuestión de la organización efectiva y metódicamente correcta del proceso educativo de capacitación química de futuros especialistas sigue siendo relevante.

El artículo proporciona una breve descripción de algunos de los métodos interactivos, sus ventajas y la posibilidad de utilizarlos en el aula. El autor realizó una revisión detallada de la literatura científica sobre este tema y mostró el uso generalizado de este método en el estudio de diversas disciplinas.

Base de la investigación: Departamento de Ciencias Naturales y Humanidades, la Rama de IUT en Surgut. El método de lectura interactiva se utilizó como un enfoque de enseñanza interactiva. En el artículo se muestra que el uso de un método de este tipo en el proceso educativo en el estudio de la química del petróleo y el gas en la universidad permite aumentar la motivación para estudiar la materia,

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desarrollar habilidades de autoorganización y autoeducación de los estudiantes.

Palabras claves: formación química, química de petróleo y gas, negocios de petróleo y gas, circunstancias prevaletentes, autoorganización, autoeducación.

Resumo

No artigo, o autor examina as questões teóricas do problema da qualidade do treinamento químico de estudantes de uma universidade de petróleo e gás. O autor mostra que a disciplina "Petróleo e Gás Química" é a disciplina da parte básica do principal programa educacional profissional da especialidade "Petróleo e Gás Negócios" na Universidade Industrial de Tyumen, portanto, o sucesso de um especialista neste campo será dependem em grande parte da qualidade do treinamento químico. Mas, devido às circunstâncias prevaletentes em que o tempo de estudo é de 51 horas por semestre, não é suficiente para o aprendizado efetivo, portanto, a questão da organização efetiva e metodicamente correta do processo educacional de treinamento químico de futuros especialistas permanece relevante.

O artigo fornece uma breve visão geral de alguns dos métodos interativos, suas vantagens e a possibilidade de usar em sala de aula. O autor realizou uma revisão detalhada da literatura científica sobre este tema, mostrou o uso generalizado deste método no estudo de várias disciplinas.

Base da pesquisa: Departamento de Ciências Naturais e Humanidades, o ramo da IUT em Surgut. O método de aula interativa foi utilizado como uma abordagem de ensino interativo. No artigo mostra-se que a utilização de tal método no processo educativo no estudo da química do petróleo e gás na universidade permite aumentar a motivação para estudar o assunto, desenvolver habilidades de auto-organização e auto-educação dos alunos.

Palavras-chave: Formação Química, Química do Petróleo e Gás, Negócios de Petróleo e Gás, circunstâncias prevaletentes, auto-organização, auto-educação

Introduction

The modern labor market today needs qualified specialists with the ability to apply knowledge in practice. The result of training students at oil and gas university in the higher education system should be a bachelor who is competent not only in a narrow oil and gas profile, but also in other areas of knowledge, which will allow him to be in demand in a rapidly changing world. The traditional educational process involves the transfer of information by the teacher, which the student must reproduce. The student takes a passive part, this approach to learning in a modern university is now outmode (Nagornyak, 2013).

In passive learning, the student acts as an object of learning activity: he must learn and reproduce the material that is passed to him by the teacher or another source of knowledge (Shibaev, 2012).

Requests of the state and society require the introduction into the educational process of new

teaching methods. In order to involve students in the educational process, it is advisable to apply individually oriented forms of education or interactive forms of education that contribute to the effective learning of students, increase interest in the information being studied (Timoshenko et al, 2015; Gordeeva, 2012; Skorykh, 2014).

The main innovations in today's education system are associated with the introduction of such classes (Skladanovskaya, 2017).

literature review

Many chemistry teachers do not have enough teaching experience, proficiency in non-traditional teaching methods, these teachers have clearly contradictory information, practice and ideas (Crippen et al, 2005).

Many Russian scientists highlight some positive aspects of such training:

- interactive learning forms the ability to think extraordinarily, to see any in their own way (Gushchin, 2012);
- in interactive forms of seminars, students get a real practice of formulating and defending their point of view, understanding the argumentation system, that is, turning information into knowledge, and knowledge into beliefs and attitudes, the subject and social qualities of the professional are formed, the goals of training and education personalities of the future specialist (Dobrynin, 2009);
- in the interactive forms of the lecture it is assumed: the creation of a problem situation through the formulation of learning problems; specification of educational problems, hypotheses for their solution; a mental experiment to test hypotheses; verification of the formulated hypotheses, selection of arguments, facts to confirm them; formulation of conclusions; summing up to new contradictions, perspectives from the teachings of the subsequent material; questions (written assignments) for feedback that help correct students' mental activity during a lecture (Ryumina, 2014);
- in the conditions of interactive learning, students experience an increase in the accuracy of perception, mental performance, and an intensive development of the intellectual and emotional characteristics of the individual: stability of attention, observation, ability to analyze and sum up. Interactive learning contributes to the development of communicative skills of students, helps to establish emotional contacts between them, activates teamwork, expands the range of educational opportunities (Privalova, 2014);
- an interactive learning method allows you to present a lesson in the form of selective control of a combination of targeted information segments (Spiece, R. J. 1989).
- Studies on the interactive learning method expect an increase in positive learning outcomes. But positive conclusions about interactive classes are controversial.
 - Scientists argue that it is necessary to conduct additional research related to the inclusion of this technology. Studies conducted by Vercellotti, M.L. did not lead to special success in teaching students when using interactive teaching methods compared to traditional ones (Vercellotti, 2017).
 - However, there is another opinion. Developing critical thinking skills for students using interactive multimedia educational materials explored Djamas, D., & Tinedi, V. The research results show that interactive multimedia educational materials are practical and effective. Therefore, based on these results, it can be argued that interactive multimedia learning materials can enhance students' critical thinking skills (Djamas et al, 2018).

With the development of electronic technology, the use of multimedia educational materials is widespread in secondary and higher education. Sharing a screen between a computer and a mobile phone via a wireless network is a form of organizing interactive learning. (Li et al, 2018).

The interactive form of education is widely used in the study of many subjects.

For example, in the study of biology (Buckley, 2000); English, which uses an interactive system of learning English grammar, developed and introduced mental models to the learning process (Liqiong, 2016; Obskov, 2012).

Theory and practice of introducing interactive teaching tools in higher vocational education on the example of teaching maths in economics, interactive teaching of mathematics in high school using an electronic workbook was reviewed by many scientists (Butakova&Osipova, 2009; Makarov &Sevastyanova, 2013).

Interactive study of students' chemical disciplines pedagogical universities on the basis of the competence-based approach was proposed by Gavronskaya. (Gavronskaya, 2008).

Also, Gavronskaya& Alekseev use virtual laboratory works in the process of interactive teaching of physical chemistry (Gavronskaya& Alekseev, 2014).

Panfilova L. V. Notes the impact of interactive teaching aids on the quality of training a future teacher of chemistry (Panfilova, 2013).

Pedagogical learning technologies –critical thinking technologies are applied on chemistry lessons (Chorov et al, 2016).

Methodology

At any technical oil and gas university "Oil and Gas Chemistry" is one of the most significant areas of natural science, studying the essence of natural phenomena, knowing its laws and using them in the practical activities of society, in science, production. This academic discipline is a mandatory discipline for studying at Tyumen Industrial University, as an understanding of the laws of chemistry and the essence of physics and chemical phenomena is necessary both to improve existing and create new processes and materials.

When studying the discipline, bachelors must acquire knowledge of the composition and properties of petroleum systems, gases of different origin, methods of their study, separation, classifications and the relationship between composition, thermodynamic conditions and physicochemical properties.

As a result of mastering the discipline, the bachelor should know:

- component composition of oil and other hydrocarbon systems of natural and man-made origin;
- physics and chemical properties of the main classes of hydrocarbons and heteroatomic compounds of oil;
- methods for the separation of multicomponent oil systems;
- research methods for oil and petroleum products;
- properties of oil as a dispersed system;
- features of oils and natural gases from Siberian fields;
- main types and principles of classifications of oil, oil disperse systems, gases;
- hypotheses of the origin of oil;
- government and industry regulatory documents governing the procedure, means and conditions for performing standard oil and gas tests.

In the process of developing technologies for the interactive preparation of students for

professional activities in the context of studying the discipline "Oil and Gas Chemistry", we relied on a set of theoretical and practical research.

Researcher A.P. Panfilova offers her own classification of interactive teaching methods (Panfilova, 2009):

1. Radical - the desire to rebuild the educational process based on the use of computer technology (distance learning, virtual seminars, conferences, games, etc.).
2. Combinatorial - connection of previously known elements (lecture-dialogue, lecture in two together, etc.).
3. Modifying (improving) - improvement, addition to the existing teaching methods without significant changes (for example, a business game).
4. Researchers T.S. Panina, L.N. Vavilova classify interactive teaching methods in three groups (Panfilova, 2009):
5. Discussion: dialogue; group discussion; situation analysis.
6. Game: didactic and creative games, including business and role-playing, organizational and activity games.
7. Training: communication trainings; sensory trainings (aimed at the formation of the figurative and logical spheres of consciousness).

The most popular among teachers are such interactive teaching methods as:

- working in small groups, where all students participate in the work of the group, practice the skills of cooperation, interpersonal communication;
- role-playing game in which the participants of the group play a scene with pre-distributed roles reflecting certain life situations;
- mini-lecture - one of the most effective forms of presenting theoretical material presented in an accessible language for students;
- development of a project that allows participants to mentally go beyond the audience and draw up a project of actions on the subject under discussion, as long as everyone has the opportunity to protect their project and prove its advantage over others;

- “brainstorming”, it is a method in which students take any answer to a given question, while evaluating the points of view expressed not immediately, but after all the presentations, the main thing is to ascertain the awareness or attitude of the participants to specific issue.

Results

In accordance with the requirements of the Federal State Educational Standard of Higher Education in Russia, the implementation of educational and professional competencies involves a wide use of active and interactive forms of training in the educational process. For example, according to the curriculum on "Oil and Gas Chemistry" on the interactive form of education takes 11 hours per 1 semester.

Interactive learning is the interaction and the establishment of a dialogue not only between the teacher and students, but also the dialogue between students.

In the educational process of students of the Branch of IUT in Surgut an interactive lecture as a form of training is widely used on "Oil and Gas Chemistry" classes.

During such a lecture, it is not enough for a student to be just attentive; he needs to take a direct and active part in the learning process.

The purpose of the interactive forms of classes is:

activating interest among students;
effective learning material;
students' independent search for ways and options for solving the set learning task (choosing one of the proposed options or finding their own options and justifying the solution);
learning to work in a team, to be tolerant, to respect the right of speech;
formation of professional skills.

Such forms of teaching contribute to changing the process of mastering the material by transferring a student from a passive listener to an active participant in the educational process.

So, when preparing the interactive lecture “Physical and chemical properties of oil”, we followed the following rules for organizing interactive learning:

1. involvement of all students in the work;
2. psychological preparation of participants;
3. the number of participants - up to 25 people;
4. inclusion of vivid examples and facts into the educational process.

For example, we will describe the method of applying this form of conducting classes as an interactive lecture on the topic “Physical and chemical properties of oil” for students studying the discipline “Oil and Gas Chemistry” for the 2nd year in the 3rd semester.

Before the lecture to the 2nd year student, the teacher proposed to prepare a report on the topic “Devices for Density Measurements”, during which the student presented a vivid presentation and videos about the operation of these devices in laboratories.

In the process of preparing for the interactive lecture, the students were given a list of questions for the purpose of holding a discussion on the lesson, enhancing cognitive skills:

1. The average boiling point of the oil fraction.
2. Molar mass.
3. Low temperature characteristics.
4. Low temperature characteristics.

Thus, in the process of independent work before the lecture, we got acquainted in parallel with other sciences, studied how the relative density of oil products is determined in the USA, Great Britain, studied the ice melting point on the Fahrenheit scale, etc., which undoubtedly demonstrates the advantage of using the interactive form study material compared to traditional.

In the course of the lecture when studying the questions: cloud point; pour point; the crystallization temperature was introduced such a method as "brainstorming." We describe the methodology for this method:

1. Conducted in groups of 5-6 people.
2. In each group we selected a leader. He monitors the implementation of the rules, suggests the direction of the search for ideas, as he knows the rules and instructions.

3. The facilitator focuses on an interesting idea so that the group does not lose sight of it, work on its development.
4. The group selects a speaker who records the emerging ideas.
5. A primary discussion and clarification of the problem conditions is carried out.

Stage 1 - the goal is to build as many possible solutions as possible.

Stage 2 - the analysis of ideas, during which the students find the correct answer to the question.

Stage 3 - processing results.

The group selects from 2 to 5 of the most interesting decisions and appoints the speaker, who tells them to all the students and the teacher.

As a result, students came to the conclusion that the cloud point is the temperature at which the oil product becomes cloudy (GOST 5066-91).

The cause of turbidity is the crystallization of paraffins and the precipitation of ice crystals. Pour point - the temperature at which the fraction cooled in the test tube does not change the level when the tube is inclined by 45° (GOST 20287-74) The crystallization temperature is from -60 to + 30 ° C; it depends mainly on the content of paraffin in oil (the higher it is, the higher the crystallization temperature) and light fractions (the higher they are, the lower this temperature).

Such work with students allows the teacher to involve all students in the pedagogical process. At the end of the interactive lecture a survey was conducted among the students, in order to diagnose the effectiveness of this method in teaching. The test included questions: how effectively does an interactive lecture allow to form professional, communicative competences, to perceive and assimilate educational material, to form skills of self-organization and self-education. The received responses were tabulated.

Table I- The effectiveness of interactive method in training

Interactive lectures let us improve:				
Levels	Professional skills	Communicative skills	Learn new material	Self-study skills
Low (0-30%)	5%	6%	4%	8%
Average (31-60%)	15%	12%	16%	20%
High (61-100%)	25%	28%	22%	30%

Conclusion

Thus, the participation in an interactive lecture of a teacher and students significantly improves the quality of education. The use of interactive forms of education activates the teaching process, increases the interest of students to study the discipline "Oil and Gas Chemistry", allows to achieve a greater understanding of educational material. This form of work allows the teacher to present the material in a heterogeneous form, to determine the sequence and form of presentation of the material, allows the teacher to act as an organizer, consultant

during the lesson, i.e. to work in the subject-subjective mode, and the most important achievement of the main goal is the active learning of educational material by students.

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