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ПЕДАГОГИКА ЖӘНЕ ОҚЫТУ ӘДІСТЕМЕСІ –
ПЕДАГОГИКА И МЕТОДИКА ПРЕПОДАВАНИЯ –
PEDAGOGY AND TEACHING METHODS

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FORMATION OF A SYSTEM OF INDEPENDENT WORK
FOR PROFILING DISCIPLINES

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Abstract: Over the past twenty years, university education has become more globalized and changed to student-centered education. This article discusses the problem of planning and organizing independent work of students in the study of specialized disciplines, identifies the key directions, content, forms and methods of teaching students, ways to activate independent activity. An innovative technique for conducting lectures using the Workbook developed by one of the authors is shown. The project method is one of the interactive methods of modern teaching. This is an integral part of the educational process. A poster presentation is a way to communicate a research or understanding of a topic in a short and concise format. Posters are becoming a more popular method of evaluation in higher education, as can be performed individually or in groups. The use of interactive animated e-Books and Videos is especially effective when studying the technology of the production process in special disciplines.

Keywords: engineering education, Project-based learning, research project, Poster presentation, competences, evaluation, examination, Workbook, eBooks.

Introduction. The significance of education – especially tertiary education – as a trigger of stable and inclusive growth. Currently particularly relevant theoretical and methodological issues and practical issues of providing quality education in a modern technical college. The process of preparing specialists in a technical university should consider permanently changing tasks of engineering works and the conditions of its implementation. The engineer's professional skills are defined by their professional qualifications, awareness in the field of modern engineering creativity and critical thinking. Modern engineers training should develop professional and creative potential of a specialist who will ensure the high competitiveness of the future engineer in the conditions of intense competition at the working places and the increasing requirements for the quality of work performed. The Higher education of Kazakhstan is included in Bologna process, which means that active methods of education are obligatory. On March 11, 2010 the Committee of Ministers of Education of the countries, which take part in the Bologna Process (46 countries) made a decision about Kazakhstan joining the Bologna Process [1-2].

Technology integration is moving from teacher-centered to learner-centered methodology. The Bologna process practically presents changes of Tertiary education standards from “teaching”, when a person is educated, to “learning”, when a person learns. During the implementation process, we could observe a gradual increase in the proportion of students' independent work due to the fact that it is treated like a significant element of the self-education of the individual and acts of means of organizing intellectual activity.

Independent work of students is planned by the teacher together with the student, but is carried out by the student on the assignment and under the methodological supervision of the teacher without his direct participation [3]. Up to 70% of the number of hours provided for the study of the discipline can be allocated for its implementation.

The planning of independent work. The planning of independent work involves the determination of the volume and timing, the complexity of specific types of independent work and the directing the student towards the appropriate distribution of work time. When independent students' work (ISW) is organized, it should be planned in a syllabus, frequency and content of ISW consultations will be defined on the base of objective criteria for students' knowledge and skills monitoring, as well as consistent improvement of the methodology for conducting ISW (independent students' work).

As the credit system of education puts independent work in the first place (70% of the total allocated study time), so ISWT should pursue a special goal: to assist students in the implementation of the ISW (in addition to the actual educational goals). The following requirements are put forward for the ISWT:

- it is included as a separate line in the class schedule;
- plans include the questions for self-preparation;
- various forms of tasks are prepared for ISW;
- conducting the ISW should be based on interactive methods, since their application increases the level of memorization of educational material by students; ISWT should be carried out in a wide variety of forms;

- demo and auxiliary materials (tasks and exercises, crosswords, tests, role-playing games, texts for interpretation, etc.) should be used.

ISWT is independent work with the participation of a teacher; during classroom lessons, students are offered group assignments, etc. In this case, such approaches as the method of critical thinking, work in groups, mini-groups, are ideal for ISW.

The organization of the system of independent students' work. The main mark in the organization of students' self-directed studies is defining the goals and aims of a lesson (or a training course in whole) [2-4]. It allows combining students' self-directed studies into a unified continuous system without any division into indoor and outdoor works.

Let us consider the organization of the system of independent work of the special subjects of the specialty "Chemical technology of organic substances" on the example of the discipline "Chemistry and Physics of Oil and Gas". In order to organize ISW in this Department of "Oil refining and petrochemistry", the following things are determined:

- 1) the main directions, content, forms and methods of preparing students for independent activity;

- 2) specific content, volume of material which is the subject of independent study in accordance with the curriculum;

- 3) a way of presenting educational material in methodological literature (textbooks, methodological instructions, etc.) in the form, accessible for effective assimilation by students.

The Department provides control over the organization and quality of students' independent work; draws up a schedule of independent work for students and a deadline for work; it analyzes its effectiveness and makes adjustments in order to activate and improve students' independent work; provides the access of all required educational, methodological and reference material; creates methodological recommendations, instructions how to organize independent work of students, tasks for independent work; questions for exams, tests and other control activities.

The Department has developed guidelines for preparing students for classes in the academic discipline "Chemistry and Physics of Oil and Gas", which defines the main directions of independent students' work during preparation for classes. Methodological instructions on a specific topic include: the chemical-technological value of the theme to encourage listeners to study it, program questions, literature, description of laboratory experiments, as well as questions for self-control of preparation for classes and a summary of theoretical material. Thus, in the course of the implementation of controlled independent work, students during the academic year develop the ability to find the optimal answers, calculations, and solutions to situational problems in oil chemistry; skills in performing educational research, developing skills in working with a textbook, teaching aids, modern scientific literature.

In order to create a successful optional course the teachers of the department provide students with the required methodological literature (lecture courses, workshops, educational and methodological complexes of disciplines). The development of innovative technologies in modern education makes it possible to increase the efficiency of students' independent work and qualitatively modernize the educational process as a whole. The use of a library, the Internet, a media library or a single telecommunication network for ISW helps to form a complete system of skills necessary for a

specialist to select and process information.

Students carry out an independent search of chemical information using various sources (reference, scientific and popular science publications, computer databases, Internet resources), they also prepare presentations in Power Point, etc.

Interactive teaching methods contribute to the effective organization of independent work, which, in its turn, helps to form and develop the professional competencies of students [4]. At the same time, this approach to the formation of ISW requires the creation of certain technical and pedagogical conditions in a higher educational institution. To provide a personality-oriented, developmental approach to organizing the learning process, an electronic study guide "Chemistry and Physics of Oil and Gas" was developed [5-6].

The use of an electronic training manual allows expanding the teacher's capabilities in organizing ISW, including the use of interactive teaching methods. The essence of this approach is the organization of interaction and mutual communication between students and a teacher [7-8]. Interactive learning is recognized as a method of comprehension, implemented in the form of combined activities of students. Interactive methods are focused on the dominance of students' activity in the educational process. The problem is that at present, methodological developments for conducting interactive classes at university are mainly aimed at organizing the work of students in the classroom, while the issue of using interactive methods in students' independent work does not have a deep pedagogical and methodological study.

Thus, the use of electronic teaching aids allows teachers to use interactive methods for organizing students' independent work, which, in turn, is an effective way to develop professional competencies of future specialists.

The proposed methodology for organizing students' independent work in the study of oil chemistry includes organizational, motivational, stimulating and content components. Let's consider the ways of implementing the organizational component.

During the first introduction lecture students are given the teacher's email address and the teacher's corporate email address, besides educational materials are presented to them.

The necessary educational and methodological materials are uploaded onto the teacher's page in the "Platonus" system: a plan of lectures and laboratory-practical classes with an indication of the types of work; educational and methodological provision of the discipline with the list of the main and additional literature; materials of lectures and practical and laboratory exercises; types and forms of control; a system of assessment of knowledge, skills and abilities of students; the policy of the discipline, etc. Texts of lectures and plans of preparation for practical classes are posted 2-3 days before the start of classroom studies. The aforementioned e-mail address are used to send students' materials, questions, assignments, etc. The end of the text of each lecture has the list of questions and tasks which should be completed (the deadline is usually within one week) and assignments could be sent to the teacher. The components of the course of ISW include preparation for lectures, practical, laboratory classes, compulsory home work and preparation for tests. Before the lecture the student should get acquainted with the concepts and issues, which will be discussed in the lecture, identify difficult topics and inform the teacher about it by e-mail. If the question is insignificant, then the student can receive the answer individually, or the teacher, taking into account the questions and wishes, answers all students' questions during the lecture and discuss them in details. Besides it gives the students an opportunity to have the text of the lecture in advance and highlight some significant points. We would like to note that, considering the special features of the studied discipline, we have proposed small tips that make understanding and study of complex formulas easier. To prepare for practical exercises the special site has training plans with a list of required knowledge and skills and a list of questions, which are going to be discussed at the lesson. During preparation for laboratory experiments students could get a laboratory journal with an instruction how to conduct experiments, description of tasks and a place for making the notes (formulas, reaction equations, formulating conclusions) during a classroom lesson. To prepare for tests, students are offered a list of questions and a sample version of the test.

Thus, the methodology developed by us for organizing students' independent work increases the efficiency of mastering the course of chemistry and physics of oil and gas, subject to the following organization of their activities:

- creating positive motivation for students when doing independent work;
- formation of skills of independent work by familiarization with plans and algorithms for its implementation;

- a variety of options for the proposed types of independent work;
- providing students with the required number of teaching aids thanks to the availability of electronic versions;
- rational use of classroom time (a significant part of the information related to the organization of the discipline study is worked out by students independently);
- operational use of the "student-teacher" feedback. The goal of further research is to improve the developed methodology by increasing the variety of kinds of independent work of students and the use of modern electronic learning technologies, as well as using it in the study of other chemical disciplines.

As commonly known, the experimental method is a significant part of studying chemistry, therefore, students are also introduced methods of planning and setting up laboratory experiments, as well as their analysis [7-8].

Participation of the student in research accustoms them to independent scientific activity. In the process of educational research, future specialists use instruments and equipment, apply their knowledge in solving specific problems, and carry out real scientific research. So, when studying the discipline "Chemistry and Physics of Oil and Gas", students take an active part in educational and research work on the following topics: "Investigation of the rheological properties of oils from various fields in Kazakhstan", "Investigation of the chemical and hydrocarbon composition of oils and oil and gas condensates of fields in Kazakhstan", "Study of the fractional composition of oils and oil and gas condensates of fields in Kazakhstan", using the collection of educational materials of the course.

The understanding of rheological properties, chemical and hydrocarbon and fractional composition allows future specialists to better understand and assimilate information about the physicochemical properties of hydrocarbon systems. In the course of research experiments, students acquire the skills of scientific and experimental work: they set tasks, form a research plan, choose the necessary research methods and techniques, perform bibliographic work, process the results obtained, analyze them, and draw conclusions.

Thus, educational research work aims to teach students (within the curriculum) to carry out independent scientific work using scientific methods of theoretical and experimental research. This allows one to have the foundation necessary not only for the further successful study of disciplines of the professional cycle, but also lays the knowledge base necessary for any theoretical and experimental industrial research [9].

The activation of independent work of students contributes to the expansion and consolidation of educational material, the acquisition of new professional knowledge, the formation of practical skills. Independent work contributes to the development of the student's skills to work with scientific literature and information resources. Of particular importance in the organization of independent work under the credit system of education is the motivation of students to study independently. In addition to traditional forms of organizing independent work, following can also be used: preparation for a business game, debate; peer review of student works by the students themselves; compilation of glossaries; preparation and writing of scientific reviews, articles.

When developing assignments for independent work, teachers should be guided by the requirement of profiling their discipline in accordance with the specifics of their specialization. For the successful organization of independent work of students, it is necessary to organize clear control and assessment by the teacher. A prerequisite for organizing independent work is the reporting of students to the teacher about its results. The forms of control can be very different - oral or written, individual or in a group, selective or holistic [10].

Assessing the students' results of educational achievements. The teaching and assessment processes are always found in tight interaction. Assessment is one of the most influential curricular elements regarding learning processes and outcomes. The current focus of assessment in higher education is to link assessment tasks with anticipated learning outcomes and criteria of competence.

Since 2018/2019 academic year our style and approach to teaching is focused on Project-based learning using cooperative and collaborative models when studying of the special subjects [11-13]. This Project-based learning strategy referred was discussed earlier [14-17]. The main part of the student self-directed study is group and individual research projects prepared in the form of presentation (PowerPoint, now as Poster Presentation). As rule, themes of group and individual projects are tightly connected with students' future specialty.

In Project-based learning, in particular, it is necessary to give student sample speaking practice. This was not possible in that scenario where assessments were conducted in the tutorials with

more 20 students each. Therefore it was deemed necessary to try out an assessment method which would increase the speaking time for each student as well as enable the teacher to evaluate students individually. The assessment method like Poster Presentation is good way to address that problem. Projects preparation and their designing demand work in team.

Structure of Poster Presentation for Research Project named “Chemistry and Physics of Oil and Gas” on the given discipline is shown in fig.1.

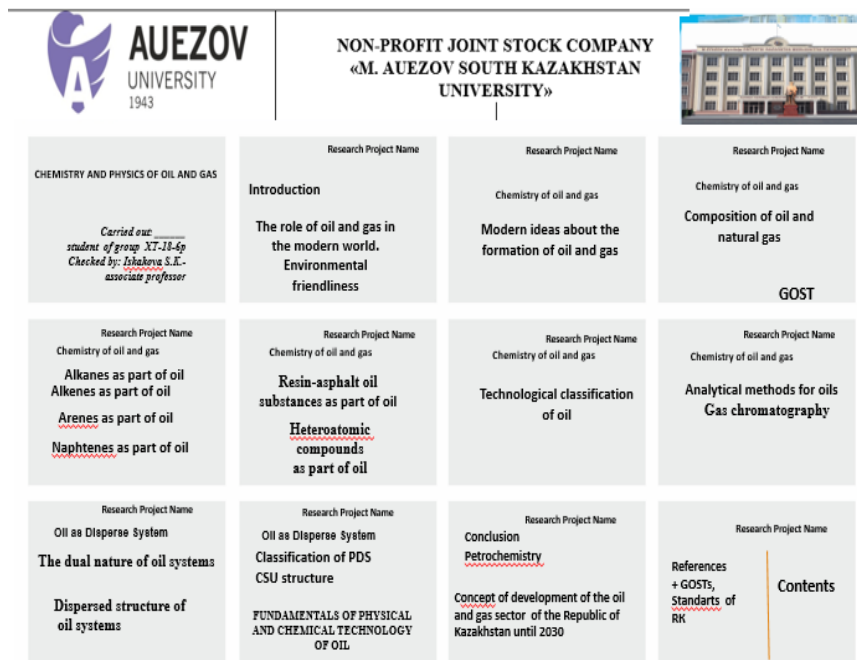


Fig.1 - Structure of Poster Presentation

Poster-Presentation advertises the project. It combines text and graphics to present the project in a way that is visually interesting and accessible. It allows to display student work to a large group of other scholars and to talk to and receive feedback from interested viewers. The Individual project completed by students during the semester.

In conjunction, simultaneously are using Workbook “Typical flow diagrams for Chemistry and Physics of Oil and Gas” both for lectures and carrying student homework. We have prepared Workbooks on the fundamental questions of the course. For example, slide on theme “Origin of oil and gas” (fig. 2).

Modern ideas about the formation of oil and gas - MIGRATION SEDIMENT THEORY

DESCRIPTION, SEE FIGURE

How crude oil and gas (fossil fuel) is formed??

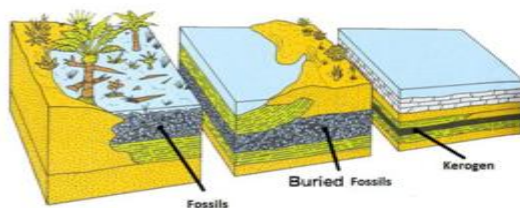


Figure 2 Modern ideas about the formation of oil and gas

The Workbook each task contains exercises designed to help students to develop the skills they need to do well in their examination. The most productive part of the lecture to use Workbook is

after studying the theoretical material. The students summarize the material in written and oral form. Workbook contributes self-stimulation in development of knowledge and *Self & Peer assessment*.

The Workbook helps students to become capable of

- demonstrating their systematic understanding of studying area,
- critically analyzing, assessing, and synthesizing new and complex ideas;
- improve ability to communicate in written and oral form.

The objectives of projects development, the acquired competences, and the levels of mastering of teaching material are given in terms of Blum's Taxonomy (table 1).

Table 1 – Individual Project-based learning method for learning outcome formation

| According to the Research projects objectives students | The acquired competences include the following: | Levels of mastering Blum's Taxonomy |
|---|--|-------------------------------------|
| deepen their knowledge on the topic of the discipline comprehending its essence | creativity and flexibility in knowledge and skills application | Analysis Synthesis Assessment |
| improve their English, | appropriate level of oral and written competences in English | Comprehending |
| learn to work by individually, a pair, and a team | individually, a pair, teamwork capability | Analysis Synthesis Assessment |
| become skillful in public presentation | self-confidence | Analysis Synthesis Assessment |

To prepare individual research projects are usually used Internet, video podcasting (screen casting).

Main aims of the research projects are:

- to deepen master's student knowledge in studied subject,
- to improve skills in research making,
- to learn how to use Internet in research,
- to use Posters as a means of communication and assessment,
- to develop skills in public Presentation,
- to work in a team,
- to share research experience.

As is shown in Table 1, presented material improves the educational level not only of the subject, but also of computer knowledge such as Office Programs skills and using of Internet.

For the assessment of competences, we know that the traditional type of exam is a useful tool, but only for the evaluation of the learning of conceptual contents. For over 150 years, examinations have been our principal assessment tool and they are still important in 21st Century teaching and learning. Examinations do have a place.

However, Poster Presentation helps to create the complete understanding of the whole course, it is logical links and connection with real production. That is why the Poster Presentation could be used during the exam as a testing material.

Conclusion.

The education of engineers is, therefore, critical to every nation to ensure the prosperity of its citizens, based on the following premises:

- Knowledge and know - how determine how well off societies are compared to other societies.
- Standard of living hinges on the ability to educate a large number of sufficiently innovative engineers.
- Research and development spending fuels innovation.
- Creation of wealth is related to a nation's ability to make products that other nations want to purchase.

The aim of the project-based learning models used was promoting active -learning by students, addressing different learning styles, adopting deeper approaches to subjects relevant for their

professional or personal development, and advancing students to higher development levels. Project-based learning is defined as student-centered, and includes the teacher in the role of facilitator or coach. Students engaged in project- or problem-based learning generally work in cooperative groups for extended periods of time, and are encouraged to seek out multiple sources of information. Often these approaches include an emphasis on authentic, performance-based assessment.

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Түйін: Соңғы жиырма жылда университеттік білім беру жаһандық сипатқа ие болды және білім беруде студентке бағытталған ұстанымға ұласты. Мақалада, бейіндік пәндерді оқыту кезінде студенттердік өзіндік жұмыстарын жоспарлау және ұйымдастыру мәселелері қарастырылды, студенттерді оқытудың шешуші бағыттары, мазмұны, формалары мен әдістері, студенттердің өзіндік іс-әрекеттерін белсенділендірудің амалдары анықталды. Авторлардың біреуі құрастырған Жұмыс дәптерін пайдалана отырып, дәрістерді жүргізудің инновациялық әдістемесі көрсетілген. Білім беру үрдісінің ажырамас бөлігі болып табылатын, заманауи білім берудің интерактивті әдістерінің бірі – Жобалық әдіс келтірілген. Постерлік презентация зерттеу жайлы немесе тақырыпты қалай түсінетіндігі жайлы қысқа және ықшамды түрде баяндаудың амалы ретінде қарастырылады. Жоғары оқу орындарында плакаттар күннен күнге бағалаудың кең таралған әдісіне айналып келеді, өйткені оларды жек немесе топпен орындауға болады. Интерактивті анимациялық электронды кітаптар мен бейнероликтерді пайдалану әсіресе арнайы пәндер бойынша өндірістік үрдістің технологиясын зерттеу кезінде тиімді.

Кілт сөздер: инженерлік білім, жобалық оқыту, зерттеу жобасы, стендтік презентация, күзiреттiлiк, баға, емтихан, жұмыс дәптерi, электронды кітаптар

Аннотация: За последние двадцать лет университетское образование стало более глобальным и изменилось на студентоцентрированный подход в образовании. В статье рассматривается проблема планирования и организации самостоятельной работы студентов при изучении профильных дисциплин, определены ключевые направления, содержание, формы и методы обучения студентов, способы активизации их самостоятельной деятельности. Показана инновационная методика проведения лекций с использованием Рабочей тетради, разработанной одним из авторов. Представлен Проектный метод - один из интерактивных методов современного обучения, неотъемлемая часть образовательного процесса. Постерная презентация рассматривается как способ в краткой и лаконичной форме рассказать об исследовании или понимании темы. Плакаты становятся все более популярным методом оценки в высших учебных заведениях, поскольку их можно выполнять индивидуально или в группах. Использование интерактивных анимированных электронных книг и видеороликов особенно эффективно при изучении технологии производственного процесса по специальным дисциплинам.

Ключевые слова: инженерное образование, проектное обучение, исследовательский проект, стендовая презентация, компетенции, оценка, экзамен, рабочая тетрадь, электронные книги.