Using Information Technology In The Teaching Of Atomic Physics In Higher Educational Institutions

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Abstract : This article was written with the aim of to develop theoretical and practical foundations using information technologies in the teaching of atomic physics in higher educational institutions. The hypothesis was tested in the article: During the study, the hypothesis was put forward that the pedagogical interaction between the teacher and students in the natural science preparation of bachelors for the nuclear industry will be strengthened if: a complex of innovative computer networks (computer classes, intelligent information technologies electronic lecture notes, classroom multimedia display) are integrated into the methodology of professional education of bachelors intelligent information diagnostic systems complex) along with the traditional components of the educational complex (handout a series in the form of a workbook, a package of control and measuring materials, printed manuals, guidelines); intensification of educational and cognitive activities of students and an increase in the volume of mastering the content of the disciplines of the natural science cycle with a reduced training period will be based on the information and communication model of the lecture process, taking into account the interaction of students with the teacher, classroom display and handout materials; pedagogical conditions will be identified that contribute to the practical implementation of the intelligent information technologies of interaction in the natural science training of bachelors. The objectives of the study are as follows: to identify and give a pedagogical analysis of the problems that arise during the transition to a tiered system of vocational education, in order to find ways and mechanisms to resolve them; create an information and communication model of the lecture process using an electronic lecture presentation and printed handouts; to develop and introduce into the pedagogical practice of the university the methodology of pedagogical design and the integrated, mutually complementary use of audiovisual means and handouts; supplement specialized education in a university organized by a higher educational institution and taking into account the specifics of nuclear industry enterprises; substantiate the choice of qualitative and quantitative indicators of the effectiveness of the methodology for the integrated use of the proposed didactic tools and intelligent information technologies in the preparation of bachelors and experimentally test the hypothesis of the study.

Keywords: atomic physics, computer technology, multimedia resources, projections, integrated learning, computer networks, information technologies, computer.

1. INTRODUCTION

The progress of science and technology is turning education into a necessary attribute of everyday life. There has always been a society in society, and in recent years there has been an acute need for specialists who are professionally trained for specific industries: chemical, machine-building, petrochemical, gas, etc. Such training, for example, for the nuclear industry, would prevent sad tragedies. The presence of such a fact as accidents in the nuclear industry once again confirmed the requirement, which was insisted by specialists in the nuclear industry, that specialized nuclear education is needed to work at nuclear plants - education related to the study and use of nuclear transformations, i.e. with nuclear physics and technology, nuclear technology, radiation chemistry, radioactive materials and waste management, etc. [16]. Nuclear education, as one of the most striking examples of education in the field of high technology, has significant differences from classical technical (engineering) education [16]. It:

- high "high technology" of nuclear knowledge (competencies) and technologies;
- a combination of complex mathematical, natural science and engineering disciplines;
- high technological culture (safety culture);
- the principle of “critical mass of knowledge” or “barrier of knowledge” (one cannot be “slightly educated” in the nuclear field);
- increased requirements for abstract thinking;
- compulsory participation of students in scientific work;
- increased volumes and complexity of training programs; long period of study and graduate design.

Developing knowledge-intensive production of nuclear weapons, nuclear fuel and nuclear energy complexes require specialists with general and special competencies, taking into account the specifics of professional activity in potentially dangerous plants with high psychological tension, with a high degree of automation of production cycle management, in which most of the information about ongoing processes hidden from direct perception by the operator is displayed on the panel in digital m and symbolically. This requires high professional preparedness of specialists, based on fundamental natural science knowledge, with an understanding of the integrity and interconnection of production processes, developed imaginative visual thinking, which allows us to mentally see the proceeding production processes for conciseness and symbolism (virtuality, visuality) of information and, in case of emergency situations, quickly analyze possible decision making options.

2. MATHERIALS AND METHODS

Qualitative changes in the field of nuclear education are naturally associated with the teaching of natural sciences disciplines at universities, in particular, general and inorganic chemistry, which is the foundation for preparing a future specialist for nuclear industry enterprises. Fund mentalization combines two aspects: first, the creation of a base for the

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subsequent assimilation of general professional and special disciplines, further replenishment of knowledge; secondly, ensuring the consistency, generalization and internal unity of the educational material. It contributes to the solution of such training problems as teaching the ability to summarize, analyze data, draw logical conclusions, and also master the physical and chemical foundations of technological processes in a particular industry. The inevitability of the development and complication of the nuclear industry cannot be recognized without fundamental natural science training. At the same time, the share of policy components in this professional activity is very high, requiring rigorous and accurate implementation of regulatory procedures, limiting initiative and introducing elements of monotony in the daily work of a nuclear industry specialist. The consequence of this in recent years has been a decrease in the image of the nuclear specialist, disruption of the continuity of generations at enterprises, and a low influx of youth into the industry. In this regard, the problems of the early vocational guidance of higher education students, the motivation for their choice of higher vocational education natural science specialties for the nuclear industry, and the enhancement of the prestige of higher education in industrial universities based on the achievements of information and communication technologies, allowing to realize the creative potential of the individual in the direction of independent study, are becoming relevant. Cognitive and educational research activities in the process of studying at a university and subsequent professional development during habilitation in the workplace. Specialized training of future natural science specialists, taking into account the real needs of the nuclear industry enterprises, should be carried out through the cooperation of the senior level of the school with the establishment of the HPE. This is due to the fact that for the most complete development of the required qualities, their formation must be started from school age, since it is at this stage that the students' abilities develop, which allow them to successfully master the natural science disciplines in the future, and their basic concepts are laid down. This will ensure continuity between general and vocational education, more efficiently prepare school graduates for mastering higher education programs. Literature Review. The use of ICTs and computer tools in teaching physics were studied in the works of Abduqodirov A.A. [1], Izvozchikov V.A. [15], Kondratyev A.S. [19], Laptev V.V.[21], Eshchanov B.Kh. [7], Otadzhanov Sh. [7], Soliyeva N. [7] et al. Techniques for organizing a training physical experiment using a computer are devoted to the work of V. Klevitskaya. [18], Chekulaeva M. [4]. Methods of using computer and physical equipment in a school laboratory in the study of physics was considered in the study Ezdov A. A. [9]. The theoretical basis of the study is the study of the use of information technology in teaching physics Belostotsky P.I. [2], Butikov E.I. [3], Gomulina N.N. [12], Kavtrev A.F. [17], Grigoriev I.M. [13], Chirtsov A.S. [5], Fateyeva I.A. [10], Fedorov A.V. [11] and foreign scientists as Innis Harold [14]. At the same time, these works, reflecting the general problems of the theory and methodology of professional education, do not give an answer to urgent questions of bachelor training, first of all, they do not take into account the specifics of the industry, for work in which the future specialist must have the necessary level of qualification, fundamental and applied knowledge, high culture of organization and implementation of professional activities. An analysis of previous works showed the relevance of the selected topic of our study. Theory and Discussion. How to use the innovative didactic tools and computer networks to resolve the contradiction between the rapidly growing amount of information that needs to be mastered at the first level of higher education, and the limited capabilities of the traditional educational process at the university? In what and in what way, to change the lecture-classroom form of organization of the educational process in order to increase its information content, to ensure the unity of rational-logical and figurative-emotional thinking? As notes D.V.Chernilevsky [5], the traditional "chalk" lecture in modern conditions is ineffective. To expand its informational capabilities, many universities started using presentation lectures (“dynamic slide lectures”) [8]. However, the process of introducing an innovative form of lecture organization is carried out empirically, according to the “trial and error” method. Thus, the theoretical and methodological aspects of integrating electronic (computer) didactic tools into traditional pedagogical technologies and their complex application in the process of preparing bachelors (when moving to a two-level system of higher education) have not been studied enough and require independent research. The research problem consists in the search for modern didactic tools and ways of their application, allowing to provide the necessary level of preparation of natural science bachelors for the nuclear industry. The purpose of the study: enhancing the pedagogical interaction between the teacher and students in the context of the integrated application in the training of natural science bachelors for the nuclear industry of electronic audiovisual didactic tools and handouts. Object of study: the process of preparing bachelors for the nuclear industry in the context of the transition to a tertiary system of higher education. Subject of research: the creation of a methodology for the integrated use in electronic training of bachelors of electronic didactic materials and handouts (on the example of the discipline "General and inorganic chemistry").In the course of the study, a hypothesis was put forward that the pedagogical interaction between the teacher and students in the training of bachelors for the nuclear industry will be strengthened if:

- a complex of innovative didactic tools (electronic lecture notes, classroom multimedia display, computer diagnostic complex) will be integrated into the methodology of professional education of bachelors along with the traditional components of the educational and methodical complex (handouts in the form of a workbook, a package of test and measurement materials, printed manuals, guidelines);
- intensification of educational and cognitive activities of students and an increase in the volume of mastering the content of the disciplines of the natural science cycle with a reduced learning period will be based on the information and communication model of the lecture process, taking into account the interaction of students with the teacher, classroom display and handouts;
- pedagogical conditions will be identified that contribute to the practical implementation of the information and communication model of interaction in the natural science bachelor's training.

The objectives of the study.

1. To identify and give a pedagogical analysis of the problems

that arise during the transition to a tiered system of vocational education, in order to find ways and mechanisms to resolve them.
2. Create an information and communication model of the lecture process using an electronic lecture-presentation abstract and printed handout.
3. To develop and introduce into the pedagogical practice of the university the methodology of pedagogical design and the integrated, mutually complementary use of audiovisual means and handouts.
4. To supplement profile training at a university of students organized by a higher educational institution and taking into account the specifics of nuclear industry enterprises.
5. To substantiate the choice of qualitative and quantitative indicators of the effectiveness of the methodology for the integrated use of the proposed didactic tools in the preparation of bachelors and experimentally test the hypothesis of the study.
Research methods: theoretical analysis of the literature on the problem under study (socio-pedagogical, psychological-pedagogical and methodical); analysis of teaching models in psychology and didactics, hypotheses and theoretical modeling of the educational process, systematization and generalization of pedagogical experience. Empirical methods: collection of scientific facts through questionnaires, testing, observation, conversation; statement of a pedagogical experiment, qualitative and quantitative analysis of its results. The reliability of the research results is provided by: a comprehensive analysis of the problem; application of modern scientific research methodology; a variety of experimental methods, a critical analysis of the results obtained over five years, using statistical methods to assess the significance level of experimental results.

The scientific novelty of the study:
1. The information and communication model of pedagogical interaction in the process of lecture-presentation is justified. The core of the model consists of three channels of student interaction: with the teacher, classroom display and workbook, which allows for the phased and didactically sound use of multimedia presentation of educational material.
2. The structure of the activities of the teacher and students at the lecture is modified based on the joint, mutually complementary use of the electronic abstract and workbook. The pedagogical interaction has been improved in the substantive (verbal-logical and figurative-emotional communications are integrated) and in the process (information sharing along the three channels of its presentation) aspects.

The theoretical significance of the study.
1. The pedagogical theory of visual thinking and visualization of educational material, previously used to create supporting abstracts and workbooks, has been expanded to include electronic means of presenting information on the classroom display and/or personal computer screen.
2. The role and didactic functions, the principles of the design and joint use of the electronic abstract of the lecture-presentation of educational material and printed handouts in the form of a workbook of the discipline are determined. The interaction of these tools in the lecture process is based on the complementary and bimodal presentation of educational information.

The practical relevance of the study.
1. A program of targeted professionally-oriented and in-depth training for university students has been developed and is being implemented, taking into account the specifics of nuclear industry enterprises. The training program allows you to acquire the qualification of a laboratory chemist and physicist with the issuance of a certificate of a standard form. Using the university teaching methodology (lectures, laboratory and practical classes, tests, system control) allows students to avoid the difficulties of adapting to the conditions of subsequent professional activity.
2. Didactic tools developed and used in the educational process can improve the success of student learning, can be adapted to other disciplines and used in institutions of higher professional education.
A means of integrating pedagogical and computer technologies in the preparation of bachelors is the educational-methodical complex of discipline (CMD), combining both traditional components (workbook, printed manuals, methodological instructions, test and measurement materials, etc.) and innovative (electronic lecture notes, presentations, electronic classroom displays, computer diagnostic complex). Strengthening the pedagogical interaction of the teacher and students is achieved in the lecture process of the university through the use of a multimedia electronic lecture notes, which implements the unity of the interaction of the cognitive (rational) and affective (emotional) aspects of the educational material. An increase in the information content and the total volume of educational material submitted to the lecture is achieved through didactically justified use of three channels for the presentation of the material by the lecturer: in oral speech, in written speech and illustrations on the lecture display, as well as in printed form in the workbook.

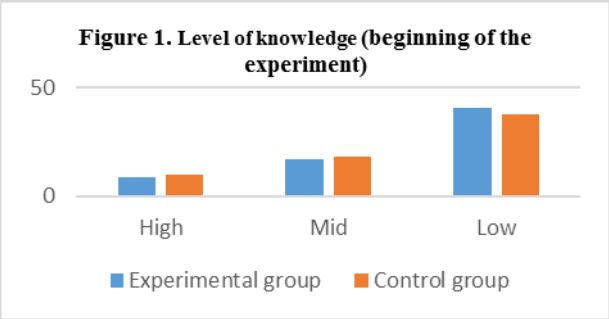
3. EXPERIMENTAL RESULTS

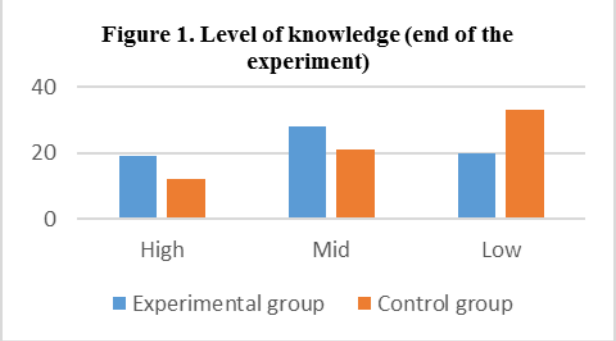
The experimental base and stages of the study. Pilot work was carried out on the basis of the Department of Physics of the National University. At the first stage, the psychological, pedagogical and methodological literature was studied and analyzed on the topic of research, the main problems of organizing continuous professional technical education in the conditions of transition to a level HPE were identified, its conceptual foundations were studied, the main ways of their implementation were determined; a student training program was developed and implemented. At the second stage, theoretical and methodological foundations for the creation and application of an electronic lecture notes and computer classes were prepared in the training for first-year students (using the example of the “Atomic Physics” discipline), methods for combining electronic notes with handouts were developed, and methods for their application in the educational process were tested. At the third stage, an experimental verification of the research hypothesis was carried out, systematization and generalization of the obtained

data, verification of the effectiveness of the implementation of the developed methodology in the educational process, making adjustments to the experimental work. A theoretical generalization of the results of experimental work was carried out, systematization of the collected material, the formulation of theoretical conclusions, the design of the text of the dissertation. The main ideas and results of the study were tested in publications on the topic of research, the preparation and publication of teaching aids.

In experimental trials participated 133 students.

Groups Number of respondents	Arithmetic expression	Level indicators					
		At the beginning			In the end		
		High	Mid	Low	High	Mid	Low
Experimental n_i =67	X_i	9	17	41	19	28	20
Control n_i = 66	Y_j	10	18	38	12	21	33





Statistical analysis of the obtained experimental results showed the effectiveness above zero, and this means that the level of knowledge of the experimental group is higher compared to the level of the control group. It was confirmed that the teaching methodology recommended by us is more effective than the traditional teaching methodology.

4. CONCLUSION

Based on the analysis of numerous works and pedagogical research in the field of vocational education, a system of natural science training of future specialists for nuclear industry enterprises (based on the example of atomic physics) was developed and experimentally implemented, based on the use of traditional and innovative pedagogical technologies and contributing to the achievement of the goal - improving the quality of vocational education using intelligent information technologies. As a result of the study, the following solutions are proposed for the tasks.

1. The analysis of the current state of professional training of engineers for the nuclear industry revealed the problem of insufficient preparedness of graduates for working in the engineering field and the conscious choice of a future specialty, as well as insufficient training time for one year to conduct leveling courses. The solution to these problems is the organization at the university or in the industrial zone of a special school, which will allow students to implement vocational training on a more fundamental theoretical basis and using the laboratory base of the university or company.
2. As a means of solving the problem of the imbalance between the growing volume of professionally important information in the natural science disciplines and the limited time for students to study at the university, an innovative teaching and learning center was used that takes into account the specifics of professional training of bachelors for nuclear fuel cycle enterprises. Along with published printed textbooks, guidelines for conducting laboratory and practical classes, the complex contains a computer and virtual testing systems with a database of pedagogical measuring materials, using intelligent information technologies, an electronic summary of lectures and presentations, and an electronic edition of the manual.
3. When mastering the content of the discipline of atomic physics, the bachelor's training curriculum for the nuclear industry, the approximate basis for student actions is created by the workbook of the discipline, which allows organizing not only classroom, but also extracurricular independent educational and cognitive activities of students.
4. Strengthening of pedagogical interaction in the main form of classroom studies at the university - lectures was achieved through the development and application of a multimedia electronic compendium of lectures and presentations of educational material in joint use with a workbook as a form of handout. This allowed us to avoid wasting time on performing routine operations to rewrite auxiliary material, to use the possibilities of visual perception of educational information, to consolidate certain theoretical provisions of the lecture in an immediate application to the practical tasks of the discipline, and thereby not only get a holistic understanding of the subject of the lecture, but also to increase the volume of the studied material in one and a half to two times.
5. The justified didactic principles of bimodality and complementarity of the verbal and symbolic representation of educational material are the basis for the design and implementation of the lecture process using intelligent information technologies, audiovisual means and handouts.
6. Systematic monitoring and diagnostics of students' academic achievements at five stages of the learning process (input, current, thematic, milestone, final) and a weekly rating assessment of the educational and cognitive activities of students have been developed.
7. Pedagogical analysis and the results of the experiment showed that the technology for visualizing educational material

in conjunction with computer tools for presenting it on the classroom display and workbook will intensify the lecture process (increase the amount of material mastered during one lecture) and enhance the educational and cognitive activity of students (classroom and independent learning). Ultimately, this resulted in an increase in the quality levels of the educational process and the successful development of the natural science discipline “Atomic Physics”.

The developed and experimentally implemented bachelor's training system with use a computer networks and a tool that provides essential qualitative features of professional training and guarantees almost all students to achieve high learning outcomes. Thus, the results of the study confirm the hypothesis of the thesis and make it possible to verify the achievement of the research objective. The obtained scientific and practical results and recommendations can find application in the general context of the reorganization of higher professional education, in the process of teaching other disciplines and are used in various educational institutions of higher education.

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