Artículo de investigación

The activity approach implementation in the formation of students' general technical competencies

Реализация деятельностного подхода при формировании общетехнических компетенций студентов

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Abstract

Intensive reform of the higher education system requires a significant modernization of pedagogical technologies, methods and techniques used in the implementation of educational standards for the preparation of bachelors and specialists in all sectors of the economy. The practice of training engineering specialists for the agricultural sector of a region with a developed mining sector of the economy reveals deep roots of the objectively existing contradictions mentioned above. This article provides a summary of research results obtained during classes in the following disciplines of the general professional cycle: Resistance of Materials, Machine Parts, Engineering Technology. New paradigm of competency-based, activity approaches to the level of higher education should be adequately expressed by new pedagogical, educational and methodological developments. The modern educational and equipment status of most educational institutions allows active realizing innovative pedagogical technologies and methods, the effectiveness of which increases when they adapt to the mental characteristics of certain categories of students. The article outlines the main features for the development and implementation of practice-oriented classes activating and stimulating students' cognitive interest in mastering the necessary professional competencies in the study of general technical disciplines. The emergence and further maintenance of learning interest in the

Аннотация

Интенсивное реформирование системы высшего образования требует существенной модернизации педагогических технологий, методов и методик, применяемых при реализации образовательных стандартов подготовки бакалавров, специалистов по всем отраслям экономики. Практика подготовки инженерно-технических специалистов для аграрного сектора региона с развитой горнодобывающей отраслью экономики выявляет глубокие корни указанных выше объективно существующих противоречий. В данной статье приводятся обобщенные результаты исследования, полученные в ходе проведения занятий по дисциплинам общепрофессионального цикла: «Сопротивление материалов», «Детали машин», «Технология машиностроения». Качественно новая парадигма компетентностного, деятельностного подходов к уровню высшего образования должна адекватно выражаться новыми педагогическими, учебно-методическими разработками. Современная учебно-материальная база большинства образовательных учреждений позволяет активно внедрять инновационные педагогические технологии и методы, эффективность которых возрастает при их адаптации к ментальным особенностям отдельных категорий студентов. В статье излагаются основные положения разработки

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study of general technical disciplines by the rural youth among the students requires a full consideration of their personal experience, the mentality of a person brought up in the circumstances of purely practical everyday life. Therefore, a significant increase in the share of practice-oriented classes using the methods and techniques of the activity approach is probably the only way to stimulate and maintain the students' learning interest.

Key words: Activity approach, personality mentality, problem situations, practice-oriented training, brainstorming method, graph-dynamic image, cognitive interest.

и реализации практико-ориентированных занятий, активизирующих и стимулирующих познавательный интерес студентов к овладению необходимыми профессиональными компетенциями при изучении общетехнических дисциплин. Возникновение и дальнейшее поддержание познавательного интереса при изучении общетехнических дисциплин студентами из сельской молодежи требует всемерного учета их личного опыта, ментальности личности, воспитанного в обстоятельствах сугубо практической повседневной жизни. Поэтому существенное увеличение доли практико-ориентированных занятий с применением методов и методик деятельностного подхода становится, вероятно, единственным путем стимулирования и поддержания познавательного интереса студентов.

Ключевые слова: деятельностный подход, ментальность личности, проблемные ситуации, практико-ориентированное обучение, метод мозгового штурма, графодинамический образ, познавательный интерес.

Introduction

Issues of modern practical pedagogical activity in the process ofeducatingprospective qualified specialists and bachelors for various industries and agriculture are becoming particularly relevant in the context of implementing educational standards. What does it mean? The pedagogical technologies, methods and techniques that have been applied to date in educational organizations require intensive improvement and radical changes corresponding to the new post-industrial economy (Skachkova, N.V., 2018, Kupavtsev, A.V., 2014). Educational and methodological support for the training of engineering and technical specialists, bachelors in a number of disciplines of the natural - mathematical and general professional cycles, continues to be based on the paradigms of formation and development of the industrial structure of economy. The didactic contradictions in the content of individual teaching materials with the practically applicableideasfor the future professional activity of ordinary (non-elite) technical educational institutions graduates are negatively perceived by students and significantly reduce their motivation for active studieswithin the educational program curriculum.

Theoretical framework

Among the insufficiently studied tasks of improving practical pedagogical activity according to A.M. Novikov (Novikov A.M., 2006) we can highlight the incompletely considered task of adapting the methods and techniques of professional engineering education to the regional requirements of the job market. The practice of training engineering specialists for the agricultural sector of a region with a developed mining sector of the economy reveals deep roots of the objectively existing contradictions mentioned above. The high relevance of expanding the study of these practical issues of pedagogy associated with new socio-psychological problems is also caused by the high level of natural outflow of skilled engineering and technical workers of agricultural enterprises of the Far East and the Far North to regions with moderate climatic conditions. The complexity and depth of such contradictions caused by the rapid transition of society to a market economy and the formation of personality in a conceptually new educational environment also bring forth the problem of studying young students' mentality and personality and, first of all, their psychological development and the formation of his professional mentality (Potapchuk, T.V., 2016).

The relationship of the extremely complex problems connected with the individual and ethnic group mentality and with the issues of practical pedagogical activity can be illustrated by a fairly simple example. For instance, the typical dense stream of passengers commuting in an industrial city public transport in the morning normally causes noticeable surprise among young people, who are frequently representatives of the rural population. The most striking and widely observed features among the majority of students in the agro-engineering areas of training is their extremely low manual labor skills as well as the lack of basic skills in manual processing of metals.

Meanwhile, S. L. Rubinstein, the founder of the domestic philosophical and psychological theory of human activity, in (Rubinstein, S.L., 2002) noted the fundamental interrelation of the categories of activity, cognition, thinking processes "... Our knowledge of objective reality begins with sensations and perceptions. However, despite its beginning with sensations and perceptions, the knowledge of reality does not end with them. From feelings and perceptions, it goes on to thinking ...". This fundamental concept of the relationship between activity and cognition is aimed at practical pedagogical activities on the development and application of new pedagogical methods and techniques that develop the cognitive interest of students, primarily students of engineering and technical fields of education. The educational and methodological support of professional disciplines, didactic materials should contribute not only to the acquisition of the necessary relevant professional competencies, but most importantly should encourage the student to think, and create a self-applying personality.

Materials and methods

The main goal of the experimental work carried out at the Faculty of Engineering of the Yakutsk State Agricultural Academy and the Mining Faculty of the North-Eastern Federal University is to develop pedagogical methods that stimulate and develop students (mainly the rural youth) and build up their interest in mastering the disciplines of general professional and special educational cycle programs in the fields of engineering.

The main basis of the experimental researched carried out over the years (Gulyaev, V.P., Ivanov M.S., 2019) is the principle of an active approach to the educational process. The initial prerequisites for achieving the goal of experimental work are: federal state educational standards for the training of specialists and bachelors in the fields of training engineers; the scope of students representing mainly rural youth served as the research target group; modern material and technical facilities of the educational organization. One of the key issues of experimental work is the question of developing and testing methods of activating and stimulating the cognitive interest of students in highlighting and understanding the guidelines of general technical and special disciplines that form professional competencies which further contribute to the transformation of the environment in a constantly changing and developing society (Verbitsky, A.A., 2010).

The sufficient duration period of the experimental work, which has been held for more than 15 years, made it possible to use in practice various methods of teaching the disciplines of the general professional cycle from traditional to modern methods that implement the principles of an active, competent approach. In the field of observation and subsequent analysis annually there were at least 60 - 70 students, mainly graduates of rural schools.

This article provides a summary of research results obtained during classes in the following disciplines of the general professional cycle: Resistance of Materials, Machine Parts, Engineering Technology. The choice of these disciplines for the study of the cognitive interest for the subjects among the students, observation of the dynamics and level of information retention acquired as a result of active mental activity, is justified as follows. First of all, the content of the disciplines directly determines and forms the basic component of the students' professional competence in the field of technology as a combination of methods and operations of meaningful changes in the form, properties of initial materials and materials with special tools and means of production. Secondly, practical training classes can be supplemented with didactically verified actions of the teacher to create new sensations in students, stimulate creative thought actions, build a chain of conclusions, design operations and expedient transformation of activity objects. Thirdly, topics and sections of the disciplines reveal new areas of human activity, previously unknown to rural youth, in the context of attaining knowledge of certain aspects in which the teachers can reveal the dynamics of the students' cognitive interest. Fourth, the content of the discipline topics and section sallows the teacher to update any set of models of critical situations which can truly occur in the field, the engineering and technical

solution of which should attract the attention and interest of students.

Results and discussion

Changes in the students' learning interests in the topics of these disciplines during the experimental work were supervised by the teaching staff of the Engineering Department of the YSAA and the Mining Institute of the North-Eastern Federal University. Important practical adjustments to the work were carried out based on the analysis of feedback from students and teachers of special disciplines cycle of the training program in the following educational programs: 35.03.06 Agro-engineering and 05.21.04 Mining. Sufficient experimental results were obtained owing to the systematic introduction of practice-oriented problem-and-solution situations into the structure of the academic subject plans.

The methodology involves the preliminary structure development, namely, singling out the key and basic aspects that ensure the professional competence of the students (Table 1) in terms of the content of these disciplines. The next step is to build up a strategy of organizing the preparatory phase, aimed at activating the cognitive interest of students in the study of sections (and/or credits) of the discipline in particular and the discipline itself as a whole. At this stage, each section is dedicated to solving a separate practice-oriented problem situation in a certain sequence of using and applying the key and basic a sets of the discipline. For example, Table 1 in column 2 gives a short outline of the topics discussed in one of the sections of the discipline Engineering Technology, which is dedicated to the technology of manufacturing rotation parts, operation and repairment of machine components.

Table 1. An abstract from the educational curriculum plan of the discipline Engineering Technology - Section Technology for the manufacture of rotation parts - round rods, hollow cylinders. Operating conditions, technology for repair and restoration of machine performance

Key, basic aspects of disciplines	The main outline of the topics presented in the discipline section
Practice-oriented problem-and-solution situation: Destruction (wear off) of rotation parts, repair and restoration of machine operability	
Machinery parts basing	General concepts of basing. Installation elements and their use in basing. Justification for the selection of technological bases. Assigning bases for roughing. Analysis of basings chemes
Technological processes design	Tasks of designing technological processes. Initial data for the design of technological processes of machining. The order of developing technological processes for the manufacture, repair and restoration of rotation parts
Machine part rationing	The technical norm of timing and its constituent elements. Definition of time piece items. Unit costing time. The rate of production. Methods for determining the time norm
Processing of the round bars class parts	Classification of parts. Technical requirements. Preparation for shafts. Shaft processing. Keyway and thread machining. Methods for finishing shaft processing. Typical shaft processing technologies.
Processing of hollow cylinder class parts	Classification of parts. Technical requirements. Billet blanks. Technological processes for processing bushings. The main methods of processing holes. Threading in holes. Schemes for the manufacture of bushings.
Quality control	Quality control of shafts. Indentations and holes quality control

The academic curriculum plan of the bachelor program for the discipline Engineering Technology with a specialization in 03.03.06 Agricultural Engineering consists of 3 sections (3 credit units). In the first section, theoretical, practical training and independent students' assignments time-periods are distributed in a proportion of 1:2:2. In the next two sections, a proportion of 1:4:4 was sustained. The main significance in putting special emphasis on the preparatory stage is that the clearly expressed necessity for preliminary educator's work on the selection and further development of practice-oriented problem situations for the transition

onto the implementation of the main stage of stimulating and supporting the students' educational interest. The success of overcoming didactic difficulties in such work process is determined by the personal and professional competence of the educator.

The sequence of studying sections and topics corresponded to the main textbooks and study guides devoted to the selected disciplines. The concept of the activity approach which was adopted in the experimental work aimed at stimulating and maintaining the learning interest of students studying the discipline, was successfully implemented with the active use of sucha well-known method as brainstorming (Globin, A. N., Krylova, M. N., 2014). An essential feature of applying the method of brainstorming to stimulate and maintain the learning interest of students is the construction of a systematic structure of the discipline, updating the content of sections and topics of the discipline with problematic production situations.

For example, the academic curriculum plan of the discipline Engineering Technology provides for the organization and implementation of the brainstorming method in three main sections, in the academic curriculum plans of other disciplines such as Material Resistance, Machine Parts by breaking them up into six sections. Structurally, each section consists of an introductory section, a brainstorming section, and a closing section. The distribution of classroom hours and extra-curricular class hours between sections is kept in the following proportions - 1:3:3.

The introductory section provides the theoretical foundations of the key and basic aspects (Table 1) of the discipline section under study, as well as the problematic, critical production situation (causes and effects) all of which are described in detail; this section also considers the possible trends of engineering and technical solutions. When conducting classes at the introductory stage, instructors use graphic-dynamic images, computer programs and other multimedia tools to achieve the effect of a maximum immersion into the professional environment (Gulyaev, V.P., Ivanov M.S., 2019).

The organization of classes in the brainstorming section follows the recommendations of the authors (Globin, A. N., Krylova, M. N., 2014). The instructor in the classroom directs the trail of thought of the trainees to help them reach and find the optimal solution of the assigned technical problems, with his/her control actions, appeals and questions, he models the working environment, involving students in the discussion and wide discussion of the topic. A sufficient duration of a collective discussion of the topics presentedin the section (1 to 3 weeks) promotes the students' in dependent work skills. There is an increase in the level of the students' learning interest. In a collective discussion of possible solutions to problem engineering and technical problems, students use possible technical solutions arising from their previous (passive) life experience; refer to literary sources, analogies and prototypes from the Internet and other sources.

The final product of the brainstorming section, for example, in the discipline Engineering Technology is the collective design of technological processes for the manufacture of real products (structures) in the lessons of the final section.

Classes of the final section are held in training workshops (laboratories). Students perform operations, work actions in accordance with the technological processes developed by them and, as a rule, are faced with the need to make corrective adjustments, additions, and changes. During the classes, following the instructions of the instructor, students measure the duration of individual operations, work actions, compose a photo of the working hour and calculate labor costs by comparing them with known norms. The instructor points out problems that have arisen as well as any previously undetected difficulties. With its help, the names of tools, fixtures, transitions, etc. are clarified, the instructor provides the necessary reference books, standards and other normative literature.

A mandatory element of the final section is a critical analysis of the errors revealed during the practical implementation of the results of the brainstorming process, as well as insufficiently developed, well-thought-out projects of labor actions, operations, and technological processes.

Conclusions

The experimental research carried out over a number of years (2000 - 2019) convincingly shows the high efficiency of the implementing an active approach to the organization of the educational process with practice-oriented classes that stimulate and support the students' learning interest throughout the course. The developed methods and techniques for conducting theoretical, practical and laboratory

classes with the introduction of practice-oriented problem situations that arise in the working environment of students' future professional activities contribute to the emergence and maintenance of students' learning interest in the process of perceiving and under standing the educational material. Preliminary planning, construction and organization of the educational process aimed at developing relevant engineering and technical solutions activate the students' mental activity.

The emergence and further maintenance of learning interest in the study of general technical disciplines by the rural youth among the students requires a full consideration of their personal experience, the mentality of a person brought up in the circumstances of purely practical everyday life. Therefore, a significant increase in the share of practice-oriented classes using the methods and techniques of the activity approach is probably the only way to stimulate and maintain the students' learning interest.

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