

# **Pedagogical Conditions of Formation of Polytechnic Competences of Students in Technical University**

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## **1. Introduction**

In the face of socio-economic and educational reforms in the country, rapid technical and technological development, professional competencies include not only the formation of knowledge, skills, but also the ability to build up polytechnic competence. The paper presents a personality-oriented approach to the formation of polytechnic competences of students in the practical activities of the scientific student club. Pedagogical conditions conducive to the formation of polytechnic competencies were identified. It has been experimentally proven that the formation of polytechnic competencies includes the development and improvement of personal and professional qualities in activities by a person itself. The article discusses the teaching experience in the "Modern geodetic technologies" scientific club of the Engineering Institute of the North-Eastern Federal University named after M.K. Ammosov (NEFU).

## **2. Relevance**

The primary concern of modern technical universities is to train highly qualified, competitive engineers, capable of not only effectively managing, but also introducing new technologies, equipment, automation, robotics and other scientific achievements in production process. The existing competency-based approach to training engineers is aimed at the formation of professional competencies, which requires the formation of professional knowledge and skills. However, the knowledge and skills acquired at the university may not be in demand, behind the times by the end of studies due to the rapid development of engineering, technology. In that context, the formation of polytechnic competencies is necessary, which we consider as the ability of an engineer's personality, ready for professional activity and constant self-education. Many experts note that in the competency model personal qualities are insufficiently represented [6,8,12]. We regard the formation of the polytechnic competence of future engineers as a holistic understanding of engineering activities: an understanding of technical and technological process, interpreting the logic of the mechanisms, its impact on the environment, the need to create safety conditions in working activity. In this case, the fundamental component is the formation of the personality, universal values of human activity, ability to selforganisation.

## **3. Research objective**

Many foreign researchers state the fact that young people of the 21st century completely lack family, household, technical competencies and note that training in professional educational institutions

should not be purely theoretical, the problem of the practical application of knowledge should occupy an important place in the learning process. Moreover, the formation of “technical, polytechnic, practical-technical, pragmatic, labor” competencies is a necessity in the high-tech age [19]. Russian experts also note the necessity to form polytechnic competencies and work experience from the school bench [7,10]. In modern conditions, the formation of polytechnic competencies and work experience is put forward as key competencies, not only among technical engineers, but also other specialists in the training process. For example, Yu.I. Nikitina states that the formation of polytechnic competencies is a necessity for future doctors [14]. From this perspective, the relevance and practical significance of the formation of polytechnic competencies, allowed us to determine the objectives of the study:

- identify pedagogical conditions for the formation of polytechnic competencies in technical universities;
- organize the conditions of pedagogical impact on the formation of polytechnic competences;
- provide pedagogical support, focused on personal identity, selforganisation, self-development in professional activities;
- empirically verify the effectiveness of the created pedagogical conditions for the component formation of polytechnic competencies and personality development.

#### **4. Theoretical part**

Psychological foundations of activity for a holistic continuous and dynamic process of personal development and improvement, significant for our research, were studied by K.A. Abulkhanova-Slavskaya, B.G. Ananyev, A.N. Leontiev, S.L. Rubinstein and other domestic educators and psychologists. S.L. Rubinstein stated that personality and its properties are formed in the process of activity, in the system of relations with society [18]. In A.N. Leont'ev opinion, activity is the essential feature and main decisive condition for the development of personality [11]. The personality theory states that each person has the desire and ability to achieve full potential and only suitable conditions are necessary.

A study on scientific research in the pedagogical field showed that today there is no consistent approach to the concept of "pedagogical conditions". There are several types of pedagogical conditions, such as organizational and pedagogical, psychological and pedagogical, instructional conditions, reflected in the studies of V.I. Andreeva, V.A. Belikova, S.N. Pavlova and others [1,3,16]. According to A.Kh. Khushbakhtov, current pedagogical conditions act as an integral element of the pedagogical system and the entire pedagogical process, should reflect the totality of the educational environment, including content, methods and forms with the active use of information and communication technologies and equipment [20]. Based on scientific research, it can be considered that pedagogical conditions change with the development of science, information, communication and other technologies.

Polytechnic knowledge of students by nature is a combination of interrelated concepts of natural, technical, mathematical, social and other areas of science, but at the same time becomes polytechnic when this knowledge is included in labor activity. A.G. Kalashnikov developed theories of polytechnical education, polytechnical foundations of technical training and integrative courses [9]. Exploring the challenges of polytechnic education, he defined polytechnical education as a scientifically developed labor experience that is acquired in the process of work at production site. Another researcher in the field of polytechnic education P.R. Arturov notes that polytechnic education and the combination of training with productive labor is a powerful factor in the comprehensive development of the student's personality [2].

#### **5. Practical part**

Unfortunately, the combination of training and labor experience is currently very limited for many reasons. For example, the lack of large-scale industry in Yakutsk, where universities are concentrated, and the disinterest of business to participate in the educational process create difficulties for organizing high-quality on-the-job training program for engineering students. Obviously, nowadays

the brisk development of computer technology and unlimited media space help students to independently acquire knowledge and practical skills on virtual simulators. The researchers note, as we are moving into the information age in education, this process creates alienation, impersonality, moreover, the lack of communication negatively affects the formation of personal qualities [13]. In such conditions, many people highlight the effectiveness of training technology in cooperation, partnership and communication [8.17]. We are impressed by the idea of contextual education, in which, on the basis of various pedagogical technologies, the subject-technological, social and moral-ethical content of students mastering professional activities is modeled [6]. The Modern geodetic technologies scientific student club was created in 2010 on the basis of the Geodesy, Topography and Geoinformatics university laboratory of the Institute of Engineering and Technology of NEFU. Students not only practically master modern geodetic instruments: digital and laser levels, electronic theodolite, total station, GPS-receiver, laser scanner in the laboratory, but also carry out specific projects, real studies, research. Over the years, the club members performed the following types of work: altimetric levelling survey of the NEFU campus; shooting using electronic total station of the buildings of architectural and historical value to preserve its geometric parameters on an electronic medium; digital level monitoring of the building foundations and footing; laser scanning of monuments and building facades for reconstruction; laser scanning of rock paintings in archaeological complexes; land surveys using GPS-receiver and other activity. The results of the scientific club activity are the preparation of articles and reports by students, performance at scientific and practical conferences, competitions and contests of the Russian and international levels [5]. Moreover, students have the opportunity to defend the graduation thesis completing bachelors or master's degree program using the results of real studies begun in junior courses obtained in the scientific club.

We have confirmed the formation of polytechnical competence within the framework of the activities of the scientific club by surveys, questioning, ranking, testing in control and experimental groups (members of the circle) for nine years. The research used the techniques of famous psychologists A.D. Ishkova, T. Leary (adapted by L.N. Sobchak), R. Cattell and others. Diagnosis of self-organisation indicates an increase in such qualities as goal-setting, life planning, situation analysis, self-control, volitional efforts from 45% to 87% over the years of activity in the scientific club. As the identification of social characteristics showed, club members mostly show benevolence, trust, concern for others, but among students in the control group these characteristics are reduced, their attention is mainly directed to themselves. Communication during the club activity contributed to the development of sociability, overcoming internal contradictions, while labor experience made it possible to obtain satisfaction from professional experience, to form willingness to self-development. Many club members state a decrease in uncertainty, fear, anxiety and fear performing operation on unfamiliar equipment; they are not afraid of the difference of opinions, approaches and technologies. Students of control groups are insecure, they are afraid of economic instability, unemployment; their life attitudes are weak or not directed towards engineering [4]. The focused creation of pedagogical conditions in the form of the activities of the student scientific club led to positive dynamics in the development of the main components of the polytechnic competences of future engineers: motivational and valuable by 93%; creative and active at 72%; operational and active at 95%; emotional and volitional at 70%.

## **6. Conclusions**

As can be seen from the above, decades of study experience allowed us to determine the substantial components of pedagogical conditions that contribute to the formation of polytechnic competencies of students in the activities of academic clubs:

- availability of modern material and technical base in educational institutions;
- availability of information Internet technologies in after-hours for students;
- motivation and organization of students' practical experience for mastering the technological process in a specific work;
- creative atmosphere for scientific club members based on subject-subject relations;

- pedagogical support, focused on ensuring self-organization, self-development of the personality in the process of scientific club activity;

- use of pedagogical techniques for cooperation, partnership, collective creative affairs, communication, interaction and other methods.

The formation of the main motivational, creative, operational, emotional components of polytechnic competencies can be defined as the “ability” and “readiness” of future engineers:

- ability of self-organization and readiness for constant self-development;
- ability to apply basic knowledge and skills in mastering new equipment operation and technologies;

- willingness to improve skills in solving professional problems;
- the ability to recognize the impact of technological imperfections on the environment and life safety;

- ability to work in a team, listen to different opinions;
- willingness to change value guidelines and personal qualities.

As a result, scientific club of modern technical university laboratories can become a pedagogical condition and educational space for the formation of the polytechnic competence of the student’s personality. In this case, the main factor is the student himself, his self, his creative and professional activity, direction, and the teacher at the same time acts as the creator of the conditions, as the coordinator.

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