Artículo de investigación

Formation features of professional ethos of future engineers

Особенности формирования профессионального этоса будущих инженеров

Características de formación del espíritu profesional de futuros ingenieros

Recibido: 6 de agosto del 2019 Aceptado: 8 de septiembre del 2019

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Abstract

Modern engineering professionalism involves not only the development of the scientific foundations of engineering design, but also the awareness of the goals, meanings and objectives of engineering. The article is devoted to the study of issues of professional socialization of technical students (future engineers). The empirical basis of the study was the results of a mass survey of students as a part of the seventh stage of sociological monitoring of Ural students (bachelors in engineering educational programs). The influence of contradictions in the development of modern engineering on the processes of forming a professional ethos for future holders of engineering diplomas is substantiated. It has been established that in the structure about a future profession of students of a technical profile, the significance of factors of free creativity is constantly decreasing. Analysis of changes in students' professional plans revealed an increase in the dominant trend of a decrease in the number of students planning to work in their specialty after graduation.

Keywords: Educational choice, engineering education, profession image, professional values.

Аннотация

Современный инженерный профессионализм предполагает не только освоение научных основ проектирования техники, но и осознание целей, смыслов и задач инженерии. Статья посвящена исследованию вопросов профессиональной социализации студентов технического профиля подготовки, будущих инженеров. Эмпирической основой исследования выступили результаты массового опроса студентов в рамках седьмого этапа социологического мониторинга уральских студентов – бакалавров инженерных образовательных программ. Обосновано влияние противоречий в развитии современной инженерии на процессы формирования профессионального этоса будущих обладателей инженерных дипломов. Установлено, что в структуре представлений студентов технического профиля подготовки о будущей профессии постоянно уменьшается значение факторов свободного творчества. Анализ изменения профессиональных планов студентов выявил нарастание доминирующей тенденции снижения числа студентов, планирующих работу по специальности после окончания обучения.

Ключевые слова: инженерное образование, образ профессии, образовательный выбор, профессиональные ценности.

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Resumen

La profesionalidad de la ingeniería moderna implica no solo el desarrollo de los fundamentos científicos de su diseño, sino también el conocimiento de sus metas, significados y objetivos. Este artículo está dedicado al estudio de temas de socialización profesional de estudiantes técnicos (futuros ingenieros). La base empírica del estudio son los resultados de una encuesta realizada a estudiantes como parte de la séptima etapa de monitoreo sociológico de alumnos del Distrito Federal del Ural (licenciados en programas educativos de ingeniería). Los resultados confirman la influencia de las contradicciones en el desarrollo de la ingeniería moderna en los procesos de formación de un espíritu profesional para los futuros titulares de diplomas de ingeniería. Se ha establecido que en la estructura sobre una futura profesión de estudiantes de perfil técnico, la importancia de los factores de la creatividad libre está disminuyendo constantemente. El análisis de los cambios en los planes profesionales de los estudiantes reveló una acentuación en la disminución del número de estudiantes que planean trabajar en su especialidad después de graduarse.

Palabras clave: Educación en ingeniería, elección educativa, imagen profesional, valores profesionales.

Introduction

Training a competitive engineer in accordance with the needs of society, individual and state with changing the nature of modern engineering remains one of the main tasks of higher professional schools (Dezhina Klyucharev, 2018). The study of the problems and prospects of modern engineering reveals certain contradictions in the development of this professional field. Today, the paradox in assessing the status of engineering activity has become obvious: the need for elite and engineering personnel is growing, which is associated with the need to maintain the existing technosphere, the implementation of innovative development strategies of the country and region, but at the same time, the prestige of engineering professions in society is still low (Myagkov, 2016; Varshavskaya, Kotyrlo, 2019; Sobolev, 2018).

Another contradiction is the following: ¨there are a lot of graduates, but few engineers¨. In other words, there are a lot of engineers after universities, but there is still a lack of competencies in the engineering labor market (Varshavsky, Kochetkova, 2015; Shmatko, 2012). The problem of combining the discipline of production, an engineering project and creativity, the innovativeness of engineering activity, demanded by modernity is also very important (Bannikova, Boronina, Vishnevsky, 2016).

The problems and challenges of the modern professional space of engineering present new requirements for the organization of the engineering training system, reveal the internal problems of the vocational training system for engineers, their insufficient practical orientation, and the qualifications of teaching staff that do not meet modern requirements. Communities of professional engineers in close collaboration with universities, as a part of global initiatives, programs and projects, discuss the problems of training engineers, conduct research, look for answers to the questions «What could we show and how could we teach engineers» (Sysoev, Vesna, Aleksandrov, 2019; (Crawley, Malmqvist, Östlund, Brodeur, Edström, 2014; Edström, 2016; Rebrin, Sholina, 2017)

How are these problems in the development of modern engineering reflected in the processes of formation of professional identity of future specialists, sometimes called as «embryos of engineers» (Livshits, 2011)

Methodology

The empirical basis of the study was the results of a mass survey of Russian students with a technical education profile (N = 1827) as a part of the seventh stage of sociological monitoring ¨Student 2016¨. At each of the monitoring stages, from a third to a quarter of respondents were bachelor's students in technical specialties of the third year of study at universities in the Sverdlovsk region. The choice was due to the fact that in the third year in all universities, students switched to the study of special disciplines, therefore they could assess the future profession more clearly. At all stages of monitoring, the quota-nesting nature of the sample was remained. Specific universities of the Sverdlovsk region were the ¨nests¨. Among the surveyed students of applied and academic undergraduate technical areas of study, one third were women (Vishnevsky, 2017).

Research results

When choosing a university, future engineers are considering the availability of abilities for this type of activity increasingly. When choosing a profession, this parameter was considered in 1995 by one in four students from technical specialties, in 2012 one out of eight respondents considered it, and in 2016 one out of ten respondents considered it. Only one of the three respondents identified «ability to realize their abilities» as the most significant life value.

In the structure of representations of technical education students about a future profession, the proportion of factors of free creativity, measured by the parameter «creative, interesting nature of work», is constantly decreasing. Over the past nine years (2007-2016), the influence of this factor decreased by 2.5 times. Universities are training technical specialties today, focused mainly on the «copying» and «maintenance» of functioning technologies. The creative, interesting nature of the work is significant only for a third of all respondents, and even less for students of technical specialties.

Choosing a technical education, a significant part of students does not see themselves in the engineering field. The number of students planning to work in their specialty after graduation has decreased. Engineering training with a strong mathematical foundation is in demand in various fields today. Our previous survey of enrollees who chose technical specialties (mechanical engineering, radio electronics, information technology), confirmed the predominance of pragmatic motives for professional choice. The enrollee seeks to choose the profession, which, in his opinion, will allow to get a job quickly, efficiently and with guarantee and to make a successful career. Technical education is universal, because it forms the skills and personal qualities that promote career growth in any of today's prestigious fields of activity, primarily in management and business (Bannikova, 2013).

It is significant to compare the structure of representations of students of humanity and technical specialties about the significance of certain characteristics of future work (Table 1). For the students of humanity, factors of free creativity, interest and personal growth, altruism are more significant, and for students of technical specialties a set of requirements for the status attributes of activity as career opportunities and prestige, working conditions, guarantees against possible unemployment is more significant.

Table 1. System of professional values of students of technical and humanitarian training profiles *, %

Options for evaluating the importance of future work	Humanitarian	Technical
Ability to achieve recognition, respect	30	24
Ability to have a high post and a power over other people	20	23
Opportunity for a career, achieving a high level of professionalism	54	48
Opportunity to fully realize your potential	31	25
Ability to earn big money, high income	54	64
Possibility of continuous self-improvement	34	31
Opportunity to benefit people	32	20
Opportunity to work in a good, friendly team	25	23
Good working conditions	31	33
High prestige of the profession	20	15
Independence, lack of petty guardianship, regulation	12	22
Correspondence of the profession to my abilities, knowledge, skills	16	10
Creative, interesting nature of work, variety of work	27	19
Guarantee against possible unemployment	10	19

* The amount is above 100%, since one respondent could give several answers at the same time

All indicators of the importance of certain professional values for future engineers are lower than for students of other training profiles. The exception is «ability to earn big money, high income». This value is higher comparing the students of other profiles.

Almost every fifth future engineer chose the answer option «guarantees against possible unemployment». Meanwhile, according to the

monitoring of employment of graduates of universities of the Sverdlovsk region according to the results of their employment, provided by the Pension Fund of the Russian Federation, Federal Service for Supervision of Education and Science and educational organizations, the highest percentage of employment (from 80% to 90%) among graduates who have completed engineering and medical fields of training. Among the leading specialties and areas for this indicator are nuclear energy and technology, nursing, pharmacy, electricity and heat, and chemical technology. Graduates with a legal and economic education are employed worst of all: almost 40% of lawyers and about 20% of those who studied economics and management do not find themselves on the labor market in the first year after graduation (Ministry of Science and Higher Education of the Russian Federation, 2016).

Evaluation of students' attitudes to ¨stay in the profession, planning the future sphere of application of forces and knowledge, can be defined as a secondary professional choice. These assessments depend on students' perceptions of the resources of their future professional communities. Analysis of the dynamics of changes in students' plans revealed an increase in the dominant trend of a decrease in the proportion of students planning work in their specialty (Table 2).

Table 2. Dynamics of students' professional plans *, 1995-2016, %

Professional plans	**1995**	**1999**	**2003**	**2007**	**2009**	**012**	**016**
Work in the specialty	66	46	48	42	44	43	35
Make your own business	24	17	29	19	16	14	14
No definite plans for future work	11	11	18	14	14	4	4
Continue education (magistracy, graduate school)	11	13	23	11	10	9	23
Work not in the specialty	12	12	12	10	7	6	6
Study or work abroad	16	9	15	7	10	9	5
Devote yourself to home, family	14	3	8	3	4	3	2
Do research work	5	2	5	3	3	1	1
Live with casual earnings (freelance)	5	4	1	1	1	1	0

* The amount is above 100%, since one respondent could give several answers at the same time

A comparative analysis of students' professional plans allows us to conclude that the previously de-professionalized tendency is turning into a pattern. This is not only the loss for the institution of vocational education of its most important function of providing a profession, replenishing professional groups. The state finances education in these areas but does not receive personnel. This is the problem of learning demotivation. Students do not plan to work in their specialty, hence the formal attitude towards learning. The process of deprofessionalization has already found appropriate reflection in the minds of young people (Cherednichenko, 2018). Most students associate the problems of future employment not with the demand for a profession, but with a lack of work experience. They respond to the requirements of most employers, for whom not the profession is important, but the length of service, therefore they try to combine education and periodic part-time jobs.

Students' professional plans are largely formed under the influence of the subjective image of the profession formed in the learning process. For two or three years of vocational training, the cognitive component of the image of the engineering profession has been enriched. For students of technical specialties, the level of ideas about the future profession increased more than three times (from 14% to 52%). The emotional component of the image of the engineer profession has also changed. For the purposes of statistical representativeness, we distinguished the category of students with a technical education profile who expressed strong agreement with the proposed judgments about the future profession (Table 3).

Table 3. Image of the profession through the eyes of the students of technical specialties, %, share of positive answers

List of judgments about the future profession	2016	∑
Interesting, corresponds to the abilities, skills	74	77
Provides opportunity to achieve recognition, respect, brings real benefits to people	70	74
Possibility to realize life plans	60	67
Prestigious	58	65
Allows for a decent existence	80	74
Is in demand on the labor market even in times of crisis	75	66

The high level of agreement with the proposed judgments about the profession can be evaluated in two ways. On the one hand, as an emotional justification for previously made professional choice. So, three quarters of respondents of technical specialties noted that engineer ¨is an interesting profession, it corresponds to abilities, skills¨, however, only 10% of respondents consider their abilities when choosing a direction of study. On the other hand, the future profession is perceived by students not as a specific set of functions, but as a tool for shaping their future status, desired lifestyle. Students of technical specialties highly appreciate the economic resources of the future profession, because it ¨allows for a decent existence¨, it ¨is in demand in the labor market even in times of crisis¨. This choice was made by up to 80% of future engineers, while only 55% of students of humanities noted this judgment about their future profession. At the same time, technical specialties rate its symbolic resource lower than students of other fields of study: 58% of them agree that engineer is a prestigious profession, 70% humanities students also agree (Bannikova, 2013).

Conclusion

In the process of studying at a university, young people develop as individuals, gain new experience, and their attitude to life and the goals that they set for themselves change. The choice of the university, the direction of preparation took place under the influence of the already formed system of value orientations, the personal meanings of the applicant. At the same time, the student's education and professional activity affect the further development of his system of views and the sociocultural characteristics of future engineers.

The state of professional self-determination of undergraduate students in engineering specialties can be qualified as diffuse, characterized by the absence of specific, established professional goals, values and beliefs. Today, the education process for future engineers is associated not with gaining knowledge and skills in the chosen profession, it is the way and time of development of one's natural inclinations and abilities.

Acknowledgment

This article was prepared in the framework of the project № 19-011-00252 «Comparative analysis of social effects and the impact of institutional conditions on the professional training of engineering specialists», implemented with the support of the RFBR.

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