

ISMGE 2020**II International Scientific and Practical Conference "Individual and Society in the
Modern Geopolitical Environment"****CRITERIA AND INDICATORS OF THE PERSONNEL TRAINING
SYSTEM DEMANDED BY PSEDA**

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Abstract

The article deals with the process of personnel training at the bachelor's level in the Yurga Institute of Technology of the National Research Tomsk Polytechnic University (UTI TPU) which has become the center of educational cluster. The authors consider different systems and forms of professional education: joint educational programs, double diploma, shortened programs, parallel training on working specialties. The article focuses on the issue of partially using the dual system of training and interaction of educational and production clusters, which allow preparing professional personnel demanded by the enterprises of the PSEDA zone meeting the requirements of employers. There is a model of the preparation system of a required specialist at the PSEDA enterprise, which uniqueness lies in the possibility of its use in training a specialist of any required specialty. The implementation of the educational program is modular and allows to account for their level of training, which made it possible to choose an individual educational trajectory depending on the need for specialists' competences considering the professional activity. The personnel training peculiarity is the close cooperation between plant and university; variability of professional training scenarios (general education - PVE-HE / working profession / double diploma / SVE); application of individual educational trajectory of a student; professional standards (including labor actions and functions) as the basis of knowledge, skills, possessions of a student.

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1. Introduction

In the period from 2017 to 2020, the Yurga Institute of Technology of the National Research Tomsk Polytechnic University (UTI TPU) became the center of educational cluster, conducts training in 7 areas of the bachelor's degree in four forms of education, has more than 500 students including the distance learning department. Following the formation of the Priority Social and Economic Area (PSEDA) on the territory of the Yurga, UTI TPU continued its activities aimed at the development of an educational cluster and integration with educational institutions. Over the past 3-5 years, the university has trained, prepared and retrained 74% of PVE and IVE graduates. Joint educational programs allowed students to get a double diploma, study in a shortened program, get working specialities, studying in parallel. Interaction of educational and production clusters allowed to train the personnel, demanded at the enterprises of the PSEDA zone according to the requirements of employers and to pass to the partial use of the dual system of training, which resembles the plant-university training system. Such training system allowed to develop practice-oriented graduates prepared to start their activity at the enterprise immediately after graduation. The educational process of UTI TPU integrated an adaptive organizational and pedagogical system of training, which allowed to train qualified personnel for a short time in the required specialties and new directions to provide new PSEDA enterprises with personnel of different levels.

2. Problem Statement

Our training system has the following features:

- it is adaptive for different age groups, which provides a possibility to use it both in the education and training of students with different levels of education, and in the supplementary vocational education of personnel with different levels of education;
- it has a modular structure to adapt it to the preparation of narrowly directed frames in a short time;
- using the system in the training of the demanded personnel allows the use of dual system of education to provide students and trainees with not only theoretical knowledge, but also practical skills;
- preparation system includes a two-circuit ABET model, which consists of the following content:
 - a) ability to clearly define the sequence of stages in the design and quality assessment of the educational program used in the training of the demanded personnel and their competencies (Steinov, 2003);
 - b) establishes the relationship between the educational processes within the training system and the external environment, thus guaranteeing quality training.

3. Research Questions

The developed model of the training system for specialists demanded by PSEDA includes the following components:

- *target* (goals and tasks of forming required competences);
- *methodological* (conditions, principles of competence formation);
- *substantial* (methods, forms, means);
- *organizational-procedural* (design stages of the process of forming competences of a demanded specialist) (Chelnokova, 2008);
- *effective* (criteria and indicators for forming required competencies) (Butko et al., 2005).

The uniqueness of the system model lies in the possibility of its use in training specialists of any required speciality (Lizunkov et al., 2020). The uniqueness of the system consists in the organizational and procedural component. At this stage, the model of training the demanded specialist takes a modular character, using the dual education component.

The organizational and procedural component includes three main subcomponents at the entrance of the unprepared specialist with deficient competences, according to the head of the enterprise located at the PSEDA, at the exit of the prepared specialist with supplemented competences. The subcomponent "training process" includes the basic educational module, universal for all demanded personnel and the additional educational module consisting of replaceable modules (disciplines) which structure depends on specialty of the demanded specialist. Implementation of the additional educational module is carried out in the environment of dual education, which implies direct interaction with interested enterprises in the process of specialist training (Lizunkov & Minin, 2015). Our system of preparation for specialists demanded by PSEDA will allow to prepare the qualified specialist for short terms through the use of modern educational and evaluation technologies and means in the system (Borisova, 2000).

This system is implemented in the process of training students and trainees on the base of UTI TPU.

4. Purpose of the Study

The purpose is to evaluate the benefits of the implemented system in the educational process of UTI TPU using the methods of mathematical statistics (Demenko et al., 2017; Lizunkov et al., 2017).

The direct criteria for the effective functioning of the educational system aimed at training personnel demanded by the PSEDA include cognitive, personal and practical competence of students (Table 1), whose significant changes resulted from the introduction of the mentioned system into the educational process of training students.

Changes in the results of educational activity of UTI TPU, which has a high level of integration into the educational space, include the following indicators:

- level of formed professional competency of future employees;
- dynamics of development and professional growth of students;
- directions of personal motivation;
- characteristic of personal integration.

Identification of criteria and corresponding indicators of formed competencies of students served as a continuation of verification of system efficiency (Table 1).

Table 01. Criteria, indicators, means and methods of diagnostics for formed competencies of PSEDA personnel

Criteria	Indicators	Diagnostic tools and methods
1	2	3
1. Personality-oriented accentuation of competencies	Motivation for personal and career growth in the acquired profession, readiness for self-improvement and self-development. Acquisition of self-analysis and self-assessment skills. Personal qualities and their formation, which consists in purposefulness and goal-setting, responsibility, accuracy and punctuality, creativity, organization and independence.	sociological (survey); expert, i.e., assessment by experts on the basis of a questionnaire or a control and test task execution
2. Cognitive - oriented accentuation of competencies	Professional competencies (in the fields of modern technologies, peculiarities of industries and manufactures, trends and dynamics of development of the industry and economy in general, etc.). High level of literacy (in areas of work with information sources, technical works and tasks, project activities, research and development, etc.). Innovative thinking (in the areas of forecasting and analytical activities, the ability to anticipate industry and market trends, etc.).	evaluating employee. The experts may include managers, responsible officials, supervisory boards, public organizations, auditors, consumers; computational (statistical), i.e. mathematical processing of an array of data.
3. Activity-oriented focus on competencies	Upper-professional and professional competencies, knowledge of norms and standards, practical possessions and skills aimed at the development of the enterprise and industry. Primary skills of research and design and implementation activities Experience of leadership, teamwork, social interaction of organizational activities.	Analysis of the received data allows drawing conclusions about the quality of personnel training with the further calculation of training efficiency.
4. Satisfaction of employers with training results	Level of employers' satisfaction with the quality of personnel training. It is determined through a survey and questionnaire of representatives of companies that use the services of personnel. It is necessary to analyze the questionnaires and calculate the level of satisfaction with the training and draw conclusions.	

We have coordinated the proposed set of criteria, indicators, methods and means of diagnostics with experts and representatives (LLC "Siberian Investment Group", PJSC "TransFin-M" and other PSEDA enterprises) of various levels (director, deputy for production and personnel, chief fish breeder, heads of production workshops, etc.), teachers of educational institutions participating in training for assessment of their completeness and relevance. While selecting experts, we applied a combined method based on the maximum competence coefficient, including elements of the hierarchy analysis method.

5. Research Methods

When developing *indicators to assess the level of formed competencies of demanded specialists*, if the "architecture" of the competence includes three components - *cognitive* (knowledge and understanding), *activity* (practical and operational application of knowledge) and *personal* (personal qualities, attitudes, value orientations), we relied on the analysis of scientific and methodological

literature on the problems of pedagogical measurements (B. Bloom, M.G. Minin, A.I. Subetto, Yu.G. Tatur et al.). The main criterion for determining the accentuation of the competency is the dominant form of its manifestation in a person's behavior (in an educational or real life situation): *demonstration of understanding of something* - cognitive-oriented competencies; *demonstration of action* (subject, verbal, communicative, intellectual, etc.) - activity-oriented competencies; *demonstration of personal manifestations* (position, quality, attitude, etc.) - personality-oriented competencies. The system efficiency experiment involved 174 employees (Table 2). To assess the level of formation of specialists' competences prior to the experiment, we used original diagnostic tools based on modern technologies to check knowledge, skills and possessions (to check knowledge we used test tasks of open and closed types, skills - practical calculation and logical tasks, possessions - cases with real production situations).

Table 02. Dynamics of forming significant competencies of the personnel demanded by PSEDA enterprises before and after the experiment

Levels Accentuations of competencies	Before the experiment			After the experiment		
	Low (P1)%	Average (P2)%	High (P3)%	Low (P1)%	Average (P2)%	High (P3)%
1	2	3	4	5	6	7
Personality-oriented	50	45	5	10	59	31
Cognitive-oriented	50	43	7	15	40	45
Activity-oriented	37	50	13	10	45	45

Comparing the results of the changes at the stages before and after the experiment determines the reliability of capabilities, prospects and efficiency of the designed training system for specialist demand by PSEDA (Tarakanov et al., 2019). The dynamics of forming the competencies of trainees was determined by the expert method of assessment, with a total number of 96 participants, including representatives of various departments of PSEDA enterprises engaged in similar activities in other regions of Russia, and businesses planning to enter the PSEDA. Table 2 presents the results of the expert evaluation before and after the experiment.

6. Findings

The final stage of the pedagogical experiment traces the positive dynamics of change in the number of students with the highest level of personally-oriented knowledge, skills and possessions, which was $\approx 31\%$, more than 25% higher than before the experiment. We assessed the level of development by using psychometric methods (a set of tests and questionnaires), the answers to which were processed by experts using special formulas and based on numbers. We believe that the use of the training system for specialists demanded by PSEDA has influenced the positive dynamics of the development of personal-oriented knowledge, skills and possessions. Assessing the level of development of **cognitive-oriented** knowledge, skills and possessions offered students to solve non-standard tasks of different types. Table 35 shows that the number of participants who reached level III of development increased more than 6 times and became equal to 45% of the total number of students.

The solutions to the tasks proposed by the trainees had a practice-oriented character based not only on the theoretical knowledge obtained, but also on the practical skills acquired by the trainees during their training directly at the enterprise within the framework of the dual training system (Inshakova & Popkova, 2017).

To reveal the dynamics of development of **activity-oriented** knowledge, skills, possessions, the trainees were offered a number of tasks that account for the specifics of the structural unit of the enterprise where the trainees work, and a set of joint tasks. For example, specialists of the management and production department, working in a team, created a business project for the development of their enterprise (the most promising and effective solutions were used in the real activities of enterprises), thus developing professional and upper-professional knowledge and skills, leadership experience and teamwork, as well as skills of research and design and implementation activities. The experts carried out diagnostics during project implementation by observing and analyzing the results of implementers. From the results of Table 35, the lines of dynamics of activity-oriented competence formation show an increase in the number of level III students by more than 30%. Probably, such dynamics in the development of practical competencies is due to the fact that trainees had the opportunity to interact not only with teachers from other educational institutions, but also with employers of foreign and Russian partner companies, which shared practical experience in the development of their organizations and teamwork in one of the modules of training conducted in the distance format (Vikharev et al., 2018).

The implementation of the educational program is modular and allows to account for their level of training, which made it possible to choose an individual educational trajectory depending on the need for specialists' competences considering the professional activity. The students had an opportunity to use all resources of educational and production cluster of Yurga (administrative, educational, industrial, social and cultural); services of teachers and employers of Russian and foreign educational institutions and production enterprises; within the dual system of training to obtain practical knowledge and skills, as well as experience at enterprises of the real economy.

7. Conclusion

Table 3 presents the results of assessing the level of personnel competencies and a list of enterprises whose employees have participated in the work of the expert commission to assess the competencies of trained specialists. The total number of representatives of the enterprises was 54 people, all of them took part in the work to identify significant competencies of demanded PSEDA personnel, conducted at the beginning of our survey. Columns 1 and 2 list the enterprises and the number of experts, in addition to the enterprises (rows 1 and 2), whose personnel passed the training. The expert commission invited representatives of organizations planning to enter the PSEDA of different regions of Russia (rows 3-5).

Table 03. The results of the expert assessment of the preparedness level of employees trained on the basis of UTI TPU

PSEDA enterprises that participated in the expertise	Total number of experts (people)	Level of training		
		1 level (low), (people)	2 level (average), (people)	3 level (high), (people)
1	2	3	4	
1. LLC "SIG"	13	1	2	10
2. LLC "Anzhero-Sudzhenskiy Melkombinat"	12	1	1	10
3. LLC "Green Project"	7	1	1	5
4. LLC "Textile-Talgar"	10	2	1	7
5. LLC "United Woodworking Commercial and Industrial Company"	12	2	1	9
Total	54	7	6	41

Table 3 shows that 41 experts rather highly assess the preparedness level of personnel trained on the basis of UTI TPU in four programs of SVE, 6 experts assess the training at an average level, which is probably due to the difficulty of students learning the educational program remotely, 7 experts rank students as low level of learning the course, which is influenced by a weak basic training of the student (Politsinskaya et al., 2019). The result of this assessment confirmed the effectiveness of implementing the Concept of training personnel demanded at PSEDA. This was largely achieved through the use of adaptive system implemented in the education and production cluster, which uses in the preparation of elements of dual system training, network interaction of social partners, domestic and foreign systems and models of training, including CDIO Syllabus and CDIO Standards, ABET models. The personnel training peculiarity is the close cooperation between plant and university; variability of professional training scenarios (general education - PVE-HE / working profession / double diploma / SVE); application of individual educational trajectory of a student; professional standards (including labor actions and functions) as the basis of knowledge, skills, possessions of a student.

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