Information support for organizational management of the training process for specialists

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Abstract. This article deals with an approach to the assessment of professional competences development among university graduates. The main attention is paid to the evaluation of academic achievements necessary for the successful fulfillment of tasks in any professional activity, taking into account the personality traits of the future professional. The model of a professional portrait of the graduate is created, including a set of competence formation assessments using types of control that are carried out within the framework of disciplinary evaluation, polydisciplinary and non-disciplinary. Polydisciplinary control allows to reveal the level of students' abilities and skills formation, non-disciplinary control includes the characteristic of student's personal qualities, which can be expressed through a portfolio. The obtained data are represented graphically in the form of vectors with the coordinates that characterize the level of competences development in various areas of production activity. The proximity of a vector to any area allows one to recommend it to a graduate for further employment, and it is assumed that in this area the graduate will be more successful.

Keywords: model of university graduate, vector approach, assessment of competence development.

1 Introduction

Information support of the training process for specialists, corresponding to current trends in the development of higher education, provides for an assessment of the learning process quality (where the competences are indicators of quality), and its timely adjustment. At the same time, educational technologies are considered as a way to form the competences (through the use of active and interactive training methods), and assessment tools (through employers, experts from the professional environment) are used as a tool for proving the competence development [1].

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Assessment of the level of competence formation is a new task for universities, which cannot be solved only with the help of traditional control methods and assessment tools. The implementation of a competence-based approach is aimed at improving interaction with the labor market, increasing the competitiveness of specialists, updating the content, methodology and relevant learning environment. At the moment, there is no universal method for evaluating the learning outcomes of university graduates. Therefore, the development of the competence assessment methodology, that increases the objectivity of evaluating learning outcomes (competence) of university graduates, is an urgent task. In particular, it includes the possibility of providing various recommendations based on the assessment for subsequent employment [2] that significantly accelerates the social adaptation of graduates, as well as solves the problem of customer satisfaction (employers).

In accordance with the Federal State Educational Standards of Higher Education (FSES) in any field of education for the successful implementation of professional tasks in each occupational category (OC) (research, production and technology, etc.) graduate must have a set of professional competences (PC), forming a specific OC (figure). Consequently, the model of graduate's professional portrait (profile) must include a set of assessments of the formation of professional competences, taking into account the personality traits of a future professional.

2 Methods andmaterials

While managing in market conditions, the principle of advancing, foreseeing of situation is extremely important. In this article, a vector method was used to assess competences. This method based on the results of students' learning activities, allows to provide individual recommendations for further professional activities.

$$\vec{R}_{спец} = \sum_{j=1}^{m} Q_j \vec{I}_j \qquad (1)$$

where $\vec{R}_{спец}$ is a vector of the professional profile of the graduate, which shows the direction of the student's professional growth;$Q_j$is a graduate readiness assessment to perform professional tasks in the *j*-th OC, characterized by a different set of competences, is a normalized value (weighted average); $\vec{I}_j$ is a unit vector in the direction of the *j*-thOC;*m* is a number of OC.

Any OC is formed by a set of competences, which is specified in the corresponding FSES. The formation of each competence is carried out consistently in the learning process during the studying a number of disciplines, passing a various types of practice. Each competence is formed in the study of several disciplines during the entire period of study, therefore the competences is crossing.

A mathematical model for assessment of the competence formation in particular OC can be represented as:

$$Q_j = F_j\left(\theta_j\right) \quad (2)$$

Where θ_j is a vector defining the composition of competences for the *j*-th OC, $\theta_j = A_j\vec{q}$;A_j is a diagonal matrix, $\left(a_{ij}\right)_{n\times n}$;

$$a_{ij} = \begin{cases} 1, \textit{ if the } i-th \textit{ competence is in the } j-th \textit{ OC} \\ 0, \textit{ if it is not} \end{cases};$$

$\vec{q}$ is a vector of acquisition assessment of $PC\left(\overline{1,n}\right), \vec{q} = \left(q_1, q_2, \ldots, q_n\right)^T$;q_i is an assessment of the formation of the *i*-th competence of the educational program.

The standard procedure for assessing students' achievements in the framework of knowledge and skills does not allow to take into account many competences that are necessary to compile a more accurate professional portrait (profile) of graduate. Currently, foreign and domestic researchers have developed the mathematical models and approaches describing the stages of the learning outcomes monitoring process [3-6]. Analysis of the work allows to conclude that it is necessary to develop and implement additional (to existing methods of control) means of assessing the students' learning outcomes, which reflect the personal qualities of the graduate.

The block of professional competences is a system of knowledge, skills and abilities acquired in a higher education institution taking into account depth and volume of their development. Professional competences describe the qualities and characteristics of a person, which are necessary for a specialist to solve tasks in a particular field of professional activity. In this regard, it is important to highlight the personal qualities of the graduate in the formation and evaluation of competences, since this component determines the level of self-esteem development, awareness of personal importance in the profession, responsibility for the results of their activities, self-realization in the professional activity.

3 Results and discussion.

There is a need to develop a competency assessment system with using such types of control, which are carried out within the framework of disciplinary, polydisciplinary and non-disciplinary assessment. Polydisciplinary control allows to identify the level of skills formation of students and includes the assessment of all types of student practices, the implementation of course projects and research projects, as well as graduate qualification work. Non-disciplinary control includes the characteristic of the student's personal qualities, which can be expressed through a portfolio. This type of control must be considered in assessment forming in each field of professional activity.

The level of graduate's competence development depends on a number of interrelated factors: knowledge of the theoretical foundations of the subjects, the ability to use this knowledge in practice, the ability to self-education, the ability to develop the personal characteristics, etc. Insufficient level of development of any factor affecting the formation competence, ultimately reduces the specialist's competence level. In

such cases, the selection criterion in a decision-making situation is a combination of individual criteria, and the problem becomes multi-criteria. In solving multi-criteria problems, various criteria convolution methods into one generalized (integral) criterion are often used.

The most popular way for obtaining a composite quality indicator is an additive convolution. It is a weighted average value, which is used if there is a possibility of compensating the values of some criteria at the expense of others, that corresponds to the assessment task of student's competence in the *j*-th OC:

$$Q_j = \delta_j \frac{\sum_{i=1}^{r} z_i q_i}{\sum_{i=1}^{r} z_i} + \gamma_j p_j \qquad (3)$$

Whereδ_j, γ_j arethe weighting factors determined by the expert method, taking into account the influence of each type of assessment (disciplinary, polydisciplinary and non-disciplinary) on competence in the *j*-th OC, provided that$(\delta_j + \gamma_j) = 1$;*r* is a number of competences included in the *j*-thOC;z_i is a number of credits for the *i*-thcompetence;p_j is an assessment for the portfolio (the part of the portfolio related to the *j*-th OC is taken into account).

Assessment of competency formation:

$$q_i = a_i \frac{\sum_{l} \alpha_l z_l d_l}{\sum_{l} \alpha_l z_l} + b_l \frac{\sum_{l} \beta_l z_l k_l}{\sum_{l} \beta_l z_l} + c_i \frac{\sum_{l} z_l t_l}{\sum_{l} z_l} \qquad (4)$$

wherea_l is a share of theoretical training for the lth discipline, forming the *i*-thcompetence;*l* is a number of competences defining a specific field;$z_l$is a number of credits z in the *l*-th discipline, forming the *i*-th competence (part of the competence);d_l is a discipline assessment (mark in the examination record or rating grade in the discipline, the midterm assessment for which is "passed");$\beta_l$is a share of training devoted to the independent work of students (the implementation of course projects and works, the preparation of practice reports, etc., $\sum_{l} [(\alpha_l + \beta_l + 1) z_l] = z_i$;k_l is apoly-disciplinary assessment of the disciplines forming the *i*-th competence, determined by the set of results of the coursework and projects, forming a specific OC;$t_l$isapolydisciplinary assessment of practices forming the *i*-thcompetence;a_i, b_i, $c_i$are the weighting factors determined by the expert method, $(a_i + b_i + c_i) = 1$.

The search for means of assessment students' personal achievements must be carried out among the forms of authentic assessment. Authentic assessment is a type of assessment used in practice-oriented education, which involves the assessment of the formation of skills, abilities and competence of students in situations as close as possible to real life - daily or professional. The authors of [7] conducted a study

which proves that the valid means for assessing student competence in the framework of non-disciplinary control are the portfolio and rating system.

In focusing on new educational goals (transition to a competence-based approach), many countries include portfolios in their educational systems. The study of works [7-9] allows to conclude that the application of the portfolio method allows to analyze the significant results of the professional development process of the future specialist, to ensure monitoring of the educational process.

Currently, researchers in the practice of foreign and domestic universities have developed a number of models and types of portfolios. Depending on the goal, a different form of the portfolio is chosen: in order to track the dynamics of the student's development - development portfolio; to predict and draw up a plan for the learning process - educational portfolio; to demonstrate academic achievements - indicative portfolio; to characterize professional readiness - employment portfolio.

The accuracy of the assessment of students' achieved results depends on the structure of the portfolio, which should be relevant to the goals of its creation and use. Therefore, it is necessary to develop such a portfolio conception that reflects the student's activities outside the disciplines, but at the same time provides an opportunity to characterize his successes in each of the professional activity fields specified by the FSES of each of the training areas. Indicators should be clearly defined by the corresponding specific training area.

The authors have developed the rating system for portfolio assessment, the advantages of which are the promotion of effective student learning, the objective assessment of each student, the ability to make timely adjustments to the organization of the educational process. In developing of variable portfolio assessment system, it is necessary to take into account different ideas about the quality of the prepared portfolio materials, and use a 5-point scale.

Each student can sum up his achievements not only after completion of training, but also after intermediate stages; specific groups of achievements are evaluated only if there is confirmation in the main sections of the portfolio. Examples of portfolio evaluation criteria are given in the table.

Table 1. Examples of the portfolio assessment.

Kind ofachievements	Evaluation of academic achievements
Scientificresearch	
1. Print and electronic publication	Article co-authored with supervisor – 2 points Selfarticle– 3 points
2	
Design-and-engineering	
1. Participation in the development of documentation	Intra-university level–1 point City – 2 points Federal –3 points
2.	
Institutional and managerial	
1. Participation in student councils and other bodies of self-government	Intra-university level – 1 point City – 2 points Federal –3 points

2.	
Production and technological	
1. Execution of course projects on topics relevant to the enterprise and commissioned by the enterprise	Board's assessmentoftheproject
2.	

The developed model makes it possible to obtain an integral indicator characterizing the readiness of graduates to perform professional tasks in a specific field of professional activity (production and technology, institutional and managerial, etc.). The complexity of introducing this technique into practice is in the labour intensity of competence assessment; therefore, the result processing must be automated with the use of modern software (MS) [10-12].

The use of information technology will reduce the workload of teacher, since it is exempts from the primary processing of the results. In this case, it is possible to evaluate the competence as an integral parameter. Consequently, the obtained assessments are scientifically based and less susceptible to the influence of the teacher's subjective opinion.

For this purpose, a system [13] has been developed, designed to assess the competences of graduates and build a vector portrait (model) of graduate. The developed system is embedded in the data base management system "Rating", available in Voronezh State University of Engineering Technology. This system consists of the following subsystems:

- - data collection subsystem;
- - data storage subsystem;
- - data calculation subsystem;
- - subsystem of statistical analysis;
- - subsystem for developing recommendations for further employment.

The obtained data are presented graphically in the form of vectors with coordinates characterizing the level of competence development in various area of production activity. The proximity of the vector to any area allows to recommend it to the graduate for further employment, and it is assumed that in this area the graduate will be the most successful.

4 Conclusions

Thus, the competence assessment model and the information system for its automated calculation have been developed, that allows to identify the specific characteristics of each graduate and recommend the most appropriate field of professional activity.

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