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L. Mironova

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Method for Assessing the Level of Formation of Flexible Competencies of University Graduates in the Context of Digitalization of the Economy

L Mironova[a)]

Ural Federal University named after the first President of Russia B.N. Yeltsin, Yekaterinburg, Russia

[a)] *Corresponding author: mirmila@mail.ru*

Abstract. The purpose of the article is to develop a methodology based on the application of the well-known mathematical method of rank standardization, which allows obtaining numerical intervals for assessing the level of formation of flexible competencies. A tiered approach is proposed for assessing their formation (low, medium, high). The construction of the methodology is based on the application of the "Big Five" approach of non-cognitive personality characteristics (soft skilles), which include conscientiousness, extraversion, neuroticism, openness, agreeableness. Despite its linguistic binding, the approach is considered universal regardless of language. The technique can be used to control the formation of soft skilles in the implementation of corporate training and education programs, as part of mentoring and coaching.

INTRODUCTION

The transformations taking place in our country lead to changes in the field of education, presenting graduates of higher educational institutions with new requirements for the quality of education, and higher educational institutions - the requirements of new priority goals and objectives of the development of modern education [1].

In this regard, in the conditions of market relations and the increased requirements of employers to the level of training of university graduates, interest in both professional and supra-professional competencies of graduates has increased.

This issue has become especially acute in connection with the intensive development of digital technologies. Over the past decades, information and communication technologies (ICT) have moved away from their narrowly focused role in information processing, becoming a universal tool that can be applied in almost any area of the economy and industry.

The stage of informatization of society according to research by Robert I.V. - a social process in which “the dominant type of activity in the sphere of social production is collection, accumulation, processing, storage, transfer, use, production of information, communication technologies” [2].

According to the strategy for the development of the information society in Russia for 2017-2030, approved by the Decree of the President of the Russian Federation of 09.05.2017 No. 203, the digital economy is understood as “economic activity in which the key production factor is digital data, processing large volumes and using the results of the analysis of which, in comparison with traditional forms of management, can significantly increase the efficiency of various types of production, technologies, equipment, storage, sale, delivery of goods and services ”[3].

This means that in the digital economy, a university graduate must not only confidently master ICT tools as a tool for collecting, accumulating, processing, storing, transferring, using, producing information in his professional field, but also know the basics of digital technologies in order to be in able to apply these technologies and devices in their professional activities.

The digital economy presupposes such a level of development of digital technologies that will allow remote control of the subject environment [4]. Obviously, such control is provided by the corresponding software interfaces, which

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allow connecting objects of the objective world to the network, as well as the operation of sensors that monitor the functioning of objects in real time.

At the same time, among the existing problems associated with making the digital economy a reality, there is a shortage of IT specialists adapted to a particular sphere of the economy, capable of developing highly specialized computer programs and applications. And on how quickly and competently these issues are resolved, the success and pace of formation of the digital economy in Russia largely depends.

Therefore, the National Program "Digital Economy" indicates the need "... to improve the education system, transform the labor market, create a motivation system for mastering the necessary competencies and the participation of personnel in the development of the digital economy ..." [5]. At the same time, for the successful development and implementation of the digital economy, it is necessary that specialists in various sectors of the economy have competencies that would allow them to effectively use software based on digital technologies.

At the same time, according to the analysis of research in the field of pedagogy and psychology, it is necessary to distinguish between competences that are directly related to professional activity (the so-called hard skilles) and competencies determined by personal qualities and attitudes, as well as social skills and managerial abilities (so-called soft skilles) which are of a supra-professional nature, but on which successful participation in the work process and high productivity significantly depend.

However, the analysis of existing theoretical developments leads to the conclusion that their content currently does not allow solving these problems from a scientific standpoint. In this regard, it should be recognized that theoretical issues related to the formation and assessment of the level of formation of flexible competencies of university graduates in the context of the digitalization of the economy need further development. This is the *relevance* of the topic of the presented article.

METHOD

The technique is based on the construction of a mathematical model, which is based on the method of rank standardization, a detailed description of which is presented in [6,7]. Let us briefly describe the algorithm for constructing a mathematical model.

As an object of modeling, a list of categories of non-cognitive personality characteristics is considered, each of which is manifested by a certain set of features.

Step 1. Ranks are assigned to features. Moreover, the more significant the contribution of a feature to a category, the higher the rank should be, and the number of ranks is equal to the number of evaluated features. In other words, the assessment is made on a scale with the number of divisions equal to the number of features.

Step 2. In general, all studied categories can have a different number of features, therefore, without special processing, it is impossible to compare the ranks, since the ranks are actually obtained by measuring using scales of different lengths.

Step 3. The procedure for standardizing ranks consists of stretching the "short" categories evenly to the longest category. The value of the standardized rank for each feature is equal to the difference between the maximum and minimum rank in the category, divided by the number of features between them. After the standardization procedure, it is possible to compare the categories with each other, in particular, we can calculate the value of the average rank for each attribute.

Step 4. We build the dependence of the average values of the ranks on the values of the assigned ranks of the category with the maximum number of features. According to the schedule of this function, we determine the boundaries of 3 numerical intervals corresponding to the low, medium and high level of formation of soft skilles.

RESULTS AND DISCUSSION

To imagine what competencies a graduate should have in the era of the digital economy, let us consider modern digital technologies that are beginning to be used or are already widely used at the present stage.

But first, let's define the concept of "digitalization". By digitalization of an object or process, we mean the transformation of data about an object or process from analog to digital form using digital technologies, followed by automated analysis of digital data and making an optimal, in a sense, management decision to improve production or business.

The most widespread digital technologies currently include: Big Data, machine learning, neural networks, artificial intelligence, human-machine interfaces, virtual reality, robotization, the Internet of things, etc.

It is obvious that a graduate of a modern university must confidently master those digital technologies that are used in the subject area he is studying: future doctors must study medical digital technologies, future city planners and architects must master those digital technologies that are used in the construction and design of building structures, future teachers should study educational digital technologies, etc. Only this approach will allow future graduates to form the necessary professional competencies (hard skilles).

However, as the analysis of publications in recent years shows in the context of technological progress and the intensively changing business environment of the early 21st century, the need for so-called soft skills, which do not depend on the specifics of a particular job, but on which the result of this work. Flexible skills are referred to as supra-professional, non-cognitive skills that are closely related to a person's personality and attitudes, as well as their social skills and managerial abilities. These include: responsibility, discipline, the ability to organize their work (self-management), communication skills, the ability to listen to a partner, the ability to work in a team, emotional intelligence (a person's ability to recognize emotions, understand intentions, motivation and desires, both their own and those of the interlocutor, as well as the ability to manage both one's own emotions and the emotions of other people in the process of solving practical problems), the ability to manage time, the ability to be a leader, the presence of critical thinking and the ability to solve problems of different levels, etc.

As the researchers note, the availability of flexible skills is currently one of the critical factors of employment in the modern labor market. This is explained by the fact that the creation of most goods and services today requires the cooperation of professionals from various fields, which requires flexible skills.

It is obvious that flexible skills are difficult to track and measure, due to the significant humanitarian component, which does not lend itself to clear mathematical definitions and measurements. However, today there are tests and interview techniques that help assess the qualitative level of development of this group of skills [8] .

The most meaningful results in terms of research on non-cognitive personality characteristics are presented in the study [9]. As a result of the research, the author identifies the so-called "Big Five" non-cognitive personality characteristics (soft skilles), which include:

- conscientiousness, which combines characteristics such as perseverance, accuracy and hard work;
- extraversion, that is, the orientation of the interests and energy of the individual to the external world and the
- people around him, and not to the internal world of subjective experience;
- neuroticism, reflecting the emotional stability of the individual;
- openness to experience (openness), implying creativity and curiosity;
- agreement (agreeableness) as the ability to compromise and show friendliness towards people.

Despite its linguistic binding, the approach is considered universal regardless of language.

As noted by K.V. Rozhkova, non-cognitive characteristics consist of genetically inherited or acquired values and behavior patterns. It is a relatively stable way of thinking, feeling and behaving over time, which reflects a tendency to react to circumstances in a concrete way [10]. Non-cognitive traits are manifested in work skills and are measured through observable aspects of behavior such as confidence, sociability, and nervousness [11].

The classification proposed by Rozhkova K.V. is based on a linguistic approach, which implies combining the entire variety of words that describe the character and behavior of people into synonymous clusters. This approach is based on the premise that to describe the most important characteristics of a person in a language, the largest number of words naturally appears, reflecting the entire spectrum of included meanings. As the author notes, the first studies began with the analysis of 18 thousand words. In the course of further research, as a result of abbreviations and mergers using the methods of factor analysis, the original list was reduced to five [12]. The prevalence of the use of the Big Five classification in labor market research is associated with the stability of characteristics over time: it is believed that these traits are generally either inherited genetically [13] or are formed under the influence of culture [14, 15]. The methodology for determining the level of soft skilles formation was based on test questions concerning non-cognitive characteristics in the Big Five categories.

According to the research of K.V. Rozhkova. The five main categories of soft skilles are manifested as follows:

- an open person is able to enjoy the beautiful, he is interested in learning something new, he is able to generate new ideas that have never occurred to others before;
- a conscientious person is able to very accurately complete the assigned task and bring the work started to the end, is able to work hard, while working well and quickly, is able to think carefully about everything before making an important decision, is able to work hard instead of relaxing and is able to work purposefully on tasks, the solution of which takes a long time;
- a person with extraversion is open, sociable and talkative, while being able to keep his opinion to himself;
- a person who has agreement, is polite with other people, is able to ask for help if something is not clear, easily forgives other people and generously shares his time and money with other people;

- a person with empathy is able to feel the emotional state of another person, to be aware of the degree of his experiences. Empathy is a key element of emotional intelligence, it is useful in communication and helps to find a common language with different people;
- a person with neuroticism easily becomes nervous, prone to anxiety, is able to remain calm in a stressful situation, is able to think about the consequences of his actions and how they affect his future, has an understanding that others use him in their own interests and not very well belong to it.

Their analysis made it possible to systematize the meaningful essence of non-cognitive personality characteristics, presented in Table 1.

To assess the formation of flexible competencies, we can apply a tiered approach (low, medium, high), first proposed in the works of the American teacher Bloom B.S. [16] and continued by the Russian teacher-researcher Bespalko V.P. [17].

Let's apply the method of rank standardization [18]. Let's describe the technique step by step.

Step 1. Let us assign ranks to the features of the soft skilles categories in ascending order of importance of the feature in this category, starting with 1 and with step 1. The result is shown in Table 1.

TABLE 1. The values of the assigned ranks to the attributes of the soft skilles categories.

Categories SOFT SKILLES	**Features**	**Rank**
OPENNESS	Interest in learning new things	1
	The ability to generate ideas that others have not thought of before	2
	The ability to enjoy the beautiful	3
CONCIENTIOUSNESS	Ability to work on tasks that take a very long time to complete	1
	The ability to think carefully before making an important decision	2
	Ability to work well and quickly	3
	Ability to complete the work started	4
	Ability to perform the assigned task very accurately	5
	The ability to work hard instead of relaxing	6
EXTRAVERSION	Ability to be open and communicative	1
	The ability to be talkative	2
	The ability to keep your opinion to yourself	3
AGREEABLENESS	Ability to be polite with other people	1
	Ability to ask for help when something is not clear	2
	The ability to easily forgive other people	3
	Ability to generously share your time and money with others	4
	Has empathy	5
NEUROTICISM	The ability to reflect on how your actions will affect others	1
	The ability to reflect on how your actions will affect your future	2
	The ability to worry	3
	The ability to easily get nervous	4
	The ability to stay calm in a stressful situation	5
	Understanding that others are using you to their advantage	6
	Understanding that others are not treating you well	7

Step 2. Let's write out the assigned ranks in table 2.

TABLE 2. Values of assigned ranks to features soft skilles categories.

No.Categories	Assigned ranks						
1	1	2	3				
2	1	2	3	4	5	6	
3	1	2	3				
4	1	2	3	4	5		
5	1	2	3	4	5	6	7

Step 3. Let's standardize the ranks, namely stretch the short categories to the longest. The stretching results are shown in Table 3.

TABLE 3. Values of standardized ranks by soft skills categories.

No. Categories	Standardized ranks						
1	1	0,4	0,4	0,4	0,4	0,4	3
2	1	1	1	1	1	1	6
3	1	0,4	0,4	0,4	0,4	0,4	3
4	1	0,8	0,8	0,8	0,8	0,8	5
5	1	2	3	4	5	6	7
Mean	1	0,92	1,12	1,32	1,52	1,72	4,8

As a result of the standardization of ranks, we received a given table function and presented in Table 4.

TABLE 4. Values of the table-specified function when determining the level of formation of soft skilles.

X	1	2	3	4	5	6	7
У	1	0,92	1,12	1,32	1,52	1,72	4,8

STEP 4. Let's plot this function on the segment [1,7] (fig.).

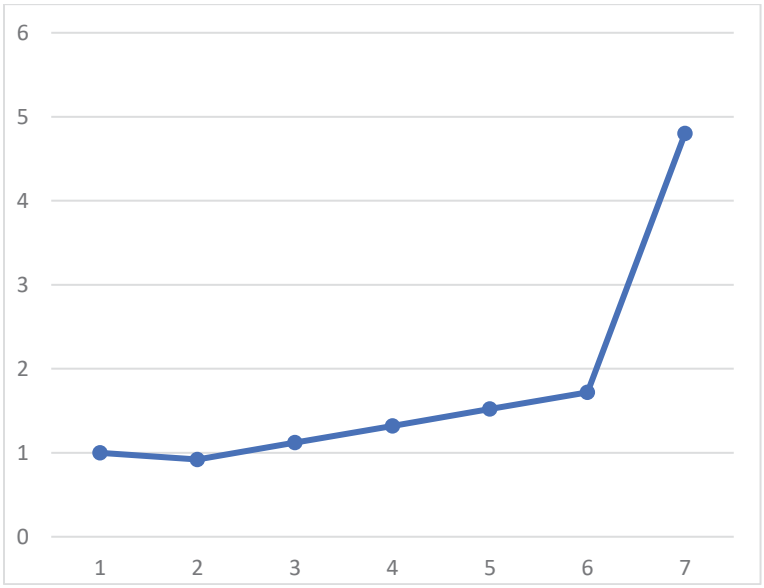

FIGURE 1. Graph of the dependence of the average values of the ranks on the values of the assigned ranks of the category with the maximum number of features.

It follows from the graph in the figure that the interval [1,7] is divided by boundary points 2 and 6 into 3 areas. The result of recalculating the boundary points to determine the estimated intervals is presented in Table 5.

TABLE 5. The results of recalculating the values of boundary points into the estimated intervals when determining the level soft skilles

The values borderline ranks	% values border ranks from maximum rank (7)	The sum of ranks corresponding to boundary points of the sum of maximum ranks (24)	Evaluative Interval
2	30	7	$\sum \leq 7$
6	85	20	$8 \leq \sum \leq 20$

Now we can formulate the final assessment intervals for determining the level of formation of flexible competencies, which are presented in Table 6.

TABLE 6. Estimation intervals for level determination formation soft skilles (SS)

№	Sum of ranks	Expert recommendations
1	Sum of ranks ≤ 7 points	SS formed at a low level
2	The sum of ranks from 8 to 20 points	SS are formed at the intermediate level
4	The sum of the ranks ≥ 21 points	SS are formed at the high level

CONCLUSION

The article proposes a method for obtaining numerical intervals that allow assessing the level of formation of flexible competencies, based on the application of the well-known mathematical method of rank standardization.
The method is based on the "Big Five" classification, which includes the main non-cognitive characteristics of a person, reflecting a wide variety of his individual traits and behavior patterns, described using a limited number of questions without reference to the situation or context.
The technique can be used in the formation of flexible skills in the work of business coaches, in the implementation of corporate training and education programs, as part of mentoring and coaching.

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