The age structure of the scientific and pedagogical staff: data from the regions of Russia

Estrutura etária do pessoal científico e pedagógico: dados das regiões da Rússia

Estructura de edad del personal científico y pedagógico: datos de las regiones de Rusia

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ABSTRACT

The purpose of our study was to evaluate the indicators characterizing the age structure of the scientific and pedagogical staff of universities and other higher educational institutions in the regions of Russia. In the course of the work, the indicators characterizing the specific weights of teachers belonging to five age groups from 25 to 34 years, from 35 to 44 years, from 45 to 54 years, from 55 to 64 years and over 65 years in the total number of teachers working in higher education institutes were evaluated. The study used official statistical information for 82 regions of Russia. We used the density functions of the normal distribution as models. The results of the research allowed us to draw conclusions: the largest number (more than a quarter) of teachers was observed in the group from 35 to 44 years; 24% of teachers were aged from 45 to 54 years; 20% of teachers were slightly older. The least number of teachers was observed in the age groups over 65 years and from 25 to 34 years. The proposed methodological approach and the results obtained have originality and scientific novelty, since the assessment of regional features of the age structure of scientific and pedagogical personnel in the regions of Russia has not been carried out before.
Keywords: Age of teachers. Higher education. Number of faculty. Regions of Russia.

RESUMO

O objetivo do nosso estudo foi avaliar indicadores que caracterizam a estrutura etária do pessoal científico e pedagógico de universidades e outras instituições de ensino superior nas regiões da Rússia. Durante o trabalho foram avaliados indicadores de gravidade específica de professores, pertencentes a cinco grupos etários de 25 a 34 anos, 35 a 44 anos, 45 a 54 anos, 55 a 64 anos e 65

anos ou mais, o número total de professores que trabalham em instituições de ensino superior. O estudo utilizou informações estatísticas oficiais sobre 82 regiões da Rússia. Usamos funções de densidade de distribuição normal como modelos. Os resultados da pesquisa nos permitiram tirar conclusões: a maior quantidade (mais de um quarto) dos professores foi observada no grupo de 35 a 44 anos; 24% dos professores tinham idade entre 45 e 54 anos; 20% dos professores eram um pouco mais velhos. O menor número de professores foi observado nas faixas etárias acima de 65 anos e entre 25 e 34 anos. A proposta de abordagem metodológica e os resultados obtidos têm originalidade e novidade científica, como a avaliação das características regionais da estrutura etária científico-pedagógicas de quadros em regiões anteriormente não foi realizada.
Palavras-chave: Ensino superior. Idade dos professores. Número de professores. Regiões da Rússia.

RESUMEN
El objetivo de nuestro estudio fue evaluar los indicadores que caracterizan la estructura de edad del personal científico y pedagógico de las universidades y otras instituciones de educación superior en las regiones de Rusia. Se evaluaron los indicadores relativos a la proporción de profesores pertenecientes a cinco grupos de edad, de 25 a 34 años, de 35 a 44 años, de 45 a 54 años, de 55 a 64 años y mayores de 65 años, en el número total de profesores que trabajan en instituciones de educación superior. El estudio utilizó información Estadística oficial sobre 82 regiones de Rusia. Utilizamos las funciones de densidad de distribución normal como modelos. Los resultados del estudio nos permitieron sacar conclusiones: el mayor número (más de una cuarta parte) de maestros se observó en el grupo de 35 a 44 años; el 24% de los maestros tenían entre 45 y 54 años; el 20% de los maestros eran un poco mayores. El menor número de maestros se observó en los grupos de edad mayores de 65 años y de 25 a 34 años. El enfoque metodológico propuesto y los resultados obtenidos tienen originalidad y novedad científica, ya que la evaluación de las características regionales de la estructura de edad del personal científico y pedagógico en las regiones de Rusia no se ha llevado a cabo previamente.
Palabras clave: Edad de los professores. Educación superior. Número de professores. Regiones de Rusia.

INTRODUCTION

In the twenty-first century, according to many researchers (for example, Pinheiro et al., 2015) there is an increasing role of higher education institutions in national economies.

In both developed and developing countries, there is an urgent need for the development of human capital based on increasing the level of knowledge and competencies (Pinheiro, Stensaker, 2014). Therefore, a wide range of measures are being implemented to improve higher education (Maassen, 2014). Most States have created conditions that ensure mass access of the population to higher education (Guri-Rosenblit et al., 2007). To solve the problems of higher education, a necessary condition is the availability of scientific and pedagogical personnel for teaching students according to appropriate programs. Taking this into account, one of the urgent scientific problems is the assessment of indicators that characterize the availability of staff, that is, professors, associate professors, as well as other categories of teachers who ensure the availability of higher education (Stiglitz, 2014; Douglas, 2011). One of the most important for governments and regulatory bodies is the assessment of the distribution number of teachers in higher education institutions by their age.

Our research was devoted to this issue on the example of Russian regions. Currently, higher education institutions are present in all 82 regions of Russia without exception. The presence of organizations in the regions that teach students according to the relevant programs, as indicated in the works (Abel and Deitz, 2011; Chiriachi, 2014), increases the attractiveness of regions, positively affects their economic growth and, most importantly, ensures the retention of school graduates in the regional labor market. The total number of teachers working at universities and other higher

educational institutions in Russia was 223088 people. Of these, 35039 people are professors, and 129328 people are associate professors (Federal State Statistics Service, 2021).

All this determines the increased interest in studying the age structure of the staff of higher education institutions. Our article responds to the calls made in a number of scientific publications (Blau, Weinberg, 2017; Ghaffarzadegan, Xu, 2018; Larson, Gomez Diaz, 2012), to study the existing features of the age structure of teachers.

The purpose of our study was to evaluate the indicators characterizing the age structure of the scientific and pedagogical staff of universities and other higher educational institutions in the regions of Russia. Our article is aimed at obtaining a certain empirical and methodological contribution to the knowledge about the distribution by age categories of the total number of teachers teaching students in higher education programs. This contribution consists in the fact that the author's method of modeling the age structure of the teaching staff of higher education institutions in the regions of Russia using the density functions of the normal distribution is proposed. The empirical contribution is associated with the determination of the average values and standard deviations by region of such indicators as the share of teachers of different age groups in their total number. In addition, the regions with the maximum and minimum values of these indicators are determined.

The structure of this work is given below. The next section presents an overview of scientific publications of recent years that characterize such aspects of higher education as the age structure of teachers in the regions. Methodology, initial data and design of the study described in our article are presented below. The following sections present the simulation results and their discussion. The last sections contain conclusions and bibliographic references.

LITERATURE REVIEW

A number of scientific publications published in recent years have been devoted to the problem of assessing such an aspect of the development of higher education in Russia, the age structure of the scientific and pedagogical staff of educational institutions. A brief description of these publications is given in table 1.

Table 1. Scientific publications describing age features of scientific and pedagogical staff.

Authors	Problems under study
1	2
Kirillina (2015)	The study of the dynamics of the age structure of research and teaching staff in Russian universities according to data for 2007-2012. The conclusion is made about the small proportion of teachers under the age of 30 in the total number of teachers of higher education organizations
Pugach (2017)	The analysis of the distribution of the number of teachers of higher education organizations by age groups for the years 1988 – 2014 is given. It is shown that during this period, the proportion of the number of teachers aged 40 to 60 years has decreased and this indicator has increased for teachers older than 65 years
Fedosyuk (2020)	The results of a sociological survey of university teachers of the Belgorod region aged from 58 to 64 years are presented. The survey results showed that about 80% of respondents plan to continue their activities after retirement
Balezina (2017)	The features of such a category of personnel of higher education institutions as young teachers, which include people under the age of 35 who carry out scientific and pedagogical activities, are studied. It is concluded that it is necessary to pay great attention to such a problem as the adaptation of young teachers in the team

Reznik, Vdovina (2020)	The problems of intra-university management and the existing structure of the scientific and teaching staff are considered
Bessonova, Paronyants (2020)	The assessment of the perception of their profession was carried out according to a survey of teachers Sevastopol State University. The results of the survey showed that young teachers associate their activities with the possibility of improving their social status and self-realization. Middle-aged teachers focus on improving the level of competence and perseverance in teaching students. For older teachers, motivation is associated with freedom of activity and altruism
Skvortsova (2016)	The changes in the system of value orientations of teachers of higher education institutions were studied on the basis of a questionnaire survey conducted in organizations located in the Penza, Ulyanovsk, Saratov regions and the Republic of Mordovia in 2014. It is shown that such motives as familiarization with new knowledge, self-improvement and the development of creative abilities decrease with increasing age of teachers
Lazarev et al. (2015)	The article presents measures to reduce the average age of scientific and pedagogical staff from 47 to 42 years at the Vladivostok State University of Economics and Service
Ilinykh (2012)	The analysis of the influence of the age characteristics of the scientific and pedagogical staff of universities on the quality of education is given. It is shown that in 2010, more than half of the teachers were over 50 years old

Source: The table is compiled by the author on the basis of the information provided in the RSCI (Science Electronic Library, 2021).

Based on the information given in Table 1, it can be stated that the problem of studying the age structure of teachers who train students in higher education programs is relevant in Russia. In most of the studies reviewed, various aspects of this problem were analyzed for higher education institutions in Russia. At the same time, a comprehensive assessment of the features of the distribution of the age structure of teachers in all regions of Russia has not been considered in scientific publications. Taking this into account, it seems appropriate to conduct a comparative analysis of the existing relative (specific) indicators characterizing the age characteristics characteristic of scientific and pedagogical personnel in all regions of Russia.

METHODOLOGY

The scientific and pedagogical personnel of higher education organizations, the age structure of which is considered in this article, trained students in 2020 in bachelor's degree programs (four years of study), specialty degree (five years of study), as well as in master's degree programs. The study examined data characterizing the specific weights of the number of teachers who were included in five groups formed in accordance with five age categories: from 25 to 34 years old, from 35 to 44 years old, from 45 to 54 years old, from 55 to 64 years old and over 65 years old. In the course of the work, the following five indicators were evaluated:

- the proportion of teachers aged 25 to 34 years, in the total number of teachers working in higher education institutions;

- the proportion of teachers aged 35 to 44 years, in the total number of teachers working in higher education institutions;

- the proportion of teachers aged 45 to 54 years, in the total number of teachers working in higher education institutions;

- the proportion of teachers aged 55 to 64 years, in the total number of teachers working in higher education institutions;

- the proportion of teachers aged over 65 years, in the total number of teachers working in higher education institutions.

The research process included five stages. At the first stage, the initial data on the regions were formed, characterizing the number of scientific and pedagogical staff of higher education institutions in five main age categories. At the second stage, indicators were calculated that characterize the specific weights of the number of teachers belonging to each of the age categories in the total number of teachers of higher education institutions in each of the regions. At the third stage, the distribution of indicators by region was evaluated based on the development of mathematical models. At the fourth stage, the average values of indicators for the regions of Russia were determined, as well as the ranges in which the values of these indicators are located for most of them.

The study used official statistical information of the Ministry of Science and Higher Education of the Russian Federation for 2020 on the number and age of teachers who worked in higher education institutions in all 82 regions of Russia (Official statistical information on additional professional and higher education, 2021).

In our study, three hypotheses were tested:

hypothesis 1 - among the scientific and pedagogical staff, relatively small proportions belong to the age categories from 25 to 34 years, as well as older than 65 years. The majority of teachers who provide training for students in higher education programs belong to three age categories: from 35 to 44 years old, from 45 to 54 years old and 55 to 64 years old;

hypothesis 2 - the values of indicators by region have a small variation, that is, they are homogeneous;

hypothesis 3 - the regions characterized by the maximum and minimum values of each of the five indicators are located in different federal districts.

The evaluation of the values of the five considered indicators was carried out on the basis of economic and mathematical modeling of the initial empirical data. As models, we used the density functions of the normal distribution, the method of developing which for estimating the values of relative cost indicators was proposed by the author. Some aspects of the use of the methodology are given in the works (Pinkovetskaya, Slepova, 2018; Pinkovetskaya et al., 2021). During the development of the functions, the initial empirical data were grouped according to the ranges of changes in the values of the indicators. These data groups can be geometrically represented in the form of corresponding histograms. Data approximation using normal distribution functions was carried out using generally accepted statistical methods. It is important to note that the average values of the considered indicators, as well as their standard deviations for the density functions of the normal distribution, were displayed in the formulas of the developed functions themselves. Therefore, by constructing a specific function, we get the specified parameters of the considered indicators without additional calculations.

The obtained functions allowed us to determine the average values of each of the five indicators for the regions under consideration, as well as the ranges of their changes characteristic of most regions. In addition, the study identified regions in which the considered indicators have values above the upper and below the lower limits of the ranges. The boundaries of the indicator ranges for 68% of the regions were determined based on the average values of the indicators and the corresponding standard deviations. The lower bound of the interval is equal to the difference between the mean and the standard deviation, and the upper bound is equal to their sum.

RESULTS

In the course of the computational experiment, economic and mathematical modeling was carried out on the basis of empirical data. The models that describe the distributions (y_1 ; y_2 ; y_3 ; y_4 ; y_5) of the five indicators (x_1 ,%; x_2 , %; x_3 , %; x_4 ,%; x_5 ,%) across all 82 Russian regions are shown below:

- the proportion of teachers aged 25 to 34 years, in the total number of teachers working in higher education institutions

$$y_1(x_1) = \frac{202.52}{3.27 \times \sqrt{2\pi}} \cdot e^{-\frac{(x_1 - 11.45)^2}{2 \times 3.27 \times 3.27}} ; \tag{1}$$

- the proportion of teachers aged 35 to 44 years, in the total number of teachers working in higher education institutions

$$y_2(x_2) = \frac{222.75}{3.61 \times \sqrt{2\pi}} \cdot e^{-\frac{(x_2 - 27.51)^2}{2 \times 3.61 \times 3.61}} ; \tag{2}$$

- the proportion of teachers aged 45 to 54 years, in the total number of teachers working in higher education institutions

$$y_3(x_3) = \frac{283.54}{3.65 \times \sqrt{2\pi}} \cdot e^{-\frac{(x_3 - 23.84)^2}{2 \times 3.65 \times 3.65}} ; \tag{3}$$

- the proportion of teachers aged 55 to 64 years, in the total number of teachers working in higher education institutions

$$y_4(x_4) = \frac{208.29}{2.51 \times \sqrt{2\pi}} \cdot e^{-\frac{(x_4 - 20.15)^2}{2 \times 2.51 \times 2.51}} ; \tag{4}$$

- the proportion of teachers aged over 65 years, in the total number of teachers working in higher education institutions

$$y_5(x_5) = \frac{303.75}{4.33 \times \sqrt{2\pi}} \cdot e^{-\frac{(x_5 - 16.68)^2}{2 \times 4.33 \times 4.33}} . \tag{5}$$

The quality of functions (1)-(5) we tested using such criteria: by the Kolmogorov-Smirnov, the Pearson and the Shapiro-Wilk. Calculated values of criteria are given in Table 2.

Table 2. Calculated values of criteria.

Indicators	Criteria		
	The Kolmogorov-Smirnov test	The Pearson test	The Shapiro-Wilk test
the proportion of teachers aged 25 to 34 years, in the total number of teachers working in higher education institutions	0.04	2.78	0.97
the proportion of teachers aged 35 to 44 years, in the total number of teachers working in higher education institutions	0.03	1.08	0.98
the proportion of teachers aged 45 to 54 years, in the total number of teachers working in higher education institutions	0.08	4.13	0.96

| the proportion of teachers aged 55 to 64 years, in the total number of teachers working in higher education institutions | 0.07 | 4.80 | 0.96 |
| the proportion of teachers aged over 65 years, in the total number of teachers working in higher education institutions | 0.03 | 0.24 | 0.99 |

Source: The data in the table are based on the results of calculated functions.

Information given in column 2 of Table 2 showed that all calculated values are less than the critical value by the Kolmogorov-Smirnov test (0.174) at significant level equal 0.05. Data in column 3 are less than critical value of Pearson criterion (9.49). Data in column 4 exceed critical value 0.93 Shapiro-Wilk test with significant level of 0.01. Thus, the computational experiment showed that all five developed functions have high quality.

At the next stage of the study, the values of indicators characterizing the number and structure of scientific and pedagogical personnel working at universities and other institutions of higher education in the regions of Russia were determined. The values of the indicators, the average by region, are shown in column 2 of Table 3. The average values were determined on the base of functions (1)-(5). The third column indicates the standard deviation for discussing indicators. The values of the indicators characterizing the upper and lower boundaries of the intervals corresponding to the majority of regions are shown in column 4. We calculate the lower limits as the difference between the average value and the standard deviation, and we calculate the upper limits as the sum of the average value and the standard deviation.

Table 3. The values of indicators describing the age structure of teachers working in the higher education institutions, %.

Indicator numbers	Average values	Standard deviation	Values for most regions
1	2	3	4
the proportion of teachers aged 25 to 34 years, in the total number of teachers working in higher education institutions	11.45	3.27	8.18-14.72
the proportion of teachers aged 35 to 44 years, in the total number of teachers working in higher education institutions	27.51	3.61	23.90-31.12
the proportion of teachers aged 45 to 54 years, in the total number of teachers working in higher education institutions	23.84	3.65	20.19-27.49
the proportion of teachers aged 55 to 64 years, in the total number of teachers working in higher education institutions	20.15	2.51	17.64-22.66
the proportion of teachers aged over 65 years, in the total number of teachers working in higher education institutions	16.68	4.33	12.35-21.01

Source: The calculations are carried out by the author on the basis of functions (1)-(5).

DISCUSSION

The data in Table 3 shows that the regional average value of the proportion of teachers aged 25 to 34 years, in the total number of teachers working in higher education institutions is almost 11.5%. That is, every ninth teacher in such organizations was younger than 35 years old. In most regions, this indicator ranges from 8% to 15%. In 2020, the average proportion of teachers aged 35 to 44 years, in the total number of teachers working in higher education institutions, was 27.5%. That is, a little more than a quarter of all teachers in the Russian regions belonged to this age category. For most regions, the indicator under consideration was in the range from 24% to 31%. The average value of the proportion of teachers aged 45 to 54 years, in the total number of teachers

working in higher education institutions, was 23.8%. In most regions, this indicator was in the range from 20% to 27%. The average value and the range of changes in the share of teachers in the age category from 55 to 64 years were slightly less. The corresponding average value was 20.2%, and the range of change was from 18% to 23%. For the category of teachers aged 65 years and older, the average value of their share in the total number of scientific and pedagogical staff by region was 16.7%. At the same time, in most regions, the values of the indicators were more than 12%, but less than 21%.

The analysis showed that among the considered age categories, teachers of higher education institutions were most often aged from 35 to 44 years. In two more age categories of teachers (from 45 to 54 years and from 55 to 64 years) their share in the total number of scientific and pedagogical staff exceeded 20% on average in the regions. The lowest specific weights were typical for the age categories from 25 to 34 years, as well as for older teachers (65 years and older). This situation seems logical, since in order to become a teacher teaching students in higher education programs, it is necessary to complete a bachelor's degree, a master's degree and in most cases get a PhD or a doctor of sciences degree. This training requires a lot of time and a lot of dedication from people. Therefore, most professionals are part of the scientific and pedagogical staff at the age of more than 34 years. A relatively small proportion of older teachers is due to the fact that many people who previously worked as teachers retire at this age. Only a part of the teachers, for whom it is important to maintain their activity, social status, as well as the desire to share their knowledge with students, continue their activities (Tnimova, 2020). It should be noted that some of them continue to work on a reduced schedule. The above analysis confirmed the correctness of the first hypothesis put forward earlier.

The next step was to determine the regions of Russia in which the maximum and minimum values of each indicator were marked. In this case, the maximum values are those that exceed the upper limits of the ranges specified in column 4 of Table 3, and the minimum values are those that are less than the lower limits of the specified ranges. The results of this analysis are shown in Table 4. Along with the lists of regions, this table also shows the values of indicators by region, as well as which of the federal districts the regions belong to.

Table 4. Characteristics of Russian regions with maximum and minimum indicator values.

Indicators	Region	Value, %	Federal district
1	2	3	4
the proportion of teachers aged 25 to 34 years, in the total number of teachers working in higher education institutions	With maximum values of indicators		
	Kursk region	14.79	Central
	Tomsk region	15.02	Siberian
	Vladimir region	15.35	Central
	Belgorod region	15.60	Central
	Perm region	15.98	Privolzhsky
	Sakha republic	15.99	Far Eastern
	Tatarstan republic	16.77	Privolzhsky
	Ryazan region	17.34	Central
	Tambov region	17.41	Central
	Chechen republic	19.25	North Caucasian
	Tyva republic	20.07	Siberian
	With minimum values of indicators		
	Kamchatka territory	4.43	Far Eastern
	Kurgan region	5.06	Ural
	Adygea republic	5.79	North Caucasian
	Magadan region	5.88	Far Eastern

	Khakassia republic	5.96	Siberian
	Murmansk region	6.15	North-West
	Dagestan republic	6.56	South
	Kaliningrad region	6.60	North-West
	Novgorod region	6.81	North-West
	Sakhalin region	7.24	Far Eastern
	Kabardino-Balkar republic	7.59	North Caucasian
	Chuvash republic	7.60	Privolzhsky
	Ingushetia republic	7.64	North Caucasian
	North Ossetia-Alania republic	7.94	North Caucasian
the proportion of teachers aged 35 to 44 years, in the total number of teachers working in higher education institutions	With maximum values of indicators		
	Mari El republic	31.18	Privolzhsky
	Mordovia republic	31.29	Privolzhsky
	Kalmykia republic	31.32	South
	Kurgan region	31.41	Ural
	Kursk region	31.45	Central
	Trans-Baikal territory	31.72	Far Eastern
	Belgorod region	32.00	Central
	Tambov region	32.44	Central
	Altai republic	32.73	Siberian
	Orenburg region	33.48	Privolzhsky
	Bryansk region	33.54	Central
	Stavropol territory	34.53	North Caucasian
	Kamchatka territory	35.44	Far Eastern
	Orel region	35.63	Central
	With minimum values of indicators		
	Novgorod region	18.68	North-West
	St. Petersburg city	21.06	North-West
	Moscow city	21.09	Central
	Tyva republic	21.15	Siberian
	Sakha republic	21.48	Far Eastern
	Tver region	21.49	Central
	Kaliningrad region	21.84	North-West
	Primorsky territory	22.12	Far Eastern
	Novosibirsk region	22.31	Siberian
	Moscow region	22.52	Central
	Ivanovo region	23.33	Central
the proportion of teachers aged 45 to 54 years, in the total number of teachers working in higher education institutions	With maximum values of indicators		
	Kurgan region	27.57	Ural
	Ingushetia republic	27.57	North Caucasian
	Vologda region	27.61	North-West
	Buryatia republic	27.89	Siberian
	Khakassia republic	27.98	Siberian
	Novgorod region	28.13	North-West
	Amur region	28.51	Far Eastern
	Mordovia republic	29.66	Privolzhsky
	Kamchatka territory	30.38	Far Eastern
	Adygea republic	30.87	North Caucasian

	Altai republic	34.55	Siberian
	Magadan region	39.22	Far Eastern
	With minimum values of indicators		
	Kalmykia republic	17.63	South
	Vladimir region	18.04	Central
	Ryazan region	18.54	Central
	Mari El republic	18.94	Privolzhsky
	Jewish autonomous region	19.12	Far Eastern
	Belgorod region	19.34	Central
	Moscow city	19.73	Central
	Tomsk region	19.74	Siberian
	Perm territory	19.76	Privolzhsky
	St. Petersburg city	19.84	North-West
	Sverdlovsk region	20.12	Ural
	Kaliningrad region	20.17	North-West
the proportion of teachers aged 55 to 64 years, in the total number of teachers working in higher education institutions	With maximum values of indicators		
	Ivanovo region	22.94	Central
	Moscow region	22.96	Central
	Karelia republic	23.23	North-West
	Udmurt republic	23.96	Privolzhsky
	Novgorod region	24.18	North-West
	Murmansk region	24.30	North-West
	Kostroma region	24.64	Central
	Khakassia republic	25.39	Siberian
	Kaluga region	25.66	Central
	Ingushetia republic	27.24	North Caucasian
	Sakhalin region	29.61	Far Eastern
	With minimum values of indicators		
	Bryansk region	15.66	Central
	Orel region	15.98	Central
	Ryazan region	16.56	Central
	Tomsk region	16.66	Siberian
	Zabaykalsky territory	16.75	Far Eastern
	Stavropol territory	17.04	North Caucasian
	Volgograd region	17.09	Privolzhsky
	Mordovia republic	17.23	Privolzhsky
	Saratov region	17.44	Privolzhsky
the proportion of teachers aged over 65 years, in the total number of teachers working in higher education institutions	With maximum values of indicators		
	North Ossetia-Alania republic	21.14	North Caucasian
	Kalmykia republic	21.32	South
	Novosibirsk region	21.68	Siberian
	Tula region	21.94	Central
	Novgorod region	22.20	North-West
	Tomsk region	22.31	Siberian
	Yaroslavl region	22.58	Central
	Sverdlovsk region	22.80	Ural
	Tver region	23.12	Central
	Primorsky territory	23.38	Far Eastern

Moscow city	24.34	Central
St. Petersburg city	24.87	North-West
Kaliningrad region	29.18	North-West
With minimum values of indicators		
Altai republic	6.06	Siberian
Chechen republic	6.54	North Caucasian
Magadan region	7.84	Far Eastern
Mordovia republic	9.11	Privolzhsky
Tyva republic	9.68	Siberian
Tambov region	9.78	Central
Kamchatka territory	10.13	Far Eastern
Orenburg region	11.63	Privolzhsky
Stavropol territory	12.00	North Caucasian
Kostroma region	12.23	Central
Ingushetia Republic	12.29	North Caucasian

Source: Developed by the author on the basis of data from Table 3.

Table 4 provides information on the values of indicators for each of the regions (column 3), as well as their territorial location (column 4). The analysis of this information showed that there is no connection between the maximum and minimum values of the indicators and the territorial location of the regions. That is, the regions with high and low values of indicators are located in different federal districts. Thus, we can state the confirmation of hypothesis 3.

CONCLUSION

In general, it should be noted that our study makes an important contribution to understanding the age structure of teachers of higher education institutions. The purpose of our study was to evaluate the indicators characterizing the age structure of the scientific and pedagogical staff of universities and other higher educational institutions in the regions of Russia. The conclusions that have scientific novelty and originality are given below. In the course of the study, a method was proposed for evaluating five indicators that characterize the age structure of teachers in higher education organizations, using the density functions of the normal distribution. Based on the proposed methodology, the distribution of indicators corresponding to five age categories in all 82 regions of Russia was estimated. The results of the computational experiment showed that the largest number of teachers was observed in the group from 35 to 44 years old. In this group, in 2020, there were more than a quarter of all teachers who worked in higher education organizations. Almost 24% of the number of all teachers were aged from 45 to 54 years. Thus, more than half of the scientific and pedagogical staff had an age in the range from 35 to 54 years. About 20% of the faculties were slightly older, that is, between the ages of 55 and 64. The least number of teachers was observed in the age groups over 65 years and from 25 to 34 years.

The analysis showed that there was no significant differentiation of the values of all five indicators by region. That is, the distribution of the number of teachers by region for each of the five age groups considered was relatively homogeneous. The regions that were characterized by the maximum and minimum values of the five considered indicators were identified. The study showed that the territorial location of the regions does not significantly affect the maximum and minimum values of the indicators.

The practical significance of the study for the government lies in the possibility of taking into account the age and territorial features of the formation of scientific and pedagogical personnel when developing programs for the development of higher education in Russia and its regions. The

results of the work can be used in the activities of regional structures related to the support of educational processes, when justifying their planned activities, improving the quality of higher education by attracting new highly qualified teachers.

The new knowledge gained is of interest and can be used in the educational process at universities. The study had no limitations on empirical data, as it was based on official statistical information for all 82 regions of Russia. Further research may be aimed at establishing gender characteristics describing the number and structure of teachers in higher education institutions in Russia.

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REFERENCES

Abel, J.R., & Deitz, R. (2011). Do colleges and universities increase their region's human capital? *Journal of Economic Geography*, 12(3), 667–691.

Balezina, E.A. (2017). Young teacher: on the question of the definition of the concept. *Bulletin of the Perm University. Philosophy. Psychology. Sociology*, 2(30), 282-293.

Bessonova, T.I., & Paronyants, I.V. (2020). Features of the perception of the profession by young and elderly university teachers. *Humanitarian and pedagogical education*, 6(1), 80-86.

Blau, D.M., & Weinberg, B.A. (2017). Why the US science and engineering workforce is aging rapidly. *Proceedings of the National Academy of Sciences*, 11, 3879–3884.

Ciriaci, D. (2014). Does university quality influence the interregional mobility of students and graduates? The case of Italy. *Regional Studies*, 48(10), 1592-1608.

Douglass, J. (2011). Higher education's new global order: How and why governments are creating structured opportunity markets. *Educational Studies Moscow*, 1, 73-98.

Federal State Statistics Service (2021). Available at: https://rosstat.gov.ru/

Fedosyuk, D.V. (2020). Specifics of social adaptation of university teachers of pre-retirement age. *Bulletin of the Maikop State Technological University,* 4 (12), 124-130.

Ghaffarzadegan, N., & Xu, R. (2018). Late retirement, early careers, and the aging of U.S. science and engineering professors. *PLoS ONE*, 13(12), e0208411.

Guri-Rosenblit, S., Sebkova, H., & Teichler, U. (2007). Massification and diversity of higher education systems: interplay of complex dimensions. *Higher Education Policy, 20*(4), 373-389.

Ilinykh, S.A. (2012). The quality of education and the personnel potential of universities: indicators of the relationship. *Problems of higher education*, 1, 22-25.

Kirillina, Y.V. (2015). The quality of higher education in the context of quantitative indicators. *Problems and prospects of education development in Russia*, 33, 132-136.

Larson, R.C., & Gomez Diaz, M. (2012). Nonfixed Retirement Age for University Professors: Modeling Its Effects on New Faculty Hires. *NIH Public Access. Service Science,* 4(1), 69–78.

Lazarev, I.G., Martynenko, O.O., & Filicheva, T.P. (2015). The problem of the quality of personnel of a regional university: the experience of solving. *University management: practice and analysis*, 2 (96), 65-73.

Maassen, P. (2014). A New Social Contract for Higher Education? in G. Goastellec and F. Picard (eds.) Higher Education in Societies Rotterdam. Sense Publishers, 33-50.

Official statistical information on additional professional and higher education. (2021), Ministry of Science and Higher Education of the Russian Federation. Available at: https://minobrnauki.gov.ru/action/stat/highed/

Pinheiro, R., & Stensaker, B. (2014). Designing the Entrepreneurial University: The Interpretation of a Global Idea. *Public Organization Review*, 14(4), 497-516.

Pinheiro, R., Wangenge-Ouma, G., Balbachevsky, E., & Cai, Y. (2015). The Role of Higher Education in Society and the Changing Institutionalized Features in Higher Education. The Palgrave International Handbook of Higher Education Policy and Governance. Palgrave Macmillan UK, 225-242.

Pinkovetskaia, I.S., Lebedev, A.V., Slugina, O.V., Arbelaez Campillo Diego Felipe, & Rojas Bahamon Magda Julissa. (2021). Informal Personal Financing of Entrepreneurs: Gender Characteristics. *Universal Journal of Accounting and Finance*, 9(3), 442-449.

Pinkovetskaia, I., & Slepova, V. (2018). Estimation of Fixed Capital Investment in SMEs: the Existing Differentiation in the Russian Federation. *Business Systems Research*, 9(1), 65-78.

Pugach, V.F. (2017). The age of teachers in Russian universities: what is the problem? *Higher education in Russia*, 1, 47-55.

Reznik, S.D., & Vdovina, O.A. (2020). Teachers of Russian universities. Formation and development of professional competencies. Mooscow. INFRA-M.

Science electronic library. (2021). Russian science citation index (RSCI). Available at: https://elibrary.ru/defaultx.asp?

Skvortsova, A.A. (2016). Differentiation of the rank structure of value orientations of university teachers: the influence of gender and age factors. *Vector of Science of Togliatti State University*, 1 (35), 106-111.

Stiglitz, J.E. (2014). Creating a Learning Society: A New Approach to Growth, Development, and Social Progress (Kenneth Arrow Lecture Series). Columbia. Columbia University Press.

Tnimova, G.T. (2020). Studying motivation to the professional activity of teachers of the university in the age and gender aspects. *Health, Physical Culture and Sports*, 2 (18), pp. 29–33.