Presentation date: Sebtember , 2024 **Date of Acceptance:** October, 2024 **Publication Date:** November, 2024

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COMPARATIVE ANALYSIS OF HIGHER EDUCATION AND SCIENCE IN RUSSIA AND JAPAN: KEY FEATURES OF DEVELOPMENT

ANÁLISIS COMPARATIVO DE LA EDUCACIÓN SUPERIOR Y LA CIENCIA EN RUSIA Y JAPÓN: CARACTERÍSTICAS CLAVE DEL DESARROLLO

Marat Safiullin[1*]
E-mail: Marat.Safiullin@tatar.ru
ORCID: https://orcid.org/0000-0003-3708-8184
Aliya Gataullina[2]
E-mail: AliAShugaepova@kpfu.ru
ORCID: https://orcid.org/0000-0001-5361-7360
Leonid Yelshin[3]
E-mail: Leonid.Elshin@tatar.ru
ORCID: https://orcid.org/0000-0002-0763-6453
[1] Kazan (Volga Region) Federal University, Kazan, Russia.
*Corresponding autor

Suggested citation (APA, seventh ed.)

Safiullin, M., Gataullina, A., & Yelshin, L. (2024). Comparative analysis of higher education and science in russia and japan: key features of development. ***Revista Conrado, 20***(101), 187-197.

ABSTRACT

The purpose of the study was to analyze the development of science and education in Russia and Japan, identify features, and determine future directions. A comparative analysis was conducted based on five criteria: education, human potential, innovation, financial and scientific activities. Authors employs a comparative statistical analysis of education and science indicators from OECD and UNESCO databases, focusing on five key areas: higher education systems, innovation activities, personnel potential, science and education funding, and scientific activities. Russia lags behind in several indicators: the number of researchers per million residents in Japan is twice as high; the share of personnel in higher education in Japan exceeds the Russian figure by 1.5 times; for every patent application in Russia, there are 6 times more researchers than in Japan. The Russian model is characterized by high state involvement, a high level of population education, and a focus on training scientific personnel, with non-competitive science funding. Certain aspects of the Asian model could be applied in the Russian context to improve the effectiveness of science and education development.

Keywords:

Higher Education, science development, innovation, funding models, human capital development.

RESUMEN

El objetivo del estudio fue analizar el desarrollo de la ciencia y la educación en Rusia y Japón, identificar características y determinar direcciones futuras. Se realizó un análisis comparativo basado en cinco criterios: educación, potencial humano, innovación, actividades financieras y científicas. Los autores emplean un análisis estadístico comparativo de indicadores de educación y ciencia de bases de datos de la OCDE y la UNESCO, centrándose en cinco áreas clave: sistemas de educación superior, actividades de innovación, potencial de personal, financiación de la ciencia y la educación, y actividades científicas. Rusia se queda atrás en varios indicadores: el número de investigadores por millón de habitantes en Japón es el doble; la proporción de personal en la educación superior en Japón supera la cifra rusa en 1,5 veces; por cada solicitud de patente en Rusia, hay 6 veces más investigadores que en Japón. El modelo ruso se caracteriza por una alta participación estatal, un alto nivel de educación de la población y un enfoque en la formación de personal científico, con financiación científica no competitiva. Ciertos aspectos del modelo asiático podrían aplicarse en el contexto ruso para mejorar la eficacia del desarrollo de la ciencia y la educación.

Palabras clave:

Educación superior, desarrollo científico, innovación, modelos de financiación, desarrollo del capital humano.

INTRODUCTION

Education and science play a crucial role in the development of individuals and states, determining their status in the world. The quality and accessibility of higher education shape the social and research environment, while science plays a decisive role in the emergence of innovations.

The level of development of education and science is a key indicator of a country's socio-economic status. In recent years, national programs aimed at improving education quality and achieving scientific innovations have gained attention. For instance, Russia's National Project "Education" focuses on developing the education system at all levels of management, and the National Project "Science and Universities" aims to position Russia among the top ten countries globally in terms of scientific research and development.

The development of the educational system is closely linked with the development of the scientific system, representing a unified process. Without an appropriate scientific base, conducting research and preparing qualified teaching staff is impossible. Many developed countries pay serious attention to this issue, allocating up to 7-8% of GDP for education development (e.g., in Russia - 2.9%, in Finland - 5.1%, in Norway - 6.4%), and the share of expenditures on R&D reaches 2-3% of GDP (e.g., gross domestic expenditures on R&D as a percentage of GDP in Russia - 1.1%, in Japan - 3.27%, China - 2.4%, Finland - 2.91%, Norway - 2.27%).

Russia's indicators lag behind global standards, highlighting the importance of researching science and education development issues in the country. Comparing the development models of science and education in Russia and Japan will help identify the most successful approaches and development prospects in this field. The choice of countries is due to their cultural-geographical proximity, existing foundation, and cooperation in scientific and educational activities, as well as their achievements in science and education efficiency indicators. For example, Japan is currently a dynamically developing technological country in East Asia, with universities ranked among the top in international academic and scientific rankings: QS WUR top-200; THE WUR top-200; ARWU top-500; Webometrics top-500. Science and education rankings are used to evaluate and compare educational institutions, considering various criteria such as research quality and productivity, educational programs, faculty level, funding, international reputation, and other factors. The rankings show a significant lag of Russian universities behind Japanese ones in all parameters. Despite Russia's larger territorial area, it has fewer universities than Japan. At the same time, a significantly higher number of Japanese universities are represented in the top-200 and top-500 rankings. Japanese universities achieve results at the top-70 level, while Russian universities are in the top-90 to top-220 range.

Economic growth and development are accompanied by changes in society, technology, and scientific knowledge (Kochetkov et al., 2023). Various studies on models of such changes are found in management and economic literature. For instance, Zolotareva (2019), identifies a "least resistance" model for Russia, focusing on strengthening the state's role in the economy while ignoring the science and education sector, and a "state-national" model for Japan, involving strict state regulation through the development and implementation of special programs supporting economic sectors, including science and education. Prasol (2020), determined that Japan needs educational modernization affecting all educational levels.

In many countries, one of the main tasks of national policy is developing the scientific and educational complex of the territory (Zein & Butler, 2022; Golubeva et al., 2023). For example, Tevlina (2012), for Norway; and Liu & Krasova (2012), for China. Regarding Japan's scientific and educational agenda, several studies can be highlighted. Duggan (2018), wrote about the positive impact of short-term exchange programs. Lim & Apple (2018), discussed the Asian education model's ideological orientation as a strength and gender inequality as a weakness.

The importance of developing science, technology, and education for Russia's future development is emphasized by both domestic and foreign researchers, including Yakovlev & Yakovlev (2019); and Rubtsova et al. (2019). Issues of globalization and its impact on scientific research outcomes were studied by (Bachion et al., 2015; Nesvetailova (2016). Some researchers analyzed the reasons for Russia's lag in science and innovation, identifying the neglect of science-intensive industries (Asprilla & Gonzalez, 2018). Scientists believe this has led to a crisis in the domestic economic model, requiring a shift to an innovative economic model based on the latest achievements in science, education, technology, and innovation.

Despite active studies on science and education, the agenda for developing and defining promising frontiers in the scientific and educational sphere remains relevant. Note that the period 2022–2031 has been declared the Decade of Science and Technology in the Russian Federation. One of the most important tasks for the state's development today is overcoming technological backwardness and directing scientific and technical development towards developing domestic technologies within the country.

Russia and Japan are two countries with rich histories and cultural heritage. They are also renowned for their achievements in science and education. However, their territorial development models in these areas differ significantly.

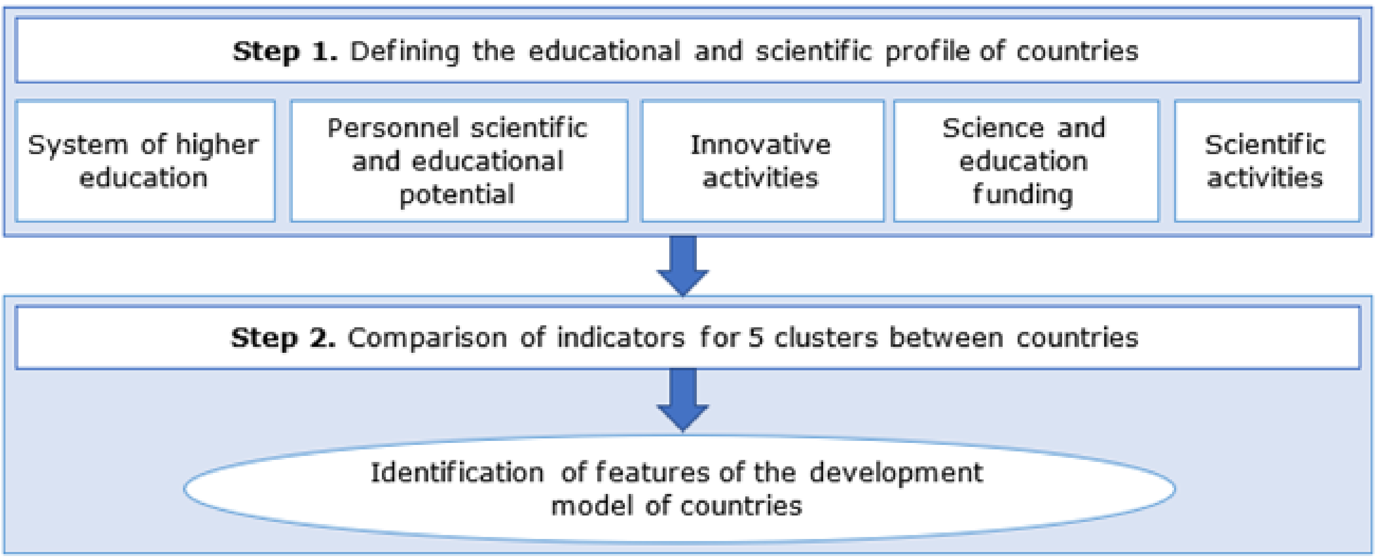
This article examines the features and differences in these two management models. Russia and Japan offer different approaches to developing scientific and educational centers, and studying their experience can be useful in finding the best solutions for forming scientific and educational policies.

The purpose of this article is to define the territorial dynamics of science and higher education, identifying development features based on multidimensional statistical and comparative analysis of Russia and Japan.

MATERIALS AND METHODS

The research methodology included a comparative analysis of countries based on the five blocks with subsequent identification of country development model features (Figure 1).

Fig. 1: Methodology for researching the territorial development of science and higher education.



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At the first stage of the study, to determine the educational profile of the region, a study was conducted on 5 blocks, which include 25 indicators: System of higher education; Personnel scientific and educational potential; Innovative activities; Science and education funding; Scientific activities. At the second stage of the study, a comparison of indicators was made to identify the features of the development and management models of science and education in the country.

RESULTS AND DISCUSSION

Education is one of the most important factors influencing the development of modern science. Here we focus on the features of the higher education systems of the countries and consider indicators such as the share of people with higher education, the gross graduation rate from higher education programs, the share of enrolled students, including by levels of education, and the UN education level index.

First, let's analyze the distinctive features of the Japanese higher education system. Currently, higher education in Japan includes public, regional, and private educational institutions that differ by ownership type. It should be noted that private universities predominate. However, public educational institutions occupy the top positions in quality assessments. This conclusion can be drawn by looking at rankings that characterize all aspects of university life. Public and especially former imperial universities like Tokyo, Kyoto, Tohoku, Osaka, Kyushu, Hokkaido, and Nagoya occupy top spots in these rankings, performing significant parts of scientific developments and works.

Public universities in Japan play an important role by providing accessible education, receiving up to 70% of budget subsidies. Among public universities, Waseda and Keio private universities stand out with high-level research bases. Other private universities also vary in size, level, and research directions. Despite receiving a smaller share of budget subsidies (about 10%), they provide quality education to students even with limited resources. Currently, private universities in Japan focus on the accessibility and simplicity of educational programs rather than conducting significant scientific research, which requires hiring highly qualified teachers and higher laboratory equipment costs.

Graduates from higher education institutions in Japan enjoy privileges related to broader employment opportunities. Due to the relatively small percentage of the population with higher education, those who decide to continue their education in Japan can expect significantly higher income levels, which is a good incentive for obtaining higher education. In 2018, the share of people with higher education aged 25 to 64 years was 51.9% (aged 25 to 34 years - 60.7%, aged 55 to 64 years - 43%) (Asprilla & Gonzalez, 2018). As in most countries worldwide, people with higher education in Japan generally have higher employment rates (Stepus et al., 2022; Stepanov, 2023).

In the Russian Federation, there are several types of higher education institutions where students can receive higher professional education: universities, federal universities, institutes, and academies. Among these institutions, federal universities play a special role as leading educational institutions in their federal districts. Federal universities play a key role in the development of fundamental and applied research in a wide range of scientific fields. In Russia, there are eight federal universities: Far Eastern, Southern, Northern, North-Eastern, Kazan, Baltic, Siberian, and Ural (Musaeva, 2019). The share of state educational institutions exceeds 70%.

As in Japan, Russia has a system of bachelor's, master's, and doctoral studies, with similar durations and conditions (typically 4, 2, and 3 years, respectively). In 2018, the share of people with higher education aged 25 to 64 years was 56.7% (aged 25 to 34 years - 62.1%, aged 55 to 64 years - 50.3%) (Stepanov, 2023).

Next, let's examine the dynamics of the graduation rate for higher education programs (bachelor's (ISCED 6) and master's (ISCED 7)) in the analyzed countries from 2016 to 2020. The gross graduation rate for higher education programs, according to the OECD methodology, is the total number of higher education graduates expressed as a percentage of the population at the theoretical graduation age for the most common first degree program (ISCED 6 and 7) in the country. In Japan, from 2016 to 2020, the gross graduation rate for the first degree in higher education remained relatively stable, with a slight increase. In Russia, there was a decline from 75.04% to 57.06% from 2016 to 2020. In 2016, there was a significant gap between Russia and Japan, but by 2020, the gap narrowed, with Russia's gross graduation rate for the first degree (ISCED 6 and 7) in higher education being higher than Japan's (57.06% vs. 48.76%) by 9.7% (Stepus et al., 2022).

In Japan, from 2016 to 2020, the gross graduation rate for the first degree in higher education remained relatively stable, with a slight increase.

Next, let's compare the number of enrolled students in Japan and Russia from 2016 to 2020 by education levels. In Japan, from 2016 to 2020, there was a positive trend in the total number of enrolled students. The number of enrolled doctoral students (PhD) and students in short-cycle tertiary education slightly decreased, while the number of enrolled bachelor and master students increased each year. Note that in the international classification, higher education levels are divided into four groups, including bachelor's, master's, doctoral (PhD), and short-cycle tertiary education. Academic programs in short-cycle tertiary education are below or equivalent to bachelor's programs and may include secondary vocational education in Russia. Overall, the picture of the number of enrolled students remains stable. The largest share of enrolled students in 2020 was in bachelor's programs – 70%, followed by short-cycle tertiary education – 19%, and master's programs – 9%. The share of doctoral programs is only 2%.

From 2016 to 2019, Russia saw a decline in the total number of enrolled students. This decline is explained by the demographic situation in the country. Unlike Japan, Russia saw an increase in the number of enrolled students in short-cycle tertiary education and master's programs, with a significant decrease in bachelor's and doctoral (PhD) programs. Structurally, half of the enrolled students in Russia in 2019 were in bachelor's programs, almost equally divided (22%) among master's and short-cycle tertiary education programs. Unlike the Japanese model, Russia focuses on training personnel for scientific research activities (a larger share of master's students). As in Japan, only 2% are enrolled in doctoral programs. Among the factors for the low attractiveness of higher qualification programs are weak motivation for academic careers and financial support for scientific activities (Stepus et al., 2022).

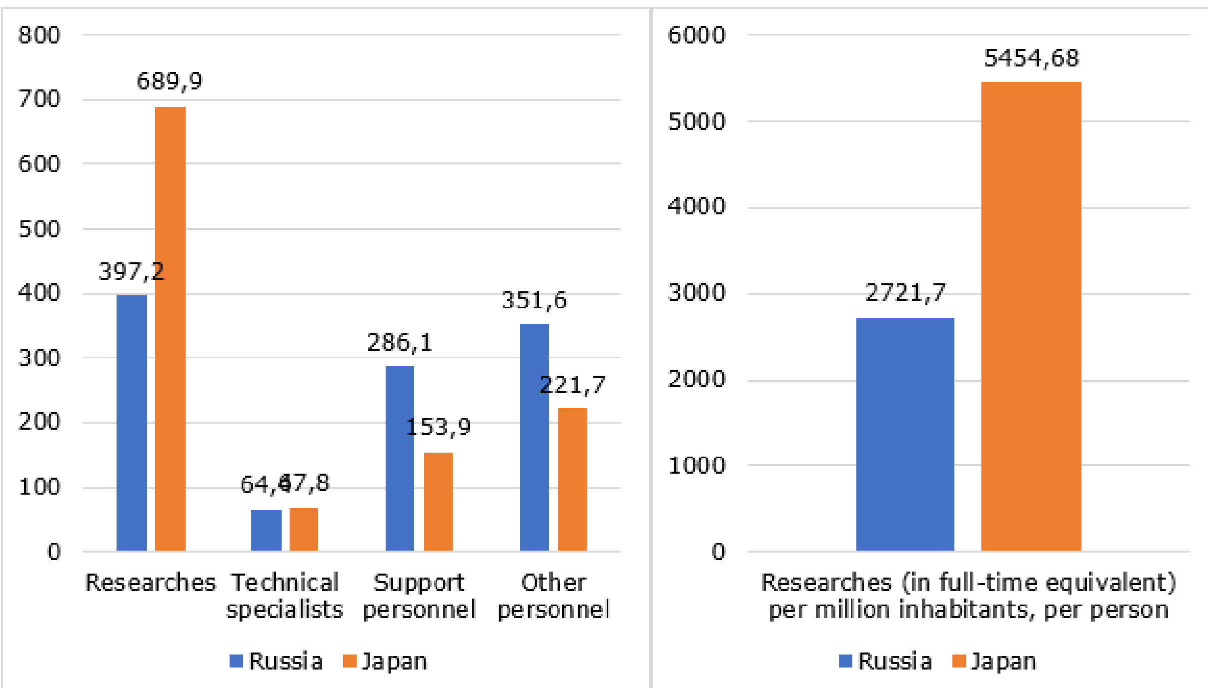
Rankings are an important tool for evaluating and comparing various aspects of life, including the economy, education, and other spheres. Russia and Japan, as two large countries with different economic and social structures, occupy different positions in rankings. The Education Index, created by the UN, evaluates the quality, literacy, and accessibility of education in different countries. Key indicators for evaluation include Expected Years of Schooling and Mean Years of Schooling. In Expected Years of Schooling, Russia (15.8 years) surpasses Japan (15.2 years) by 0.6 years. In Mean Years of Schooling, Russia (12.8 years) lags behind Japan (13.4 years) by 0.6 years. In the 2022 world ranking by Education Index, Japan ranks 28th, while Russia ranks 29th, indicating that according to this evaluation methodology, Russia and Japan have approximately the same level of education quality and accessibility, at a level above average.

Thus, Russia and Japan have similar higher education systems, but there are differences in several indicators characterizing efficiency and effectiveness. The level of population education is high in both countries according to international organizations. The Russian model is characterized by a focus on state universities, with science and education issues being equally distributed as basic functions of the educational institution. The Japanese model focuses on private education, emphasizing the labor market training of literate specialists, while science development is concentrated in state universities, which are fewer in number. The completion rates for bachelor's and master's programs also show differences. Russia has a higher percentage of students completing their studies at the expected age, although a negative trend has been observed over the past five years. Japan is characterized by an increase in the number of students, with the highest interest and dynamics at the bachelor's level. In Russia, the opposite picture is observed: the number of students is decreasing, which may be due to factors such as the demographic decline of the 1990s, youth migration, the decreasing prestige of higher education, and the growth of online education. Unlike the Japanese model, Russia focuses more on training personnel for scientific research activities (master's students).

The necessity and relevance of developing scientific personnel arose and remain a problem with the transition to a market economy when there were significant personnel losses in science and the economy. This section examines indicators such as the total number of R&D personnel and its structural ratio by types of specialists, the number of researchers per million inhabitants, the share of the higher education sector (HE) in the total number of R&D personnel, and the share of researchers and other categories of specialists in the HE sector.

The scientific potential of a country becomes more powerful with an increase in the share of researchers in the total number of R&D personnel (Figure 2).

Fig. 2: Total R&D personnel (in FTE, thousand people) and researchers (in FTE) per million people in 2020.

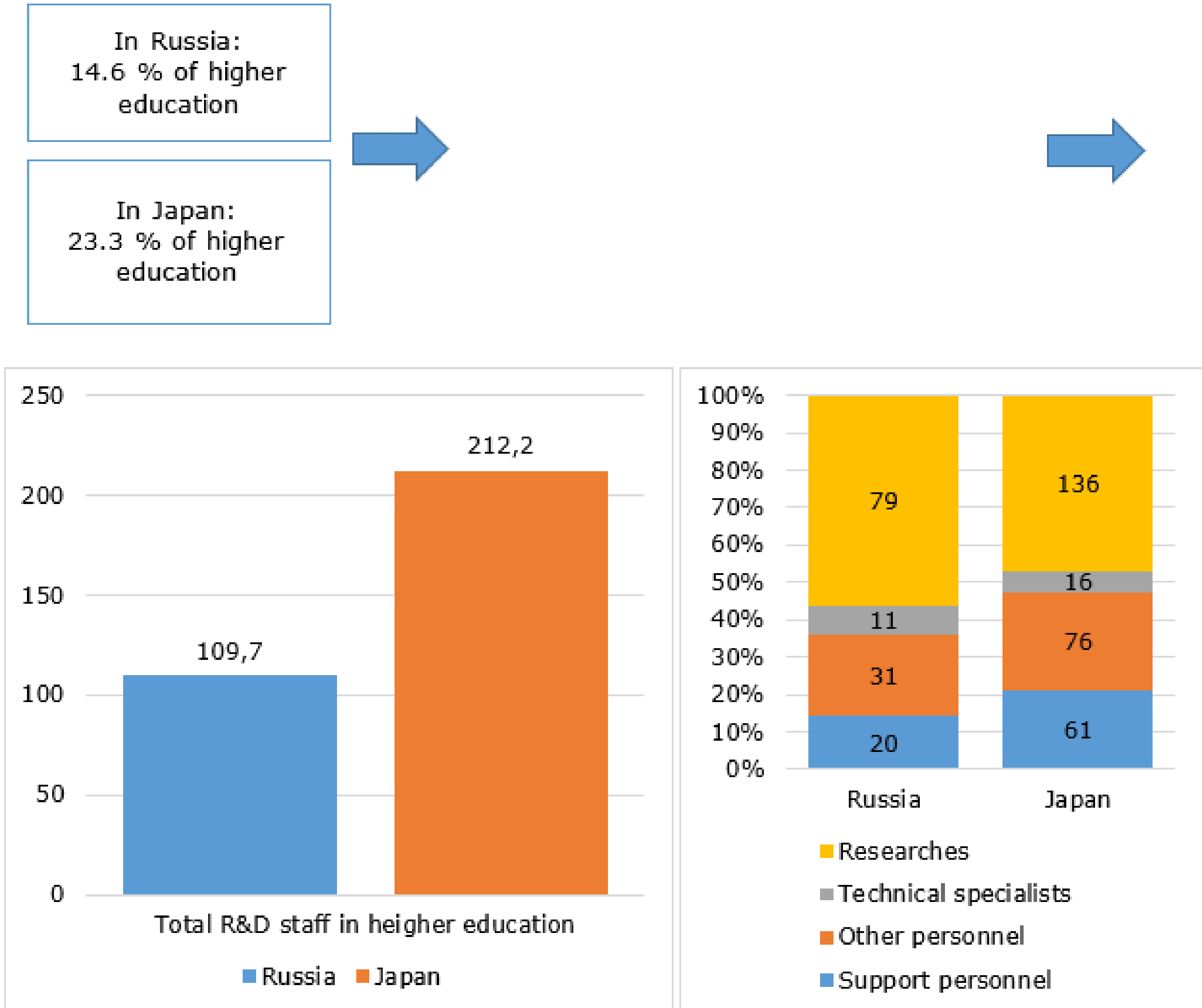


Source: Prepared by the authors

In both analyzed countries, "Researchers" make up the largest part of the R&D personnel structure. The significant proportion of researchers in Japan indicates a strong emphasis on scientific human resources potential, ensuring a high level. "Technical specialists" occupy the smallest share in both countries. Japan surpasses Russia in the number of researchers; simultaneously, Russia has a larger share in the categories of "Other personnel" and "Support personnel" (Musaeva, 2019). In Russia, the structure of R&D personnel is "burdened" with additional personnel and "lightened" in the portion directly related to research work. This could indicate a high bureaucratic burden on scientific research activities, as well as low attractiveness in terms of science funding.

Regarding the higher education sector, the following picture emerges (Figure 3).

Fig. 3. Total R&D personnel in the higher education by country and its structure in 2020 year, thousand people



Source: Prepared by the authors

Scientific activities in Russia are largely concentrated (85.4%) in the public, commercial, and private non-profit sectors, rather than in the higher education sector. In Japan, almost a quarter of R&D personnel are employed in higher education, while the remaining 76.7% are employed in the entrepreneurial and public sectors. The number of R&D personnel in the higher education sector in Japan surpasses that in Russia across all structural divisions.

Examining the structure of the scientific workforce reveals significant differences between the Russian and Asian models. The number of R&D personnel is significantly lower in Russia, both in absolute terms and per capita. Notably, a larger portion of scientific staff is concentrated in the higher education sector in Japan. Regarding the structural analysis of R&D personnel, the share of researchers (scientists and engineers involved in the development and/or creation of new knowledge and developments) is 53.05% in Russia compared to 75.68% in Japan. Thus, in the Russian model, the researcher's work is more supported by the work of other specialists than in the Asian model. Factors contributing to this imbalance include the low cost and value of labor in the R&D field, low researcher salaries leading to the use of auxiliary workers, and excessive bureaucratization of research processes, which requires additional personnel for reporting and other tasks.

The R&D personnel support policy should aim to form an effective system for increasing and utilizing the scientific and intellectual potential of scientific and educational personnel in the region. This may include attracting outstanding scientists and educators to the country, enhancing the qualifications of local staff, involving youth in science and innovation, and creating a comfortable and competitive social infrastructure for the scientific community. Note that a more detailed objective analysis and identification of the causes of these factors require additional research based on more in-depth information.

The effectiveness of innovation activities is indicated by science "productivity" indicators such as the number of patent applications per researcher and the share of global patent applications. The introduction of technological innovations and the development of new technologies are essential conditions for the social and economic progress of states and their economic stability.

In innovation activities, Japan has a significant advantage in the number of patent applications. In 2020, Japan had 308,000 patent applications, 8.5 times more than Russia's 35,000. In terms of the number of patent applications for inventions in 2021, Japan had a huge lead over Russia: 26,000 applications in Russia compared to 413,000 in Japan. This difference is well-reflected in the percentage share of global patent applications: 0.8% for Russia and 12% for Japan.

The scientific "productivity" of researchers in these countries varies. In Russia, there are about 11 researchers per patent application, indicating a collective nature of work. In Japan, however, there are on average 2 researchers per patent application, indicating high individual productivity in the scientific field.

Given this significant difference in the number of applications, the countries have the following results in the World Intellectual Property Organization (WIPO) ranking by the number of patents: Japan ranked 3rd globally in 2021, while Russia was in the top ten.

Additionally, Russia and Japan frequently appear in rankings related to innovation and technology, such as the Global Innovation Index (GII) and the GII Cluster Ranking (Leading Global Clusters for Science and Technology). In 2022, the Russian Federation ranked 47th and was in the top 50, dropping two positions from 2021 (45th place). It has a medium level of innovation activity. In contrast, Japan ranked 13th in the GII in 2022, indicating a high level of innovation characterized by successful investments in scientific research, development of new technologies, creation of innovative enterprises, and stimulation of innovation activities in society. The closest indicators for Russia (27) and Japan (21) are in the category of human capital and research. The highest level of lag is observed in institutions, with Japan in 21st place and Russia in 89th. To achieve high innovation results, Russia needs to improve infrastructure, increase the number of educational institutions, and other factors that contribute to innovation activities.

In the top 100 most productive clusters (according to the GII), Japan has five clusters: Tokyo-Yokohama (1st place), Osaka-Kobe-Kyoto (in the top 10). Russia is represented by three clusters: Moscow (31st place), as well as St. Petersburg and Novosibirsk (not in the top 100). In the top 25 for their scientific and technical activity, Japan is represented by the clusters of Kanazawa (14th place) and Tokyo-Yokohama (20th place), while Moscow is in 94th place. Japan leads in innovation, while Russia holds average positions.

In innovation activities, Japan has a significant lead in the number of patent applications (8.5 times more than Russia). This is supported by the high scientific and inventive productivity of the country's researchers (0.5 applications per researcher). The Russian model is characterized by a more collective form of work, and given the structure of R&D personnel, where the share of researchers is lower than in the Asian model, this result has objective reasons. This result is reflected in the scientific innovation productivity rankings: the Global Innovation Index and the GII Cluster Ranking, where the countries are represented in the top 15 and top 45, respectively. Russia and Japan place great importance on innovation activities in the system of science and education development. However, the nature and direction of innovation activities differ. Japan focuses on patenting and developing productive clusters. According to the ranking results, to achieve high innovation results, Russia needs to improve and increase such successful activity components as infrastructure and the number of educational institutions.

One of the main goals of analyzing research funding is to identify funding sources that ensure the research process and highlight the development models' features. Based on available statistics, four main categories of science and education funding sources can be identified: government, commercial enterprises, higher education, and business. In recent years, many countries have gradually reduced their participation in science funding from the state budget due to the economic crisis, which caused an economic downturn worldwide, leading to increased funding from the private sector. This section will focus on the following indicators: gross domestic expenditures on R&D financed by various sectors of the economy (sources); gross domestic expenditures on R&D carried out by various sectors of the economy; internal expenditures on research and development; allocations for research and development from the state budget.

Next, we will examine the sources of R&D funding by country and the sectors of the economy that incurred expenses. Gross domestic expenditures on R&D are financed by sectors such as business, commercial enterprises, government, higher education, and the rest of the world. In Russia, 68% of R&D is funded by the government and 29% by commercial enterprises. In total, 3% of funding comes from business, higher education, and the rest of the world. The model for supporting science development is state-oriented. In Japan, R&D is funded in different proportions: in 2020, 78% of R&D funding was provided by commercial enterprises, 15% by the government, and a total of 7% by the higher education sector (5%), business (1%), and the rest of the world (1%). The model for supporting science development is privately commercial-oriented (Stepanov, 2023).

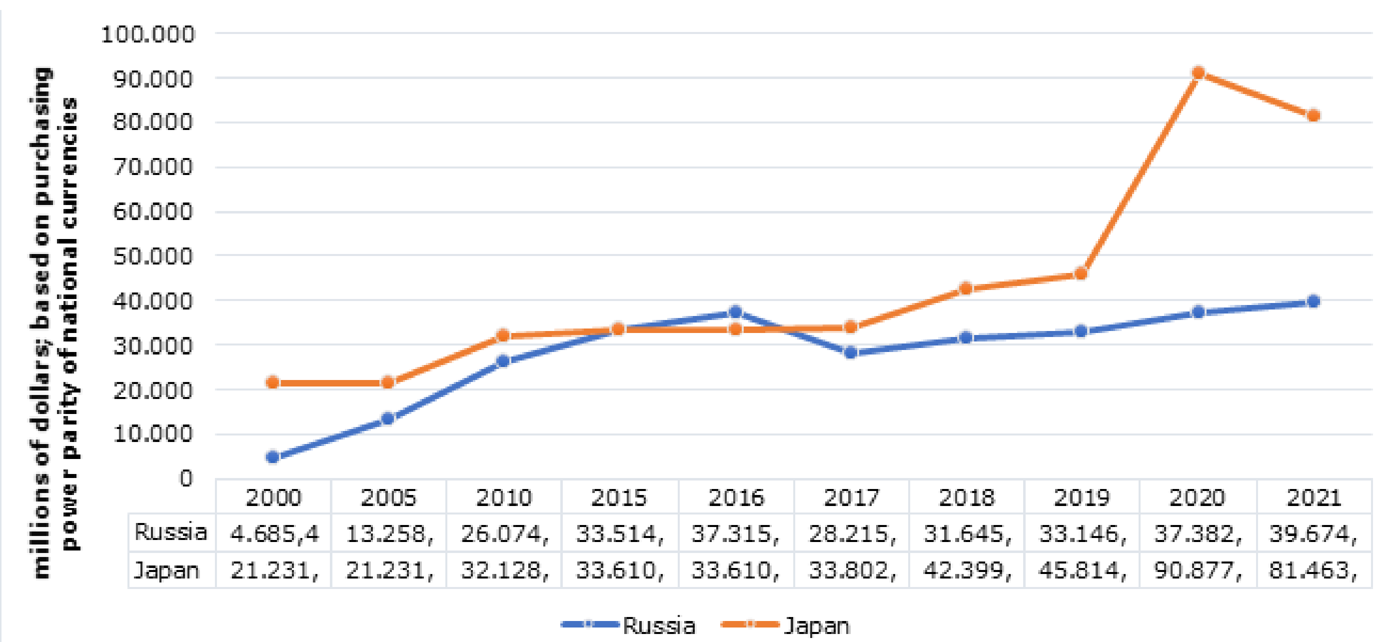
In 2020, the majority of R&D expenditures were carried out by commercial enterprises in both countries: Russia – 56.60%; Japan – 78.65%. Commercial enterprises play a crucial role in funding R&D. They invest significant funds in the development of new technologies, products, and services, which contributes to the innovative development of society and the economy as a whole. In Russia, 32.83% of R&D expenditures were covered by the government, whereas in Japan, it was 8.28%. Russia places great importance on government-led research and development, which can promote centralized planned scientific and technological development of the country. Government funding is directed towards supporting key sectors of the economy, developing new technologies, and addressing urgent problems and tasks related to societal development.

Higher education sector expenditures on R&D are approximately equally distributed between the two countries: in Russia – 9.85%, in Japan – 11.70%. The sector with the least R&D expenditures is the private non-profit sector, with shares of 0.73% in Russia and 1.37% in Japan. This is due to the fact that non-profit organizations have limited budgets and interest in performing technological and innovative projects, focusing on solving social issues.

R&D expenditures as a share of gross domestic product (GDP) represent the total expenditures on research and development divided by the total output of the economy. This is a key indicator of a country's scientific and technological development, showing the financial potential invested in its innovative development. A high degree of government participation and stability in science and education investment is observed in high-income countries. In Japan, from 2000 to 2020, R&D expenditures as a percentage of GDP ranged from 2.86% to 3.27%, indicating a high level of scientific and technological development. In contrast, in Russia, this figure ranges from 0.99% to 1.13%, indicating a lower level of investment in science and innovation. Despite a slight increase in this indicator in Russia, continued development of financial support and the creation of conditions to attract investments in research activities are necessary to reach global standards.

One of the main sources of funding for the research and development sector in Russia is allocations from the state budget. An analysis of "Allocations for research and development from the state budget" was then conducted (Figure 4) (Stepanov, 2023).

Fig. 4. Allocations for research and development from the state budget, millions of dollars



Source: Prepared by the authors

Throughout the analyzed period, Russia's allocations for research and development exceeded Japan's only once, in 2016. In 2021, Russia's allocations for research and development from the state budget were comparable to those of most highly developed countries, while Japan was on par with countries like the USA and Germany.

Russia is characterized by high government involvement in funding R&D activities, whereas in Japan, commercial enterprises handle most of the funding. The model of supporting the development of science and innovation in Russia is state-oriented, largely implemented in the commercial sector, although the share of the state sector also remains relatively high. The Asian model, exemplified by Japan, is purely commercial and private in nature. Support for science and innovation in Japan's economy remains very high, with the share of the value of all goods and services produced in the country directed towards supporting science reaching 3.3%, while in Russia it remains around 1%. Despite the high level of government participation in science funding, absolute values significantly lag behind Japan. Thus, aside from the high government involvement in funding science and education, the Russian model is also characterized by underfunding of R&D.

The effectiveness of scientific potential can be characterized by bibliometric statistics. The scientific community widely uses indicators based on publication activity and citation, as well as their effectiveness relative to researchers. The sources of information are the Web of Science (WoS) and Scopus databases. The following indicators were selected for analyzing the scientific activities of Russia and Japan (Table 1).

Table 1. Indicators of scientific activity of Russia and Japan for 2022 year, units.

Indicator	Russia	Japan
Number of publications in scientific publications indexed in Scopus	108038	139382
Citation on publication in Scopus	0,56	0,82
H-Index in Scopus	702	1236
Share in the global number of publications in scientific publications indexed in Scopus, %	2,12	2,73
Number of publications in scientific publications indexed in Scopus per 1 researcher	0,27	0,20
Number of publications in scientific publications indexed in the Web of science	46499	93127
Normalized Citation Effect (CNCI) in WoS 2013-2022	0,7	0,89
Number of publications in WoS (articles and reviews) per 1 researcher (FTE) for 2013-2022	0,12	0,15

Source: Prepared by the authors

The scientometric analysis showed that Japan significantly surpasses Russia in its contribution to global research outcomes, both according to Scopus and WoS data. The quality of scientific work in Japan also exceeds that of Russia. However, it should be noted that the productivity per researcher in Russia is higher or close to Japanese levels. Given that the number of researchers in Japan is higher, it should be emphasized that the Japanese model is more targeted in publishing highly cited sources, focusing on the quality rather than the volume of publications

As a result of the study, we highlight the Russian and Asian models of territorial development of science and education, whose features are assessed in five areas: higher education system, scientific and educational personnel potential, innovation activity, science and education funding, and scientific activity.

Higher Education System: (share of people with higher education, gross graduation rate from higher education programs, share of enrolled students by program, UN Education Index). The Russian model has the following specific features in the higher education system: it is state-oriented; the percentage of the population with higher education is higher, and compared to the world, the education system is aimed at training personnel at a young "appropriate" age with an emphasis on preparing for scientific research activities, which is understandable given the stagnation of scientific and educational personnel in the economy; there is a decline in the number of students, which is partly due to socio-demographic processes in the country's history; science is a fundamental component of universities. The Japanese model has the following specific features in the higher education system: emphasis on private education with training skilled specialists for the labor market; focus on science in a few select state universities; literacy of the population is lower than in Russia.

Scientific and Educational Personnel Potential: (total number of R&D personnel and its structural ratio by type of specialists, number of researchers per million inhabitants, share of higher education sector in the total number of R&D personnel, share of researchers and other categories of specialists in the higher education sector). In the Asian model, unlike the Russian model, the following features can be distinguished: high number of scientific personnel; about a quarter of R&D personnel are concentrated in the higher education sector, indicating a higher targeted concentration of scientific staff in the mentioned state institutions for science development; high share of research staff. In the Russian model, the following specifics can be highlighted: low number of scientific personnel; high share of auxiliary staff in research.

Innovation Activity: (number of patent applications per researcher, share in the global number of patent applications. High inventive activity is characteristic of the Asian model, which, in turn, is characterized by an almost individual nature of patenting applications). The Russian model, on the other hand, is characterized by collective and low inventive productivity.

Science and Education Funding: (gross domestic expenditures on R&D financed by various sectors of the economy (sources); gross domestic expenditures on R&D carried out by various sectors of the economy; internal expenditures on research and development; allocations for research and development from the state budget). In the Asian model, R&D funding is primarily provided by commercial enterprises, resulting in a significantly higher level of science funding. In the Russian model, R&D is mostly funded by the government. The similarity between the two models lies in the fact that R&D is largely carried out by commercial enterprises. However, the Russian model is also characterized by a low level of R&D funding.

Scientific Activity: (the share of countries in the global number of publications in scientific journals indexed in Scopus; the share in the global number of publications with a Hirsch index in Scopus; the average number of citations of publications in Scopus; the share of publications in the global indicator in Web of Science; normalized citation impact (CNCI) in Web of Science; the number of publications per researcher). The Russian model significantly lags behind the Asian model in terms of productivity and quality of scientific activity. While the share of countries in the global number of publications in scientific journals indexed in Scopus shows slight differences in favor of Japan, other indicators reveal a substantial gap between Russia and Japan.

CONCLUSIONS

The analysis of statistical indicators showed that the Russian and Asian models have several similarities and differences. As of today, the Asian model exemplifies a successful strategy for the territorial development of science and education, surpassing the Russian model in several qualitative parameters. A serious trend for Russian science and education is the growing gap in training personnel for this sector of the economy and the non-competitive level of its funding. In Japan, the development of science (R&D expenditures) is predominantly managed by commercial enterprises and certain state universities that are interested in high-tech equipment and enhancing the country's competitiveness in the global market. In contrast, in Russia, funding is provided by the government and in smaller volumes.

The implementation of the chain "education – science – technology – industrial production" is the driving force behind the creation of modern technologies and innovations, and the development of the state's economy. Therefore, the development of science and education, creating a significant scientific and research potential, is an essential aspect of the strategic development of a territory. This article addresses the issue of identifying the features of the territorial development of science and education in Japan and Russia. At the same time, it is noted that identifying specific advantages of the Russian and Asian models of territorial development of science and education requires additional research into the reasons and factors of their formation and effectiveness.

We express our gratitude to the employees of the Sector for research of territorial university leadership at KFU who participated in the preparation of the article. This paper has been supported by the Kazan Federal University Strategic Academic Leadership Program.

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