

# International Analysis of National Databases of Educational Statistics and Analysis of the Technologies' Educational Data in Countries of the World

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## ABSTRACT

This study reports the results of the international analysis of national databases of educational statistics for macro-regions: America, Asia, Europe, Africa, and Oceania, a sample of which is based on international ratings: The Global Innovation Index and Networked Readiness Index. The analysis of the national databases of educational analytics and statistics was carried out according to the following parameters: the functional purpose of the educational analytics and statistics database; legal regulations for the collection and analysis of data; types of educational data collected, their nature; and the use of educational data for decision-making. As a result of the study, practice-oriented conclusions on a comparative analysis of national databases of educational statistics and technologies for the analysis of educational data are presented.

**Keywords:** big data in education, data-driven education management, digital education infrastructure, electronic repositories of educational data, national databases of educational statistics, methodology, and technologies for analyzing educational data

## Introduction

The technology of big data analysis transforms the organizational principles of the development of socio-economic spheres, including education. Education management is based on the principles of evidence-based development of education<sup>[1]</sup>. In the countries of the world, the ideology of open government, open data, and data-driven management is being implemented. For this, countries are forming a technological infrastructure of digital open data in education, national electronic databases of

educational statistics and services for processing large data in education<sup>[2, 3]</sup>. The educational policy begins to be built on educational analytics using new analytical and managerial methods: a) development forecast based on a combination of known data; b) the method of revealing the structure and clustering; c) network analysis.

In order to assess the development of digital infrastructure, digital technologies in the countries of the world, the following indices are used: Country Readiness Index for the Network Society (NRI), The Global Innovation Index<sup>[4]</sup> and the Country Readiness Index<sup>[5]</sup>.

To study the technological infrastructure of educational data analysis in the countries of the world, we conducted an international analysis of national databases of educational statistics and technologies for the analysis of educational data.

The above actualizes the need to solve the problem: the study of methodologies and technologies for analyzing big data, the digital infrastructure for their collection, systematization, and analytics used in countries worldwide.

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## Methodology

For the analysis of national databases of educational statistics, we used the classification of countries of the world by macro-geographical regions: America, Asia, Europe, Africa, and Oceania, for statistical purposes in the United Nations in accordance with the document "Standard codes of countries or areas for use in statistics", developed by the UN Secretariat [6].

A sample of representative countries from the macro-regions was based on the following international studies: The Global Innovation Index 2019 [4] and the Country Readiness Index 2019 (2). The Country Preparedness Index for a Network Society (NRI) is a ranking of 121 countries and reflects the level of countries' readiness for the widespread use of ICTs for socio-economic development" [7]. Sweden showed the highest value of the Country Readiness Index for a network society based on a survey for 2019. The leading position of European countries is also confirmed by the United Nations e-Government Survey [8], conducted by the United Nations Department of Economic and Social Affairs (UNDESA), in which the main attention was paid to the development of local e-government in 40 cities of the world. EGDI is used to measure the willingness and capacity of national institutions to use ICTs to provide public services (UNDESA, 2018, p. XX). The results showed that Europe is a leading macro-region in the development of e-government and e-services in general.

For the analysis of national educational statistics databases, the countries representative of the macroregions were selected: America, Asia, Europe, Australia, and Oceania, which have high ratings in the GII and NRI ratings for their macroregion. In comparison with the databases of educational statistics of foreign countries, Russian databases of educational analytics and statistics are also considered. Also separately presented are the databases of world educational statistics of the Organization for Economic Co-operation and Development Organization for Economic Co-operation and Development (OECD) [9], the UNESCO Institute for Statistics [10] and the World Bank [11].

The research methodology of digital national databases of educational statistics is based on the analysis of the following aspects of digital national databases of educational statistics: 1) the functional purpose of the digital national database of educational statistics; 2) legal regulations for the collection and analysis of data; 3) types of collected and systematized educational data; 4) applied digital data analysis technologies; 5) the use of educational data for management decisions.

The study used the analysis methodology developed in the framework of the project "Methodology and technology for the analysis of big data in education" [12, 13] with financial support from the Russian Foundation for Basic Research [14].

### Purpose and objectives of the study

For the purpose of developing methodology and technology for big data analysis we will make an international analysis of national databases of educational statistics and technological

infrastructure of digital open data in education.

The objectives of the study were to:

- make a comparative analysis of methodologies, technologies for organizing digital national databases of educational analytics and statistics.
- investigate the possibilities of electronic services and information systems in education in the countries of the world for solving the problems of building analytics
- identify the infrastructural and technological possibilities of systematizing data from various information systems and electronic services
- obtain arbitrary samples and slices of information of interest for organizational, pedagogical, and managerial decisions in education.
- explore the methodological principles of educational analytics in national repositories and educational statistics databases.

### Research Issues:

- 1) what types of educational data are systematized and analyzed in digital repositories of national educational data?
- 2) what legal regulations govern the operation of these digital databases for the collection and analysis of data?
- 3) what is the nature of these educational data (which institutions provide educational data, who is the subject of the generation of educational data)?
- 4) how are data collected in the statistics databases functionally used?
- 5) what digital technologies are used to analyze data on the servers of national educational statistics and analytics?

## Results

The results of the analysis of the possibilities and technologies for the use and interpretation of educational data in countries are presented based on the analysis of national databases of educational statistics.

### Macroregion America.

*USA* - according to the results of studies in 2019, takes 3rd place in the GII from the rating of 129 countries, 8th place - in the NRI from the rating of 121 countries.

Resource "National Center for Education Statistics" (NCES) [15] is the main federal authority for the collection and analysis of data related to education in the United States. The center belongs to the US Department of Education (U.S. Department of Education) [15], Institute of Education Sciences [16] (Institute of Education Sciences -IES). NCES fulfills the Congressional mandate to collate, collect, analyze, and present complete statistics on the state of American education, perform and publish reports, and review and report on educational activities internationally.

The legal regulations of educational analytics and statistics are as follows. The collection, analysis and use of data is carried out in accordance with the IES Policy on Public Access to Research, the Internet Privacy and Security Policy and statistical standards, which are consistent with the US Department of Education plan and public access policy development guidelines approved by United States Government October 21, 2016

The base of educational statistics and analytics - NCES - is a multifunctional database of educational data. Technologically, the database as a digital service provides free access to the following sections and data: surveys and programs (Surveys & Programs); data processing tools (Data & Tools); fast overview of data (Fast Facts); public reports (Publications & Products); Information about organizations (About Us).

The database contains a section on data on the assessment of educational achievements at the national and international level (National Assessments, International Assessments), data on early childhood, primary, secondary, and higher education (Early Childhood, Elementary/Secondary, Postsecondary); system data, use and privacy, additional resources (Data Systems, Use & Privacy, Library, Resources).

The types of educational data systematized in the database are structured into sections. The National Assessments section provides official statistical information on the results of The National Assessment of Educational Progress (NAEP) and the National Assessments of Adult Literacy (NAAL) at the national level. The International Assessments section contains information on the work of NCES in the framework of the program of international activities and the provision of statistical educational data for international research in the education field. NCES integrates educational data into the OECD's International Indicators of Education Systems (INES) program. The database also contains educational analytics and statistics of international assessments and research in the USA: the results of the international monitoring the Trends in International Mathematics and Science Study (TIMSS), international study of the quality of reading and understanding of the text (Progress in International Reading Literacy Study - PIRLS), International Computer and Information Literacy Studies (ICILS), Programme for International Student Assessment (PISA), Program for the International Assessment of Adult Competencies (PIAAC), international study of Teaching And Learning International Survey (TALIS), and the International Early Learning Study (IELS). The sections related to Early Childhood, Elementary/Secondary, and Postsecondary provide a large list of statistical studies at the national level, for example: Career and Technical Education Statistic (CTE); education finance statistics (EDFIN); The Education Demographic and Geographic Estimates (EDGE); National Household Education Survey (NHES); National Teacher and Principal Survey (NTPS); etc.

Data processing tools are represented by digital services Data Tools, Navigator. The International Data Explorer (IDE) is an interactive digital tool that allows you to systematize educational

achievements, the service allows you to organize data on student performance according to the results of assessments for thousands of variables in the United States, as well as analyze data. DataLab as a digital tool is an online tool for creating tables and graphs that include a large amount of educational data. DataLab has 3 powerful tools for the analytical needs of the user: QuickStats - allows novice users to create simple charts and tables; PowerStats - allows researchers to create complex tables, linear and logistic regressions; and TrendStats - allows you to create complex tables covering several years of data collection. In addition, this digital tool includes a table repository containing more than 5,000 published analytical tables by topic, publication, and source. Thus, the electronic portal of the National Center for Educational Statistics (NCES), USA, is a multifunctional open database of educational analytics and statistics in the United States with various application possibilities.

The US National Electronic Database for Educational Analytics and Statistics: NationMaster <sup>[17]</sup> contains a large catalog of variables covering 300 industry verticals, including industry vertical - education. With NationMaster, you can track thousands of statistics from reliable sources (UNESCO Institute for Statistics, World Bank, WHO, OECD, etc.). NationMaster provides the ability to quite simply and conveniently obtain accurate, reliable, and up-to-date information and statistics from 305 countries, including education statistics <sup>[17]</sup>. For the United States as the holder of this electronic data repository, this is an opportunity for constant data comparability and educational policy based on comparative analysis.

*Canada* - according to the results of research in 2019, takes 17th place in the GII rating, 14th place - in the NRI rating. The main source of analytical and statistical data of Canada, including in the field of education, is Statistics Canada <sup>[18]</sup>. The collection, analysis and use of statistics are regulated by federal laws, in particular the Statistics Act (Statistics Act - RSC, 1985, p. S-19) <sup>[19]</sup>, according to which the provision of statistics is a federal responsibility, Statistics Canada Legislatively called to perform this function throughout the country. Also, a member of the United Nations Statistical Commission, the Canadian Statistical Office is guided by the fundamental principles of official statistics adopted by the United Nations Statistical Commission in 1994 (The Fundamental Principles of Official Statistics) <sup>[20]</sup>. Statistics Canada is also committed to protect the confidentiality of all entrusted information and ensuring that the information provided is timely and relevant to Canadians. To fulfill this obligation, Statistics Canada has created a Privacy Framework that describes approved methods, procedures, and management related to privacy. All personal information collected, used, disclosed, or stored by Statistics Canada is protected by the Privacy Act and the Statistics Act <sup>[21]</sup>. The site also features the Statistics Canada's Trust Center, where you can learn how Statistics Canada provides data security and privacy. All legal grounds for collecting and analyzing statistics are available to anyone on the Statistics Canada website using a hyperlink system.

Types of educational data and the structure of the digital database of analytical and statistical data Statistics Canada:

- The Subjects section (thematic sections) contains information on statistical data on topics, including education;
- the Data section provides the ability to quickly and conveniently search for statistical information on given parameters (data geography, statistical program/survey, frequency of conducting, etc.), as well as the choice of the presentation form of available statistical data (in the form of tables, maps, graphic visualizations, etc.);
- sections Analysis (analytics), Reference (reference), Geography (geography) are also search engines similar to those presented in the Data section, but with a different ability to filter and display information (Analysis presents data on educational achievements of students by educational level, in Reference data about all educational organizations and programs, in Geography - data on the map of the country);
- the Census section (census) contains data on fertility statistics and statistics of studying children at different educational levels);
- the Surveys and statistical programs section (studies and statistical programs) contains analytically processed information for respondents, a list of the results of all statistical programs, studies and available documentation with the ability to quickly search, as well as information on the possibilities and applications of statistical data;
- the About StatCan section (about StatCan) contains information about the statistical office of Canada, legal regulations for the collection and analysis of data, career growth in StatCan, etc.

The education, training, and learning statistics section <sup>[22]</sup> is overseen by the Canadian Center for Education Statistics, which provides up-to-date information on education, training, and learning, combining data, tools, and reports. This information portal provides access to a centralized collection of information about students and educational systems in Canada. The section of educational statistics provides access (with the possibility of search and geographical filtering) to statistical data on various national studies in the field of education, such as education and labor market outcomes; educational indicators (Education Indicators); Literacy primary and secondary education (Elementary and secondary education); higher/vocational education (Postsecondary education); financing of education (Financial resources invested in education) and others. As a prospect for applying educational statistics to its citizens, Statistics Canada offers the use of The Education and Labor Market Longitudinal Platform (ELMLP). This platform is a database of reliably integrated anonymous data that is longitudinal and accessible for research and statistical purposes. The platform of educational analytics and statistics allows us to analyze anonymous data on graduates of schools, colleges,

universities to better understand their development paths and the impact of their education on career prospects in terms of earnings. The data available within the platform is integrated using an anonymous communication key; they can also be connected in a longitudinal direction, which allows researchers to better understand the behavior and results of students over time. Statistics Canada provides researchers, provincial and provincial education authorities, and educational organizations with data from government and private sector organizations that are collected as part of their ongoing activities. Statistics Canada integrates this data into official statistics.

An electronic database, including educational analytics and statistics, is the electronic portal of the Government of Canada (Canada.ca) <sup>[23]</sup>. As part of the development of e-government, the portal contains sections of the Open Government and Open Data, which provides analytics and statistics for all sectors, including educational.

### Macroregion Asia.

*Singapore* – According to the rating of technological infrastructure development and data openness, in 2019, it ranked 8th in GII, 2nd place in NRI. One of the main sources of educational statistics in Singapore is the Educational Department of Statistics (DOS) educational analytics database <sup>[24]</sup>, which aims to provide comprehensive statistics and reliable statistical services that enhance decision-making. Official statistics are compiled and compiled by the Singapore Department of Statistics, as well as by the Research and Statistics Units (RSU) in government ministries and government committees.

The collection, analysis and use of statistical data are regulated by the Law on Statistics (Statistics Act, 2012) <sup>[25]</sup>, which is the main legislative act regulating the statistical activities carried out by DOS and RSU. The Department bases its activities on statistical standards and developed leading principles for working with statistical data (Guiding Principles) <sup>[26]</sup>.

Types of analytical data on education and sections of the digital base of the Department of Statistics:

- the Find Data section provides access to topic data in the A-Z alphabetical search engine; access to the table constructor SingStat; access to characteristics of statistical methods and concepts; access to the Yearbook of Statistics, etc.
- The Publications section provides access to public reports;
- The section Our Services and Tools (services and tools) presents services and tools for analysis and work with data. For example, SingStat Table Builder provides free access to more than 27,000 data series, the ability to create individual data tables, and load them in the form of files of various formats; The SingStat Mobile App provides access to more than 200 diagrams of frequently requested statistics from mobile devices, etc.

Direct statistics on education in the statistical database are in the section "Education, Language Spoken and Literacy" <sup>[27]</sup>. Statistics on education, language, and literacy are compiled by the

Singapore Ministry of Education and the Department of Statistics.

Educational statistics of Singapore on the Department of Statistics website have the following sections and types of educational data:

- The Latest Data section contains statistics on recent research in the education field;
- The section Publications and Methodology (public reports and methodology) includes public reports on educational data;
- the section Visualizing Data (data visualization) reveals educational data in the form of graphs, charts and other types of data visualization;
- The Related Info section provides information on the annual educational statistics (Yearbook of Statistics Singapore);
- The External Sources section contains integrated services with databases of other institutions, for example, the website of the Singapore Ministry of Education.

The data disclosed by the Department of Statistics is used by educational organizations, student parents, researchers, and experts, policymakers to develop and evaluate policies, planning and research, and automated reporting.

Additional sources of educational analytics and statistics from Singapore are the website of the Ministry of Education (MOE) of Singapore [28], the Education Statistics section provides an overview of educational analytics and statistics, as well as Singapore's public data portal Data.gov.sg [29], which in the section "Education" presents analytical and statistical data on education.

### China.

China – according to the results of research in 2019, it ranks 14th in GII, 41st in NRI.

One of the sources of educational data in China is the website of the Ministry of Education (The Ministry of Education of the People in Republic of China) [30]. The Documents section contains educational analytics and statistics on organizations, results, and professional staff: the condition of buildings and the conditions for implementing educational programs, the number and geography of educational organizations, the number of teachers, their academic qualifications, and professional ranks (Number of Full-time Teachers in Special Education Schools by Academic Qualifications and Professional Rank) and others.

The collection, analysis, and use of statistics in China are governed by the Statistics Law of the People's Republic of China and the relevant provisions of the State Council [31].

An additional source of educational statistics is the website of the National Bureau of Statistics of China [32], which contains a compilation of annual statistics of the country (China Statistical Yearbook) [33], including educational statistics.

### Macroregion Europe.

Switzerland – by ratings of technological infrastructure and data openness in 2019 takes 1st place in GII, 5th place in NRI. The

main official source of Swiss data, including educational data, is the Federal Statistical Office, available on the website of the Swiss Government (Federal Council) [34]. The Federal Department of Home Affairs - FDHA section [35] contains the Federal Statistical Office (FSO) online resource [36]. It offers users information in the public domain about the state and development of the population, economy, society, territory, and environment in Switzerland. It provides information on statistics of various spheres of life, grouped thematically into such sections as: Population; Territory and environment; Work and income; National economy; Prices; Industry and services; Agriculture and forestry; Energy; Construction and housing; Tourism; Mobility and transport; Money, banks and insurance; Social security; Health, education and science; Culture, media, information society, sport; Politics; etc. Data is collected in accordance with scientific criteria, converted into statistical information, and published in an anonymous form. Catalogs and databases of statistical information are offered to users in the form of tables, graphs, maps, publications, and press releases. A separate section presents the methodological foundations, surveys/studies, and data classification with the ability to search by topic and title.

Also, the FSO resource in the Services section in the public domain contains:

- Interactive visual tools for searching and analyzing statistical data: Infographics, Interactive diagrams, Weekly charts, Statistical atlases, etc.;
- Media resources: press releases, publications, photographs, as well as the possibility of subscribing to FSO on Twitter, Facebook, Youtube;
- Information on the portal of open government data (Open Government Data - OGD);
- research results and search by subsections: STAT-TAB-interactive tables, access to anonymized individual data, methodological reports, the use of individual data, experimental statistics;
- statistical information about geodata;
- information on historical data, etc.

Data protection and personal integrity are fundamental principles of state statistical activity in Switzerland, and statistical secrecy is regulated by the 1992 Federal Statistics Act [37].

Education statistics are presented on the website of the Swiss Federal Statistical Office in the section "Education and science" [38] (Education and Science). This section contains publications, press releases, visualizations and other data on the results of recent and past statistical studies, grouped by topic: pupils and students (Pupils and Students), diplomas (Diploma), teaching staff (Educational staff), educational institutions (Educational institutions), financing of the educational system (Finances of the educational system), etc.

The website of the Swiss Federal Statistical Office provides statistical information on important areas of society, necessary for monitoring, evaluating the current development situation, planning, and managing key political areas. Official statistics are

characterized by their transparency, scientific grounds, and compliance with international standards. In this connection, official statistics provide information, but do not evaluate the results - including from a political point of view - and do not derive recommended actions from them. Only in this way can official statistics be able to withstand the pressures of certain interests and continue to guarantee the reliability, security, and trust of official information.

An additional source of official information and statistics in Switzerland, including in the field of education, is the open data portal [Opendata.swiss](https://opendata.swiss)<sup>[39]</sup>, also linked to the portal of electronic government of Switzerland (E-Government Switzerland)<sup>[40]</sup>. [Opendata.swiss](https://opendata.swiss) is the central portal of open government data developed as part of the "Open government data strategy in Switzerland from 2019 to 2023".

## Sweden

*Sweden* - by ratings of technological infrastructure and data openness in 2019 2nd place in GII, 1st place in NRI. The source of official information about Sweden's statistics, including educational statistics, is the portal of Statistics Sweden - Statistics Sweden<sup>[41]</sup>. The Statistical Office is responsible for providing quality official statistics that are easily accessible to users and coordinates the work of the entire system of official statistics in Sweden. Statistics Sweden also runs long-term cooperation projects with statistical offices in developing countries, funded by The Swedish International Development Cooperation Agency (SIDA).

Statistical data, impartial and up-to-date, scientifically sound, are provided and protected in accordance with Swedish laws and regulations, developed policies and strategies, as well as international standards and principles. Thus, official statistics are regulated in accordance with the Law "On Official Statistics" (Official Statistics Act, 2001: 99) and the regulation "On Official Statistics" (The Official Statistics Ordinance, 2001: 100), as well as a number of other laws and regulations (law "On Personal Data" (Personal Data Act), etc.)<sup>[42]</sup>. In addition, Statistics Sweden has developed an Activity Strategy until 2020, a Quality Policy, a Revision Policy, and an Environmental Policy, which also regulates statistics. Statistics Sweden adheres to several guidelines in its work, among them: the principles of official UN statistics from 2014 (The UN's basic principles for statistics); the principles of European statistics adopted by Eurostat and the Committee of the European Statistical System in 2011 (European Code of Practice)<sup>[43]</sup>; professional ethical principles (Declaration on professional ethics)<sup>[44]</sup>, prepared and adopted by the International Statistical Institute (ISI) in 2010. The high quality of processing statistical data is also confirmed by certification in accordance with ISO 20252: 2012 for conducting market surveys, public opinion, and social research. The environmental management system of Statistics Sweden is also certified according to the international standard ISO 14001. The databases of Statistics Sweden are freely available in accordance with the PSI (Public sector information) directive<sup>[45]</sup>.

The main page provides a standard search engine for quick access to information, and the Statistics Sweden main menu includes the following sections for working with statistics:

- Finding statistics contains statistics on the following topics: Agriculture, forestry and fishery, Environment, Financial markets, Health and medical care, Business Activities (Business activities), Culture and leisure, Education and research, Social services, Housing and construction (Housing, construction, and building), Transport and communications (Transport and communications) and others.
- Services provide contacts and additional services: Data collection and surveys; Regional statistical products; Key indicators by industry; A guide for researchers and universities.
- Documentation contains detailed information about the research process, classifications, standards, and methods.
- The Data collection is divided into: Surveys of the business sector research, Survey of individuals, Private sector research, Surveys of the public sector.

The data of educational statistics are contained in the Education and research subsection and include such groups of statistical studies as: Analysis, trends, and forecasts in the development of education and the labor market (Analysis, trends, and forecasts in education and the labor market), Education of the population (Education of the population), Financial aid, Folk High School, Higher education, Higher vocational education and arts and culture courses, Research (Research), School system and kindergarten (School system and child daycare).

The educational statistics data page also provides separate access to the pages Statistical database, Regional statistics, International statistics, Thematic areas, Older statistics, Publications)

Statistics Sweden, Sweden, meets today's and tomorrow's need for reliable statistics as a basis for analysis, discussion, and decision-making by providing open access to official statistics through its portal, as well as social networks and newsletters.

Additional sources of educational statistics from Sweden include the Swedish National Data Service (SND) portal<sup>[46]</sup>, which, together with a network of more than 30 universities and state research institutes, has the primary function of ensuring accessibility, preservation, and reuse of research data and related materials; as well as the Swedish Schools Inspectorate<sup>[47]</sup> and Swedish Higher Education Authority (UKÄ)<sup>[48]</sup> sites, which provide information, including statistics, about school and higher education in Sweden.

## Macroregion Africa.

*The Republic of South Africa* - by ratings of technological infrastructure and data openness in 2019: 63th in GII, 72th in NRI. The main source of statistics in South Africa, including education, is the portal of Statistics South Africa - Statistics South Africa (Stats SA)<sup>[49]</sup>. The Statistical Office of South Africa, as a government agency, is responsible for producing official

statistics, attaching great importance to the quality of data provided to statistical services and products to meet user needs. Official statistics produced by Stats SA are based on data collected from censuses, studies, and administrative data sources and are characterized by common statistical principles and practices. The legal basis for the activities of Stats SA, as reported on the portal, are: the Law on Statistics (Statistics Act), developed principles (Fundamental principles of statistics), standards (Statistics South Africa Services Standards, South African Statistical Quality Assessment Framework (SASQAF), etc.), a work program (Work program) and a strategic plan of activity (Strategic plan). The main sections for working with statistics on the portal are:

- Find Statistics offers a search for statistical data on the topic, indicators, locations, SDGs (Sustainable development goals - SDG);
- Publications provides the ability to search for publications by subsection: Statistical publications, Tariff policy, Codes and classifications, Questionnaires, Order publications;
- Census contains statistical information on the census;
- Suppliers informs about portal providers.

In South Africa, education is managed by 2 national departments, the Department of Higher Education and Training (DHET) and the Department of Basic Education (DBE), the latter is responsible for primary and secondary schools. Statistics are mainly published by the Departments of Basic and Higher Education and Statistics South Africa.

Educational statistics are contained in the thematic section of the Education portal<sup>[50]</sup>. It presents:

- a description of the process of collecting and using statistical data, as well as the types of educational data obtained;
- Interactive visualization of the basic data of educational statistics for quick, visual familiarization (Quick Fact) in the form of graphs, charts, histograms, etc. on the level of education (Educational Attainment), the cost of higher education (Tertiary Education Fees), etc.;
- publications, basic statistics in percentage terms (Key Statistics);
- links to additional resources in the form of documents, tools, videos, sites, etc.

Education information published by Statistics South Africa is mainly based on annual general household surveys, as well as population censuses. Education data include school attendance, educational attainment, areas of study, and literacy rates. Such data supplement school and institutional data prepared by the Departments of Basic and Higher Education. Thematic reports compiled from the results of these studies contain information on a number of issues in the field of education statistics. For example, they include data on the level of education, literacy, number of students, the mode of transportation used to deliver them to educational institutions, and the educational continuity of generations. Factors affecting educational outcomes, the

relationship between educational outcomes of parents and their children, the average price change for tuition for both secondary and higher education, which is covered by the release of the Consumer Price Index (CPI), are also given. In addition, educational statistics from South Africa include the statistical publication "Financial Health of Higher Education Institutions", which contains the economic and practical classification of financial transactions of higher education institutions for each financial year.

Additional sources of educational statistics for South Africa are the websites of the Departments of Basic and Higher Education: the Department of Basic Education (DBE)<sup>[51]</sup>, the Department of Higher Education and Training (DHET)<sup>[52]</sup>, and the South Africa Data Portal.<sup>[53]</sup>

### Macroregion Australia and Oceania.

*Australia* - by ratings of technological infrastructure and data openness in 2019: 22nd in GII, 13th in NRI. One of the main sources of official statistics in Australia, including in the field of education, is the portal of the Australian Bureau of Statistics - Australian Bureau of Statistics<sup>[54, 55]</sup>. The ABS is the national statistical agency of Australia, which provides reliable official statistics on various environmental, demographic, social, and economic issues of importance to the country.

The main statutes that define the responsibilities and functions of the Australian Bureau of Statistics are the Australian Bureau of Statistics Act 1975 and the Census and Statistics Act 1905.

The main page of the portal with a standard search engine contains the following sections for working with statistical data:

- Statistics provides access to research statistics, grouped thematically into sections: Economics (Economy: Key Economic Indicators, Business Indicators, Finance, Lending, Household income & Wealth, International Trade, Balance of payments, Imports & exports, Price Indexes & Inflation etc.); society (People: Aboriginal & Torres Strait Islander Peoples, Crime & Justice, Culture & Recreation, Education, People & Communities, Population etc.); health (Health: Causes of Death, Disability, Health Conditions & Risk Factors, Health Services etc.); industry (Industry: Manufacturing, Agriculture, Building & Construction, Energy, Mining, Technology & Innovation, Tourism & Transport etc.); and also contains a subsection on methodological foundations and classifications (Methods & Classifications: Classifications, Methodology, Standards, etc.);
- Census contains statistical information about the census with the ability to search;
- Complete your survey opens the opportunity to participate in surveys and research of the bureau with the need to register/enter your account using login and password.

The portal also provides free access to online tools and resources for searching and analyzing statistical data, such as: ABS.Stat

(Beta), CPI inflation calculator, Data by region, Microdata access, TableBuilder, as well as mobile applications (Mobile Apps).

The section of educational statistics of the portal ("Education")<sup>[56]</sup> contains information on the following statistical data, divided thematically: Number of Staff, Students, and Schools; Literacy, Numeracy and Problem-Solving Skills in Adults; Preschool Education; Schools Australia, Education and Work; Preschool Education and Child Care; Work-Related Training and Adult Learning; Qualifications and Work; Educational outcomes, experimental estimates; Outcomes of Vocational Education and Training in Schools, experimental estimates; etc.

The following websites can be used as additional sources of educational statistics in Australia: the Department of Education, Skills and Employment<sup>[57]</sup> and Universities Australia<sup>[58]</sup>; as well as the Australian Data Archive (ADA)<sup>[59]</sup>, which represents the Australian National University's (ANU) national digital data collection and preservation service, ADA disseminates this data for secondary analyses by academic researchers and other users.

*New Zealand* - by ratings of technological infrastructure and data openness in 2019: 25th in GII, 16th in NRI.

The main source of official statistical information in New Zealand is the Stats NZ portal<sup>[60]</sup>, the agency is the leading provider of state statistics.

The main legal regulation of Stats NZ is the Law on Statistics of 1975 (Statistics Act 1975). The Government Chief Data Steward (GCDS), together with the Privacy Commissioner, have also developed six key principles to support safe and efficient data analysis, including algorithmic decision-making. They are part of a range of government initiatives, including: Social Investment Agency's consultation on the development of guidance for Data Protection and Use; MSD's Privacy Human Rights and Ethics (PHRaE) Framework; Data Futures Partnership work; AI Forum (Artificial Intelligence Forum).

The main sections of the Stats NZ portal for working with statistics are:

- Statistics contains subsections: Publications, Statistics by topic, Statistics by place, Methods, standards, and research;
- Tools provides a wide range of tools for searching and analyzing statistical data by subsections: Large datasets (Infoshare, NZ.Stat, CSV files for download), Indicators and snapshots (Social indicators, Progress indicators, Environmental indicators), Regional data and maps (Geographic data service, StatsMaps etc.), Data for business, Experimental initiatives, etc.;
- Services offers a range of services: Information center, Customized data services, Integrated Data Infrastructure, Longitudinal Business Database etc., as well as services and contacts to help users;
- Census contains census information for New Zealand.

According to the provisions stated on the portal, education increases the ability of people to meet their basic needs, expands

the range of career options available to them, and allows them to better control their life direction. In this regard, the educational statistics on this portal are presented in the framework of social research (NZ social indicators), for example: Source of funding for the higher education sector, Youth workforce and educational status, 18-year-old youth with higher qualifications, Educational level of adults in age 25 to 34 years old, Participation in early childhood (Source of funds to the higher education sector, Youth Labor Force and Education Status, 18-year-olds with higher qualifications, Educational attainment of adults aged 25 to 34 years, Participation in early childhood education).

However, there are additional portals specialized in educational data, including statistical ones. Such sources of official educational statistics supported by the Ministry of Education of New Zealand include the Education Counts portal<sup>[61]</sup> with an interactive interface and the following sections of the main menu: Know your Region, Communities of Learning, Find a School, Early Learning Services, Topics, Publications, Statistics, Data Services The Statistics section provides educational statistics, grouped into: Early Childhood Education, School Education, Higher Education, Maori Education, Pacific Education, International Education, Indicators, Education Support (Early Childhood Education, Schooling, Tertiary Education, Māori Education, Pacific Education, International Education, Indicators, Learning Support). Another official resource for educational data, including statistics, is the portal Education.govt.nz<sup>[62]</sup>, which also functions as part of the New Zealand Department of Education.

### **Russia.**

Russia - by ratings of technological infrastructure and data openness in 2019: Ranks 46th in GII and 48th in NRI. The main source of official statistical information in Russia, including education data, is the portal of the Federal State Statistics Service (Rosstat)<sup>[63]</sup>. Rosstat "is a federal executive body that exercises functions of generating official statistical information on environmental, demographic, economic, and social other public processes in the Russian Federation, as well as in the manner and cases established by the legislation of the Russian Federation on the control in the field of official statistical accounting. The Federal State Statistics Service is administered by the Ministry of Economic Development of the Russian Federation.

The Federal State Statistics Service is guided in its activities by the Constitution of the Russian Federation, federal constitutional laws, federal laws, acts of the President of the Russian Federation and the Government of the Russian Federation, international treaties of the Russian Federation, acts of the Ministry of Economic Development of the Russian Federation"<sup>[64]</sup>. Rosstat is also guided by the following regulatory documents governing the collection, analysis, and use of educational statistics:

- Federal Law № 282-FZ of 10.29.07 "On Official Statistical Accounting and the System of State Statistics in the Russian Federation";



- Federal Law №273-FZ of December 29, 12 "On Education in the Russian Federation";
- Federal Law dated 09.02.2009 No. 8-FZ "On providing access to information on the activities of state bodies and local governments";
- Decree of the Government of the Russian Federation of 02.06.2008 №420 "On the Federal State Statistics Service";
- The development strategy of Rosstat until 2024;
- The order of Rosstat dated November 29, 2018 №705 "On approval of the official statistical methodology for calculating the main indicators of education and culture statistics".

The main page of the portal provides the possibility of a standard search, as well as subscribing to Rosstat in social networks and by email. The main sections for searching and analyzing statistical information on the Rosstat portal are:

- "Statistics" includes subsections: Official statistics, Censuses and surveys, Methodology and reference information, Interactive statistical services (Age and Sex Pyramid, Migration), Announcements, Statistics News, Infographics, Frequently Asked Questions);
- "Publications" contains subsections: Publications production plan, Publications catalog, Publications of territorial bodies, Subscription;
- "Respondents" presents the following subsections: Information for respondents, Individual list of TIN/PSRN (OGRNIP)/OKPO forms, Statkalendar, Forms of federal statistical observation, and forms of accounting (financial) statements, Notification of codes for all-Russian classifiers, Statistical reporting in electronic form.

In the "Population" section, the "Education" subsection <sup>[65]</sup> on the Rosstat portal, educational statistics are presented for the following groups: Preschool education; General education programs, educational programs of secondary vocational education, educational programs of higher education; Programs for the training of scientific and pedagogical personnel in graduate school and the training of scientific personnel in doctoral studies; Methodology; Operational Information (Education in 2019); Official publications (Russian Statistical Yearbook, Regions of Russia. Socio-economic indicators, etc.); the results of federal statistical observations (Preschool education, Additional education of children, Training of highly qualified personnel, Children's recreation).

An additional source of educational statistics in Russia can be the site of the Unified Interdepartmental Information and Statistical System (EMISS) <sup>[65]</sup>, which provides access "through the Internet of government bodies, local governments, legal entities and individuals to official statistical information, including metadata, formed in accordance with the federal statistical work plan" <sup>[65]</sup>.

### Databases of world educational statistics.

Organization for Economic Co-operation and Development (OECD) - Organization for Economic Co-operation and Development (OECD) <sup>[9]</sup> provides for public use on its portal a section of statistical data, including educational, for a large number of countries and indicators, with the ability to conduct a comparative analysis between countries.

So, on OECD.Stat <sup>[9]</sup> in the section "Education and Training", in the subsection "Education at a Glance", the following statistical information is presented: Educational attainment and outcomes; Students, access to participation and education; Financial resources invested in education; learning environment and the teachers (Level of education and its results; Students, access to and participation in education; Financial resources invested in education; Teachers and educational environment). The educational section also contains information on the International Study of Teaching and Learning International Survey –TALIS and the Measuring Innovation in Education in two parts: Part 1 - Comparing innovation in education with other sectors, Part 2 - Innovation as changes in schools and classrooms. Other statistics, including educational statistics, can be found in the Data and Statistics sections <sup>[9]</sup>.

The OECD is committed to protecting the personal information of users of its websites. OECD employees and external processors who have access to personal information and are associated with the processing of this information are required to consider the confidentiality of information in accordance with the Decision of Secretary-General on the Protection of Individuals with Regard to the Processing of their Personal Data.

International statistics on education are also provided by the UNESCO Institute for Statistics (UIS) <sup>[10]</sup> in the Education & Literacy section with data on the following thematic sections: Sustainable Development Goal 4, Learning Outcomes, Out-of-School Children and Youth, Literacy, Gender Equality in Education, Education in Africa, Education Finance, Higher Education, International Standard Classification of Education (ISCED), Equity in Education, Teachers, Capacity Development (Sustainable Development Goal 4, learning outcomes, children and youth outside of school, literacy, gender equality in education, education in Africa, financing educated I graduated, the International Standard Classification of Education (ISCED), equality in education, teachers, capacity building). The statistics of each country in the educational section contain information on: Education System, Participation in Education, Progress and Completion in Education, Education Expenditures, Illiterate Population, Literacy Rate, Annex (Education system, participation in education, progress and completion of education, expenses education, illiterate population, literacy rate, applications). Separately, the portal presents the resource UIS.Stat - an official and reliable source of internationally comparable data on education, science, culture, and communication <sup>[10]</sup>. The international development community has given UIS the mandate to develop the methodologies, standards, and indicators necessary to achieve SDG 4 – Education

2030 and key goals in innovation and science, culture and communication in close consultation with partners.

Another reliable source of international educational statistics is the World Bank portal <sup>[11]</sup> Education Statistics (EdStats). It is a comprehensive source of statistics and analytics on key education topics, such as access, completion, learning, expenditures, policy, and equity. Sources of information include administrative data from UIS countries; international learning assessments (EGRA, PIAAC, PIRLS, TIMSS, and PISA) and 3 regional learning assessments (LLECE, PASEC, SACMEQ); World Bank databases, household surveys, such as MICS, DHS, LSMS. EdStats includes a database of World Bank educational projects, classified by type of activity, component, and subsector of all World Bank educational projects since 1998. Education Statistics offers the following tools and capabilities for searching and analyzing educational statistics: EdStats Query is the main data set from more than 1000 internationally comparable education indicators for all levels of education from preschool to higher education; Learning Outcomes Query - data from five international assessments of education (EGRA, PIAAC, PIRLS, TIMSS, and PISA); Education Equality Query - data from MICS and DHS about inequalities in the provision of education based on gender, income and geography; Educational Attainment Query - data on average years of schooling, level of education among age groups/genders and population distribution; Education Expenditure Query is the main group of internationally comparable indicators of education spending around the world, etc. <sup>[11]</sup>.

## Conclusion

The study of national databases of educational analytics and statistics revealed the following:

- 1) trends in the implementation of a management policy based on data and the ideology of open data are associated with ensuring the organizational coherence of institutions providing educational data through legal regulations and laws of countries, as well as with the implementation and development of integrated digital technologies that integrate different types of educational data through digital programs processing to build a system of relationships and forecasting opportunities;
- 2) countries that implement the human development policy through projects of state education development programs organize data collection and analysis based on two Data-Analys methodologies: a) a humanitarian methodology in which the nature of the data is related to the activities of a person (students) - these are digital traces of educational subjects activities; b) an institutional methodology in which the nature of the data is related to reports on the conditions of educational activity, reports on the implementation of educational development programs. Subsequently, these two variables in educational data are compared in the search

for correlation links for evidence-based analytics as the basis for making effective decisions;

- 3) countries that implement a policy of openness of educational data and openness of data analytics services on digital educational data platforms, as a rule, implement an ethical policy by explaining to users the ethical protocols for working with educational data;
- 4) according to the management structure, the institutions responsible for ensuring the functioning and development of digital databases (repositories) of educational analytics and statistics data report directly to the government of the country or the branch ministry - the ministry of education;
- 5) countries with developed technological infrastructure of analytics and statistics of educational data and highly functional repositories of educational data integrate for processing and interpretation educational data of institutional, national and international levels of assessment of educational results related to school systems for assessing educational results, national certification examinations and the results of international quality studies education. This allows timely adjustment and harmonization of education monitoring systems and assessment tools.

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