



# DATA-DRIVEN EDUCATION QUALITY MANAGEMENT: ON MONITORING AND EVALUATION IN RUSSIAN SCHOOLS

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## ABSTRACT

A review of foreign and Russian research on the problems of assessing the quality of education at the institutional level is undertaken. Various aspects of the problem including the cross-country and sub-national contexts, the impact of international comparative research about in-school assessment, and teachers' training in working with assessment data are compared. The effect of regional policies on the development of internal education quality evaluation systems in Russian schools is studied through analyzing official departmental websites. Expert evaluation method and the concordance coefficient are used to determine the key factors of the internal quality assessment system in general education institutions. The authors go beyond the control and inspection paradigm of education quality management and consider said systems from the point of the information-analytical paradigm. Data-driven management involves using data analysis and interpretation to predict students' progress and motivational choice of educational profiles to design the content of electronic educational environments and individual educational trajectories.

**Keywords:** Data-driven management. Educational data. Internal quality assessment systems for general education. In-school control.

GESTÃO DA QUALIDADE DA EDUCAÇÃO BASEADA EM DADOS: NO MONITORAMENTO E AVALIAÇÃO NAS ESCOLAS DA RÚSSIA

GESTIÓN DE LA CALIDAD DE LA EDUCACIÓN BASADA EN LOS DATOS: SOBRE EL SEGUIMIENTO Y LA EVALUACIÓN EN LAS ESCUELAS RUSAS

## RESUMO

É realizada uma revisão da pesquisa estrangeira e russa sobre os problemas de avaliação da qualidade da educação no nível institucional. Vários aspectos do problema, incluindo os contextos nacionais e subnacionais, o impacto da pesquisa comparativa internacional sobre o tema da avaliação na escola e o treinamento de professores para trabalhar com dados de avaliação, são comparados. O efeito das políticas regionais no desenvolvimento de sistemas internos de avaliação da qualidade da educação nas escolas russas é estudado por meio da análise dos sites oficiais dos departamentos. O método de avaliação especializada e o coeficiente de concordância são usados para determinar os fatores-chave do sistema interno de avaliação da qualidade nas instituições de ensino geral. Os autores extrapolam o paradigma de controle e fiscalização da gestão da qualidade da educação e consideram esses sistemas a partir do paradigma analítico-informacional. O gerenciamento baseado em dados envolve o uso de análise e interpretação de dados para prever o progresso dos alunos e a escolha motivacional de perfis educacionais para projetar o conteúdo de ambientes educacionais eletrônicos e trajetórias educacionais individuais.

**Palavras-chave:** Gerenciamento baseado em dados. Dados educacionais. Sistemas internos de avaliação da qualidade do ensino geral. Controle na escola.

## RESUMEN

Se lleva a cabo una revisión de las investigaciones extranjeras y rusas sobre los problemas de evaluación de la calidad de la educación a nivel institucional. Se comparan varios aspectos del problema, incluidos los contextos transnacionales y subnacionales, el impacto de la investigación comparativa internacional sobre el tema de la evaluación en la escuela y la capacitación de los maestros para trabajar con datos de evaluación. El efecto de las políticas regionales en el desarrollo de sistemas internos de evaluación de la calidad de la educación en las escuelas rusas se estudia mediante el análisis de los sitios web oficiales de los departamentos. El método de evaluación experto y el coeficiente de concordancia se utilizan para determinar los factores clave del sistema de evaluación interna de la calidad en las instituciones de educación general. Los autores van más allá del paradigma de control e inspección de la gestión de la calidad educativa y consideran dichos sistemas desde el paradigma de la información-analítica. La gestión basada en datos implica el uso de análisis e interpretación de datos para predecir el progreso de los estudiantes y la elección motivacional de los perfiles educativos para diseñar el contenido de los entornos educativos electrónicos y las trayectorias educativas individuales.

**Palabras-clave:** Gestión basada en datos. Datos educativos. Sistemas de evaluación interna de la calidad para la educación general. Control en la escuela.

## INTRODUCTION

The information component of the education system is developing in two main directions. The first one involves the digitalization of information flows; the second one implies renewing data structures to obtain relevant managerial data. The increase in the array of educational data amplifies the workload associated with them and obliges to modify the organizational algorithms of control and evaluation activities as the main source of data. While data itself has always had a place in general education and has characterized its quality management, the current entropy of professional information and the growing market for digital information products are becoming a challenge to all education management. The structure of educational data that has a direct impact on the dynamic of students' academic achievements is designed at the institutional level. Managers are required to understand the characteristics of the information itself and create databases to serve the authentic education quality management strategies.

The demand for information-analytical service of education quality management is changing and the need of educational management for "evidence-based pedagogy" is increasing. State municipal assignments start to include more positions on the provision of information services related to the results of education quality assessment. Assessment information becomes a separate subject of management (FIOFANOVA, PANARIN & KLIMIN, 2020; FIOFANOVA, 2020) and internal education quality assessment systems themselves serve as a factor of change in the environment and the translation of the social demand into the educational goal of a particular educational organization (SAVINYKH, 2019). Meanwhile, both scientific and theoretical discourse and public expertise do not yet properly cover the design and organizational culture of internal education quality assessment systems (IEQAS) that corresponds to the trend of data-driven management, is effective in planned and operational data handling, and is adapted to the idea of "smart data".

In the present article, we demonstrate that IEQAS can and have to be the operational resource for the concept of data-driven management. This calls for progressive differentiation of the functions of IEQAS and administrative control and designing IEQAS from the position of responsibility for its subjects for the relevance of the structure of available data, launching frames for obtaining new data, and the direct integration of databases into education quality control. The novelty of the proposed solutions lies in the substantiation of the procedural and functional aspects of IEQAS as a byproduct of its design. In our research assumptions, we go beyond the control and inspection paradigm of education quality management (SAUTKIN, 2002) and consider the operability of IEQAS from the point of the information-analytical paradigm as a source of authentic managerial information. The empirical base of the study is formed by the results of an experiment of introducing procedural and functional IEQAS algorithms in general education organizations in different regions of the Russian Federation. The analysis and evaluation of the results of the experiment use mathematical data processing methods modified by us considering the specifics of the field of research.

## LITERATURE REVIEW

As previously noted, the design and organizational culture of IEQAS is not yet explored properly in scientific research and public expertise despite a fairly substantial amount of research on handling educational data. Considering Russian practice, we should first of all note the research on educational data methodology conducted in the Center for Educational Management of the Russian Academy of National Economy and Public Administration, among other things, within the framework of the "Data-driven pedagogy" and "Smart data management in education" training programs for teachers and managers in education (FIOFANOVA, PANARIN & KLIMIN, 2020; FIOFANOVA, 2020). The key idea of the ongoing research is to move the education system away from the concept of big data to the concept of smart data. The methods of educational data analysis and the ways of using said data in pedagogical and management practices in education are also studied and the role of in-memory analytics of students' "digital traces" in electronic services (journals, diaries) is emphasized (ILYUKHIN & LEPUSTIN, 2004; VACHKOVA, 2013).

Earlier studies that predetermined the modern concept of IEQAS as a channel for generating educational data include research carried out at the beginning of the century in the context of education quality criteria (PANASYUK, 2000), education quality management (BAKHMUTSKY, 2004), and regulations for control and inspection activities in education (SAUTKIN, 2002). The noteworthy modern studies include the works of V. Tsibulnikova (2016) who has undertaken a scientific analysis of the history of the management of educational systems (TSIBULNIKOVA, 2016) and the study of S. Vachkova (2013) showing that school life is contingent on the characteristics of the information and communication environment, a part of which is the results of assessment procedures (VACHKOVA, 2013).

We should also note our own research experience in ensuring the functioning of IEQAS at the present stage of the development of education (SAVINYKH, 2018; SAVINYKH, 2019). Of special interest is the scope of interdisciplinary research on simulation modeling that we consider as one of the circumstances of methodological synergy. In non-humanitarian research, simulation modeling comprises the methods of probability theory, mathematical statistics, and random processes theory. “Procedures for the formation of matrices of transient probabilities” for the subsequent development of intelligent systems for monitoring the implementation of technological processes are proposed (KHOLLOPOV, KASHIRSKAYA, SHMELEVA & KURNASOV, 2019). Characteristic are the approaches introduced by M. Averill and D. Kelton (1991) who investigated the skills of simulating the operations of various types of real-world objects or processes. Herein, the methodology of simulation modeling covers the issues of information systems’ “behavior” and the balance between simulation modeling and mathematical methods of working with data in cases of complex systems, as well as the need for “correct logical relationships” between its subsystems are further explored (AVERILL & KELTON, 1991).

Simulation modeling is aimed at analyzing data, identifying dependencies and mutual influences, evaluating the significant characteristics of the studied systems, and serves as the basis for determining important patterns of methodological synergy. Of particular interest are interdisciplinary studies on simulation modeling of problems that are difficult to formalize. Such problems include analyzing expert evaluations and the value of information, evaluation of innovations, and designing models for effective management and the creation of optimal information infrastructures of organizations (SHAMIN, CHURSIN, SHMELEVA & BONDARCHUK, 2019). The resolution of difficult-to-formalize tasks deploys mathematical modeling methods that are modified with consideration of the initial data and the area of research and focus on reducing uncertainty and evaluating the results of management.

Simulation modeling in humanitarian research draws on the experience of information technology research where mathematical methods are applied to solve applied hybrid problems containing a set of ideas and approaches from different scientific fields. For example, creating an effective information system for technological process management requires using different methods at different stages: expert evaluation, statistical analysis of abnormal situations, Pareto analysis, Markov chains, neural networks for intelligent data analysis (KHOLLOPOV, KASHIRSKAYA, SHMELEVA & KURNASOV, 2019). We believe that the creation of mathematical models for studying innovative approaches in education is dictated by the very trend of data-driven management. An example of this is the work of V.A. Rogova who proposes a mathematical model for modeling the impact of marketing activities and random factors on the results in a new set which can be used for forming a ranked list of activities and the optimal allocation of resources (ROGOVA & SHAMIN, 2020).

Practice shows that in most cases, mathematical data processing methods are modified by the authors with an account of the specifics of the study as is done in the present study. Considering the subject of our study, we should pay due attention to the organization and the analysis of the results of the international comparative PISA study (CALLOT, 2004; HATTIE, 2012; STEVEN, JASON, BRIAN & BRIAN, 2020), as well as the works focused on the implementation of formative assessment mechanisms in schools and universities (BLACK & WILIAM, 2006; LUKITA, SUWANDI, HARAHAHAP & RAHARDJA, 2020). These two directions of research in the general problem field of education quality assessment are most open to digital assessment tools and, therefore, have greater relevance to the trend of data-driven management (PANDINA, 2009; HENDRA, ARIFIN & KOM, 2018).

Separately, it is worth noting the growth of research on data training for teachers. Quite illustrative is the experience of C. Wiljes and P. Cimiano (WILJES & CIMIANO, 2019) who developed the methodological and conceptual foundations of a new interdisciplinary branch of knowledge called “Data-Driven Pedagogy” (WILJES & CIMIANO, 2019). The researchers have tested the methods of traditional data analysis (data mining) in teacher training: classification of educational data, data clustering, sequential pattern analysis, and have also introduced the issues of the intellectual analysis of texts in the form of students’ research projects (text mining) into the content of teacher training. We can only provide several isolated examples of studies on the direct use of educational data in the internal systems for assessing the quality of general education. Johan van Bruggen (2010) poses the problem of balancing official state inspections and in-school evaluations (BRUGGEN, 2010); Ch. Chien-Chin’s study (2018) focuses on the issue of the evaluation of school teaching staff as part of the “pedagogical supervision” of school principals (CHIEN-CHIN, 2018); K. Biernacka, D. Dolzycka, and K. Helbig (2019) offer their experience in training educators to analyze data (BIERNACKA, DOLZYCKA & HELBIG, 2019).

Overall, we should note that the currently proposed scientific approaches and expert judgments on the provision of IEQAS do not provide a comprehensive understanding of the mechanics of its work with educational data. The problem of managerial demand for up-to-date data structures and optimizing the functionality of the subjects

of IEQAS dealing with processing primary data for the preparation of operational management information remains open. The inertia of the education sector in the transition to digital data platforms should also be taken into account.

## METHODS

Given the stated level of research, we raise the question from the perspective of the transition from mass declarative education quality control to quality management based on the uniqueness of the school infrastructure and the characteristics of the student population. In our study, the categorical field of IEQAS is represented by three categories:

- the category of a system that determines the organizational modality of IEQAS allowing to view its core definition as “a system of procedures”;
- the category of management within which IEQAS presents an education quality management subsystem and is subject to a quality management strategy;
- the category of control that determines the composition, content, forms, and sequence of IEQAS procedures.

Therefore, IEQAS is essentially defined as “a subsystem of education quality management that is subordinate to the quality management strategy and realizes the goals and objectives of management control through a set of control and evaluation procedures” (SAVINYKH, 2018). The subject of IEQAS and the subject of quality management are considered to be related. This applies not only to officials but also to individuals. Otherwise, the educational organization runs the risk of substituting evaluation for control, or, equally counterproductive, of allowing control procedures and evaluation procedures to overlap. To show that working with data within IEQAS neutralizes the counterproductive effects of control and evaluation activities and ensures a functional balance between management, control, and evaluation of the quality of education, we analyzed websites of ministries and departments of education in all 85 subjects of the Russian Federation from July to August 2020 for the presence of information reflecting education quality management in the region. Moreover, we conducted a survey of the employees of regional quality management structures on the factors of working with data. Considering the three-tier architecture of data (physical level, user level, conceptual level), we operated at the conceptual level of working with data.

## RESULTS

At the time of the analysis, only 48% of the websites had pages dedicated to regional education quality assessment systems. Moreover, even in the regions where such pages were present, they contained different phrasings. For example: “Education system monitoring” (Belgorod region); “Education quality evaluation and management” (Vladimir region); “Monitoring and research of educational achievements of schoolchildren” (Kaliningrad region); “Regional system of education quality assessment” (Moscow region); “Education Statistics and Monitoring” (Khanty-Mansiysk Autonomous Okrug - Ugra). The website of the Ministry of Education of the Chelyabinsk region had two separate pages: “Education system monitoring” and “Evaluation of the quality of general education”. The discovered inconsistency in presenting information and the variation in the approaches to listing the existing regional education quality assessment systems testifies to deficiencies in the information and analytical service of education quality management and indicates an insufficient level of managerial practices of working with data.

We also separately noted how regional control and monitoring bodies publish information about the conducted field and documentary inspections on departmental websites. Only in isolated cases (5 regions out of 85) did we see detailed information with comments on the issued prescriptions rather than a limited quantitative list of the results of inspections. The most illustrative experience was found in the Novgorod region where the prescriptions issued by the control and monitoring bodies were presented in terms of specific legal norms in the context of individual educational organizations. An example of such comments is as follows: “In violation of paragraph 3.3 of Order No. 785 of the Federal Service for Supervision of Education and Science, the “Documents” subsection of the official website of the organization does not contain copies of the local regulations stipulated by Part 2 of Article 30 of Federal Law № 273-FZ of December 29, 2012 “On Education in the Russian Federation”, the internal regulations for students, the internal work regulations, and the collective agreement” (FEDERAL LAW no. 273-FZ, 2012).



The experience of the Novgorod region illustrates one of the possible approaches to structuring data in education quality management at the regional level. We have conventionally defined this approach as a norm-based approach in which the structure of incoming and outgoing information is determined by a “list” of federal norms. We greatly relied on the relevant trends in working with data derived from the policy of the Federal Institute for Educational Quality Assessment (FIEQA) that developed the “Methodology and methodological recommendations used by Rosobrnadzor for the evaluation of education quality management mechanisms in the subjects of the Russian Federation” (hereinafter – the Methodology). The pilot mode of the implementation of the Methodology started in 2017 and, as of today, this methodology covers all subjects of the Russian Federation. The Methodology establishes the requirement for planned and comprehensive work with data in all priority areas of regional education systems.

From the point of the structure of data adopted in the examined Methodology, we should note the allocation of two interrelated indicators: indicator 1 – “Mechanisms for managing the quality of educational outcomes” and indicator 2 – “Mechanisms for managing the quality of educational activities”. The first indicator covers data on the quality of students’ training, work with schools with low learning outcomes, the system for identifying, supporting, and developing the abilities and talents of children and young people, their self-determination, and professional orientation. The second indicator covers data on the objectivity of education quality assessment procedures, monitoring of the effectiveness of the heads of all educational organizations in the region, the quality of additional professional education of teachers, methodological work, and students’ education and socialization.

The indicated composition of data expected from regions supports our assumption about the norm-based approach to modeling data structures at the regional level since each of the indicators reflects a particular target indicator of the National Project “Education” (THE NATIONAL PROJECT «EDUCATION», 2019). The quality norm established at the state level is projected onto the regional education system becoming a prerequisite for the corresponding requirements for the composition of managed data. It is important that within each criterion, the region has to determine data collection methods, plan and conduct monitoring within the framework of the undertaken evaluation event, and prepare recommendations as a result of the assessment. This array of data has to become the basis for the regional educational authorities in making managerial decisions with compulsory analysis of their implementation and taking the necessary action.

However, since data itself is added to regional information bases (through municipalities) from institutional education quality assessments systems, we pay special attention to this level of handling data. We surveyed an allocated group of school principals and the employees of regional institutions of education development (70 respondents in total) on the significant characteristics of education quality assessment within an educational organization. The respondents were asked to rank 7 items (on a scale ranging from 1 to 7: 1 – the least importance, 7 – the most important parameter) without repeating ranks, i.e. prioritize explicitly. Each item reflected one of the factors of an internal education quality assessment system:

- competence of the head of an educational organization;
- elaboration of local regulations;
- orientation on the state policy;
- focus on the unique school development strategies;
- the organizational and technological evaluation algorithm;
- the pedagogical practices of assessment.

The condition of not repeating ranks encouraged the respondents to take a more balanced approach to ranking. We hypothesized that experts have a shared opinion viewing all factors as essential and relevant in school education quality management. The coefficient of concordance (consistency) of expert judgments was used to assess the objectivity of expert conclusions in the analysis of survey data.

The correlation coefficient was calculated according to the formula:

$$W = \frac{12 \sum_{i=1}^m (R - \bar{R})^2}{n^2(m^3 - m)}, \quad (1)$$

where  $n$  – the number of experts,

$m$  – the number of ranks,

$R$  – the total score,

$\bar{R}$  – the average rank,

$$\bar{R} = \frac{1}{m} \sum_{i=1}^m R_i. \quad (2)$$

The concordance coefficient sufficient for accepting the judgments provided by the expert group had to exceed 0.7, i.e. at least 70% of the expert group members had to be unanimous in their assessments. The overall concordance coefficient we obtained was 0.8 which confirms our hypothesis. The greatest concordance of expert opinions was observed in items “focus on the unique school development strategies” and “the organizational and technological evaluation algorithm”. A bit lower concordance than expected was demonstrated by experts regarding “the pedagogical practices of assessment”. We interpret this result as a manifestation of the maintaining deficit of school leaders attributing the predominant role in institutional data-driven education quality management to the internal assessment information.

## DISCUSSION AND CONCLUSION

Thus, we found that the IEQAS practices existing in general education mostly operate with data from the results of federal monitoring and the state final attestation. Even self-assessment reports that have to reflect the data architecture unique to the given educational organization focus on the statistics of subject learning and the equipment of the educational process. The demand for relevant data structures and their digitization is, therefore, not met properly. The data obtained based on the predictive scenario of quality management not so many states the fact of educational activity as it explains or anticipates it. A closer examination of the structure of data demonstrates one of the key functions of IEQAS – planning authentic data structures considering the conditions of educational activity unique to each organization. Working with data should not become “an insurmountable obstacle to minimizing the financial and time costs of evaluation”. What is important is “a minimum sufficiency of data” determined by the objectives of a particular evaluation procedure important in terms of management decisions.

In addition to collecting, storing, and processing information, educational organizations have to learn to understand the characteristics of the information itself and create databases to serve authentic educational quality management strategies. Today, managing the quality of education means managing the quality of data including modeling data structures by specifying the contents of information flows. As an example, we can examine the “CODATA” platform (Committee on Data of the International Science Council) promoting “equitable data governance” in cooperation with its partners. Such management includes “robust planning, policy, infrastructure, training and support”. The ideologists of the platform follow the policy that “institutes that produce and consume data are required to ensure seamless accessibility to data and ensure practices that foster its reuse” (RESEARCH DATA AND RESEARCH INSTITUTIONS CODATA-HELSINKI 2019 FAIR RDM WORKSHOP, 2019).

Following R. Standaert (2010) in his understanding of the interplay of global data trends in education (STANDAERT, 2010), we must emphasize one of the key trends in the changing structure of data at the institutional level of education quality assessment. This trend is associated with the increasing influence of international comparative studies on the composition of educational quality measures and their progressive orientation towards civic and social contexts of education.

In Russia, the indicated trend manifests in all-Russian monitoring following the “PISA For Schools” model (PISA 2009 RESULTS: LEARNING TRENDS) in which surveys of parents, teachers, and school administrators are conducted along with the diagnostics of students’ functional literacy. All research information is processed in an annual comprehensive analysis of data on the quality of general education in each subject of the Russian Federation. An argument in favor of designing an expanded IEQAS data structure with PISA in mind is the innovative project of the Ministry of Education “Monitoring Functional Literacy Formation: Main Directions and First Results”. The idea behind the project is to adjust the subject of general education monitoring to allow assessing not only a narrowly focused outcome but also the skills of “alternative ways of solving problems, conducting research or group projects” and the choice of “students’ behavior strategies in different life

situations” (BASYUK & KOVALEVA, 2019).

Since the concept of data-driven education quality management is only starting to infiltrate, the critical mass of scientific and expert data that would lead to management actions on the use of data in educational systems is not yet reached. Our calculations confirm that the inertia of inspection control in the format of linear management of the educational process is still strong in general education organizations (SAVINYKH, 2018). Nevertheless, our study demonstrates that the functions of IEQAS have changed with the change in the range of consumers of its results. The function of processing data and transforming it into a feedback tool has become an expression of the right of educational service consumers not only to quality education but also to receive information about the means ensuring this quality.

We associate the perspectives for the development of this research topic with expanding the IEQAS tools for information-analytical data-based management service, as well as the formation of a new class of methodologists capable of forming advanced data architectures to work with the risks of education quality reduction or destabilization.

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