

Data Analytics in Education and Management Decision Styles in the Evidence-based Development of Education

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Abstract

Introduction: The development of data culture is considered today as a social norm of the "information society". The leaders of education systems are faced with the task of consolidating the activities of "data evangelists", "it-evangelists" (technology evangelists) in education quality management systems. Data analyst competencies should dominate management decision-making. When examining the influence of relevant competencies on the style of management decision-making, we proceed from the existing technological data infrastructure in Russia, and also take into account the role of the public sector in quality control of education.

Materials and methods: A review of foreign and domestic sources on the problems of evidence-based management in education has been undertaken. Various aspects of the problem are compared: intercountry and subnational contexts; revealed the role of international comparative research in the development of data analytics competencies. It was studied, using the Alan Rowe methodology, the influence of data analytics competencies on the style of making management decisions. The study sample consisted of 350 people. The author's case simulators were used for the built-in diagnostics of data analytics competencies.

Results: The empirical facts of the change in the style of making management decisions under the influence of the competencies of data analytics have been obtained. The relevant competencies were the subject of training for the heads of regional education systems on the basis of the Russian Academy of National Economy and Public Administration. The connection between the competencies of data analytics of the conceptual and analytical style of making management decisions with the content and methodology of training managers has been substantiated. A list of competencies of data analytics for scaling in the practices of training subjects of management of educational systems has been formulated.

Discussion and conclusions: The novelty of our proposed solutions lies in the substantiation of the influence of data analytics competencies on the style of management decision-making. We expand the boundaries of the data-driven paradigm of education quality management and consider such systems in the logic of the information-analytical paradigm, where the competence of data analytics is both a condition and a resource for evidence-based education development. Conclusions are formulated about the development of a new type of culture in public administration - data-culture. Data as a

valuable asset in a state with a developed data culture changes the ontology of the information state and logically leads to the idea of a new social contract.

Key-words: Data Culture, Data Driven Management, Development Management Values, Management Decision Making Styles, Open State, Open Data, Data Analysis Competencies in Education Management, Management Decision Styles.

1. Introduction

In the context of the methodological substantiation of the concepts "Evidence-based management", "Evidence-based policy" and the development of infrastructure for the analysis of educational data, the implementation in Russia of the National Data Management System change as the qualification requirements for management activities [9, 32], and the styles of formation of managerial decisions of education leaders.

The styles of management decisions of education leaders change both under the influence of situationally emerging factors (the need to work with a large number of digital data sources) and under the influence of predictable factors (participation of managers in advanced training programs and the development of data competencies for evidence-based management).

Factors of the technological infrastructure of data and services of analytics and statistics are associated with the development of digital platforms in education, presented on the portals:

- The national data management system (<https://nsud.info.gov.ru>) [17];
- Open data of the Russian Federation (<https://data.gov.ru/o-proekte>) [19];
- Open data of the Ministry of Education and Science of Russia (<http://open-data.minobrnauki.rf/opendata/>) [18];
- The information system "Schools of Russia" (<https://eduru.ru/about>) [31];
- An independent system for assessing the quality of services provided by organizations (<https://bus.gov.ru/pub/independentRating/main>) [10] and other educational analytics services.

In addition, the possibilities of analyzing and forming managerial and pedagogical decisions based on educational data are associated with the development of the technological infrastructure of regional digital services for statistics and data analytics in education. Such opportunities are provided by regional open data portals in the field of education: <https://open-data.obrazovanie33.rf> [11] and ot.)

New formats of digital options in education management require managers to have new competencies that allow them to manage educational systems in the context of a developed

technological infrastructure of big data. Calling such competencies the competencies of data analytics for the evidence-based development of education, we hypothesize that mastering these competencies changes the style of management decision-making. The bearer of data analytics competencies is able to give preference to the analytical style of decision-making, even if this style was not organic for him in his previous professional experience.

2. Literature Review

In studies on the current state of management of educational systems, the issues of competence of data analytics are heterogeneous in terms of setting and focus of problematization.

From domestic experience, first of all, it should be noted the experience of the formation of the methodology of educational data on the basis of the Center for Management in Education of the Russian Academy of National Economy and Public Administration (RANEPA). Here, within the framework of the training programs for teachers and education leaders "Data driven pedagogy" and "Smart data management in education" [8], studies of the factor of data analytics in the development of education management systems are carried out.

The main message of the research being undertaken is the transition of education systems from the concept of big data to the concept of smart data [34]. The approaches to the construction of educational data structures at the regional, municipal and institutional levels of education are studied separately. Research practices take into account the scientific achievements of the early XX century, related to the substantiation of the criteria for the quality of education [1, 15], regulations of control and inspection activities in education [5, 28, 30] and educational management in the field of quality [4, 10, 16].

In the aspect of designing educational data structures, technologies for their analysis and interpretation, the problem of evidence-based development of education is posed in the article "Methodology of Data-Driven Pedagogy and the Development of a Culture of Analysis of Educational Data in Pedagogical Communities" (Fiofanova, 2020) [6]. Forecasting methods, methods of structure detection and identification of educational data relationships for making managerial decisions have been substantiated.

The features of evidence-based management at the institutional level of educational systems are described in the article "A functional approach to the organization of an internal system for assessing the quality of education" (Savinykh, 2018) [26]. It is shown that evidence-based management is the goal and result of the functioning of internal systems of education quality

assessment. Modeling of internal systems for assessing the quality of education is a key prerequisite for evidence-based management [25, 27].

We see a special meaning of evidence-based management in the “latent dependence” of the quality of education on the organizational and pedagogical design of digital educational platforms, their software and digital services for the “learning digital user”. This is considered the premise of a new educational ontology - Digital Ontology of Personalized Education, the essence of which is in the generation of system data, not so much stating the educational result, as translating the path to this result. In the new educational ontology, individualization and variability should be "supported by analytical data to form personal development scenarios for the student" [7].

The ability to understand the characteristics of the information itself and to create databases to serve authentic management strategies is one of the characteristics of an effective manager. Scientists (Basyuk, Kovaleva, 2019) associate the development of evidence-based management in domestic education, among other things, with Russia's participation in PISA, a corresponding adjustment of the state strategy for managing the quality of general education and the transition to a new methodology for assessing the quality of education [2, 33].

We consider the nature of the information and analytical request of the subject of modeling to be the source of modeling the structures of educational data. The subject of modeling can be sectoral ministries and departments (federal level of education quality management), executive authorities in the field of education (regional level of education quality management), collegial management bodies of an educational organization (institutional level of education quality management).

The area of intersection of interests of subjects of different levels of modeling is the requirements of national educational standards. The structure of such requirements can either be adequate to the information and analytical request of the modeling subject, or differ greatly from it, both in the direction of redundancy and deficiency [3, 9].

We can refer to the international project Russia Education Aid for Development (READ) [24], carried out in 2008-2015. (extended until 2019) with the support of the Ministry of Finance of Russia in cooperation with the World Bank for Reconstruction and Development. The main idea of the project was to support the participating countries in building the capacity of institutions responsible for measuring educational achievement and using the obtained data to improve the effectiveness of learning. Even then, the project was an example of a new methodology for structuring data at the international level of quality management in education. Despite the fact that the project solved the problems associated with the preparation of tools for measuring the level of educational achievements

of students, the issues of managerial strategies for using data to increase the effectiveness of training were indirectly solved. That is, even then the need for new approaches to managing the educational results of students was obvious.

Foreign studies also point to the influence of the novelty of understanding the quality of education on the subject and objectives of the evidence-based development of education [14,15]. For example, Standaert (2010) notes this against the background of the international test boom, which was the result of an economic view of the results of training students in mathematics, science and languages [29]. We see similar arguments in Patrick Maine and his colleagues (Maanen, Shaini, Grossi, Varga & Gabriadze, 2016) [16]. Scientists show the role of the “framework of international criteria for the quality of education”, arguing that “states participating in international research should not lose the right to their own priorities for understanding quality, and hence their own design of working with data” [16].

Of interest are the works of foreign researchers (Callot, 2004 [13]; Steven, Jason, Brian, Brian, 2020 [30]), addressing the problem of the cross-country context of data analytics. For example, Joanna Kallo discusses Finland's educational policy in its interaction with the OECD and points to the experience of countries that did not allow the reduction of national practices for assessing the quality of education in the process of participating in international studies of the quality of education [11].

In the organizational and pedagogical aspect of the evidence-based development of education, the experience of Viljes George and Cimiano Philippe (Wiljes, Cimiano, 2019) is interesting, who developed and implemented a special program based on the new interdisciplinary branch of knowledge “Data Driven Pedagogy” [31]. Evon D. and Bessie D. (Owan, Bassey, 2020) study of university management processes based on data is typical. The scientist concludes that it is necessary to create a "data management unit" with the transfer of the function of "developing a policy for managing research data and hosting research data" [15]. No less indicative are the practices of Weiner I., Green R. (Weiner, Greene, 2008), who, long before the approval of the management trend on the basis of data, systematized approaches to the comprehensive assessment of students' educational results [36].

In general, we can talk about a sufficient scientific and informational context of the stated research problems. The format of problematization of data analytics in education is open to the study of styles of management decisions in evidence-based development of education.

3. Materials and Methods

To test our hypothesis about the impact of data analytics competencies on the style of management decision-making, we used training programs for leaders of regional education systems on digital transformation of education based on the RANEPА.

The role of modern additional professional programs, their focus on improving existing professional competencies and “obtaining new competencies necessary for the professional activity of an employee” was taken into account [5, p. 4, Art. 76]. Data analytics competencies were positioned as new professional competencies with a primary focus on the requirements of the industry professional standard of the leader.

The sample of participants for the study was 350 people.

The style of making management decisions in the context of data analytics was studied during the use of digital platforms and data analytics services by program participants.

The following methods were applied: a) a structured interview on the use of data sources and digital data analysis services to form management decisions; b) Alan Row's methodology (cognitive-situational model) for defining management decision-making styles. The classification of decision-making styles was taken as a basis, based on the criteria: 1) the cognitive complexity of the tasks being solved, 2) an orientation towards the way to achieve the goal. The criterion "cognitive complexity of the tasks to be solved" characterizes the complexity of the analyzed control object, the system of data sources about the controlled object, the complex of applied data analysis methods. The criterion "focus on the way to achieve the goal" characterizes the priorities of the leader, namely: focus on solving a problem or on people.

Figure 1 shows the criterion characteristics of the styles of management decisions with a highlighted analytical style, which we considered as the dominant of evidence-based management of educational systems. The style of making managerial decisions was understood as "the ways and options for actions that managers most often use in the process of preparing and making decisions" [12].

The results were processed based on the frequency of application of directive, analytical, conceptual and behavioral decision-making styles. The mean values and standard deviations of the scores were recorded for each style group: directive style, analytical style, conceptual style, and behavioral style. If the respondent broadcast certain "deviations" from typical style characteristics, then the so-called dominant style of managerial decision-making was revealed.

The procedural side of measurements was built based on similar research practices of Russian colleagues (Kasprzhak, Bysik, 2014). In particular, they took into account the idea of moving from the “concept of directorship” to the “concept of leadership”, which, in relation to the subject of our research, could be interpreted as a transition from fixative quality inspection to data-driven management. We also took into account the arguments of scientists that “styles in their pure form do not occur in nature, there are styles that are dominant and reserve (preferred and avoided)” [12].

Since Alan Rowe's methodology for studying the style of managerial decisions is based on two coordinates: cognitive complexity (preference for structure or uncertainty) and preferential orientation (towards people or tasks) [23], it allows us to identify two fundamentally opposite styles of forming managerial decisions - “directive- behavioral "and" conceptual-analytical "(Fig. 1). The styles of making managerial decisions are changing: from directive-behavioral to conceptual-analytical - in the context of the development of data analysis for the formation of managerial decisions and evidence-based development of education.

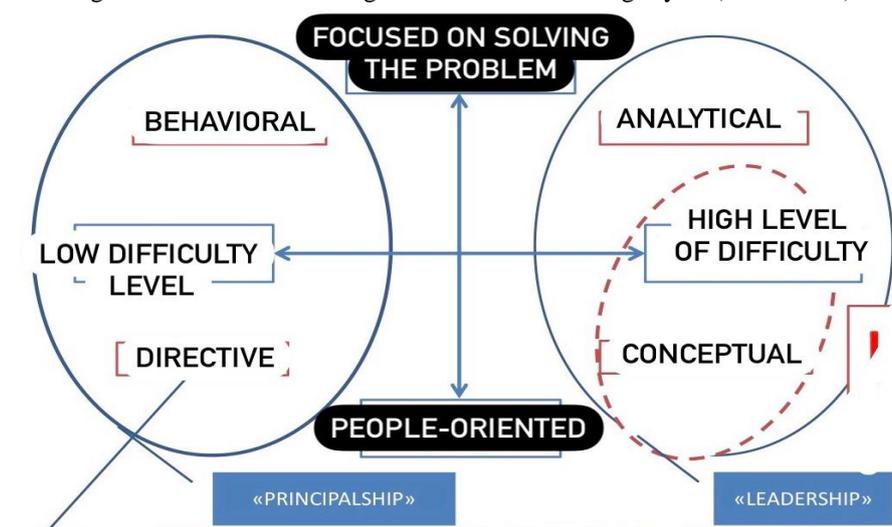
Measurements according to the Alan Rowe method were carried out within the framework of the implementation of the program of additional professional education "Data analytics in public administration" twice: at the beginning of the development of the program and after its completion.

The program was originally designed in the structure of educational modules that develop the ability to use the technological data infrastructure, choose digital platforms and data analytics services that are appropriate for management tasks, the ability to identify and apply appropriate data analysis methods to various objects of management analytics, and the ability to form management decisions. This made it possible to study the dynamics of management decision-making styles built into the program.

The markers of management decision-making styles built into the methodology made it possible not only to see how immersion in evidence-based management affects the reflection of managers, but also to observe individual external circumstances of the choice of style, such as the level of managerial responsibility, work experience in the position, age, general managerial experience, professional installations.

The observed results were correlated with the results of the interviews, which were aimed at increasing the conscious attitude of managers to what they were broadcasting in the process of applying the Alan Rowe methodology.

Figure 1 - Essence of Management Decision Making Styles (Alan Rowe)



4. Research Results

At the start of training under the program, 280 out of 350 managers from the sample group demonstrated the directive-behavioral style of making managerial decisions as dominant, and upon completion of training on the program, 340 people from the same group broadcast the “conceptual-analytical” style of making managerial decisions.

The validity of the data obtained was ensured by the conceptual integrity of case-simulators of evidence-based management, the solutions of which were analyzed according to the method of Alan Rowe.

The case-simulator of input diagnostics concerned the design of the architecture of educational data within the framework of the initiative of the Federal Institute for Education Quality Assessment (FIOCO) "Methodology and guidelines used by Rosobrnadzor to assess the mechanisms of education quality management in the constituent entities of the Russian Federation" (hereinafter - the FIOCO methodology) [<https://fioco.ru/Media/Default-2021.pdf>]. The reporting directions set by the methodology had to be systematized and built up the optimal composition of reporting documents units that would provide the full completeness of the requested information. The immediate stylistic marker in this case was the question about the expediency / in expediency of using data on the results of the state final certification in regional ratings of heads of educational organizations.

The case simulator of control diagnostics was also developed on the basis of the FIOCO methodology. It dealt with methods of collecting information as a component of reporting and

monitoring the effectiveness of reporting activities. A stylistic marker was the question of including / excluding data about consumers of information and analytical monitoring products in monitoring.

We recorded the most noticeable changes in the style of making managerial decisions according to the position of Alan Rowe's methodology "When I face a problem, I: rely on 1) proven practices, 2) conduct a thorough analysis, 3) look for creative solutions, 4) rely on my own feelings" ... In the input diagnostics used to solve the first case-simulator, the answer "2" was chosen by 115 managers (33% of the respondents); in the control diagnostics, this answer was already chosen by 320 managers (90% of the respondents).

A similar dynamics was observed for the position "When I turn for information, I prefer: 1) specific facts, 2) accurate objective data, 3) expert opinions, 4) information available to the mass consumer". In the input diagnostics used in solving the first case-simulator, the answer "2" was chosen by 125 managers (36% of the respondents); in the control diagnostics, this answer was already chosen by 332 managers (95% of the respondents).

These two positions of Alan Rowe's methodology reflected the general picture of changes in the style of management decision-making. We have confirmed the hypothesis about the influence of data analytics competencies on the style of making management decisions.

Based on the empirical data obtained, we formulated a list of the most significant competencies of data analytics, which characterize the subject managing the educational system as implementing strategies for the evidence-based development of such systems. The designated competencies include:

- Reflected professional attitude to the management of education development on the basis of data in the conditions of "open-data", "open-governance";
- The formation of basic concepts of data-based management methodology; knowledge of regulatory and legal regulators of assessment and monitoring in education;
- Deep awareness in the current state of federal information systems for assessing the quality of education; a comprehensive understanding of similar systems of regional and institutional significance;
- Readiness and ability to form teams of "data-evangelists", "it-evangelists" (technology evangelist) at the imputed level of official responsibility as subjects of information and analytical support of education management;
- Willingness and ability to develop in a professional environment a culture of trust in data sources and to organize the necessary measures to consolidate this culture in the ethical standards of education management;

- The willingness and ability to respond to evidence based on the study of public opinion in a mobile way? results of public opinion polls, etc.;
- The formation of individual regulations for accessing educational data obtained as a result of scientific research, pilot projects; access to statistical information.

The consistent implementation of these competencies in educational leadership training programs will require the involvement of a wide range of institutions. Resources for scaling up evidence-based management practices will be required, such as regulatory impact assessment procedures; activation of consulting and advisory bodies of executive power; creation of analytical centers; conducting public opinion polls, etc. The content of internships for heads of educational systems must change.

5. Discussion

The conducted research has shown the need for a radical rethinking of the content of personnel training in the information and analytical service for managing the quality of education.

We see the greatest risk that the education system, which has grown in a pre-digital economy, will continue to dictate irrelevant queries to itself on data structures and impose archaic patterns of working with data. Hence, the biggest challenge for the ideologues of data in education is the training of personnel for "evidence-based management" and the transition to evidence-based development of education.

We need cross-sectoral integration of institutions that ensures the consistency of interests of consumers of information and analytical products for working with data, copyright holders and technical executors of the relevant digital services and the students themselves. Only under these conditions can digital portfolios based on blockchain technology and an international navigation system in educational products become real.

In the evidence-based development of education, the predictive scenario of quality management is important, which does not so much state the fact of educational activity as explain it, or anticipate it. This view of the data structure expresses one of the key functions of assessment - to plan authentic data structures, taking into account the educational conditions unique for each organization. Working with data should not become an insurmountable obstacle to minimizing the financial and time costs of conducting an assessment. What is important is the minimum sufficiency of data, which are determined by the objectives of a specific assessment procedure and are important from the point of view of making managerial decisions.

Along with collecting, storing and processing information, educational organizations must learn to understand the characteristics of the information itself and create databases to serve authentic strategies for managing the quality of education. Managing the quality of education today means managing the quality of data, incl. simulate data structures by specifying the content of information flows. As an example, the CODATA platform (Committee on Data of the International Science Council), together with partners, is promoting “fair data governance”. Such governance includes “sound planning, policy, infrastructure, training and support.” The ideologues of the platform adhere to a policy according to which “institutions producing and consuming data are obliged to provide unhindered access to data and to guarantee practices that promote their reuse” [22].

Progressive can be considered such practices of evidence-based development of education, which will function on the principle of accumulating bonuses for positive markers of participation in federal studies of the effectiveness of education quality management. National databases should be supplemented with the option of digital mentors, based on the data obtained, generating primary feedback with the subject of educational system management. Such mentoring can and should be provided with methods similar to the one that we used to test the hypothesis about the impact of data analytics competencies on the style of management decision-making.

The study of the influence of the competencies of data analytics on the style of making management decisions opens up broad prospects for studying the mechanisms of evidence-based development of education. It is necessary to substantiate the principles of the content and operational relationship of educational data structures at the intercountry, federal, regional and institutional levels. Consistent intersectoral cooperation requires the development of a methodology for training leaders of regional education systems as responsible for the authenticity of the quality of education in the context of its standardization.

In general, we believe that the competence of data analytics, being a resource of Evidence-based policy of education quality management, should be understood in convergent logic - in logic that blurs the boundaries between the humanistic meanings of the evidence-based development of education and technical meanings related with software and hardware solutions for data analysis.

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