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Abstract	The paper focuses on the degree of influence of Big Data on building the educational process at Russian law university in the COVID-19 pandemic. We use analysis, interpretation, and the sociological method as primary research methods. Furthermore, we conduct sociological studies. The main research result is the demonstration of the influence of the collected information on administrative decision-making. Additionally, we describe the organization of the educational process at the selected university. The paper demonstrates students' attitude towards Big Data on various aspects, including awareness of this technology and its significance for management processes of a university. The dependence of collected and analyzed information on the form of education is traced. We conclude that Big Data has not yet found widespread use in Russian higher education. Therefore, we identify reasons preventing the reveal of the full potential of Big Data in education. Simultaneously, the use of "useful" Big Data content in university management is predicted to grow, provided that the objectives of Date University Science outlined in the article are met. The study is novel in that it defines the impact of Big Data on the architecture of the university educational process in different periods of the COVID-19 pandemic. It happens when educational institutions of higher education implement distance and online communication or mixed learning exclusively.

Keywords (separated by '-')	Big data - Data science - University management - Educational process - Master's degree - Graduate students - Online learning - Distance learning - Lawyers - Digital economy - COVID-19 pandemic

Architecture of University Educational Processes in the COVID-19 Pandemic: From Small Data to Big Data and Data Science

Inna V. Ershova, Ekaterina E. Enkova, Vasiliy A. Laptev, Andrey Yu. Petrakov, and Olga A. Fiofanova

Abstract The paper focuses on the degree of influence of Big Data on building the educational process at Russian law university in the COVID-19 pandemic. We use analysis, interpretation, and the sociological method as primary research methods. Furthermore, we conduct sociological studies. The main research result is the demonstration of the influence of the collected information on administrative decision-making. Additionally, we describe the organization of the educational process at the selected university. The paper demonstrates students' attitude towards Big Data on various aspects, including awareness of this technology and its significance for management processes of a university. The dependence of collected and analyzed information on the form of education is traced. We conclude that Big Data has not yet found widespread use in Russian higher education. Therefore, we identify reasons preventing the reveal of the full potential of Big Data in education. Simultaneously, the use of "useful" Big Data content in university management is predicted to grow, provided that the objectives of Date University Science outlined in the article are met. The study is novel in that it defines the impact of Big Data on the architecture of the university educational process in different periods of the COVID-19 pandemic. It happens when educational institutions of higher education implement distance and online communication or mixed learning exclusively.

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1 Introduction

The current challenges require constant reassessment of methods, forms, and means of the educational process. The era of digital technologies and the emerging information space indicate the need to systematize existing approaches, including education. Constant increase in the amount of data requires the ability to efficiently process and extract "useful" information from the boundless and unsystematic information field. Therefore, there are national databases of educational statistics in many countries. Their studies are of interest to Russian education. The interest lies in borrowing effective methodologies and technologies for analyzing Big Data, digital infrastructure for their collection, systematization, and analysis (Fiofanova and Toporkova 2020).

According to the common understanding, the Big Data category refers to structured and unstructured data of considerable volume and significant diversity. Additionally, horizontally scalable software tools that emerged in the late 2000s handles this data effectively. The processing occurs through databases and solutions of the "Business Intelligence" class, which are alternatives to traditional management systems. "Concept of creating a digital analytical platform for statistical data provision" contains similar but more succinct interpretation of Big Data (Government of Russian Federation 2019).

In a broad sense, Big Data is a socio-economic phenomenon associated with the emergence of technological capabilities for analyzing big amounts of data (Mayer-Schoenberger and Cukier 2014).

Regarding education, Big Data is a technology providing at least three critical opportunities. One can create methods adapted to a large number of students. Additionally, it allows one to personalize content and customize education model (Gvozdenko et al. 2019).

By 2019, the vast majority of Russian institutions of higher education had been working mostly with small data. It was due to the fact that there was no special electronic environment that would contain a significant amount of online content and would allow a large number of users, including academic staff and students, to interact. The federal project "Personnel for the Digital Economy" is being implemented as part of the national program "Digital Economy of the Russian Federation" (Government Commission on Digital Development and the Use of Information Technology to Improve the Quality of Life and the Conditions for Doing Business, 2019). The project provides training of competent, highly qualified professionals and encourages educational institutions of higher education to intensify the relevant work. The digitalization of education becomes possible because several general-purpose technologies are simultaneously developed and implemented. These technologies include mobile devices, the Internet, biometric technologies, cloud computing, Big Data analytics platforms, and artificial intelligence (AI) (Frolov et al. 2018). However, the period of the COVID-19 pandemic included real breakthrough—there was a clear tendency for universities to make management decisions in education based on Big Data.

Indeed, the traditional notion of face-to-face educational processes has become irrelevant due to the spread of the COVID-19 infection. The transition of universities to distance learning led to the rethinking of methods of acquiring general educational and professional competencies by students.

The paper uses the example of one of Russia's leading universities in the field of law—Kutafin Moscow State Law University (Kutafin University)—to analyze the stages of the transition from the "analog" to the digital understanding of the educational reality in the COVID-19 pandemic. We identify the impact of Big Data on the construction of the educational process at Kutafin University and define the extent and prospects of this impact.

2 Materials and Methods

The methodological basis of the research includes such methods of scientific knowledge as analysis, synthesis, deduction, classification, interpretation, prediction, observation, and sociological methods. In June 2020, we conducted a sociological survey, "Distance Learning During the Spread of Coronavirus Infection." The survey included 76 first-year students of the master's programs "Legal Support of Business (Business Lawyer)" (MP "Business Lawyer") and "Lawyer in Corporate Law" of the Kutafin University. The distribution of students by the form of study was as follows:

- 19 full-time students;
- 19 part-time students;
- 38 part-time students.

In September 2020, we conducted a questionnaire survey, "Managing the educational process of a university during the COVID-19 pandemic: The impact of Big Data". The purposive sampling of our survey involved 72 first-year students getting a master's degree in "Business Law".

Our sociological research should have been described as applied research due to the fact that the research aimed to study certain issues related to distance learning, university management, and the use of Big Data. These were accelerated studies, lasting from a week to a month. We can divide the studies into one-time, point-by-point, and exploratory according to the depth of analysis. They were carried out once to obtain information about the state of the studied object at a particular point in time in the shortest time possible.

During the sociological research, we implemented a survey method, followed by analysis and interpretation of the received information. Survey is the most common type of sociological research. It is the most used method of collecting primary information, given limited research time. There was a written interaction between researchers and respondents. Namely, we conducted an anonymous face-to-face and distance questionnaire using purposive sampling. Based on the design of the questions asked, we created semi-closed questionnaires. For some questions, along with

choosing one of the proposed options for an answer, the respondents had the opportunity to express themselves freely. For other questions, all answer options were provided in advance. According to the criterion of the source (carrier) of primary sociological information, a mass survey was carried out. Students of Kutafin University represented the primary information source.

We manually processed the obtained results due to the small (less than 100 people) number of respondents. The research task was identified through the application of the above-mentioned methods. The research goal is to study approaches to the application of Big Data and Data Science in the structure of the modern educational process in the context of the spread of new coronavirus infection, particularly in terms of the following issues:

- Understanding categories of Big Data and Data Science by university students;
- Establishing forms of educational processes based on the Big Data analysis;
- Identifying useful and negative aspects of the application of Big Data (in space, time, and a circle of learners);
- Modeling architecture of the modern educational process using Big Data.

3 Results

The primary value of Big Data is not in the information in electronic form but in the result of its analysis. The sources of Big Data are any information that is of analytical interest in processing and study. This information is obtained by the relevant services (e.g., Google Analytics or Yandex Metrika). A well-trained AI, using Big Data, can replace traditional face-to-face forms of education involving a human teacher in terms of analytical data processing and the formation of final decisions. Such work can only be performed by AI. Nevertheless, the cognitive system of the human teacher is not dismissed but unloaded from unnecessary work (the processing of unstructured information accumulated by humankind). The educational process at universities needs to accumulate and process content using Big Data. In this matter, the use of AI is inevitable. Its work is set by university faculty based on the current and professional needs and traditions of academic schools and universities.

3.1 Regulatory Certainty

The beginning of the formation of a special electronic environment as the basis for the emergence of Big Data at the Kutafin University was set by Order No. 148 (May 17, 2019), which approved the Regulation on the electronic information and educational environment (Kutafin Moscow State Law University 2019).

In this local act, the electronic information and educational environment of the Kutafin University (EIEE) are understood as a system-organized set of information,

technical, educational, and methodological support in electronic form. The main objectives of the EIEE include the following:

- Creating a unified educational and communicative space based on modern information technologies;
- Providing students, regardless of their location, with the access to curricula, working programs of disciplines (modules), practices, publications of electronic library systems, and electronic educational resources through the Internet;
- Recording the progress of the educational process, the results of interim certification, and the results of developing basic educational programs;
- Conducting classes and assessment of learning outcomes, the implementation of which is envisaged with the use of e-learning;
- Forming electronic portfolios of students.

EIEE operates on the principles of accessibility, openness, complexity of construction, user-friendliness, consistency, integrability, and multifunctionality.

One of the critical elements of EIEE is the digital scientific, educational, and social network of the Kutafin University (DSESN). It is designed to create a personality-oriented information and communication environment that provides informational interaction of all participants in the educational process of the Kutafin University. DSESN should provide publicly available and personalized reference, scientific, educational, and social information. It should be implemented through services based on the applied information systems of the Kutafin University. The DSESN system provides for the operation of electronic personal accounts. Personal accounts have personalization of profiles and portfolios and provide social interaction between participants in the learning process.

The reviewed local act assigned the responsibility for forming the EIEE to the technical unit of the Kutafin University. However, the Regulation on Electronic Educational Resources (approved by Order No. 17, January 17, 2020) (MSAL 2020c) requires teachers to develop EIEE. In this case, the electronic educational resource is positioned as an element of the University EIEE structure. An electronic educational resource (EER) is understood as a system of educational and teaching materials presented in electronic digital form and providing the implementation of e-learning. The Regulation stipulates that the structure, subject content, and metadata of EERs must correspond to their purpose in the educational process and to requirements for educational activities of the Kutafin University. Metadata includes information on the educational content, describing its structure and content, including the level of education, its form, number of hours in the curriculum, number of hours in the EERs, and forms of control.

E-learning refers to the organization of educational activities using the University's e-Learning resources, which allows one to interact with students through ICT. Intensified implementation of e-learning is facilitated by the University Order "On the organization of educational activities in conditions of prevention of the spread of new coronavirus infection in the Russian Federation" (March 17, 2020, No. 10p) (MSAL 2020b). The Kutafin University established a mode of academic (lecture and practical) classes and weekly consultations exclusively in its electronic information

and educational environment. Additionally, classes can use all available external resources granting online and remote communication with the ability to identify students (e-mail, Zoom, Google Hangouts Meet, Skype, Microsoft Teams, Discord, messengers, streaming platforms, etc.).

Two months later, the university approved the "Regulation on the use of e-learning and distance learning technologies in the implementation of educational programs" (Regulation) (May 6, 2020, No. 149) (MSAL 2020d). It took into account the short but very extensive in terms of content experience of applying the previous Order.

The Regulation and Order No. 317 (August 21, 2020) "On the start of the academic year 2020–2021 and the specifics of the organization of educational process" (Order) (MSAL 2020a) are based on the analysis of Big Data. It is due to the fact that the Kutafin University has created and operates EIEE.

Therefore, the vice-rector for educational and methodological work of the Kutafin University initiated and conducted an anonymous survey "Transition to Distance Education: Anti-Coeducation and My Impressions." More than 1200 undergraduate and graduate students participated in the survey—42% of them were satisfied with the way distance learning was organized at the university during the pandemic. Speaking about the format of distance learning, a third of respondents (35%) indicated that most classes were held online using the distance learning system of the university (DLS) and Zoom, Skype platforms, etc. Only 15% of respondents indicated that teachers preferred the asynchronous form of conducting classes (issuing and assessing assignments).

The survey results allowed one to provide various forms of e-learning in the Regulations (according to the criterion of the form of interaction, it was divided into synchronous and asynchronous). Moreover, the results allowed us to classify distance learning technologies (video lecture, lecture-webinar, lecture-forum, practical training in a webinar format, and practical forum-lesson).

In developing the Order, the rector decided to actively implement blended learning. It was based on a combination of various proportions of full-time education with e-learning and the use of distance learning technologies, depending on the level of education, form of training, year of study, period of time, etc. The students' opinions directly influenced this decision. The majority of respondents (41%) voted for the traditional training format, assessing it as more effective and convenient. At the same time, 52% of respondents indicated that distance learning is more time-consuming. Only about one-fifth of respondents (19%) show support for a full transition to distance learning in the future. The numbers spoke for themselves.

3.2 Sociological Perspective

The high relevance of studied issues made it necessary to determine the students' position.

In June 2020, the authors conducted a sociological study with the participation of students getting their master's degree at the Kutafin University. The study was

conducted right after spring distance learning and the use of the new Regulation in the classroom. Table 1 illustrates the survey results on positions of interest.

The students perceived both formats of interactions proposed by Order No. 10p (March 17, 2020) as rather convenient and effective. Remote asynchronous interaction was favored by 52.6% and synchronous online communication—by 47.4%.

As for the format of the lectures, the top three were as follows:

- Synchronous webinar lecture (50%);
- Synchronous lecture-forum (26.3%);
- Asynchronous video lecture (23.7%).

Practical lessons in a webinar format were pointed out as the most promising and effective by 64.5% of respondents. Another 35.5% of respondents preferred a practical forum-lesson.

Table 1 Distance learning during the spread of COVID-19 infection

Question	Level: master's degree/form of study			
	Full-time	Part-time	Extramural	Total
1. What form of interaction with the teacher turns out to be the most convenient and effective?				
(A) remote asynchronous interaction by directing and executing tasks	A—5	A—10	A—25	A—40
(B) synchronous online interaction	B—14	B—9	B—13	B—36
2. What form of lecture seems more promising and effective?				
(A) synchronous webinar lecture	A—12	A—8	A—18	A—38
(B) synchronous lecture-forum;	B—4	B—7	B—9	B—20
(C) asynchronous video lecture	C—3	C—4	C—11	C—18
3. What format of the practical session out of those provided by the Regulation seems more promising and effective?				
(A) Practical training in webinar format	A—14	A—15	A—20	A—49
(B) Practical forum-training	B—5	B—4	B—18	B—27
4. What elements of distance learning would you suggest to retain and use at the end of the lockdown regime				
(A) Weekly online consultations from faculty members	A—6	A—13	A—18	A—27

(continued)

Table 1 (continued)

Question	Level: master's degree/form of study			
	Full-time	Part-time	Extramural	Total
(B) Online consultations before exams	B—10	B—13	B—18	B—41
(C) Initial passing of credits and examinations	C—3	C—5	C—8	C—16
(D) Retaking tests and exams	D—0	D—2	D—4	D—6
(E) Video lectures posted in the DLS along with lectures delivered by teachers in the classroom	E—7	E—8	E—19	E—34
(F) Video lectures posted in the DLS instead of lectures delivered by teachers in the classroom	F—4	F—10	F—8	F—22
(G) Partial conducting of practical lessons in the form of webinars	G—0	G—12	G—21	G—33
(H) Remote laboratory workshops	H—1	H—7	H—8	H—16
5. What are the main problems that you faced during distance learning?				
(A) Imperfections of my computer equipment and connection quality	A—4	A—6	A—14	A—24
(B) Imperfections in the technical support of the university	B—8	B—2	B—11	B—21
(C) My (personal) lack of qualifications	C—0	C—0	C—0	C—0
(D) Insufficient qualifications of teachers	D—3	D—1	D—4	D—8
(E) Increased labor and time costs	E—4	E—4	E—3	E—11

Source Compiled by the authors

The responses of students regarding the elements of distance learning were of particular interest for the construction of a blended learning regime. We believe it is advisable to use their opinion after the end of the coronavirus pandemic. Thus, 54.7% of respondents were in favor of distance consultations before the exams. Adding to that, 45.3% of respondents positively evaluated the idea of posting video lectures in the DLS in the addition to lectures given by professors in the classroom. Moreover, 44% of students supported maintaining partial hands-on classes via webinars. Weekly online consultations were optimal for 36% of respondents. Online workshops and primary tests and exams were approved by 21.3% of respondents. The students'

opinion was taken into consideration in the process of developing Order No. 317 (MSAL 2020a).

The transition to distance learning had inevitably revealed several issues. The primary one was having technical problems (70.3% of respondents). The problem arose equally among individual students and the entire university. According to 12.5% of students, insufficient qualifications of teachers was a factor hindering communication in distance learning. It is also noteworthy that master's students considered the level of their digital literacy to be appropriate, judging by their responses. Growth in labor and time costs was considered a problem by 17.2% of respondents.

In September 2020, we conducted another sociological study. Table 2 presents its results.

Table 2 Management of the educational process of the university during the COVID-19 pandemic: the impact of big data

1. Do you know what Big Data is?	
(A) Yes	A—40
(B) No	B—16
(C) The concept is familiar, but the content is unknown	C—16
2. Does the analysis of big data affect management decision-making at the university?	
(A) Yes	A—39
(B) No	B—4
(C) Partially	C—29
3. Big data is	
(A) Self-sufficient, its knowledge allows one to draw a particular conclusion	A—12
(B) Subject to subjective evaluation like any data	B—60
4. What data influences the construction of the educational process in the university?	
(A) Regulatory legal and non-regulatory acts of federal executive authorities	A—47
(B) Data on the sanitary and epidemiological situation	B—9
(C) Data from sociological studies involving teachers and students	C—16
(D) Other (specify)	D—0
5. What factors have the most significant impact on the formation of the educational process at the university?	
(A) External (e.g., epidemiological situation and its evaluation in the act of the Federal Service for Surveillance on Consumer Rights Protection and Human Wellbeing)	A—30
(B) Internal (e.g., needs of students, opinions of teachers)	B—42
6. When university management makes management decisions, big data	
(A) Is currently used	A—26
(B) Will be used in 1–3 years	B—37
(C) Will be used in 3–5 years	C—9

Source Compiled by the authors

More than half of the respondents (55.6%) were substantively aware of digital technology being studied. The absolute majority of respondents believed that the analysis of Big Data completely (54.2%) or partially (40.3%) affected the adoption of management decisions by the university's management. Simultaneously, the majority of respondents (83.3%) shared our considerations that results obtained using the analyzed technology were final. In our opinion, analysis, interpretation, and systematic interpretation of the data were necessary for completeness and objectivity.

More than half (65.3%) of the respondents were positivists. They gave preference to the regulatory and non-regulatory acts of federal executive bodies in terms of the degree of influence on the construction of the educational process at the university. The data of the sociological survey and the data on the sanitary-epidemiological situation ranked second (22.2%) and third (12.5%).

At the same time, among the factors having a more significant impact on the formation of the educational process in the university, respondents preferred internal factors (58.3%) to external ones (41.7%).

Only a small percentage (36.1%) of students believed that the management of the university used Big Data in making management decisions. However, the absolute majority of the participants of the sociological survey saw the prospect of this technology in the near (51.4%) or distant future (12.5%). These results turned out to be encouraging.

4 Discussion

The potential of Big Data is a discussion topic for Russian and foreign researchers. Ray Saptarshi (2013) emphasizes the ability of Big Data to identify the interest of an educational course and the visualization benefits of interactive educational processes. Vaitsis et al. (2016) explore data manipulation combined with the appropriate use of visual Big Data analytics. Alonso and Arranz (2016) highlight the potential of Big Data as a source of information in student distance learning and education automation. Javidi et al. (2017) reveal the benefits of Big Data analysis for making educational decisions, determining learner behavior, and applying effective learning models.

Technologies for analyzing educational data are becoming a new tool for transforming educational systems based on the principle of individualization of learning and the concept of data-driven teaching (Fiofanova 2020).

At the same time, the full use of Big Data in education seems to be difficult due to several reasons.

First of all, the special electronic environment that generates Big Data is in its infancy at many universities. In this regard, Big Data of higher educational institutions contains not yet considerable volumes of information of significant diversity compared to the classical Big Data. In its essence, it is Big Data in miniature. Increasing the rate of forming and improving electronic information and educational environment accelerates the full application of Big Data.

Second of all, as developers of electronic educational resources, teachers are often aware of the lack of technical knowledge and skills necessary to implement effective online interaction with learners. Ways to improve digital literacy vary from self-education to various professional development courses (Ershova et al. 2020). For example, in June 2020, the Kutafin University organized a massive mandatory professional development for its teaching staff under the program "The Use of Information and Communication Technologies in the Educational Activities of a Modern University."

Third of all, Russian universities often do not possess horizontally scalable software tools allowing them to process enormous information amounts efficiently. The technical means and software of higher education organizations can process Big Data in test mode, but not permanently. As a consequence, only isolated management decisions will be made using this advanced technology. The access of the university to the Big Data analytics platform will be possible due to a partnership agreement with a relevant company.

Fourth of all, Big Data usually contains unstructured data of great volume. The collection and primary processing of such data are not enough to make management decisions based on them. One requires a serious analysis of such data. On this subject, the profession of a Big Data analyst is in high demand. Therefore, it is desirable to find a place in the university staff for the position of Big Data analyst. For example, the Center for Academic Development and Educational Innovation at the Kutafin University has a full-time position of the analyst of innovative forms of education.

5 Conclusion

In large educational organizations of higher education, the transition from Small Data to Big Data in the aspect of management decision-making based on the analysis of such data has been made. The Kutafin University serves as an example of such transition. It is possible through forming the electronic information and educational environment of the university with the help of scientific and pedagogical staff and professionals of technical departments. A powerful catalyst for this process is the COVID-19 pandemic.

Nevertheless, there are only first experiences with the use of Big Data in the field of education.

The defining characteristics of Big Data are "three V's:" (1) volume (in the sense of the size of the physical volume), (2) velocity (in the sense of the growth rate and the need for high-speed processing and obtaining results), and (3) variety (in the sense of the ability to simultaneously process different types of structured and unstructured data).

The goal of the further development of Big Data in relation to the educational process is both the early achievement by universities of these essential features and the development of "two more V's" (veracity and value of the accumulated information). Big Data is important for higher educational organizations. The technology has a use

value—the ability to bring informative benefits and include the final socio-economic effect. Additionally, this technology has an applied nature.

In particular, the authors of the study predict an increasing use of such useful content of Big Data as:

- Location of the audience (coverage of the audience depending on taught disciples);
- Tracking the activity of accounts in addressing interactive forms of learning (analysis of popular educational technologies: Interactive presentations, business games, testing, video lectures, etc.);
- Tracking student visits to websites and their sections (determining the relevance of educational disciplines and programs, individual qualities of faculty depending on the composition of published video lectures, articles, monographs, theses of reports, and other electronic works);
- Discussion by students of various issues in the educational process (e.g., questions about taught disciplines, misunderstanding concerning the topic, unclear material);
- Keyword analysis of search queries (assessing student needs and the content of existing web search pages).

We are convinced that there should be clear separation between Big Data categories as a form of processing and storage of large unstructured data and Data Science as an intelligent processing of Big Data with the construction of models of understanding of particular problems. The modern educational process will integrate human memory, cognitive (individual) capabilities of the individual with corresponding cognitive (collective) systems of social groups and society as a whole, and with artificial intelligence.

We see the task of "university AI" in the analysis of Big Data in education (Date University Science) as follows:

- Determination of the geosocial audience and the time of its educational activity (attendance);
- Identification of effective educational technologies and teaching methods;
- Establishment of the faculty rating and criteria for additional remuneration for the work function;
- Formulation of in-demand professional competencies;
- Structuring controversial issues and identifying tendencies in future interest of students in specific disciplines;
- Error correction work of the university.

We believe that the inevitable need of modern society to educate social groups on the core competencies of the digital economy in the future can be achieved using Big Data and Data Science technologies.

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