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Abstract

Big data analytics in education is considered as the accumulation of cultural, symbolic, and methodological capital. It provides an analysis of institutional contradiction between high technological entrepreneurship, academic institutions, and government management. Big data becomes a more attractive field for educational institutions. However, it is still a resource-intensive subject for research in contradiction to the opportunities of commercial, scientific organizations that are technically well equipped. Therefore, an important question arises: who will be a legitimate source of scientific knowledge and expertise—either academic institutions or commercial organizations. In this context, the key research problem is the growing

influence of technology companies in the field of educational expertise and the emerging institutional contradictions. The research aims to determine the sphere to which the stakeholders who dictate trends in the application of artificial intelligence in education in the near future belong. The methodology is within the boundaries of an analytical review of sources containing a description of trends in the application of big data and artificial intelligence in education. As a result, the authors generalize two key institutional contradictions: (1) between science and technology business, and (2) between the state and business. The analysis of these contradictions allows us to make a preliminary conclusion that the commercial sector, due to its activity and technological equipment, will become the main beneficiary of the massive introduction of artificial intelligence in education, which in the future may lead to a shift from the values of current democratic education.

Keywords (separated by '-') Big data - Artificial intelligence - Political economy - Educational analysis - Digital educational platforms - Data analytics digital services - Commercial education

Big Data Discourse in Education

Aleksander A. Popov and Pavel P. Glukhov

Abstract Big data analytics in education is considered as the accumulation of cultural, symbolic, and methodological capital. It provides an analysis of institutional contradiction between high technological entrepreneurship, academic institutions, and government management. Big data becomes a more attractive field for educational institutions. However, it is still a resource-intensive subject for research in contradiction to the opportunities of commercial, scientific organizations that are technically well equipped. Therefore, an important question arises: who will be a legitimate source of scientific knowledge and expertise—either academic institutions or commercial organizations. In this context, the key research problem is the growing influence of technology companies in the field of educational expertise and the emerging institutional contradictions. The research aims to determine the sphere to which the stakeholders who dictate trends in the application of artificial intelligence in education in the near future belong. The methodology is within the boundaries of an analytical review of sources containing a description of trends in the application of big data and artificial intelligence in education. As a result, the authors generalize two key institutional contradictions: (1) between science and technology business, and (2) between the state and business. The analysis of these contradictions allows us to make a preliminary conclusion that the commercial sector, due to its activity and technological equipment, will become the main beneficiary of the massive introduction of artificial intelligence in education, which in the future may lead to a shift from the values of current democratic education.

Keywords Big data · Artificial intelligence · Political economy · Educational analysis · Digital educational platforms · Data analytics digital services · Commercial education

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1 Introduction

The research aims to identify promising stakeholders of artificial intelligence application in education. The key tasks are to analyze materials that have prognostic and strategic importance for stakeholders and experts' opinions using artificial intelligence in education.

Artificial intelligence in education [AIE] is a complex social and cultural phenomenon comprehended differently by stakeholders of education, entrepreneurship, and educational policy. It is crucial to understand these different perspectives of the subject and related practices to build a balanced social attitude for educational development and accessibility.

Eynon and Young (2021) analyze an interview with all three stakeholders' groups and conclude that the commercial approach is inclined to become the main field for the whole educational technology soon. The authors detected very few overlaps in the understanding of what AIE is between stakeholders of education, entrepreneurship, and educational policy points of view. Their perspectives of these stakeholders could be indicated as "methodology," "mythology," and "rhetoric" as well (Fiofanova 2020).

AIE for the academic community represents a scientific research method of the learning process, educational systems, and their improvement. It is under discussion in the community to identify specific ways to achieve the goal and transform educational approaches for the new technological reality. This group proposes ideas opposite to the views of industrial Artificial intelligence [AI] followers. For example, instead of constructing a methodology, technic members are involved in things that are good to sell. Personalization in education is so popular because it sells well. At the same time, there are only a few recognized projects developed in academic surroundings, which are appropriate for implementation. This situation occurs because of its complexity and lack of relation to the AI industry and practice (Baker 2016).

In their turn, industry, and media mythologize AIE like any other commercial product. Organizations, which develop educational technology [ED-tech] programs, need to scale their successful products and satisfy customers and educational institute's needs at the same time. The AIE implementation success for stakeholders from the industry means the current commercial efficiency of their product but not only improvements in the educational process and results in a long-term perspective. According to the market challenges, organizations bring out products that could technically be implemented at the very moment and provide benefits and maintain entrepreneurship stability now but not on a long-term perspective.

For politicians in different countries, AI is a rhetorical tool that gives a few practical impacts yet but is used for external signs about the "modern" educational system in their country. During the last ten years, government documents associate AI development with the global competitiveness increase and state economy success (Accenture 2016). However, measures directed to AI development in education in different countries are in their infancy, and specific steps usually occur outside of the government field. To a large extent, politicians transfer responsibility for technological

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innovation in education to the commercial sector (Biesta 2005; Jarvis 2007). There is a lack of the necessary knowledge potential of AI in general and education in particular in political circles. It leads to a lack of understanding of why and how to use AI (for example, considering the issue of confidentiality of personal data), and political rhetoric goes far ahead of reality.

However, despite the lack of real interest, small investments, and the beginning form of developing an appropriate regulatory framework for AIE, AI is used by the government as a sign of current and progressive educational policy. For example, Advanced Research Projects Agency for Education program (ARPA-ED) in the USA, directed to win the future by outrunning the whole world in innovation and education development invested to the AI implementation to school education. China invests great resources in AI to support school education and transform the country into a global "AI Superpower" (Westerheide 2020). "National AI development strategy to 2030" (Presidential Executive Office 2019) was approved in October in Russia. The implementation of the strategy will increase the service quality in education (including an adaptation of the educational process to student's needs and market challenges, a system analysis of education efficiency index for optimization of vocational guidance and early revealing of children with high ability level, automation of knowledge quality assessment and data analysis of educational results). Thus, governments of all states use AIE as a rhetoric tool to demonstrate education progress in their countries in the twenty first century (Selwyn 2016).

2 Materials and Methods

The research attempts to analyze and generalize the current tendencies, which we can follow in the emerging discourse about big data in education. The authors chose those sources, which allow to highlight the stakeholders of AI in education implementation and substantiate prospects for the big data in education. As such sources, we take government documents that establish the main vector of development in the application of artificial intelligence and big data in education, analytical materials of commercial companies involved in the implementation of technologies in the educational process, and materials of expert discussions concerning the application of technologies in education.

This approach allows us to consider the discussion around the prospects for the introduction of educational technological innovations in the tradition of P. Bourdieu as a symbolic power (Bourdieu 1993), where it is important to understand which subjects accumulate a greater amount of symbolic capital today to influence educational policy and theory soon. Williamson (2017) guided this logic in his research when analyzing the possible consequences of data science transition in education from the academic to the commercial sector.

The limitations of this approach are that we limit ourselves only to an assessment of possible consequences, which is based on projections and a "visionary" view of the further development of events of artificial intelligence and big data in education

from the part of actors playing an important role in the development and application of technological innovation in education. Williamson built a genealogy and roadmap for the technological field of data analysis in education, trying to frame the associated "sociotechnical imagery" (Jasanoff 2015) that becomes a socially accepted vision of the technological process. For the reality of Russia's educational policy, such processes are a subject of interest in the near future and just began to acquire a more explicit and broad character. Therefore, we aim only to define the general contours of the symbolic power of artificial intelligence and big data in education, which can serve as one of the supports for further, more detailed research.

3 Results

The authors generalize the following contributions in the AIE field:

- **Between science and technological entrepreneurship**. Commercial actors support the media agenda around AI, creating usable commercial AIE products, which can solve specific tasks in the limited learning context but covering the largest possible market at any given time. Scientists do not accept market demands that dictate the fast implementation of what is possible but not what is right from the educational methodology point of view (Eynon and Young 2021). In the opinion of academic members, the market influence on making decisions in educational reforms by using modern technology often leads just to wasting state resources;
- **Between state and entrepreneurship**. State systems cannot set the interaction with EdTech industries. Business is interested in bringing its IT products to wide common education usage. However, the government applies the commercial experience of the organization very desultory in this field. Russian schools and universities cannot solve by themselves how and with whom to work with about AIE. Commercial organizations need opportunities to test products and pilot projects and move forward to bring their products to the relevant educational service market. That is what the state educational system is not able to provide yet. In the industry actor's opinion, the digitalization of the educational process has only essence—come to service with a predictable result. Customers should clearly understand how much time and money they need to achieve these results. Nowadays, public education is not responsible for the educational result at all. The industry does not have such KPI (Laryanovsky n.d.).

AIE common implementation suggests digitalizing many aspects of education and decision making related to curriculum content, pedagogical models, teachers' professional development, and assessment systems (Ball 2018; Williamson 2017). These are fundamental changes for both the system and the individual educational experience. As a rule, they lead to the automation and standardization of knowledge, curricula, and pedagogical work, but, depending on the stakeholders' actions, they may be far from the current democratic education values (Saltman 2016). In such

a situation, we have two ways. The first is to maintain the standard as a norm for personalization and diversity. The second is to provide "one way of thinking" in Russia: one textbook, one list, and one educational platform ("Results of FSES 4.0" 2020).

It is quite possible that the business sector becomes the main beneficiary of the AIE common implementation due to activity and technological equipment. This tendency was discussed in the analysis of changes in USA school education. In those changes, both private businesses and philanthropic organizations lobbied government decisions in the educational policy field. Private businesses—to maintain the demands of their products for school digitalization (Ball 2018). Philanthropic organizations—to implement initiatives supporting educational corporatization (Ball 2012; Reckhow and Tompkins-Stange 2018).

AQ1

Today, various educational platforms are developed by corporations. The most famous and large are "YaClass" ("YaClass" n.d.), developed by Yandex, and "SberClass" ("SberClass" n.d.), developed by Sber (Sberbank). The most famous digital solution from the government side is the Moscow Electronic School (Moscow Digital School n.d.), but it spreads only within Moscow city. Although, the other two products are implemented in the whole country ("YaClass"—40,000 and "SberClass" more than 2500 schools). There is no reason to assume that these developed resources will be combined into a single infrastructure or ecosystem (Fiofanova et al. 2020).

However, there are various intentions for all three stakeholders to work together, for example, for the business sector to share their data with academia to improve knowledge, for scientists working with the business sector to enhance the implementation of scientific results into practices. It is up to the government to ensure (and regulate where necessary) that businesses adhere to responsible codes of practice that meet high ethical standards (Muller-Eiselt 2018).

4 Discussion

Educational data analysis and data generation sources are not concentrated in science labs but in commercial organizations. As a result, new educational methods turn out to be embedded in technological solutions, which EdTech organization offers to schools and universities in the form of algorithmic personalization technologies.

From the developers of AIE solutions point of view, big data and algorithmic analysis forms identify inconsistencies between learning patterns found in the data and existing conceptual approaches for its interpretation. They use the methodology and epistemological approaches of data science to close the gap between theory and practice. This methodological shift in educational knowledge production and theory constructing acquires a political and economic dimension when well-equipped organizations like Pearson Publishing and prestigious institutions such as Stanford University gain legitimacy and credibility through their technical knowledge and expertise in big data analytics.

Big data analysis as a new knowledge field accumulates significant social, economic, and cultural capital. It creates a new capital type—methodological, which gives an opportunity to get a competitive advantage over other methods and approaches in digital learning and digital media research.

We can consider the implementation of methodological innovations as a symbolic authority field (Bourdieu 1993). Thus, the field of educational data analysis can be considered in terms of (1) its access to economic capital in the form of funding and resources; (2) its cultural capital in terms of the production of new knowledge, and (3) social capital that acquires through its networks of partnerships and connections. In other words, data science in education is an emerging methodological field of symbolic power with its distinctive combination of economic, cultural, and social capital and special view of "datafication" of educational technologies, research, and knowledge future. Born as an informal movement in the mid-2000s, it is now a state-recognized (Professional standard "Specialist in modeling, collection, and analysis of digital footprint data" n.d.) institution that requires funding and specialized employee training (Federal portal of Draft Regulatory Legal Acts n.d.).

Conceptually, the sphere of educational analytics as a scientific and technical direction is formalized in the Stanford report "On the construction of the field of educational analytics for the large-scale implementation of personalized learning" (Pea 2014), which was the result of a series of seminars and meetings with the participation of universities (Chicago, MIT, Carnegie Mellon, etc.), government (National Science Foundation, Office of Science and Technology Policy and US Department of Education's Institute of Education Sciences), commercial organizations (Khan Academy, Coursera, Intel, etc.) and non-profit organizations (Educational Testing Service (New Jersey, USA), SRI International (Menlo Park, USA)) and funds (Bill & Melinda Gates Foundation) (Seattle, USA). The report proposes the design of a new scientific and technical direction that combines data science, learning research, and the creation of infrastructure for solving the problems of analyzing large volumes of educational and training data. The document indicates the need for a new type of professional infrastructure of teaching analytics and data mining in education, which trains analysts with the following competencies (Pea 2014):

- Statistical tools and research methods, including traditional knowledge of statistics, and new methods, such as machine learning, network analysis, natural language processing, and agent-based modeling;
- Comprehensive basis of cognitive science and socio-cultural principles as applied to learning;
- Principals of human and machine interaction, user experience development, and research design;
- Awareness of ethical and social issues related to big data both in the context of formal education and in the extracurricular learning environment;
- Knowledge of psychometrics and educational measurements, cognitive neuroscience, bioinformatics, computational statistics, and other computational methods.

Another visioner material is "Liberated Intelligence: The Case for Artificial Intelligence in Education" (Luckin et al. 2016) was published by Pearson PLC, one of the world's largest publishers and an important actor in the digital learning and big data education market. AI-development vice-president at Pearson, J. Berens, indicates the ability to recognize patterns generated as a result of student actions on learning platforms and its analysis for educational trajectories constructed for individual learners, groups of learners, and the schools (Behrens 2014; DiCerbo and Behrens 2014). Pearson's researchers use the whole list of algorithms and machine learning methods for recognizing such patterns to reveal hidden learning models and build generalizable models of cognitive development. According to Behrens (2014), the discoveries that will lead to the analysis of huge volumes of educational data will challenge the existing theoretical foundations of educational research since new forms of data and experience will create a gap between the dramatic increase in data-driven outcomes and opportunities current theories for their unification. Pearson believes big data will open the door to new learning theories.

The organization has a wide administrative, technical, and expert infrastructure—analysts, developers, and strategic partners, which provide platforms for adaptive learning and AIE. Pearson aims to use the ideas explored by such analysis for new conceptional models and educational theory development, which can be implemented into new e-learning products.

These examples suggest that learning and education knowledge will increasingly come from private organizations with their well-funded research facilities, partnerships, intellectual property rights, proprietary IT solutions, and market ambitions.

That returns us to the idea about educational data and AIE as a symbolic authority field and a special set of social structures and relationships between a range of actors seeking to create economic, cultural, and social capital. The big data in education as the domain of technology experts began to accumulate significant economic capital through funding and institutional resources. It requires significant social capital through its connections to the data and information technology industry, prestigious academic institutions, legislatures, and executives. It also accumulates cultural capital through innovative methods of generating new knowledge and has serious ambitions to create new learning theories based on data.

5 Conclusion

As big data gains more credibility, it is possible that the legitimization of scientific and technical organizations with enough resources to analyze and provide new knowledge will occur. Educational data research becomes more recent in the current conditions of digitalization and data-driven management, which are directed to legitimize specific forms of political action (Rieder and Simon 2016). And, these research can be used by government departments to explain and legitimize their decisions.

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According to this logic, the sources of new knowledge and learning theories will be actors with economic, social, and cultural capital, generating knowledge-based on big data analysis. Williamson (2017) alarmingly suggests that some of them could then benefit from the commercial patenting of educational software solutions based on their models. In essence, this will be a victory for patents over learning theory: the explanation of learning will be embedded in proprietary, intellectual property-protected algorithms for personalizing educational platforms, access to which will be purchased by schools and universities. These platforms will generate even more data, proving the effectiveness of the models and algorithms on which they are based. With this "unimaginable data efficiency" in hand, in the words of the director of research at Google, Peter Norvig, the need for any theorization of education on the part of the scientific community will disappear by itself (Watters 2016).

As educational research becomes increasingly related to big data, and its analysis is most effectively carried out by commercial companies with the appropriate resources and proprietary algorithms, the question of who owns the theory of education becomes a serious problem. Possession of big data in learning, knowledge of educational theory, and the application of those theories in patent-protected commercial systems may in the future lead to private companies with market imperatives, rather than academic institutions, becoming government-approved platforms for educational expertise.

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