

UDC 519.252: 519.256

CAN BIG DATA AND ADVANCED ANALYTICS ADDRESS PROBLEMS OF ETHICAL, PRIVACY, AND EQUITY CONCERNS IN UNIVERSITY EDUCATION?



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Abstract. In recent years, the adoption of big data and advanced analytics in various industries has revolutionized decision-making processes and yielded significant outcomes. Universities, too, have begun to harness the power of data analytics to enhance educational experiences and student success rates. However, as data-driven practices become more prominent, concerns regarding ethical considerations, privacy, and equity arise. This article explores the potential of big data and advanced analytics in addressing these concerns within university education.

Key words: Big Data, educational data mining, digitalization of education, Analytics, Education, University Education.

Introduction. The role of big data and analytics is becoming increasingly significant in shaping the educational landscape of universities. As higher education shifts away from conventional teaching and learning models, the advent of data analytics is redefining schools' strategic decision-making, advancing learning outcomes, and refining administrative tasks. This discussion explores how these technologies are molding the future of collegiate learning environments.

Data analytics has been adopted by universities looking to improve administrative functions. It plays a decisive role in streamlining activities such as managing admissions and efficiently distributing resources, leading to cost reduction and better operational efficiency. Predictive analytics is employed to forecast trends in student enrollments, facilitating proactive planning in course availability and resources, thus averting potential logjams and promoting a smooth educational journey.

Personalized educational experiences are made possible through the interpretation of student data, allowing instructors to customize teaching approaches that suit diverse learning preferences. This individualization increases understanding and student participation. Learning analytics are applied in evaluating student achievements, pinpoint shooting learners who may need additional help, and intervening at the right moment, significantly improving learning experiences and scholastic successes.

Moreover, big data is a boon for path-breaking research by offering access to large-scale data sets, enabling researchers to investigate intricate correlations, discern patterns, and extract important insights. Such analysis is instrumental in driving innovation across many academic fields. Advanced analytics propel collaborative research by uniting investigators, enhancing data exchange, and fostering cross-disciplinary initiatives, thus speeding up the research progress and supporting the spread of knowledge.

Educational analytics tools are employed to conceive warning systems that spotlight students who might confront academic difficulties or consider withdrawing. Interventions like study support, counseling, or mentorship are pivotal to bolstering student retention rates. Data analytics also serve in harmonizing academic programs with professional trajectories by evaluating labor market patterns and sector demands, thus refining career counseling services and preparing students effectively for employment [1].

Nevertheless, the wide-ranging utilization of student information prompts privacy and ethical issues. Universities are tasked with ensuring adherence to data protection laws and the security of personal data. While the potential for analytics to personalize education is evident, it carries the risk of amplifying existing educational disparities. To evade the creation of a digital chasm, it is essential to ensure all students have equal access to technological and academic resources.

Identification and Framing of Ethical, Privacy, and Equity Challenges in University Education. As universities increasingly utilize big data and analytics to refine educational processes, it is crucial to thoughtfully consider the ethical dilemmas, privacy concerns, and potential unequal effects that emerge in this advancing technological context. This segment outlines and contextualizes principal apprehensions, illuminating the intricate ethical considerations, privacy implications, and possible fairness issues that must be carefully maneuvered in advancing data-centric educational methods.

Key Considerations:

1 Balancing data-gathering objectives with the ethical necessity to secure informed consent from students and pertinent parties.

2 Guaranteeing that individuals comprehend how their data is employed, coupled with providing them with the capability to decline participation.

3 Preserving openness in analytical applications, ensuring parties are cognizant of the objectives, methodologies, and prospective repercussions of data-influenced choices.

4 Confronting inherent biases within algorithms and decision-making frameworks that could inadvertently reinforce pre-existing disparities, and pushing for impartiality within analytic techniques to avert discriminative results.

5 Defending student data against unauthorized acquisition or security breaches by enacting stringent data protection protocols for safeguarding sensitive details like academic performance, attendance, and personal identification information.

6 Balancing the objective of performing in-depth analyses with safeguarding personal privacy by employing anonymization and de-identification tactics.

7 Alleviating issues regarding student categorization and observation, confirming that data analysis benefits educational growth instead of leading to unwarranted scrutiny.

8 Acknowledging the technological gap, making certain that every student has equal access to the technological assets essential for a data-oriented education, and closing infrastructural and technology availability gaps to avoid unequal opportunities.

9 Addressing the potential risk of algorithms intensifying or maintaining pre-existing imbalances, ensuring analytical models are conscious of and address existing biases to provide equitable chances for all students.

10 Stepping through challenges linked to the even-handed allocation of educational resources informed by data insights, evading situations where some student groups might gain or lose disproportionately.

11 Realizing that ethical, privacy, and equality issues often coalesce and have reciprocal effects – for example, unequal resource distribution may lead to biased datasets and threaten privacy.

12 Recognizing the evolving nature of ethical, privacy, and equality challenges as they progress with technological advancements, advocating for continuous review and revision of policies to tackle new issues.

13 Highlighting the crucial role of educational bodies in taking the initiative to overcome these hurdles. Institutions should integrate setting of ethical parameters, robust privacy measures, and the drive for fairness as part of their foundational goals.

Historical Context of Data Utilization in Education:

The use of data within educational settings has morphed from simple record-keeping to the present-day's intricate data analytics, integral in contemporary higher education. Grasping this progress is vital to understand the revolutionary influence of data-guided decision-making upon pedagogy, student development, and school management. This historical perspective lays ground for an enriched understanding of the current situation and the innate ethical, privacy, and fairness challenges of educational data analysis.

Present-day Big Data and Analytics in Higher Education:

Today's state of big data and analytics in higher education marks a significant evolution in institutional functionality and educational delivery. With this change comes opportunities for augmented decision-making and student achievement as well as hurdles related to privacy, safety, and necessitating a cultural paradigm shift in academic environments. Recognizing this shifting terrain is key to devising strategies for responsible and principled data use within the sphere of higher education.

The Ethical, Privacy, and Equity Challenges in Educational Data Analytics [2]:

The ethical, privacy, and equity implications embedded in educational data analytics constitute a sophisticated matrix demanding diligent contemplation. As educational institutions utilize data's potential to ameliorate education, it is of utmost importance to build and abide by moral frameworks, enforce stringent privacy protocols, and assure that decision-making influenced by data fosters inclusivity rather than intensifying inequities. Confronting these challenges is essential to nurture a ethical and inclusive data culture in higher learning institutions.

Ethical Considerations.

Importance of Informed Consent in Educational Data Analytics and Its Implementation. In educational data analytics, the role of informed consent is paramount for ethical data handling. It honors individuals' control over their personal data and upholds principles like transparency and fairness. By clearly explaining data usage, educational institutions respect and protect the autonomy of their community members, ranging from students to faculty.

Transparent disclosure about data collection's purpose and impact is not only a foundational aspect of trust but also a matter of legal compliance with regulations like GDPR and FERPA. Ensuring informed consent can prevent legal issues and misuse of information, reinforcing the institution's dedication to ethical practices.

To achieve this, institutions must:

Articulate the intent, extent, and consequences of data handling in clear, easily digestible terms., Offer clear choices to individuals regarding their data, with straightforward options to consent or withdraw., Recognize consent as an evolving agreement, keeping the community updated on changes and allowing for adjustments to their consent choices., Balance thorough

information with clarity to avoid overwhelming stakeholders, modifying consent methods for the diverse academic community.

Transparency in Educational Data Analytics: Necessity and Implementation.

Transparency in data practices, especially in educational analytics, is crucial for maintaining ethical standards. It underpins stakeholder trust, including students, faculty, and parents, ensuring confidence that data is managed with integrity. When data practices are transparent, an institution's reputation for ethical and responsible data use is bolstered.

It's essential to explain clearly the reasons for data collection and its role in improving educational outcomes, preventing misunderstandings and ensuring everyone is an informed participant. Transparency also enables stakeholders to make knowledgeable decisions regarding their data interaction, aligning with the principles of informed consent.

Open dissemination of how privacy is protected increases support for data initiatives. It also provides proof of an institution's ethical commitment, alleviating worries about potential data misuse. Further, transparent operations enable accountability for an institution's actions, encouraging responsible conduct [3].

Accessible communication regarding data practices is vital, and using clear, non-technical language facilitates broader understanding. Establishing feedback channels is also key, promoting an environment of open dialogue. Despite the challenges in explaining complex data analytics, it's important to articulate these matters clearly and to keep the community updated as practices evolve.

The Role of Stakeholders (Students, Educators, administrators, course developers) in Ethical Data Practices. Ethical data management in educational environments demands the involvement and cooperation of all participants.

Students should advocate for transparency by understanding and querying how their data is used, reinforcing their consent rights. Becoming data literate enables them to handle their data responsibly. Educators play a pivotal role by embedding data ethics into their teaching and setting an example of ethical practice, which helps in cultivating a responsible data culture.

Educational institutions need to define and adhere to ethical data guidelines consistent with legal and ethical norms. This requires establishing solid data governance, involving data oversight roles, ethics committees, and adherence to privacy laws, while also incorporating stakeholder feedback into policy-making, ensuring fairness and inclusion.

Open dialogue on data policies and objectives, alongside feedback mechanisms, is essential for transparency and trust-building. Continuous professional development for educators in data ethics and consent, privacy considerations, and ethical teaching methods is crucial. Similarly, student workshops on data ethics are vital for fostering a conscientious data engage in the education ecosystem (figure 1).

Institutions must balance educational ambitions with ethical data handling, prioritizing student and educator welfare and rights. Cultivating an ethical data culture might necessitate a shift within institutions, where a unified commitment to ethical standards is essential for sustained practice.

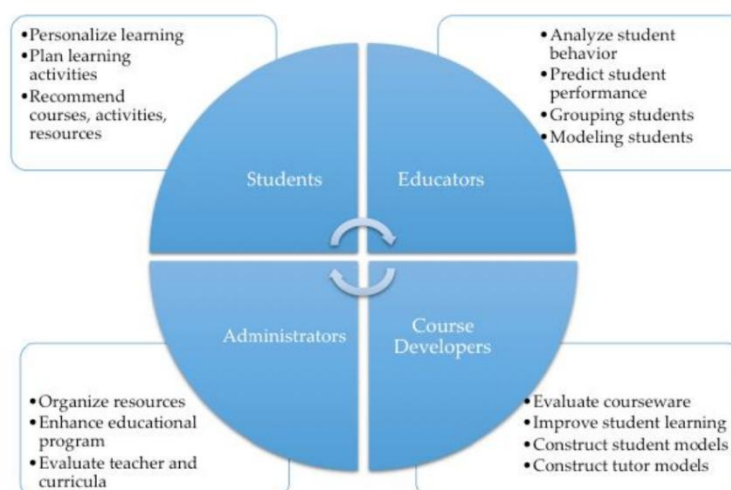


Figure 1. Big data scopes for four users in higher education

Methods for Safeguarding Individual Privacy in Educational Datasets.

Educational institutions are increasingly relying on data, making it critical to protect individuals' privacy within this context. This research delves into potent ways to ensure this privacy.

By removing personally identifiable details such as names and IDs, anonymization makes it impossible to trace data back to individuals. Aggregating this anonymized data, like grouping ages, maintains its utility while protecting identities.

Pseudonymization replaces personal identifiers with unique codes, preserving the ability to analyze data sets without revealing who's who. It can be reversed, unlike anonymization, allowing detailed study when needed [4].

Differential privacy secures individual privacy by adding noise to the data, which obscures individual input but keeps over-arching patterns intact, ensuring that one person's data doesn't overly influence analysis results.

When data is in transit, SSL/TLS encryption keeps it hidden from prying eyes, and encryption of stored data thwarts unauthorized access, providing an additional security barrier. Role-Based Access Control (RBAC) tailors data access precisely, giving people only the information needed for their role and guarding against breaches.

Data masking and redaction shield personal details like social security numbers and other identifiable information in circulated reports. Data sharing agreements set strict

Analyzing Concerns Related to Student Profiling and Surveillance in Educational Data Analytics.

The use of educational data analytics for student profiling and monitoring presents pressing ethical and privacy issues. This scrutiny treads into private territories, capturing an array of student behaviors and risks infringing on personal boundaries. Algorithms for profiling may unintentionally embed bias, exacerbating inequality and discrimination, potentially anchoring students in predetermined roles steeped in bias and stereotype. Such constant oversight can inflict stress and inhibit unconventionality and experimentation among students, fearing repercussions for non-conformity.

The accumulation of sensitive data raises the stakes for security breaches, with dire implications for students' privacy and safety. Moreover, opaque algorithms obscure the decision-making process, impeding accountability and transparency. The awareness of being monitored might curtail students' freedom, stifling diverse thinking and reinforcing a culture of

conformity that can further widen gaps in equity. In implementing these systems, educational bodies must navigate intricate legalities and ethical dilemmas, ensuring they align with regulations like FERPA and GDPR and considering the trade-offs between perceived benefits and individual rights. Poor communication about these surveillance tactics can breed distrust in the student, parental, and broader community, emphasizing the need for transparency to sustain communal trust.

Examination of Laws and Regulations Governing Educational Data Privacy in Russia.

Russia has enacted several laws and regulations related to data privacy, but it's essential to note that legal landscapes can change. Federal Law No. 152-FZ «Personal Data» This law, often referred to as the «Personal Data Law», is a fundamental piece of legislation governing the processing of personal data in Russia, including data related to education. The law outlines principles for processing personal data, requirements for data controllers, and the rights of data subjects. Educational institutions processing personal data are subject to compliance with these regulations. Federal Law No. 273-FZ «On Education in the Russian Federation». This law focuses on general provisions related to education in Russia, and while it may not specifically address data privacy, it sets the broader context for educational activities. The law outlines the structure of the education system, rights and responsibilities of educational institutions, and the principles of educational activities. Data privacy considerations are often implied within the broader framework of educational operations. Russia has introduced data localization requirements that impact how personal data, including educational data, is processed and stored. The law mandates that the databases containing personal data of Russian citizens should be located within the territory of the Russian Federation. This requirement may affect how international educational institutions handle data of Russian students [5]. Government Regulation No. 687 «On the Requirements for the Protection of Personal Data during Its Processing in Personal Data Information Systems» (Data Protection Regulation) This regulation provides more detailed rules on the protection of personal data, including in information systems used by educational institutions. The regulation sets requirements for the protection of personal data during processing and outlines measures that organizations, including educational institutions, should implement to ensure data security. While there may not be a specific law exclusively dedicated to educational data privacy, various regulations, guidelines, and standards may impact how educational institutions handle data. Educational institutions should stay informed about sector-specific guidance that may come from education authorities or regulatory bodies, ensuring alignment with broader data protection laws. Russia may be a party to international agreements or conventions that have implications for data privacy in the educational context.

International agreements, particularly those related to data protection and privacy, may influence how educational data is handled, especially in cases involving cross-border data transfers.

Strategies for Leveraging Analytics to Reduce Disparities in Academic Achievements.

Using educational analytics effectively helps to identify and tackle academic achievement gaps. Schools can adopt specific, data-informed tactics to support fair educational opportunities. By analyzing academic data – including demographics, economic background, and learning preferences – schools can set up early warning systems that pinpoint students needing immediate support, enabling proactive measures.

Adaptive learning systems fine-tune content to meet unique student needs, while analytics models suggest custom learning paths tailored to individual abilities and progress rates. Predictive analytics are utilized to earmark students for extra support or specialized programs. Interventions are then customized to overcome particular obstacles, such as language barriers or financial limitations.

Moreover, analytics are applied to ensure resources are fairly distributed, guiding budget decisions to address achievement gaps. Tools also evaluate the cultural appropriateness of educational content and pinpoint where teachers might need training in culturally aware instruction.

Educators, administrators, and parents can monitor student progress through instant access to performance dashboards, while data meetings allow for strategy adjustments based on observed trends. Platforms for seamless communication encourage parental engagement, and data aids in selecting candidates for mentorship and fostering peer-learning setups.

Regular equity audits assess strategy effectiveness, driving necessary amendments for enhanced results. Professional Learning Communities (PLCs) are instrumental in sharing insights and data-led teaching solutions, honing in on collaborative methods to minimize academic disparities.

Examples of universities effectively using big data while addressing ethical concerns.

These examples highlight how universities are actively working to harness the benefits of big data while respecting ethical principles, privacy, and transparency. It's important to note that ethical considerations are an ongoing focus, and universities continue to evolve their approaches in response to emerging challenges and societal expectations.

Stanford launched the «Stanford 2025» initiative, utilizing big data to personalize education and improve student outcomes. Stanford emphasized transparency, student consent, and the protection of privacy. They developed algorithms that adapt to individual learning styles while allowing students control over their data.

The University of Michigan formed a Learning Analytics Task Force to explore the ethical use of big data in improving teaching and learning. The task force emphasized responsible data stewardship, transparency, and the importance of maintaining trust. They developed guidelines for the ethical use of learning analytics.

The University of Amsterdam implemented a personalized feedback system using big data analytics to enhance student learning experiences. The university prioritized transparency and provided students with clear explanations of how their data would be used. They also incorporated mechanisms for obtaining student consent.

Carnegie Mellon's Simon Initiative uses big data to improve educational outcomes through data-informed decision-making. The initiative emphasizes transparency, privacy protection, and responsible data use. They incorporate privacy controls, data anonymization, and informed consent mechanisms.

The University of Edinburgh hosts an annual Data Fest, where students and researchers collaborate on projects using big data to address societal challenges. The university promotes responsible data use by encouraging participants to consider ethical implications in their projects. They emphasize the importance of obtaining consent and respecting privacy.

Harvard's Data Privacy Lab focuses on researching and addressing privacy concerns in the era of big data analytics. The lab actively engages in research and advocacy for privacy rights. Their work includes developing tools and policies to protect individuals' privacy in the age of data analytics.

BIDS at UC Berkeley fosters interdisciplinary collaboration in data science research. BIDS incorporates ethical considerations into its research practices, emphasizing transparency, openness, and the responsible use of data. They engage in discussions about the ethical implications of data science.

MIT has undertaken research projects focusing on the privacy implications of big data analytics. Researchers at MIT investigate and propose solutions to privacy challenges associated with big data. They contribute to the development of privacy-preserving technologies and advocate for ethical practices in data analytics. Skoltech is a private graduate research university in Moscow that focuses on science and technology. While specific big data initiatives may not be

extensively documented, institutions like Skoltech are likely to incorporate ethical considerations into their research practices. Universities in Russia, including Skoltech, are expected to adhere to national and international data protection and privacy regulations. HSE is one of the leading research universities in Russia with a focus on economics, social sciences, and humanities. Institutions like HSE are likely to address ethical concerns related to big data use in research and education. This includes considerations of data privacy, transparency, and informed consent when dealing with large datasets. Russian universities, as part of broader academic and research communities, may be involved in developing data governance policies. Efforts to establish guidelines and policies for the responsible use of big data would likely include considerations of ethical practices, protection of privacy, and adherence to relevant laws and regulations. Russian universities often collaborate with international institutions on research projects that involve big data analytics. Collaborations with international partners may bring about a focus on aligning with international standards for ethical data use and privacy protection [6].

The Russian government has expressed interest in developing digital technologies and big data analytics. Government initiatives would likely include considerations for ethical use of data, especially as they pertain to citizens' privacy and the responsible implementation of data-driven technologies.

Instances where institutions faced challenges in maintaining ethical standards. Instances where institutions faced challenges in maintaining ethical standards are diverse and can occur across various sectors, including education, business, healthcare, and research. Ethical challenges often emerge due to a variety of factors such as organizational culture, pressure for results, lack of oversight, or evolving technologies.

The college admissions scandal involved wealthy parents bribing college officials to secure spots for their children in prestigious universities. The scandal revealed issues of privilege, unequal access to educational opportunities, and a lack of fairness in the college admissions process. It prompted discussions about ethics in higher education.

This example underscore the importance of maintaining ethical standards across various domains. Institutions that face ethical challenges often experience severe consequences, including legal actions, reputational damage, and loss of public trust. In response, many organizations have strengthened their ethical frameworks and governance structures to prevent and address ethical lapses.

Guidelines for universities to develop robust ethical and privacy policies. Developing robust ethical and privacy policies is crucial for universities to ensure responsible data practices, protect individuals' privacy, and maintain trust within their communities:

1 Clearly articulate the fundamental ethical principles and values that guide the university, emphasizing integrity, respect, transparency, and a commitment to fairness and equity.

2 Ensure that policies align with national and international laws and regulations governing data protection and privacy, such as Federal Law No. 152-FZ «On Personal Data» and amendments to the Personal Data Law (2015), Federal Law No. 149-FZ «On Information, Information Technologies and Protection of Information», or other relevant legislation depending on the country.

3 Clearly define the scope of the policies, specifying the types of data covered, the entities to which the policies apply (e.g., students, faculty, staff), and the contexts in which the policies are applicable.

4 Establish procedures for obtaining informed consent from individuals for the collection, processing, and sharing of their data, ensuring transparency about the purpose and scope of data use.

5 Implement a data minimization approach, collecting and retaining only the necessary data for the intended purpose, reducing the risk of privacy breaches and unauthorized access.

6 Define robust security measures for protecting data, including encryption, access controls, and regular security audits, to safeguard against data breaches and unauthorized access.

7 Clearly outline the ownership of data and establish guidelines for who has access to different types of data, ensuring that access is granted only on a need-to-know basis.

8 Promote transparency by clearly communicating the university's data practices to stakeholders. Provide accessible and understandable information about data processing activities.

9 Establish protocols for ensuring the accuracy and quality of data, including mechanisms for individuals to update their information and correct inaccuracies.

10 Develop specific policies for handling sensitive data (e.g., health records, biometrics) with additional safeguards and heightened security measures.

11 Specify the duration for which data will be retained and establish procedures for the secure and timely deletion of data that is no longer needed for its original purpose.

12 Provide regular training to staff, faculty, and students on ethical data practices, privacy policies, and the importance of adhering to established guidelines.

13 Establish ethics review boards or committees to review and approve research projects involving human subjects, ensuring compliance with ethical standards and privacy regulations.

14 Develop a comprehensive incident response plan to address potential data breaches, including procedures for notifying affected individuals, authorities, and mitigating risks.

15 Regularly evaluate the effectiveness of ethical and privacy policies, seeking feedback from stakeholders, and making necessary adjustments to address emerging challenges and technological advancements.

16 Clearly outline mechanisms for enforcing policies and holding individuals accountable for violations, including disciplinary measures and consequences for non-compliance.

17 Involve key stakeholders, including legal experts, privacy advocates, and representatives from diverse university departments, in the development and review of ethical and privacy policies.

18 Emphasize the university's commitment to public accountability by regularly reporting on its data practices, privacy initiatives, and any updates or changes to policies [7].

19 Schedule regular reviews and updates of ethical and privacy policies to ensure alignment with evolving legal standards, technological advancements, and institutional changes. By following these guidelines, universities can establish a robust framework for ethical and privacy policies that not only comply with legal requirements but also foster a culture of trust, transparency, and responsible data use within the academic community.

The inclusion of data ethics in educational curricula.

Integrating data ethics into education is essential for equipping students with the knowledge to use data responsibly across various disciplines. Incorporating principles like privacy, fairness, and accountability, curricula should: Provide a clear definition of data ethics, Encapsulate ethical data use in diverse fields from technology to healthcare, Cover ethical research practices, including informed consent and addressing biases, Teach responsible data management, emphasizing privacy and data integrity, Use practical examples to highlight ethical challenges and foster critical thinking, Address digital privacy and security concerns, including encryption and sensitive information protection, Discuss the impact and mitigation of bias in data and algorithms for just outcomes, Inform about data protection laws and legal responsibilities in data handling, Promote interdisciplinary projects that reflect real-world ethical application, Encourage critical thinking through ethical dilemmas in data use, Prepare students for professional ethical challenges and encourage maintaining ethical standards in their careers, Develop leadership that values ethical decision-making in data practices, Emphasize the evolving nature of data ethics and the need for ongoing education, Explore ethical aspects of emerging technologies like AI and biotechnology, Include a global perspective on data ethics, recognizing cultural and ethical diversity.

This comprehensive ethical foundation in education prepares students to be proficient and principled in their future careers, ensuring they value and enact responsible data practices for societal benefit.

The collaborative efforts among institutions, policymakers, and technology providers.

Stress the collective responsibility of institutions, policymakers, and technology companies to foster a tech ecosystem that upholds ethics, privacy, and societal good. Push for the creation and embracement of ethical guidelines shaping tech's lifecycle and advocate for cooperative policy-making to tackle new tech challenges, aligning institutional practices with government regulations and standards. Promote joint education efforts to raise awareness about ethical tech implications amongst everyone from the public to industry leaders. Call for continuous, interdisciplinary discussions to sync up priorities and expertise across sectors and push for collaborative research to inform evidence-based policy development. Argue for international coordination in regulatory approaches, avoiding fragmentation and supporting innovation. Urge the drafting of industry standards with wide-ranging input to ensure broad acceptance. Press for inclusive decision-making, taking into account diverse groups and ensuring various perspectives are heard. Encourage a culture where tech providers consider ethics, transparency, and societal impact. Push for privacy integration into technologies from the start and propose independent evaluations of new tech's societal and ethical impacts. Demand openness and responsibility in tech practices and decisions, and facilitate multi-stakeholder forums for discussion and collaboration. Support public-private partnerships that combine the strengths of both for ethical innovation. Boost initiatives for capacity building through training and educational resources to handle ethical digital challenges. Advocate for regular review and adjustment of collaboration efforts to meet the dynamic changes in tech, and lobby for legislation that reflects ethical standards. Finally, back global governance efforts uniting different actors to set ethical benchmarks for worldwide tech application, looking towards a sustainable, ethically-driven technological future.

The role of upcoming technologies in shaping the future of educational analytics.

Emerging technologies significantly impact the evolution of educational analytics by introducing new methods and innovative tools to improve teaching and learning. Artificial Intelligence (AI) and Machine Learning (ML) analyze extensive data for tailored student learning experiences. Predictive analytics enable early interventions by identifying at-risk students. AR and VR provide dynamic, interactive dashboards for real-time data analysis, while Internet of Things (IoT) devices gather data on student engagement for instructional optimization. Wearables offer insights into student health and attention for a holistic view of engagement.

Blockchain provides secure credentialing while maintaining educational records' integrity. Natural Language Processing (NLP) offers automated assignment evaluation and assists students via virtual support. Robotic Process Automation (RPA) eases administrative workload, so educators can prioritize teaching and student aid. AR and VR facilitate immersive learning, with VR especially useful for practicing skills in safe, controlled environments [8].

5G technology ensures robust connectivity essential for remote learning and access to online resources. Edge computing processes data locally for faster analytics and fortified privacy. Gamified and immersive learning through extended reality (XR) engages students and offers valuable performance data. Biometric authentication secures online learning, while voice recognition tech streamlines content analysis and aids language learning.

Quantum computing foretells a leap in data processing capabilities, enhancing predictive analytics and pattern recognition. Advanced cybersecurity protects educational data, while smart learning environments adapt to individual progress. Sustainable technology considerations address environmental concerns, and collaborative platforms across institutions allow for shared insights.

The successful integration of these technologies in education depends on stakeholders' collaborative efforts to address ethical, privacy, and equity issues, alongside a commitment to ongoing research and responsible technology deployment.

Conclusion. In conclusion, the integration of big data and advanced analytics in university education holds immense potential for transforming teaching and learning experiences. However, this transformative power comes with ethical, privacy, and equity considerations that demand careful attention from all stakeholders – educators, policymakers, technology providers, and students. The journey through this scientific article has explored the historical context, current landscape, challenges, and potential solutions in the realm of educational analytics.

The historical evolution of data use in educational settings has paved the way for the current era of sophisticated analytics. From traditional record-keeping to contemporary data-driven decision-making, the trajectory reflects a continuous quest for improving educational outcomes.

The current state of big data and analytics in higher education reveals a landscape where data is a driving force in shaping policies, curricula, and student experiences. Institutions are leveraging data to enhance efficiency, personalize learning, and make informed decisions, contributing to the evolution of the educational ecosystem.

However, this data-driven paradigm is not without its challenges. Ethical, privacy, and equity concerns have emerged as critical considerations. The identification and framing of these challenges underscore the need for proactive measures to ensure responsible data practices.

This article has proposed a range of solutions, including the importance of informed consent, transparent data collection, and the role of stakeholders in fostering ethical data practices. Strategies for protecting privacy, complying with regulations, and leveraging analytics to reduce disparities in academic achievements have been explored.

Acknowledging the global nature of these challenges, the examination of laws and regulations governing educational data privacy in Russia provides insight into the diversity of approaches and the importance of a global dialogue on ethical standards.

The impact of emerging technologies, from AI and machine learning to blockchain and 5G, has been discussed in shaping the future of educational analytics. These technologies offer immense potential for personalized learning, enhanced data security, and immersive educational experiences. However, careful consideration of their ethical implications is paramount.

Throughout the discourse, the importance of collaborative efforts among institutions, policymakers, and technology providers has been emphasized. Advocating for shared responsibility, ethical frameworks, and inclusive decision-making processes is critical for navigating the complex intersection of technology and education.

In the final analysis, the conclusion underscores the ongoing need for continued research, adaptive policy development, and heightened ethical awareness. As technology evolves and educational analytics become more sophisticated, stakeholders must remain vigilant in addressing ethical challenges, safeguarding privacy, and promoting equitable access to educational opportunities.

This scientific article has illuminated the path forward a path that values innovation but places ethical considerations at its core. By advocating for responsible data practices, informed decision-making, and a commitment to inclusivity, the educational landscape can evolve sustainably, ensuring that the benefits of big data and analytics are equitably distributed and contribute to the betterment of education worldwide.

In the dynamic intersection of technology and education, the journey is ongoing. By fostering a culture of collaboration, ethical consciousness, and continuous improvement, the educational community can navigate the challenges of big data and analytics, steering toward a future where technology enhances education in a responsible and inclusive manner.

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Авторский вклад

Аль-Нами Башер Али – Окончил Санкт-Петербургский электротехнический университет «ЛЭТИ». Научные интересы связаны с проектированием виртуальных средств информационных технологий, 3d полигональным моделированием и эргономикой, стандартизацией и проектированием (юзабилити) программных продуктов, Web-проектированием и дизайном, информатикой и компьютерным дизайном. Визуальное проектирование интерфейсов цифровых продуктов, Информационные технологии, Информационные технологии визуализации данных и исследовательских процессов в Санкт-Петербургском государственном университете Телекоммуникаций им. профессора М. А. Бонч-Бруевича.

МОГУТ ЛИ БОЛЬШИЕ ДАННЫЕ И РАСШИРЕННАЯ АНАЛИТИКА РЕШИТЬ ПРОБЛЕМЫ ЭТИКИ, КОНФИДЕНЦИАЛЬНОСТИ И СПРАВЕДЛИВОСТИ В УНИВЕРСИТЕТСКОМ ОБРАЗОВАНИИ?

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Аннотация. В последние годы внедрение больших данных и передовой аналитики в различных отраслях произвело революцию в процессах принятия решений и принесло значительные результаты. Университеты также начали использовать возможности анализа данных для улучшения образовательного опыта и повышения успеваемости студентов. Однако по мере того, как практики, основанные на данных, становятся все более распространенными, возникают опасения относительно этических соображений, конфиденциальности и справедливости. В этой статье исследуется потенциал больших данных и передовой аналитики в решении этих проблем в рамках университетского образования.

Ключевые слова: Большие данные, интеллектуальный анализ образовательных данных, цифровизация образования, аналитика, образование, университетское образование.