



"21st Century Education System "

"Big data and its impact on teaching and learning "

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"Big data in education refers to the collection and analysis of vast amounts of student-related data. It impacts teaching and learning by providing insights into student performance, personalized learning experiences, and data-driven decision-making, ultimately enhancing educational outcomes and adapting teaching methods to individual needs."

"Introducing 'Big data in teaching and learning' is essential to connect data-driven insights for personalized education, early intervention, and evidence-based decision-making. It optimizes resources, improves teaching methods, and enhances student outcomes, ensuring education remains relevant, effective, and tailored to individual needs in the digital age."

"The importance of big data in teaching and learning lies in its ability to enhance educational quality. It enables personalized learning, early intervention for struggling students, evidence-based curriculum design, and efficient resource allocation. Big data fosters data-driven decision-making, leading to improved student outcomes and more effective teaching methods."



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"The benefits of big data in teaching and learning include tailored learning experiences for students, early identification of learning gaps, improved teaching strategies, data-backed educational policies, and enhanced student engagement. It promotes efficiency, accuracy, and adaptability in education, ultimately leading to better academic outcomes and lifelong learning."

"Big Data and its Impact on Teaching and Learning"

21st century has undergone a profound transformation in the field of education due to the beginning of big data analytics. Big data, characterized by its immense volume, velocity, variety, and veracity, has emerged as a powerful tool in shaping teaching and learning experiences.

It is time to explore the concept of big data in education, focusing on its impact, benefits, challenges, and future prospects. It is time to investigate the significant role of big data which plays in optimizing educational practices and nurturing personalized learning.

Our aim is to examine comprehensively the role of big data in education and its profound impact on teaching and learning. It will explore the significance of big data analytics in educational contexts, the benefits it brings to students and educators, the challenges it poses, and the future trends that are likely to shape the educational landscape. We will consider a few case studies and examples, which will demonstrate how big data can revolutionize education by enhancing data-driven decision-making, customizing learning experiences, and ultimately improving student learning outcomes.

The Significance of Big Data in 21st Century Education:

Big data has emerged as a transformative force in education. Big Data is bringing a multitude of advantages that are reshaping the educational landscape.

It is observable that big data enables educators and institutions to gain extraordinary insights into student performance and behavior. Big Data in 21st century education provides a comprehensive view of student progress, from academic achievements to engagement patterns. It allows educators to identify learning gaps and modify instruction accordingly. Big data becomes instrumental in fostering personalized learning experiences, where each student's unique needs and preferences are considered, ultimately enhancing their comprehension and retention of knowledge.



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We believe that big data promotes data-driven decision-making in education. We witnessed a paradigm shift that has gained prominence in recent years. Educators and administrators can employ data analytics to make informed choices regarding curriculum design, resource allocation, and educational policies. We see that data-driven approach minimizes guesswork and maximizes efficiency, and indeed, it leads to better outcomes for both students and institutions.

In fact, big data facilitates early intervention strategies. It can detect signs of academic struggle or disengagement in real-time. Teachers can provide timely support and interventions to prevent students from falling behind. This proactive approach significantly improves the chances of student success, since it addresses issues before they escalate.

21st century education system is well-known of big data's significance in education. It lies in its ability to empower teachers with data-driven insights, personalize learning experiences, enhance decision-making, and promotes early intervention strategies. The 21st century educational landscape continues to evolve. Undoubtedly, big data will play an increasingly vital role in ensuring that students receive the personalized support they need to excel in their learning journeys.

Benefits of Big Data in 21st Century Education System:

The integration of big data in education brings forth an innumerable benefit that revolutionize teaching and learning. We will explain several advantages, focusing on improved student outcomes, personalized learning, and resource optimization, accompanied by illustrative examples.

Five Essential Benefits of Big Data in 21st Century Education System:

1. Improved Student Outcomes:

Big data analytics have the potential to substantially enhance student outcomes. Educators can gain insights into individual and collective student performance i.e. they can identify struggling students early in the academic year, allowing for timely intervention. This proactive approach can result in improved grades, higher graduation rates, and decreased dropout rates.

Example: An educational institution implemented predictive analytics using big data to identify students at risk of dropping out. By offering targeted support to these students, they witnessed a 15% increase in graduation rates over a three-year period.



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2. Personalized Learning:

Big data enables personalized learning experiences personalized to each student's needs, preferences, and learning pace. Learning analytics can track a student's progress in real-time, suggesting customized content and interventions. This adaptability fosters deeper engagement and comprehension.

Example: Adaptive learning platforms, such as Khan Academy, employ big data analytics to provide students with exercises and tutorials based on their proficiency levels. Students can progress at their own pace, resulting in improved retention and mastery of subjects.

3. Resource Optimization:

Educational institutions can optimize their resources through big data analytics. This involves efficient allocation of funds, faculty, and infrastructure. Data-driven decisions can lead to cost savings and better utilization of available resources.

Example: Schools can utilise big data to optimize school bus routes. By analyzing traffic patterns and student addresses, they reduced transportation costs by 20%, allowing funds to be reallocated towards educational programs.

4. Curriculum Enhancement:

Big data helps in curriculum design and enhancement. We can analyse student performance data and feedback. Teachers can make informed decisions about curriculum revisions, and s/he can ensure that it remains relevant and effective.

Example: A school used big data to assess student feedback and course evaluations. This data-driven approach led to the restructuring of certain courses, resulting in improved student satisfaction and learning outcomes.

5. Predictive Analytics:

Big data allows institutions to forecast future trends in education. Big data enables institutions to prepare for changing student needs and labor market demands. Predictive analytics can inform decisions about program offerings and career guidance.

Example: An institution used predictive analytics to identify the most in-demand career fields over the next decade. The institutions expanded their programs in those areas, ensuring their graduates were well-prepared for future job opportunities.

The benefits of big data in education are multifaceted. They encompass improved student outcomes through early intervention, personalized learning experiences, efficient resource allocation, curriculum enhancement, and predictive analytics. These advantages emphasize the transformative potential of big data in shaping the future of 21st century education.



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Challenges and Concerns in Big Data in Education:

Big data holds immense promise in education, its adoption is not without its share of challenges and concerns. We need to think seriously and concretely of its ethical and privacy concerns associated with collecting and using student data, as well as explore potential challenges in implementing big data analytics in educational institutions.

1. Ethical and Privacy Concerns:

a. **Data Privacy:** One of the primary concerns is data privacy. Educational institutions collect and store big amount of students' data, however collecting and storing vast amounts of student data raises questions about who has access to this information and how it is protected. Certain places it is observed that unauthorized access or data breaches can compromise sensitive student information.

b. **Informed Consent:** There is often ambiguity regarding informed consent, especially when collecting data from minors. Students and parents may not fully understand how their data will be used, leading to ethical dilemmas.

c. **Algorithmic Bias:** The algorithms used in big data analytics can unintentionally perpetuate biases. For example, if historical data contains biases, the algorithms may make biased recommendations, affecting fairness and equity in education.

2. Implementation Challenges:

a. **Infrastructure and Resources:** Implementing big data analytics requires significant infrastructure and resources. Many educational institutions, especially smaller ones, may lack the necessary technology, skilled personnel, and budget.

b. **Data Quality:** Ensuring the quality of data is a persistent challenge. Generally, inaccurate or incomplete data can lead to flawed analyses and ineffective decision-making.

c. **Resistance to Change:** Resistance to adopting data-driven decision-making culture is common among educators and administrators. Traditional teaching methods may clash with data-driven approaches.

d. **Security Measures:** Safeguarding student data from cyber threats is a constant concern. Educational institutions must invest in strong cybersecurity measures to protect sensitive information.

3. Educational Equity:

a. **Access Disparities:** Not all students have equal access to technology or the internet. Big data analytics may inadvertently exacerbate educational inequities if some students are left behind due to lack of access.

b. **Privacy and Vulnerable Populations:** Students with disabilities or other vulnerable populations may face unique privacy challenges. Collecting data about these students by the educational institutions must be done sensitively and ethically.

4. Regulatory Compliance:

a. **Compliance with Laws:** Navigating the complex landscape of data privacy laws, such as the Family Educational Rights and Privacy Act (FERPA) in the United States, Bharat



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Digital Personal Data Protection Act, 2023, and 'Protection of Children Against Sexual Offences Bill (POCSO), Bharat can be challenging for educational institutions.

5. Overemphasis on Data:

a. **Reduced Focus on Holistic Education:** Since we are handling human being, it has its own nature. There is a risk of overemphasizing data and standardized testing, which may narrow the educational experience and fail to capture the full spectrum of students' abilities and potential.

In fact, big data analytics holds great potential to transform education, it must be approached with sensitivity to ethical and privacy concerns of different stakeholders. Our major challenging tasks i.e. overcoming implementation challenges, ensuring data quality, and addressing issues of equity and regulatory compliance are crucial for the responsible and effective use of big data in education. School administrator, institutional leaders and higher management need to think critically and creatively in balancing the benefits of data-driven decision-making with these concerns is essential for the continued advancement of education through big data analytics.

Case Studies and Examples of Big Data in Education:

Real-life case studies and examples vividly illustrate how educational institutions have harnessed big data to enhance teaching and learning.

We will discuss some of noteworthy examples along with the specific strategies and outcomes achieved.

1. Georgia State University's Student Advising Success:

- **Strategy:** Georgia State University implemented a proactive advising system that uses predictive analytics to identify students at risk of dropping out or facing academic challenges.
- **Outcomes:** Over six years, the university increased its graduation rate by 23 percentage points. The system has also helped close achievement gaps among various student demographics, ensuring more equitable educational outcomes.

2. Summit Public Schools' Personalized Learning Platform:

- **Strategy:** Summit Public Schools, a charter school network, developed a personalized learning platform that uses big data to provide customized learning paths for each student.
- **Outcomes:** Students using this platform have shown significant academic gains. Summit Public Schools' success has inspired other educational institutions to explore similar approaches.



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3. Rio Salado College's Adaptive Learning System:

- **Strategy:** Rio Salado College implemented adaptive learning technology powered by big data to personalize course content and assignments.
- **Outcomes:** This approach resulted in a 12% increase in course completion rates. Students who used the adaptive learning system outperformed their peers who did not.

4. Purdue University's Course Signals:

- **Strategy:** Purdue University developed Course Signals, a system that predicts student success and identifies those who may need additional support.
- **Outcomes:** Students who received Course Signals interventions had a 21% higher course completion rate than those who did not. The system contributed to improved retention and graduation rates.

5. Arizona State University's eAdvisor:

- **Strategy:** Arizona State University introduced eAdvisor, an early alert system that uses data to identify students who may struggle academically.
- **Outcomes:** The university experienced a 10% increase in the six-year graduation rate and significantly improved retention rates. The system also helped reduce the time to degree completion.

6. Khan Academy's Data-Driven Insights:

- **Strategy:** Khan Academy, a prominent online education platform, employs big data analytics to gain insights into student learning behaviors.
- **Outcomes:** By analyzing user data, Khan Academy continuously refines its content and learning pathways, resulting in more effective educational resources that cater to individual student needs.

7. Bharti Foundation's Satya Bharti Quality Support Program (SBQSP) (India):

- **Strategy:** The Bharti Foundation, in collaboration with the government of Rajasthan, launched the SBQSP, which uses big data analytics to monitor and improve the quality of education in government schools. It collects data on student attendance, teacher performance, and classroom activities.
- **Outcomes:** As a result of the program's data-driven interventions, there has been a noticeable improvement in student attendance, teacher engagement, and learning outcomes in Rajasthan's government schools.

8. Educational Initiatives' ASSET (India):

- **Strategy:** Educational Initiatives developed the ASSET (Assessment of Scholastic Skills through Educational Testing) program, which leverages big data to assess and enhance students' critical thinking and problem-solving abilities.
- **Outcomes:** ASSET has provided valuable insights into students' strengths and weaknesses. Schools using ASSET have seen improved academic performance and a focus on holistic development beyond traditional exams.



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9. Sri Lanka's Open University's Learning Analytics (Sri Lanka):

- **Strategy:** Sri Lanka's Open University implemented a learning analytics system to track student progress and engagement in online courses. It collects data on how students interact with course materials and identifies students who may be struggling.
- **Outcomes:** The institution has been able to provide timely support to at-risk students, resulting in improved course completion rates and a more inclusive learning environment.

10. i-Saksham's EdTech Platform (India):

- **Strategy:** i-Saksham, an Indian EdTech startup, utilizes big data to offer personalized learning experiences to students in underserved areas. It tracks student performance and adapts content accordingly.
- **Outcomes:** i-Saksham has helped bridge the digital divide and improve access to quality education in rural India. Students using the platform have shown significant improvements in their academic skills.

Educational institutions have used predictive analytics, personalized learning platforms, and early alert systems to enhance student success rates, narrow achievement gaps, and create more inclusive and effective learning environments. These examples underscore the transformative potential of big data in education and serve as models for others seeking to embrace data-driven approaches to education.

Future Trends and Prospects in Big Data in Education:

The future of big data in education is marked by promising trends and technologies that have the potential to revolutionize the learning landscape. Big data is transforming education, enabling personalized learning, predictive analytics, adaptive learning, and immersive learning experiences. It is also improving educational research, administration, and policy. In the future, big data will play an even greater role in education, helping to create a more equitable and effective system for all students.

Emerging trends and predict how big data might further transform education in the coming years.

1. Artificial Intelligence (AI) and Machine Learning Integration:

- AI and machine learning will play a pivotal role in analyzing vast datasets and providing real-time insights. Adaptive learning systems, chatbots for student support, and personalized content recommendations will become more sophisticated.

2. Predictive Analytics for Student Success

Educational institutions will increasingly rely on predictive analytics models to identify students at risk of academic challenges. These models will become more accurate, allowing for timely interventions and tailored support to improve student success rates.

3. Learning Analytics Dashboards:

- Learning analytics dashboards will become standard in educational institutions, providing teachers and students with intuitive tools to monitor progress, set goals, and make data-driven decisions about their learning paths.

4. Gamification and Engagement Analysis:

- Gamification elements will be integrated into educational platforms to enhance student engagement. Big data will be used to analyze how gamified content impacts learning outcomes and motivation.

5. Personalized Learning Pathways:

- Personalized learning will become more refined, with big data tailoring content, assessments, and pacing to each student's unique needs and preferences. This will foster greater student autonomy and self-directed learning.

6. Ethical Data Use and Privacy Protection:

- As data collection expands, there will be a growing focus on ethical data use and privacy protection. Educational institutions will need to implement robust data governance policies and comply with stringent data privacy regulations.

7. Virtual and Augmented Reality Integration:

- Virtual and augmented reality technologies will leverage big data to create immersive learning experiences. These technologies will allow students to explore complex subjects in depth and visualize abstract concepts.

8. Lifelong Learning and Credentialing:

- Big data will enable the recognition of informal and lifelong learning achievements. Digital badges and micro-credentials will gain prominence, providing individuals with more flexible and diverse pathways to skill development and employment.

9. Global Collaboration and Data Sharing:

- Educational institutions and organizations worldwide will increasingly collaborate and share educational data. This will lead to cross-cultural insights and the development of global best practices.

10. Continuous Professional Development for Educators:

- Educators will undergo continuous professional development in data literacy and data-driven teaching methods. This will empower them to make informed decisions and adapt to evolving educational technologies.



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Some specific examples of how big data is being used in education today:

- **Schools are using big data to identify students who are at risk of dropping out and provide them with additional support.**
- **Teachers are using big data to track student progress and identify areas where they need extra help.**
- **Curriculum developers are using big data to create more effective and engaging learning materials.**
- **Educational researchers are using big data to study the best teaching practices and to identify factors that contribute to student success.**

In the 21st century educational arena, big data will continue to reshape education by offering personalized learning experiences, enhancing student success rates, and providing valuable insights for educators and policymakers. These emerging trends and technologies promise a more adaptive, efficient, and equitable education system that prepares learners for the challenges of the future. We believe that the future of big data in education is bright. Big data has the potential to revolutionize the way we teach and learn, and to make education more accessible and effective for all students.

"Big Data and its Impact on Teaching and Learning"

Big data has emerged as a powerful tool that is reshaping education in profound ways. Its significance lies in its ability to provide valuable insights into student performance, facilitate personalized learning experiences, and drive data-driven decision-making in educational institutions.

One of the primary advantages of big data in education is its potential to improve student outcomes significantly. Through early intervention strategies and personalized learning pathways, educators can identify and address learning gaps, resulting in higher graduation rates, improved grades, and reduced dropout rates.

Personalized learning, enabled by big data analytics, is another critical aspect. It tailors educational content to individual student needs, ensuring a more engaging and effective learning experience. This adaptability fosters deeper engagement, better comprehension, and increased knowledge retention.

Resource optimization with the help of big data is another noteworthy benefit. Educational institutions can efficiently allocate their resources, from budgeting to faculty allocation, using data-driven insights. This enhances the overall efficiency of the education system, ensuring that resources are utilized optimally.



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Challenges and concerns exist, particularly in the realms of data privacy, ethical considerations, and equity. Protecting student data and addressing algorithmic biases are crucial to responsible big data use in education.

We tried to highlight some of real-life case studies and examples from, Western World, South Asia and India, showcasing successful implementations of big data in education. These examples demonstrated the transformative power of data-driven decision-making, personalized learning, and improved student outcomes.

Big data's importance in education cannot be overstated. It is a driving force that is reshaping the future of education. Educational institutions can provide personalized learning experiences, improve student learning outcomes, and make informed decisions that optimize resources and enhance teaching methods. We look forward to reflect on responsible data use and ethical considerations for safeguarding student privacy and equity in education. It is time to embrace emerging trends and technologies shaping the future of education, making it more inclusive, effective, and adaptive to the needs of students worldwide.

Key Terms and Topic for Understanding:-The Role of Learning Analytics in Personalized Learning, Using Learning Analytics in Personalized Learning, Get Personalized Learning with Learning Analytics, Learning Analytics In eLearning and Their Importance, Designing Personalized Learning Environments, learning analytics in personalised learning environment, What is Learning Analytics, The Role of Big Data Analytics in Personalised Learning, What is the role of personalized learning, How learning analytics can make your teaching more effective, What are the 7 principles of personalized learning, What is the purpose of learning analytics, What is the key advantage of analytics, Personalized Learning, **Data Analytics in School Education, Data Analytics,**

Grow Together Glow Together

Regards

Rajeev Ranjan

School Education

“Let knowledge grow from more to more.”

Alfred Tennyson, “In Memoriam”, Prologue, line 25

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Love to Think

One of the things we have to tackle if we want to democratize education, is we have to put an emphasis on making sure that anybody who can and wants to, can connect to some sort website.

— Hadi Partovi Founder and Chief Executive Officer, Code.org

“

AI can create a more equitable society if used right.. Reskilling is the most important part of this.

”

— Mihir Shukla, Co-Founder and Chief Executive Officer, Automation Anywhere, Inc.

There is always a wave of concern and fear about job loss and whether or not there will be mass unemployment. In fact, unemployment is at a record low right now.

What AI is doing is changing the way that we do work. One thing we are looking at Stanford is keeping humans in the loop.

”

— Erik Brynjolfsson, Jerry Yang and Akiko Yamazaki Professor; Director, Digital Economy Lab, Stanford University