

Leveraging Educational Data Mining to Enhance the Quality of Higher Education in India in Alignment with NEP 2020

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Abstract - India has a complex and evolving system of education policies and regulations. Education is primarily a state subject in India, meaning that each state and union territory has significant autonomy in formulating and implementing its education policies. However, there are also overarching national policies and initiatives that guide and influence education across the country. NEP 2020 is one of the most significant education policy reforms in India in recent years. It aims to transform the education system at all levels, from school to higher education. The National Education Policy (NEP)- 2020, 3rd Post independence policy focusing on Indian Education System, aims to reform the present education system in India and creating an education framework & eco-system which is career oriented, futuristic, globally competitive and meaningful. Being the first National Policy of Education in the 21st century, the NEP 2020 is the third after independence. It was preceded by the first – framed in 1968 (which was primarily influenced by the progressive Kothari commission of 1964-66) and second - 1986 (which was revised in 1992). The NEP-2020 [1] aims at ways & means to recuperate the ailing school system of India through concerted and targeted measures that will improve both quality and growth. Most importantly, the NEP-2020 policy document foresees a transforming from an inputs-based approach to an outcomes-based approach; however, the recommendations on this front are mainly directions and a lot will depend on how the stakeholders and government chooses to implement them. It is true that the Policies proposes remarkable job at aiming on some obvious paucities in Indian schooling system, however it lacks certain important factors to address the issues of the private sector in India, which is a very important contributor in providing quality education in rural and urban parts at a reasonable cost. Thus, without the involvement of private sector, the objectives of NEP 2020 would be difficult to achieve. If we, as a country, wish to establish India as a knowledge hub of the world and foresee ourselves as a superpower, it is required to encourage, support and nurture with constructive engagement with private player for investment in education. Further a proper planning, assessment of capabilities and a careful mapping to analyse and understand the student's competence level, available job options and mapping with student's potential to identify the skill competence gap is very importance as it will help in targeted and focused training and skill development. This would require adoption of technology and appropriate tools that can help this effectively and efficiently with high degree of correctness by making timely and accurate prediction. The Data Mining tools and its analysis by applying AI/ ML based algorithms could be of immense help in this process. To see it in reality on ground it is also very important to create a positive and favorable ecosystem where they are encouraged to participate and can flourish & improve the educational standards of India. This research paper explores the symbiotic relationship between NEP 2020, EDM, and the pursuit of higher education quality in India.

Keywords – Watermarking, Haar Wavelet, DWT, PSNR

I. NEP & EDUCATIONAL DATA MINING

The National Education Policy (NEP) 2020 in India has ushered in a transformative era for higher education, emphasizing quality, innovation, and global competitiveness. This visionary policy aims to revamp the country's educational landscape, emphasizing holistic development, flexibility, and quality. Achieving these ambitious goals requires innovative solutions, and one such powerful tool is Data Mining, particularly in the context of education, known as Educational Data Mining (EDM). Ensuring and enhancing the quality of higher education is a central objective of NEP 2020, and this research paper explores how Educational Data Mining (EDM) can play a pivotal role in achieving this goal. EDM, through data-driven insights and interventions, can assist in monitoring, evaluating, and continuously improving the quality of higher education in India. This paper presents an overview of NEP 2020, discusses the role of EDM in higher education quality assurance, explores case studies, identifies challenges, and suggests future directions for integrating EDM into the higher education landscape in India.

The National Education Policy 2020 (NEP 2020) marks a significant milestone in India's education sector. Among its myriad objectives, ensuring the quality of higher education emerges as a paramount concern. NEP 2020 envisions a higher education ecosystem characterized by excellence, innovation, and global competitiveness. Achieving these goals necessitates a data-driven approach, and Educational Data Mining (EDM) holds tremendous promise in this endeavor.

II. THE NEP 2020: A GLIMPSE

The National Education Policy (NEP) 2020 introduced by the Government of India is a visionary document that seeks to transform the education system to meet the demands of the 21st century. The policy envisions a holistic approach to education that focuses on foundational learning, critical thinking, creativity, and inclusivity. Achieving these goals requires a data-driven approach, and Educational Data Mining (EDM) offers a promising avenue to harness educational data for informed decision-making. Before delving into the role of Data Mining, let's briefly recap the core objectives of NEP 2020:

- Universal Access to Quality Education: Ensuring equitable and inclusive education for all, regardless of background or location.
- Early Childhood Care and Education: Focusing on the crucial early years of a child's development.
- Foundational Literacy and Numeracy: Prioritizing basic skills in reading and mathematics.
- Curriculum and Pedagogy Reforms: Reimagining the curriculum to promote critical thinking, creativity, and experiential learning.
- Vocational Education and Skill Development: Preparing students for the demands of the 21st-century job market.
- Teacher Training and Professional Development: Empowering educators with the latest teaching methodologies and practices.
- Equity and Inclusion: Ensuring that no student is left behind, irrespective of their background.
- Use of Technology in Education: Leveraging technology to enhance learning outcomes and access.

III. DATA MINING AND ITS APPLICATIONS

Data mining is a process of discovering patterns, trends, associations, or useful information from large volumes of data. It involves the use of various techniques and algorithms to extract meaningful insights and knowledge from datasets. Data mining is employed in diverse fields, including business, healthcare, finance, marketing, and science, to help organizations make data-driven decisions. Here are some key aspects of data mining include Data Collection, Data Pre-processing, Exploratory Data Analysis (EDA), Data Mining Techniques: Classification, Regression, Clustering, Association Rule Mining, Anomaly Detection, Text Mining, Time Series Analysis, Model Building, Evaluation, Deployment, Interpretability, Data Privacy and Ethics, Continuous Improvement and Domain Knowledge). [8,9]

Data mining is a powerful technique for extracting knowledge and insights from data, which can be used to inform decision-making, solve complex problems, and gain a competitive advantage in various domains. It plays a critical role in today's data-driven world, where organizations leverage data to make informed choices and optimize their operations.

IV. EDUCATIONAL DATA MINING (EDM)

Educational data mining refers to techniques, tools, and research designed for automatically extracting meaning from large repositories of data generated by or related to people's learning activities in educational settings. Quite often, this data is extensive, fine-grained, and precise [8]. For example, several learning management systems (LMSs) track information such as when each student accessed each learning object, how many times they accessed it, and how many minutes the learning object was displayed on the user's computer screen.

Education Data Mining (EDM) is a subfield of data mining that focuses specifically on the application of data mining and machine learning techniques to educational data. It involves the collection, analysis, and interpretation of large volumes of data generated within educational settings to gain insights into various aspects of the education process.[7] EDM aims to improve educational practices, enhance student learning outcomes, and inform educational decision-making through data-driven approaches. Some of the key aspects of Education Data Mining include - Data Sources, Data Pre-processing, Data Analysis Techniques, Predictive Analytics, Personalized Learning, Recommendation Systems and Learning Analytics. The EDM with these features can immensely help in Research in Education, Institutional Decision-Making.

The Ethical Considerations are critical in EDM, particularly when dealing with sensitive educational data. Privacy, data security, and responsible data use are paramount concerns. The EDM fosters a culture of continuous improvement in education by encouraging data-driven decision-making and ongoing assessment and refinement of educational practices.

If we look at EDM from holistic perspective, Education Data Mining is a multidisciplinary field that leverages data and analytics to gain insights into the educational process, improve teaching and learning outcomes, and inform evidence-based decision-making in education. It has the potential to positively impact the quality and effectiveness of education at all levels, from K-12 to higher education and beyond. In fact Data Mining (EDM) is a specialized field that focuses on the application of data mining techniques and methods to educational data. It involves the collection, analysis, and interpretation of data generated in educational settings to gain insights into various aspects of education, such as student learning, teaching methods, and educational system effectiveness. EDM aims to improve educational processes and outcomes through data-driven decision-making and research.

V. EDUCATIONAL DATA MINING AND NEP (NATIONAL EDUCATION POLICY) 2020

The educational data mining focuses on the development techniques for exploring the special types of data that originate from an educational context. These data originate from various sources, including data from the traditional face-to-face classroom environment, online courseware, educational software, etc.

Quality assurance is an integral aspect of higher education, and NEP 2020 underscores the need for rigorous assessment and continuous improvement. The policy advocates for a multidimensional approach to quality, emphasizing holistic development, research, and employability. Educational Data Mining (EDM) involves the application of data mining techniques to educational data. EDM enables institutions to gather, process, and analyze a wealth of data generated within educational settings, including student performance data, engagement patterns, and course outcomes. Data Mining, particularly Educational Data Mining, involves extracting valuable insights and patterns from educational data. It's about using data analytics to inform educational decisions. [1,7]

The National Education Policy 2020 represents a significant step forward in reimagining education in India. To achieve its ambitious goals of personalized learning, early intervention, curriculum development, teacher empowerment, inclusivity, and evidence-based policy decisions, it is imperative to leverage data-driven approaches. Educational Data Mining stands as a powerful tool in this endeavor, offering the potential to harness educational

data for informed decision-making. By integrating EDM into educational practices, institutions can contribute to the realization of NEP 2020's vision for a modern and inclusive education system in India. Institutional and policy-level decisions can be data-driven. EDM can provide valuable insights to policymakers, helping them assess the impact of educational initiatives and reforms.

VI. NEP OBJECTIVES AND POTENTIAL CONTRIBUTION OF EDUCATIONAL DATA MINING IN ACHIEVING THESE GOALS

The National Education Policy (NEP) 2020 introduced by the Government of India is a visionary document that seeks to transform the education system to meet the demands of the 21st century. The policy envisions a holistic approach to education that focuses on foundational learning, critical thinking, creativity, and inclusivity. Achieving these goals requires a data-driven approach, and Educational Data Mining (EDM) offers a promising avenue to harness educational data for informed decision-making. [6]

In fact, the National Education Policy (NEP) 2020 in India heralds a transformational era in higher education, emphasizing quality, relevance, and global competitiveness. Ensuring and enhancing the quality of higher education is at the heart of NEP 2020's vision[1,5]. This research paper explores the role of Educational Data Mining (EDM) in achieving the quality assurance objectives of NEP 2020 in the Indian higher education landscape. By harnessing EDM's power to analyze data and uncover insights, educational institutions can optimize teaching and learning, personalize education, ensure equity, and continuously improve quality, all while aligning with NEP 2020's guiding principles.

VII. EDUCATIONAL DATA MINING AND QUALITY OF HIGHER EDUCATION

Educational Data Mining (EDM) can play a crucial role in improving the quality of higher education and in achieving the goals of the National Education Policy (NEP) 2020 in India by providing insights and actionable information from educational data. by providing valuable insights and data-driven solutions to various aspects of the educational process [10]. It can play a significant role [2,3] Here are several ways in which data mining can help in the education sector to align with the objectives of NEP 2020, some of which may include, to enhancing the quality of higher education:

Personalized Learning: One of the cornerstones of NEP 2020 is personalized learning. Each student is unique, and Data Mining can help educators tailor learning experiences to individual needs. EDM can analyze students' past performance, learning preferences, learning behaviors and performance to create personalized learning pathways. This customization can help students achieve better learning outcomes by addressing their individual strengths and weaknesses. This aligns with NEP 2020's emphasis on a flexible and student-centric approach to education.

Early Intervention:

NEP 2020 places a strong emphasis on early intervention to ensure foundational literacy and numeracy. EDM can provide early warning systems that identify students at risk of falling behind academically. By analyzing data related to student performance and engagement, institutions can intervene in a timely manner to provide the necessary support and guidance. [1, 4]

Early identification of students who may be struggling is crucial for preventing dropouts and ensuring foundational literacy and numeracy. Data Mining can provide early warning systems that flag at-risk students based on their performance and engagement metrics, enabling timely interventions. Early warning systems can trigger timely interventions, such as academic advising or tutoring, to improve student retention and success rates. This allows educators to intervene early and provide necessary support, which is in line with NEP 2020's focus on foundational literacy and numeracy.

Curriculum Improvement: EDM can provide insights into the effectiveness and identify areas where improvements are needed of different courses and modules. Institutions can use this information to refine their curriculum, update course materials, and align them with industry trends and demands. This can help

in aligning curriculum with NEP 2020's multidisciplinary approach and focus on critical thinking and problem-solving.

Teaching Methodology: Analyzing student engagement and performance data can help educators assess the effectiveness of their teaching methods. They can then adapt their approaches to meet the diverse learning needs of students.

Resource Allocation: Educational institutions can optimize resource allocation based on data insights. This includes assigning faculty, classrooms, and technology resources more efficiently, leading to cost savings and improved resource utilization. Institutions can use data mining to optimize the allocation of resources, including teachers, classrooms, and teaching materials, to ensure equitable access to quality education, which is one of the NEP 2020 goals.

Quality Assurance: EDM can help institutions assess and maintain the quality of education by monitoring key indicators such as course completion rates, student satisfaction, and learning outcomes [5].

Program Evaluation: Institutions can evaluate the effectiveness of their academic programs by analyzing student performance and feedback data. This can inform decisions about program modifications and enhancements. Data mining can improve assessment methods by identifying patterns in student performance and suggesting changes to assessments to make them more meaningful and aligned with NEP 2020's emphasis on holistic development.

Teacher Training: Analyzing data on teacher performance and student outcomes can identify areas where teacher training is needed. NEP 2020 emphasizes continuous professional development for educators. For effective implementation of NEP 2020, teachers play a central role. EDM can aid in teacher empowerment by identifying areas where professional development is needed. By analyzing student data and assessing teaching methodologies, institutions can offer targeted training programs to enhance teacher effectiveness. For teachers to deliver high-quality education, they need continuous professional development. EDM can identify areas where teacher training is needed, guiding targeted professional development programs.

Graduate Outcomes: EDM can track the career trajectories of graduates, helping institutions assess the long-term impact of their education on students' employability and success in the workforce.

Research and Innovation: Researchers can use EDM to conduct studies on various aspects of higher education, leading to innovations in teaching and learning practices.

Technology Integration: Leveraging technology for education is vital. EDM can track the impact of technology on learning outcomes, helping institutions make informed decisions about tech integration.

Evidence-Based Policy: Data Mining isn't limited to the classroom; it extends to the policy level. EDM can provide valuable insights to policymakers by offering evidence-based assessments of educational initiatives and reforms. By analyzing data on program outcomes and impact, policymakers can make informed decisions to shape the education landscape.

Accreditation and Compliance: Educational institutions can use EDM to demonstrate compliance with accreditation standards by providing evidence of educational quality and continuous improvement efforts.

Data-Driven Decision-Making: Administrators and policymakers can make informed decisions based on data analysis. This includes decisions related to budget allocation, faculty hiring, and strategic planning. EDM can help policymakers evaluate the effectiveness of different educational policies and initiatives introduced under NEP 2020. This allows for data-driven decision-making and adjustments to policies based on real outcomes.

Parental Engagement: Data mining can provide insights to engage parents in their children's education by sharing information about their child's progress and suggesting ways they can support their learning at home.

Identifying Talent: Data mining can help identify talented students in various domains, aligning with NEP 2020's focus on nurturing and promoting excellence.

Language and Cultural Diversity: Data mining can assist in tailoring educational content and resources to diverse linguistic and cultural backgrounds, ensuring inclusivity as per NEP 2020's objectives.

Continuous Improvement & Evidence-Based Policy: EDM fosters a culture of continuous improvement in higher education institutions. Regular analysis of data encourages institutions to adapt and evolve their practices to meet the evolving needs of students and society. EDM supports a culture of continuous improvement by providing data-driven insights into educational processes and outcomes. Policymakers can use EDM to make informed decisions about resource allocation and policy formulation.

Efficiency and Cost Reduction: By identifying areas where resources are underutilized or where operational inefficiencies exist, EDM can help institutions reduce costs while maintaining or improving educational quality.

Inclusivity: Data analysis can reveal disparities in educational outcomes among different student populations. This information can guide efforts to enhance equity and inclusivity in higher education. NEP 2020 emphasizes inclusivity and equity in education. EDM can help track and address disparities in educational outcomes among different student groups. By analyzing demographic data and performance metrics, institutions can develop strategies to bridge these gaps and ensure that all students have equal access to quality education.

Data Mining can help track educational disparities and ensure that NEP's goal of inclusivity is met. By analyzing demographic data, it can provide insights into the challenges faced by different student groups and inform policies to bridge these gaps.

Thus Educational Data Mining has the potential to enhance the quality of higher education by providing actionable insights and promoting evidence-based decision-making [10]. When used responsibly and ethically, EDM can help institutions and educators continuously improve the educational experience for students and meet the goals of providing high-quality, accessible, and effective higher education. [6,7]

Educational Data mining can be a valuable tool for education stakeholders to make informed decisions, improve the quality of education, and align with the goals and principles of NEP 2020. However, it's crucial to ensure data privacy and ethical considerations when implementing data mining practices in the education sector.

VIII. CONCLUSION

The National Education Policy 2020 has set the stage for a new era in Indian education, aiming for quality, inclusivity, and innovation. Data Mining, through Educational Data Mining, is the beacon that can illuminate the path to realizing these goals. By leveraging data analytics, educational institutions can create personalized learning experiences, ensure early intervention, enhance curricula, empower educators, and bridge gaps in access and quality. Data Mining isn't just a tool; it's the key to unlocking India's educational potential and achieving the vision set forth in NEP 2020.

The National Education Policy 2020 envisions a higher education landscape characterized by quality, equity, and global competitiveness. Educational Data Mining (EDM) emerges as a powerful tool to help institutions in India achieve these goals by harnessing data-driven insights to enhance teaching and learning, ensure personalized education, promote equity, and drive continuous improvement. By embracing EDM, higher education institutions in India can align with the guiding principles of NEP 2020 and contribute to a brighter future for education in the country.

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