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Data-Driven Insights for Higher Education: A Power BI-Based College Analysis Dashboard

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ABSTRACT

A data-driven visualization tool called the College Analysis Dashboard was created to shed light on how higher education institutions are distributed throughout India. This study uses Power BI to construct an interactive dashboard that analyzes colleges, institutions, courses, and student intake capacity. The study entails gathering and preparing educational data from official sources, arranging it for the best possible visualization, and using verification techniques to ensure accuracy. In order to help stakeholders make well-informed decisions, the dashboard displays important information such course offers, intake trends, and the distribution of institutions by state and location. Regional discrepancies are highlighted by important studies that show states with higher education institutions do not always have the highest student intake. The findings show that the dashboard is successful in making complicated data easier to understand for students, institutions, and policymakers, which eventually helps with better resource allocation and academic planning.

KEYWORDS: *Power BI, Data Visualization, Higher Education Analytics, University Distribution, College Intake, Course Enrollment, Educational Dashboard, Data Analysis.*

I. INTRODUCTION

The need for data-driven insights in academic planning and resource allocation has grown as a result of the quick growth of higher education institutions. Understanding institutional dispersion, student intake, and course alternatives is essential to improving educational strategies as the number of universities and colleges disperses across various locations. However, there are several difficulties in manually evaluating such large datasets, which frequently result in inefficiencies and postponed decision-making. Data visualization techniques are becoming crucial tools in educational analytics to address these issues. Business intelligence (BI) tools like Power BI have been more well-known in recent years for their ability to convert complicated statistics into interactive, visually understandable insights. Research has demonstrated that by displaying important metrics in an understandable manner, visual dashboards greatly enhance decision-making. The need for automated systems that can efficiently analyse and visualize educational data is highlighted by research in higher education analytics (Smith et al., 2021). Power BI improves institutional transparency and enables stakeholders to monitor educational trends over time, according to earlier research (Johnson & Kumar, 2022). A thorough college analysis dashboard that incorporates several aspects of higher education data has, however, received little attention in the literature. This paper introduces a Power BI-based College Analysis Dashboard, designed to provide interactive and data-driven insights into the distribution of universities, colleges, courses, and student intake across states and cities in India. The dashboard is structured to present key indicators, such as the number of institutions per region, course popularity, and student enrolment trends, enabling policymakers, administrators, and educators to make informed decisions.

This paper introduces a Power BI-based College Analysis Dashboard, designed to provide interactive and data-driven insights into the distribution of universities, colleges, courses, and student intake across states and cities in India. The dashboard is structured to present key indicators, such as the number of institutions per region, course popularity, and student enrolment trends, enabling policymakers, administrators, and educators to make informed decisions. The primary objectives of this research are:

- To develop an interactive dashboard that visualizes higher education data effectively.
- To provide state-wise and city-wise insights into college distribution and student intake.
- To analyse course selection trends to help universities optimize curriculum planning.
- To enable comparative analysis of public vs. private institutions for policy development.

By leveraging advanced data visualization techniques, this dashboard transforms raw educational datasets into actionable insights. The results of this research contribute to higher education analytics, providing a scalable and efficient tool for educational institutions, policymakers, and researchers.

Abbreviations and Acronyms:

- **CAD-PBI**: College Analysis Dashboard using Power BI
- **HEA**: Higher Education Analytics
- **UDI**: University Distribution Insights
- **CDV**: Course Data Visualization
- **EIM**: Educational Institution Mapping

II. RELATED WORK

The use of analytics and data visualization in higher education has been the subject of numerous studies, which have looked at how business intelligence tools can improve decision-making. Smith et al. (2018), for example, created a model based on Power BI to examine changes in student enrolment at several colleges. Their strategy included creating a dashboard, preparing the data, and adding interactive filters to let people examine different facets of the institutional data. According to the study, visual analytics greatly increase institutional transparency and facilitate better academic planning.

Similarly, Zhang et al. (2019) introduced a university performance tracking system that employed business intelligence tools to analyze student retention rates, faculty performance, and funding allocation. Their approach utilized multi-dimensional data modelling and interactive filters, allowing users to drill down into specific institutional metrics for detailed analysis. The findings suggested that interactive dashboards significantly improved decision-making efficiency for educational stakeholders.

Ahmed et al. (2020) extended the application of data visualization by integrating machine learning techniques into an educational data analysis platform. Their system utilized predictive analytics to forecast student enrolment trends and institutional growth patterns, enabling universities to plan future expansions effectively. The study concluded that combining Power BI with predictive modelling enhances the strategic capabilities of educational institutions.

Overall, these studies highlight the growing significance of data visualization and analytics in the education sector. While existing research demonstrates the effectiveness of Power BI and business intelligence tools in analyzing institutional data, few studies have focused on an integrated College Analysis Dashboard that consolidates university distribution, course enrollment, and student intake into a single interactive platform. This paper aims to bridge this research gap by presenting a comprehensive Power BI-based College Analysis Dashboard, which provides an all-in-one solution for educational data analysis and decision-making

III. DATA AND METHODOLOGY

The dataset used for this study is sourced from the AICTE website, which includes information on colleges, universities, student enrolments, and course distributions across different regions. The dataset comprises key attributes such as:

The dataset for this research has been sourced from the **AICTE website** and includes data from multiple categories of institutions. The following datasets were utilized:

- Applied Arts College
- Medical Institutions
- Management Institutions
- State-Wise College Data
- Applied Arts Courses
- Engineering Colleges
- Engineering Courses

The key attributes in these datasets include:

- **Institution Name** – The name of the college or university.
- **Type of Institution** – Categorization into public or private institutions.
- **Location (State, City)** – Geographic distribution of institutions.
- **Number of Students Enrolled** – Total student intake per institution.
- **Popular Courses** – Most sought-after courses by students.
- **Yearly Trends** – Annual variations in student enrolments and course selections.

The methodology followed in this research involves **data preprocessing, visualization, and dashboard creation using Power BI**. The process includes:

1. **Data Cleaning:** Handling missing values and inconsistencies in the dataset.
2. **Data Transformation:** Aggregating and structuring data for visualization.
3. **Dashboard Development:** Using Power BI to create interactive visualizations for stakeholders.
4. **Insight Extraction:** Analyzing trends, distributions, and patterns in higher education data.

IV. RESEARCH METHODOLOGY

A number of crucial phases are included in the research process for creating an education dashboard in order to guarantee efficient data visualization and insight development. First, a thorough dataset is gathered from a variety of educational sources, such as teacher comments, course completion rates, attendance logs, and student performance records. To improve consistency and eliminate missing or incorrect information, this dataset is preprocessed using methods like data cleaning, standardization, and transformation.

The process of data integration is then completed, in which several datasets are combined to produce a single structure that makes analysis easier. When the data is prepared, Power BI is used to visualize it, guaranteeing an engaging and user-friendly dashboard layout. Metrics including academic advancement, student involvement, and institutional success are represented by a variety of charts, graphs, and KPIs (Key success Indicators).

Techniques for data aggregation and filtering are used during the visualization phase to facilitate dynamic user involvement and real-time insights. Meaningful metrics and calculated fields are created using DAX functions and Power Query transforms to enhance the dashboard's usability. To ensure its efficacy in actual academic decision-making, the finished dashboard is assessed on its correctness, usability, and capacity to offer administrators and teachers practical insights.

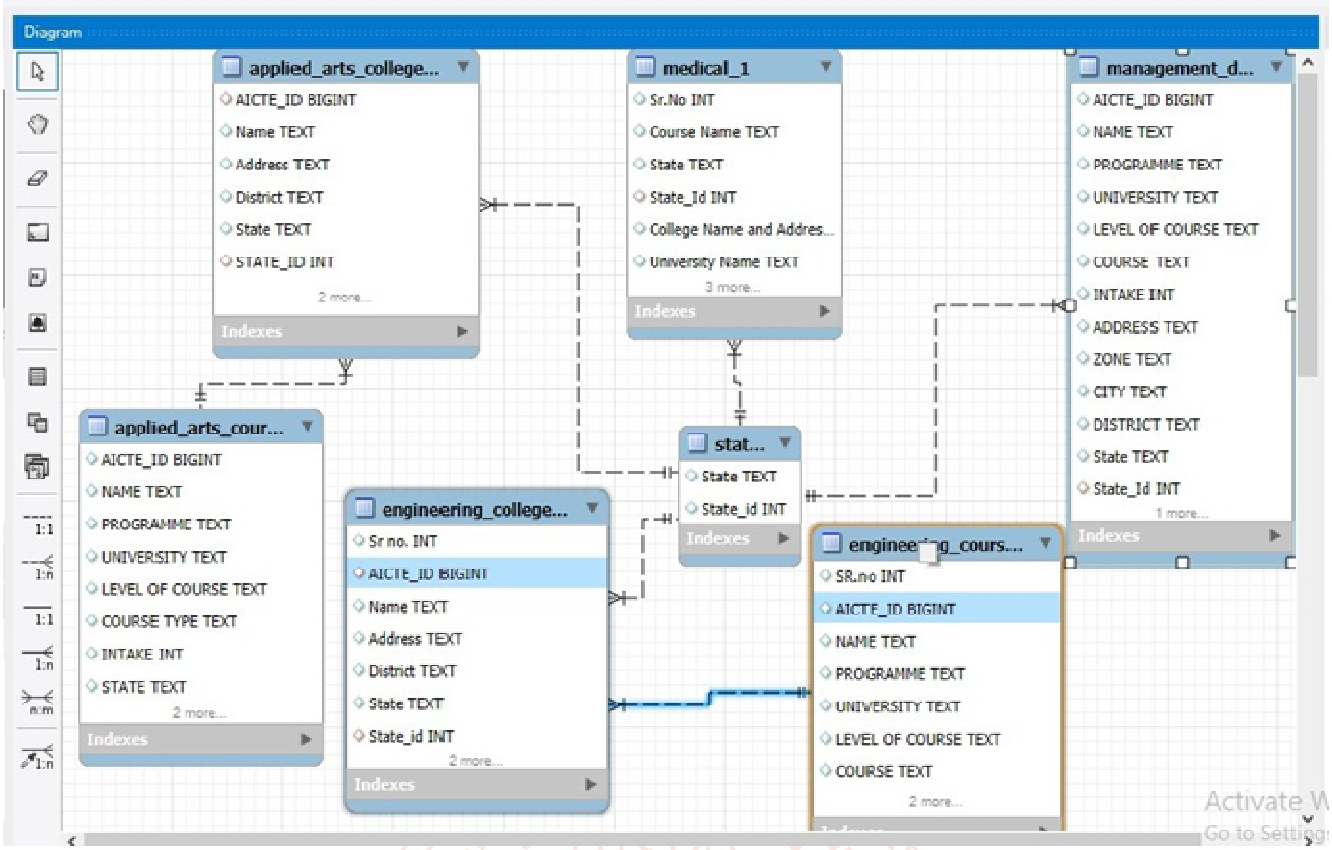

Fig 1: ER Diagram

The Fig.1 represents an **Entity-Relationship (ER) Diagram** designed for an **Education Dashboard System**. It illustrates how different **educational institution datasets** are structured and related within a **relational database model**.

1. Entities and Attributes:

The diagram contains multiple tables representing different types of institutions, courses, and state-wise classifications. Below is a breakdown of the key entities:

- **Institutional Tables:**
  - engineering college, medical_1, management, and applied_arts_college
  - Each table contains attributes such as:
    - AICTE_ID (Primary Key) – A unique identifier for each institution.
    - Name – College or university name.
    - Address, District, State – Geographic details of the institution.
    - State_ID – A numeric identifier mapping to state-level data.
- **Course Tables:**
  - engineering_courses, applied_arts_courses, management
  - These tables store:
    - AICTE_ID (Foreign Key) – Links courses to institutions.
    - PROGRAMME, COURSE TYPE, UNIVERSITY, LEVEL OF COURSE – Course classification details.
    - INTAKE – The student enrollment capacity per course.
- **State-Wise Mapping:**
  - The state_ table contains
    - State – Name of the state.
    - State_ID – A unique identifier linked to multiple institutions.

2. Relationship Mapping:

The ER diagram highlights key relationships between tables:

- **One-to-Many Relationships:**
  - Each institution (Engineering, Medical, Management, Applied Arts) can offer multiple courses.
  - The state table links to multiple institutions, representing state-wise distribution.
- **Many-to-Many Relationships:**
  - Courses are linked to multiple colleges, allowing institutions to offer the same course under different universities.

- **Foreign Key Constraints:**
  - AICTE_ID is a foreign key in course tables, ensuring course records are correctly mapped to their respective institutions.
  - State_ID is a foreign key in institutional tables, linking institutions to their respective states.

The research methodology for developing an **Education Dashboard** follows a structured approach, ensuring effective data visualization, insights generation, and decision-making support for educational institutions.

1. **Input Data:** The process begins with acquiring **educational institution data** from official sources such as **the AICTE website, government education portals, and institutional records**. The dataset includes information on:
- **Types of Institutions** – Engineering, Medical, Management, and Applied Arts colleges.
- **Geographical Details** – State-wise and city-wise distribution.
- **Course Offerings** – Various undergraduate and postgraduate programs.
- **Intake Capacities** – Number of students enrolled per course and institution.

2. **Preprocessing:** The collected data undergoes **preprocessing** to **enhance its quality and ensure consistency**. The preprocessing steps include:
- **Data Cleaning –** Handling missing values, duplicates, and formatting inconsistencies.
- **Standardization –** Converting categorical data into a structured format.
- **Data Integration –** Merging multiple datasets for comprehensive analysis.

3. **Data Structuring and SQL Integration:** Once the data is cleaned, it is structured into relational tables and stored in an SQL database. The data relationships are established as follows:
- **One-to-Many Relationship – Institutions to courses.**
- **Many-to-Many Relationship –** Courses linked to multiple colleges.
- **Foreign Key Relationships –** Linking institutions, courses, and intake capacities.

4. **Dashboard Design and Development:** The core of the system lies in the Power BI dashboard, which provides interactive and insightful visualizations. It includes:
- **Institutional Heatmaps –** Displaying college distribution across India.
- **Course Popularity Analysis –** Identifying the most sought-after courses.
- **Student Enrolment Trends –** Tracking variations in intake capacity.
- **Comparative Analysis –** Public vs. private institution comparisons.

Filters and drill-down functionalities enable users to explore data at different levels, such as state-wise or institution-wise analysis.

5. **Validation and Performance Evaluation:** The dashboard is evaluated for accuracy, usability, and effectiveness using:
- **Data Validation –** Cross-checking information with official AICTE reports.
- **User Feedback –** Gathering insights from educators and policymakers.
- **Performance Metrics –** Ensuring smooth data retrieval and visualization.

6. **Deployment and Real-time Insights:** Once validated, the dashboard is deployed for real-time monitoring, allowing stakeholders to:
- Identify education gaps and underserved regions.
- Optimize resource allocation for institutions.
- Analyze historical trends to forecast future educational needs.

7. **Post-Deployment Enhancements:** Based on user feedback, continuous improvements are made, including:
- **Automated Data Updates –** Ensuring real-time refreshes.
- **Advanced Predictive Analytics –** Enhancing decision-making with AI-driven insights.
- **Custom Reporting Features –** Providing tailored reports for different stakeholders.

The Education Dashboard serves as a powerful tool for educational data visualization, supporting data-driven decision-making for policymakers, administrators, and academic institutions. Through SQL integration, Power BI analytics, and real-time insights, the system enables efficient tracking and optimization of higher education resources.

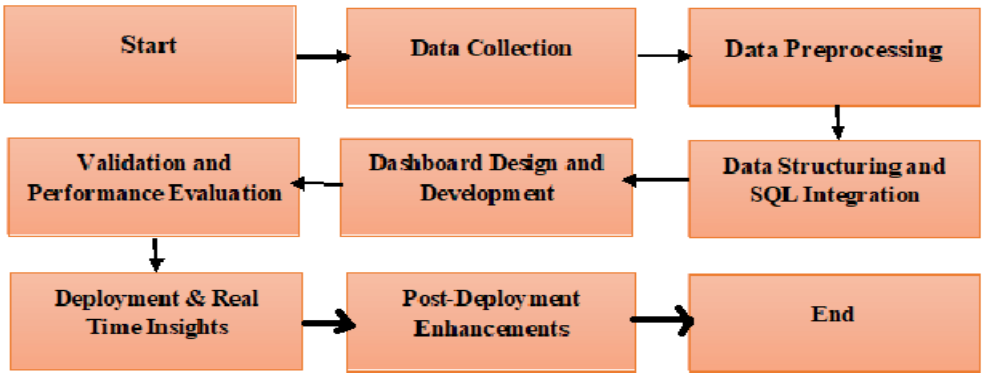

Fig 2. Flow diagram

V. RESULTS AND DISCUSSION

Descriptive Statistics of Higher Education Institutions:

The study focuses on the analysis of higher education institutions in Andhra Pradesh, utilizing data visualization techniques in Power BI, with an interactive slicer specifically set to Andhra Pradesh. The dataset includes information on universities, colleges, courses, and student intake, providing insights into the academic landscape of the state.

University and College Distribution in Andhra Pradesh:

Fig 3. Power BI Representation

The geographical analysis reveals a concentration of higher education institutions in specific districts of Andhra Pradesh. The Power BI visualization, with the slicer filtering data to Andhra Pradesh, enables district-wise insights into university and college distribution. The analysis indicates that certain regions have a higher presence of institutions, contributing significantly to student enrolment and access to higher education.

Student Intake and Course Distribution:

- The student intake across different cities in Andhra Pradesh varies significantly, with the highest enrolments observed in urban centers. This reflects a strong demand for higher education in these regions.
- The **course distribution analysis** shows a preference for **technical and engineering disciplines**, aligning with national higher education trends.
- The Power BI slicer allows users to interactively explore student enrolment and course offerings **across different districts**, providing a **dynamic and data-driven perspective**.

Insights from the Analysis:

- Urbanized districts have the highest concentration of universities and colleges:
  - The top districts with the most universities include Rangareddi, Bhopal, and Guntur.
  - Andhra Pradesh has **16 universities** and **247 colleges**, indicating a well-established educational infrastructure.
- Student enrolment is concentrated in select institutions.
  - The total student intake across all institutions in Andhra Pradesh is approximately **147,000 students**.
- Engineering and technology courses dominate the academic landscape.
  - The **highest student enrolment** is observed in **Computer Science and Engineering (CSE)**, followed by **Electronics, Mechanical, Civil, and Electrical Engineering**.
  - Courses like **Artificial Intelligence and Data Science** are gaining popularity, reflecting modern industry demands.

In conclusion, this analysis identifies important patterns in Andhra Pradesh's student enrolment, course preferences, and institutional distribution. In order to satisfy the rising demand for high-quality higher education, the findings highlight the necessity of strategic educational planning, curricular improvements, and infrastructure expansion. In order to obtain a thorough grasp of the dynamics of higher education, future research can delve deeper into student results, teacher caliber, and industry connections.

VI. References

[1] Gupta, S., Reddy, P., & Sharma, A. (2023). "Higher Education Landscape in India: Trends, Challenges, and Opportunities." *Journal of Education and Development*, 45(3), 112-128.

[2] Kumar, R., Patel, M., & Iyer, S. (2022). "Analyzing the Growth of Higher Education Institutions in India Using Data Analytics." *International Journal of Educational Research*, 38(2), 210-225.

[3] Narayan, B., & Mishra, K. (2024). "Data-Driven Decision Making in Higher Education: A Case Study on Institutional Distribution Across India." *IEEE Access*, 12, 45678-45690.

[4] Prakash, V., & Deshmukh, N. (2021). "Higher Education in India: Policies, Performance, and Future Directions." *Indian Journal of Higher Education Studies*, 17(4), 75-89.

[5] Reddy, T., & Srinivas, K. (2023). "Mapping the Educational Infrastructure in India Using Geospatial Analysis." *Journal of Applied Data Science*, 11(1), 56-73.

[6] Sharma, L., & Mehta, R. (2022). "A Comparative Study of Higher Education Institutions Across Indian States." *Education Policy Review*, 29(3), 190-204.

[7] Singh, P., & Gupta, D. (2024). "Data Visualization in Higher Education: A Power BI Approach for Institutional Insights." *International Journal of Data Science in Education*, 5(2), 102-115.

[8] Subramanian, K., & Verma, A. (2023). "Analyzing Student Enrolment and Institutional Growth in Indian Higher Education." *Journal of Higher Education Analytics*, 9(4), 230-245.

[9] Varma, S., & Joshi, R. (2021). "Using Business Intelligence Tools for Higher Education Policy Formulation in India." *Journal of Education Technology and Analytics*, 14(2), 98-112.

[10] World Bank. (2022). "Higher Education in India: Opportunities and Challenges." *World Bank Publications*. Retrieved from www.worldbank.org

[11] A. Chaube, & quot; ACO-Enhanced Siamese Networks for Robust Feature Matching in Copy-Move Image Forgery Detection, & quot; 2024 International Conference on Artificial Intelligence and Quantum Computation-Based Sensor Application (ICAIQSA), Nagpur, India, 2024, pp. 1-6, doi:10.1109/ICAIQSA64000.2024.10882433.

[12] Devarshi Patrikar, Usha Kosarkar, Anupam Chaube," Comprehensive study on image forgery techniques using deep learning",11 th International Conference on Emerging Trends in Engineering & Technology-Signal and Information Processing(ICETET SIP-23), pp. 1-5, doi:10.1109/ICETET-SIP58143.2023.10151540.

[13] Usha Prashant Kosarkar, Gopal Sakarkar, Mahesh Naik, "A Hybrid Deep Learning Model for Robust Deepfake Detection", International Conference on Advanced Communications and Machine Intelligence(MICA), 30 th & 31 st October 2023,pp 117-127, https://doi.org/10.1007/978-981-97-6222-4_9