Analyzing Polytechnic College Distribution And Academic Performance Trends In West Bengal's Diploma Program

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Abstract: Technical education stands as a pivotal component within the spectrum of Human Resource Development, offering substantial potential to enhance product and service value, bolster national economies, and elevate quality of life. This paper seeks to furnish a lucid overview of the present condition of Polytechnic education in West Bengal. Our inquiry spans various crucial domains, encompassing students' inclinations towards diverse streams such as CST, ME, IT, ETCE, SE, and others. Additionally, we aim to scrutinize the geographical dispersion of colleges across different districts along with their respective departments. Furthermore, our investigation extends to the academic performance of students pre and post the advent of the Covid-19 pandemic. By examining data from academic sessions spanning 2019-2020 to 2022-2023, our endeavor is to pinpoint noteworthy trends or shifts in student outcomes during this unparalleled period. Through rigorous data analysis, we seek to glean insights into the status quo of Polytechnic edu- cation in West Bengal, with a specific focus on comprehending student preferences, institutional distribution, and academic achievements amidst the prevailing circumstances. This re- search endeavor is poised to foster a deeper understanding of the challenges and opportunities intrinsic to Polytechnic education within the region.

Index Terms - Component, formatting, style, styling, insert.

I. INTRODUCTION

The history of Technical Education in India traces back to the British colonial era, beginning with its establishment in 1794 to address infrastructure needs post the Battle of Plassey in 1757 [12]. Post-1990s liberalization policies led to India's industrial growth, increasing the demand for skilled labor. West Bengal, aligning with national policies, prioritizes industrial development, utilizing Polytechnics and Industrial Training Institutes (ITIs) to fulfill technical manpower needs. However, limited data impedes strate- gic planning. The West Bengal Education of Technical Council (WBSCTE) aims to assess manpower require- ments and enhance training quality to meet national and international standards. Polytechnic institutions emphasize practical training, producing skilled technicians crucial for industries, thereby boosting productivity and innovation. These institutions often serve economically and socially disadvantaged sections, offering affordable and accessible technical education, promoting social inclusion and mobil- ity. Additionally, polytechnic education provides a pathway for further education, including advanced degrees and specialized certifications.Here a diagram is included The diagram presented in Figure 1 is adapted from [1] Overall, polytechnic education addresses the skill gap, promotes economic development, and fosters social inclusion. Its importance cannot be overlooked, especially in the context of India's National Education Policy 2020, which should recognize and prioritize the contributions of polytechnic education to the nation's development agenda. In this paper, we aim to analyze the distribution of student streams across various districts of West Bengal, categorized by zone and stream type.

Additionally, we investigate student perfor- mance within each stream and zone, along with the number of dropouts. Our objective is to discern trends in student preferences and interests across different subjects such as Civil Engineering (CE), Mechanical Engineering (ME), Electronics and Telecommunication Engineering (ETCE), Computer Science and Technology (CST), and other stream also.
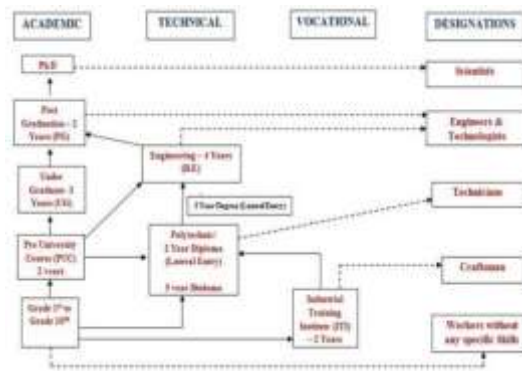

Fig. 1: Flowchart of present structure of Technical educa- tion in India. This Figure is adapted from reference [1]
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LITERATURE REVIEW

Polytechnics play a vital role in imparting both the- oretical and practical skills, offering intermediate-level qualifications that facilitate entry into the workforce or progression to higher education. Moreover, they serve as a pathway for self-employment and offer opportunities for socially disadvantaged groups,in this paper [2]the study highlights the multidimensional bridging function of Polytechnics within India's education and training sys- tem, underscoring their importance to diverse stakeholder groups.In addition to technical education, the significance of humanities in shaping well-rounded professionals here

[8]The study highlights challenges in how students perceive humanities subjects and proposes a model for enhancing humanitarian education in technical universities. Empha- sizing pedagogical interactions and educational content, the article calls for a reevaluation of the role of humanities in polytechnic education to enhance the quality of engineering education. Despite the expectations from Polytechnics, there are instances where the quality of education falls short of perceptions. This gap between expectation and reality underscores the need for enhanced quality education, par- ticularly in the context of Madhya Pradesh,India, assesses service quality in polytechnic education institutes (PEIs) in [6] focusing on students' and teachers' perceptions. It identifies gaps using Kano and SERVQUAL methodolo- gies, finding significant differences between perceived and actual service. also recommend areas needing improvement including academic excellence, library facilities, infrastruc- ture, and career counselling aim to attract more enroll- ments and guide education planners and policymakers for enhancing service quality in PEIs.Here in this paper [7] Madhya Pradesh, India aims to prioritize National Board of Accreditation (NBA) quality parameters by incorpo- rating service quality factors from students' perspectives in polytechnic education institutes (PEIs). Service quality factors are identified, categorized using the Fuzzy Kano ap- proach, and prioritized using Quality Function Deployment (QFD). The results guide improvements in PEIs' service quality, assisting education planners and administrators. The study addresses the challenge of enhancing service quality and skills of diploma engineers for employment and entrepreneurship. It adopts a "student as customer" strategy and systematically prioritizes service quality factors to enhance educational services. [11]The study explores the effectiveness of project-based learning (PBL) in enhanc- ing communication skills, comprehension, and cognitive abilities among polytechnic students. By blending PBL with guided inquiry-based learning, the research aims to assess its impact on students' skills and engagement. The study, conducted in Telangana, involves multiple phases, including testing students' communication skills, assigning projects, and assessing their performance. Findings suggest that PBL, when combined with inquiry-based methods, promotes collaboration, critical thinking, and self-directed learning, aligning with the development of 21st-century skills essential for students' academic and professional success. The West Bengal State Council of Technical Education (WBSCTE) oversees diploma education in the state, originally offering 29 branches across government and private polytechnic colleges [3] However, with the introduction of new

programs, the council now offers

43 branches for the academic year 2024-25, including emerging fields like Travel and Tourism, Food Processing Engineering, and Fire Technology and Safety. Despite these advancements, the current diploma education system faces challenges in accessibility and innovation this paper proposes an e-learning model utilizing tablet computers to address these shortcomings. Each student is provided with a tablet pre-installed with course materials, facilitating flexible learning. The proposed e-learning model aims to enhance accessibility, reduce costs, and improve stu- dent engagement across West Bengal's diploma education landscape. The above studies emphasise the pivotal role of polytechnics in India's education system and propose innovative approaches like project-based learning and e- learning to enhance service quality, skill development, and overall student success in technical education.

METHODOLOGY

The data for this study was primarily sourced from the "Website of West Bengal State Council of Techni- cal Education," West Bengal State Council of Technical Education. [Online]. Available: https://webscte.co.in/. [Ac- cessed: April 2024]. [17]. Additionally, data about the marks of all subjects, subject-wise and stream-wise, for the academic sessions 2019-2020, 2020-2021, and 2021- 2022 was obtained upon request from Tapas Kumar De, Principal in Charge, Uluberia Govt. Polytechnic [4] This dataset provides detailed information on the performance of students across different streams and polytechnic colleges. Our research has two main objectives. Firstly, we plan to analyze and visualize the distribution of colleges across West Bengal using mapping techniques. Secondly, we aim to conduct an in-depth evaluation of student academic performance and the impact of Covid-19 on education. Prepossessing steps were applied to ensure the quality, integrity and also suitability of the dataset collected from [**de_council_marks**] for the analysis of student perfor- mance.

1.1 Data Prepossessing

In preparation for analysis 3.2, zone-wise streams are established. The initial analysis involves standardizing scores for first-year students and then repeating the process for subsequent academic years. Additionally, stream-wise calculations are made for semesters 3 through 6.

1.2 Zone wise Distribution of Stream wise Colleges

The list of polytechnic colleges was sourced from [20]. From there, we obtained a total of 154 colleges categorized into government, government-sponsored, and private insti- tutions. These colleges are primarily distributed across 14 different zones, as shown in Table II.

TABLE I: Distribution of Polytechnic Colleges

Type	Count
Private	78
Govt	73
Sponsored	3

We've generated a graph illustrating the distribution of colleges across various zones for different streams. The graph, depicted in Figure 2, plots the frequency of colleges in each zone, with the X-axis representing the zone names and the Y-axis denoting the number of colleges within each zone. In addition, we have provided maps of West Bengal to help visualize the geographical distribution of these colleges across the region. To create these maps, we first gathered the location data (Longitude, Latitude) of colleges holding certain departments. We then plotted them using Google My Maps Services, a Google service that allows users to create custom maps based on location data. We clustered the departments into three parts, which are shown on the map. 3

TABLE II: Zone-wise Streams of Colleges

Zone (Abbreviation)	Streams (Colleges)
Bankura (BNK)	CE (4), CST (2), ME (5) , MET (1), EE (5), ETCE (2)
Birbhum (BIR)	AE (1), CHE (1), CE (8), ECE (1), EE (7), ETCE (3), CST (6), ME (8) , SE (3)
Bardwan (BRD)	AE (3), CE (23), CSE (1), CST (13), EE (20), EIE (2), ETCE (7), IT (1), ME (22), MEP (1), MET (1), MIN (5), MLT (1), MS (1), SE (2)
Cooch Behar (CB)	AE (1), CE (2), EE (2), ETCE (1), ME (2), PT (1), SE (1)
Darjeeling (DRJ)	ARCH (1), CE (4), CST (4), EE (3), EIE (1), ETCE (4), ME (1)
Dinajpur (DNJ)	AE (1), CE (3), CST (1), EE (3), EEE (1), ETCE (1), ME (3), SE (2)
East Midnapore (EM)	CE (3), CHE (2), CST (3), EE (4), EEIC (1), EIE (1), EPS (1), ETCE (1), ME (3)
Jalpaiguri (JP)	CE (5), CST (1), EE (4), ETCE (2), FPT (1), ICE (1), ME (4), SE (1)
Kolkata NS 24 Pgs Howrah, Hooghly (KNSHH)	AE (4), ARCH (4), CAU (1), CCN (1), CE (37), CFS (2), CHE (2), CSE (1), CST (21), DP (1), ECE (2), EE (39), EERC (1), EIE (3), ETCE (18), FPT (2), FWT (1), GIS (1), ID (1), LGT (1), ME (38), MET (1), MOPM (1), MT (1), MTR (1), PHO (1), PT (1), RE (2), SE (2)
Malda (MLD)	AE (1), ARCH (1), CE (3), CST (2), EE (3), FPT (2), IT (1), ME (3)
Murshidabad (MUR)	AGE (1), CE (13), CSE (1), CST (4), CSWT (1), ECE (1), EE (13), EIE (1), ETCE (2), FPT (1), ME (12), MLT (1)
Nadia (NAD)	AE (1), CE (5), CST (2), EE (5), EEE (1), ETCE (1), FPT (1), ME (6), SE (2)
Purulia (PUR)	CE (2), CST (1), EE (4), ETCE (1), ME (4), MET (1)
West Midnapore (WM)	CE (6), CST (3), EE (7), ETCE (1), ME (6), MET (1)

In West Bengal, there are around 25 streams including Agricultural Engineering (AGE), Geographical Information System (GIS), Renewable Energy (RE), and Communica- tion and Computer Networking (CCN), which are available only in a few colleges, one or two at most for Diploma Program. Although some of these streams may be very specific and regionally in demand, but some hold signifi- cant potential for societal and economic growth across the state.

For instance, given West Bengal's reliance on agricul- ture, AGE can drive economic development by leveraging agriculture's role as a vital livelihood [14] and resource
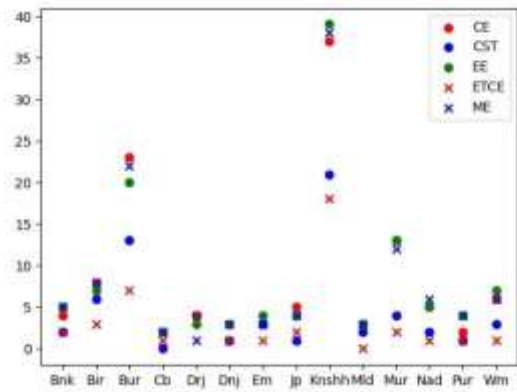

Fig. 2: Frequency of colleges in each zone for different streams

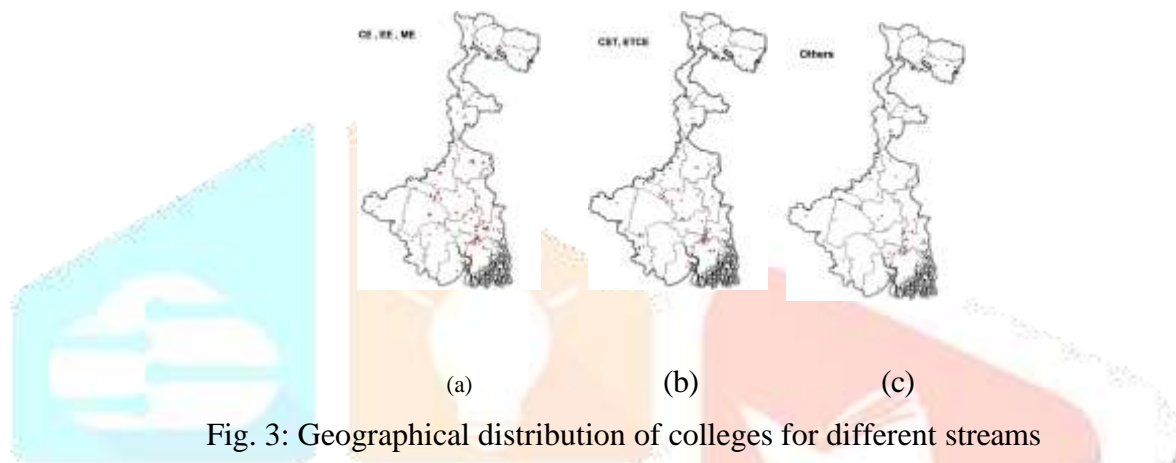(a)   (b)   (c)

Fig. 3: Geographical distribution of colleges for different streams

provider [5]. Women's substantial contributions [9] to agriculture further underscore its importance. But only in Murshidabad. The contribution of renewable energy to financial development underscores [16] its significance for sustainable development [13]. However, with only two colleges offering related courses, there is limited opportunity to develop skilled professionals in this field.

Moreover, integrating GIS technology in West Bengal can revolutionize data collection, boost investor engage- ment, and promote environmental conservation, supporting sustainable economic growth [10] [15]. Additionally, streams like CCN and Packaging Technology (PT) offer promise but require skilled professionals, highlighting the need for educational investment.

1.3 Student Performance Analysis

To facilitate comparison, the initial step in analyzing student performance data involves processing to standard- ize the scores, including both percentile and percentage scores. This process begins with first-year students and is subsequently replicated for each academic year and from the 3rd to 6th semester it is also calculated stream-wise.

Session-wise box plots have been generated for semesters 1 and 2 to illustrate the distribution of perfor- mance across academic sessions visually. Notably, these plots reveal the presence of outliers in both semesters.

Upon closer examination, it becomes evident that the distribution of marks in these semesters tends to be skewed towards lower scores. This indicates that a significant portion of students' performance falls within the lower mark ranges. Also, it indicates that a significant number of students may be struggling or facing challenges in these semesters. Also, it is notable that for academic sessions 20-21, it is significantly dense towards lower marks. In contrast, the box plots for semesters 3 to 6 show relatively fewer outliers rather than no outliers, suggesting a more homogeneous distribution of marks within each semester. This implies that, overall, the majority of students tend to perform within a similar range [it is important to note that marks for semester 5 in the academic session 19- 20 are unavailable, limiting the comprehensive analysis of performance trends across all semesters.]
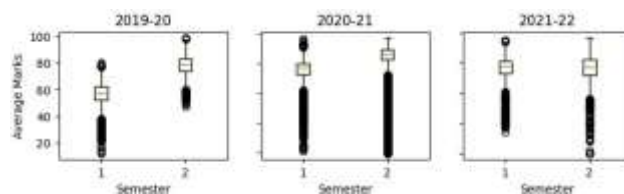
Fig. 4: Performance of students in 1st and 2nd SEM in different academic years
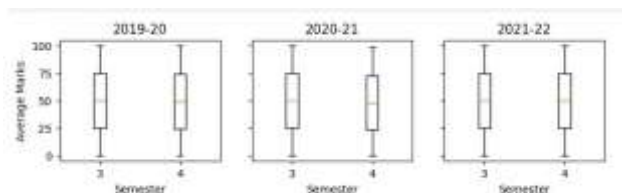

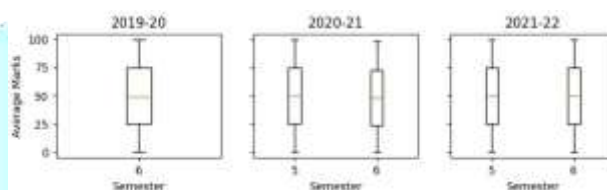Fig. 5: Performance of students in 3rd and 4th SEM in different academic years

Fig. 6: Performance of students in 5th and 6th SEM in different academic years

According to Memo No. WBSCTVESD/TED/SNB/2020-21/0034 dated April 27, 2021, the first-year examinations for the academic session 2020-21 were conducted online in June 2021 [18]. This shift to online mode was necessitated by the prevailing pandemic situation, which can be further understood by referencing the COVID-19 bulletins available on the West Bengal Health Department's website (https://www.wbhealth.gov.in/pages/corona/bulletin). Additionally, the second semester of the academic ses- sion, spanning from September to December, coincided with a critical period in managing the pandemic. This temporal alignment underscores the challenges faced by students and educational institutions in navigating the dis- ruptions caused by the pandemic while ensuring academic continuity. To enhance clarity, the marks have been seg- mented into three distinct ranges: 0-44, 45-75, and 76-100, which are plotted along the X-axis. This categorization allows for a clearer understanding of the distribution. Additionally, the percentage of students is represented on the Y-axis, providing a comprehensive view of performance across the different mark ranges. Also, these box plots offer valuable insights into the density of marks within each range, facilitating straightforward comparison across sessions.

Notably, the analysis reveals a concerning trend in the performance of students during certain semesters. Specif- ically, semesters 4 and 6 exhibit a notable decline in average percentile scores. This decline aligns with the disruption caused by the COVID-19 pandemic. According to Memo No.: WBSCTVESD/TED/2019-20/711 Dated: 28th June 2019, [19] The even semester academic session 2019-20 was actually scheduled from January 9, 2020, to April 18, 2020. However, the pandemic severely impacted classroom study and academic activities during this period. Consequently, the average percentiles for semesters 4 and 6 were significantly affected 8
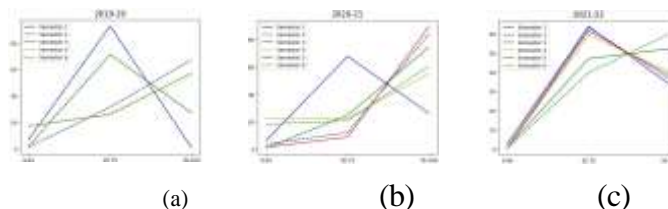
(a) (b) (c)

Fig. 7: Performance of students in different academic years
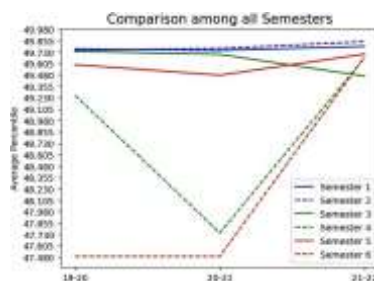]

Fig. 8: Performance of students in different academic years, displayed per semester

DISCUSSION AND FUTURE WORK

This study aims to conduct a thorough analysis of the distribution of colleges across the state. The focus will be on whether there are enough institutions that cater to specific academic streams. The purpose is to identify any

patterns or disparities in the distribution of educational resources and to highlight areas where there may be a shortage of colleges offering certain disciplines. Factors such as location and program offerings will be considered to gain insights into how accessible and equitable educa- tional opportunities are distributed.

The investigation will examine the distribution of marks among students of all streams and session-wise, both before and during the COVID situation. Also, the focus is on first and second-semester students, as the distribution of marks was non-homogeneous the purpose is to explore areas where students exhibit lower interest, particularly in foundational subjects such as basic sciences and hu- manities. Also by analyzing the variability in academic performance, we aim to identify areas where interventions may be needed to ensure fairness and equity in educational outcomes.

Looking ahead, the research agenda includes a com- prehensive exploration of student dropout rates, with a particular emphasis on identifying departments or fields of study that are most susceptible to attrition. The underlying reasons for student disengagement or withdrawal will be understood to develop targeted strategies to improve reten- tion and support student success.

Furthermore, future research plans include a deeper understanding of student dropout rates, with a particular emphasis on identifying departments most affected by this phenomenon. The tracking of transfer students and examination of the reasons behind their decision to transfer

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