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IS INFRASTRUCTURE A STUMBLING BLOCK OF ENGINEERING EDUCATION IN INDIA: A STUDY

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ABSTRACT

The country's education system is plagued with inadequate infrastructure and faculty. Higher Education Institutions, should ideally be guided by Education 4.0 and NEP 2020 which are premised on the planks of technology, flexibility, customization, and experiential learning. But there is no adequate investment on infrastructure as reflected in (1) poor employability of graduating students, (2) low placements, (3) poor reputation of the college in the eyes of the employing industries, (4) low occupancy rate, and (5) low success in securing research grants. Nevertheless, promoters are, apparently and quite strangely, unwilling to invest in this critical area. They don't seem to understand the positive impact of such investment on their success. This research attempted to establish the link between investment in infrastructure and their success. Originality: This research establishes the link between investment in infrastructure and success outcomes clearly to drive home the need for investment in infrastructure. In this part of the world, promoters are still clueless about why they should invest in infrastructure. Findings:(a) Offering of New Age courses moderately influences Occupancy Ratio (Admissions) of graduate students; (b) creating Hostel Facility for students does not influence any of the success outcomes chosen for research; (c) library resources, i.e., Journals, Volumes, and Titles have some modicum of relationship with success outcomes, but Computers have nothing to do with success outcomes. Importantly, Journals moderately influence the success outcomes, i.e., 1st Division, Placements, and Graduate Admissions; and (d) Online Library facility in some way influences

Occupancy Ratio (Admissions). Managerial Implications: With the findings of this research, promoters of educational institutions are shown the way forward and counselled to invest in specific areas like introduction of new age courses, and adequate resources in the library.

KEYWORDS: *Engineering Education, Higher education, Infrastructure, Library, and Services Industry.*

INTRODUCTION

India boasts a large pool of technical human resources, and a fairly large portion of them is finding employment in the developed countries (Kaul, 2006). Globalised businesses, and growth of IT-enabled services, which would potentially create a large overseas employment for Indian graduates, point our country's education industry in the single direction of developing high quality technical education. Interestingly, provisioning of higher education has become a global business arena and thus makes a good investment avenue for both government and private sectors.

Farinha et al (2018) found in their research that for countries including India which are considered to be at Stage 1 of economic development, higher education and training which is said to be the fifth among 12 important pillars for Global Competitiveness Index contributes significantly to their global competitiveness.

India has a large education-ready young population of 500 million persons in the age bracket of 5-24 years. The number of universities in India by December 2020 is 967 while that of AICTE-approved institutions is 9700 with 37.5 million students enrolled in higher education in 2019. India saw a gross enrolment ratio (GER) of 26.3% in 2019. The AICTE-approved institutions, in all, offer 4100 undergraduate, 4951 post-graduate, and 4514 diploma courses in 2020-21. The expected growth of higher education in India in the next 2 to 4 years is 38%, achieving a GER of 50. India expects that 20 universities in India will find place in the list of the top 200 world class universities. It is expected that one in every four graduates in the world will be a product of Indian higher education (*Education & Training Sector in India: Education System, Growth & Market Size | IBEF*, July,2021).

The World Bank in its working paper (Blom& Cheong, 2010), notes that Indian technical and engineering education system is huge and complex and requires reforms. The key issues include (1) fair access and affordable participation, (2) tremendous growth of private institutions with issues of governance, autonomy and accountability and (3) inadequate partnerships with industry and peer institutions for effective delivery; these issues need to be addressed, if India has to give more employment opportunities to the graduating students, and to prepare them to compete in the international arena too.

The country's education system is plagued with inadequate infrastructure, faculty position vacancies, low student enrolment rate, outdated teaching methods, poor research quality, cramped classrooms, and socio-economic imbalances. The number of HEIs and their intake increased enormously but the quality of learning delivery has a lot to be desired (K. Kamar&Selvarani, 2015).

The problems and challenges currently faced by higher education in India as identified in the New Education Policy 2020 document include : (1) a highly fragmented higher educational ecosystem which is characterised by disconnection from one another; (2) low focus on cognitive skills and learning; (3) early, rigid, and narrow specialisations; (4) poor access to disadvantaged communities and lack of impartation in local languages; (5) limited autonomy to teachers and institutions; (6) inadequate opportunity for merit in teaching career; (7) lacklustre research focus; (8) poor governance and leadership of HEIs; (9) errant regulatory mechanism, and (10) large affiliating university and the consequent low standards of undergraduate education (*National Education Policy 2020*, 2020).

Quality Orientation

Organisation for Economic Cooperation and Development (OECD)2030 Future of Education and Skills Project advises the nations that new education standards should consist of an educational framework that combines knowledge with new age skills of creativity, critical thinking, communication and collaboration; they necessarily require self-directed learning and personalization besides values and attitudes (Yeravdekar et al., 2021)

Education 4.0 and NEP 2020

Higher Education Institutions, regardless of who owns them, should ideally be guided by Education 4.0, which is a new wave of transformation of education, and NEP 2020 (New Education Policy 2020 of India) which are premised on the planks of technology, flexibility, customization, and experiential learning. Education 4.0 is aligned with the needs of fourth industrial revolution. It is student-centric and thus empowers the student to choose and make their own learning paths based on their final, intended outcomes. In the light of this, HEIs should redesign the ecosystem to ensure student learning experience, self-paced learning, employability, and research excellence. Ultimately, education system should produce graduates that can occupy global leadership positions. Broadly, micro credentials, blended learning, use of technology for teaching and learning, collaborative and cooperative research efforts, cross-border partnerships, interdisciplinary linkages,institutionalised technology infrastructure, and ensuring student experiences are some success factors that world class institutions focus on ((Yeravdekar et al., 2021); the same can be guiding principles for all other HEIs intending to make their mission a success.

Infrastructure

Chauhan and Sood (2018) observed that during the past 15 years, there has been an explosion of technical education institutions and their permitted intake; while expansion of educational facilities is welcome, it has caused the mushrooming of non-viable institutions due to improper planning; it is also common knowledge that the quality of technical education is deteriorating at an alarming speed; private institutions have an important and major role in imparting engineering education in Himachal Pradesh but there are two challenging issues that require immediate attention of the governments and institution promoters ; they are : (1) inadequate infrastructure, and (2) shortage of competent faculty ; quality of education will improve only if they are addressed immediately.

Kumar (2014), in his doctoral thesis on quality initiatives in technical education institutions, notes that in spite of tremendous growth in engineering education institutions in India, the

system is plagued with a multitude of issues; some important ones among them include: dilution of quality, infrastructural inadequacy, faculty shortage, quick earning motivation etc.

Zainab (2017) found in his study that as regards the land of private technical education institutions, it is somehow conformed to the AICTE norms, but in reality it is inadequate to support the different activities of the institutions; particularly, the buildings and classrooms are cramped and quite inadequate since they are apparently not according to ideal requirement.

Chaturvedi (2003), Kalpana (2012) and Devi (2013), based on their studies, suggest that physical facilities including latest equipment in the labs, wi-fi etc should be provided; working conditions of the faculty should be improved and provided with necessary resources like computers, internet, decent rooms for sitting and reading, and also fresh and hygienic work areas and restrooms; regulatory body should keep a check on the availability of such essential requirements.

Hussain, Akhtar and Lavanya (2014) found through their study that students and faculty wanted enough number of computers and well -equipped cubicles for accessing e-content. Their study concluded that engineering colleges, to keep the users satisfied, should provide well-equipped libraries with good hardware and software and a well - curated collection of e-resources.

Ressler, Ressler and Stanton (2010) proposed a model for educational capacity building for Afghanistan, with 5 parallel axes as recounted in the following: (1) Physical Infrastructure composed of buildings, classrooms, labs, hardware, software, and communications systems; (2) Faculty with a well-conceived design for long-term professional development, who can create and offer appropriate curriculum; (3) Technical personnel to support labs, hardware, software, communication systems etc.; (4) Curriculum designed and implemented for continuous learning of integrated courses as well as co-curricular learning; and (5) Governance and leadership development for formulating policies and effective program administration. This model underlines the importance of physical infrastructure and faculty development.

Libraries

Saleem, Tabusum and Batcha (2013) have studied the extent and pattern of application of ICT and use of ICT tools in the academic libraries of India; they found the inadequacy of up-to-date infrastructure, and thus suggested provisioning of additional ICT equipment and services to modernise the libraries.

Haneefa (2007) who studied on “Use of ICT Based Resources and Services in Special Libraries in Kerala, India” reported that a good number of users are not satisfied with the access and availability of e-resources in the libraries, citing inadequate ICT infrastructure as a major reason; further, it was suggested that the library staff need to be trained in the use of ICT-based resources.

Mahindra & Kumar (2015) found in their study that 57.7% users visit the library on a daily basis; 71.9% of the respondents opine that library is of great help in their academic success. They also found that library environment and library services are responsible for user satisfaction to an extent of 26.2 (a significant regression coefficient/beta value).

Computers

Computer infrastructure and libraries make a critical component of academic system for providing teaching, research, and learning resources; adequate computer infrastructure supports library in making the latter effective. Computer Infrastructure (CI) facilities are the primary tools to automate library functions and provide services easily and accurately (Rao & Choudhury, 2010). Besides, for the best use of library and its services, the users find it convenient to use and access CI facilities in the process of meeting the important academic needs.The information revolution is the central phenomenon in the contemporary world comprising information profusion and computer technology.Libraries are no longer storehouses of information but facilitators of access to information. Technology has changed the entire concept of libraries from holding to access (Khalid, 2000).

Theories on Infrastructure

Porter's Value Chain theory (Porter, 1985) postulates that value for the customers is built through focusing on 5 main activities and 4 supporting activities; infrastructure is one of four supporting activities of an organization; superior customer value and his delight flow from infrastructure.

Parasuraman, Zeithaml, and Berry proposed a service quality measurement model, called SERVQUAL, which is premised on five dimensions of service. They are: (1)Tangibles, (2)Reliability, (3) Responsiveness, (4) Assurance, and (5) Empathy. The primary source of tangibles, reliability, and assurance is infrastructure. Grönroos proposed a model of service which is premised on three dimensions: technical, functional and image; all the three dimensions are rooted in infrastructure. Haywood-Farmer (1988) discussed a service quality model comprising three basic attributes, namely, (1) physical facilities, processes and procedures, (2) conviviality of staff and pleasant people behaviour and (3) professional judgment; the first attribute is a product of infrastructure. Brady and Cronin (2001) developed a model for evaluating service quality. This model postulates that service quality is determined by (1)interaction quality; (2)physical service environment quality and (3)outcome quality that was formed by waiting time, tangibles, and multiple choices; the second and third kinds of quality is based on physical infrastructure. Philip and Hazlett (1997) proposed a hierarchical structure model called P-C-P for assessing service quality in service institutions. The model was based on (1) pivotal, (2) core, (3) and peripheral attributes. Core and peripheral attributes result from infrastructure. Extant theories claim with one single voice that infrastructure is an essential component in the system of service delivery.

Investment on institutional infrastructure is often advised by the quality advocates, regulatory bodies, and peers, since infrastructure is generally believed to be the cornerstone of quality.

On one side, investment on infrastructure is advocated incessantly hammer and tong, but in this part of the world, complying with such advice, on the other, is not honoured; the outcomes of such inadequate investments are reflected in the indicators like : (1) poor employability of graduating students, (2) low placements, (3) poor reputation of the college in the eyes of the employing industries, (4) low 1st division pass percentage, (5) high faculty turnover, (6) failure to attract high IQ and highly motivated students, (7) low occupancy rate, (8) low success in securing research grants, and (9) failure to retain accreditation or obtain fresh accreditation.

Infrastructural investment advice apart, institutional promoters, who first enthusiastically invested in expensive basic infrastructure like land and building, are later, strangely enough, baulking at investing adequately on the infrastructure. Lack of investible funds is one factor that may prevent them from investing. But, in view of multiple opportunities that are openly available to those seeking finances, investible funds can in the least be an obstruction.

Apparently, the promoters are suspicious of the link between (a)investment in infrastructure and (b) institutional success outcomes like occupancy (Admissions), and student success outcomes like Placements, Pass, and Annual Salary Package for the placed students.

This research, thus sets out to find out link between institutional infrastructure and the college and student success outcomes. The following hypothesis is formulated to proceed with our research.

Hypothesis

Infrastructural Investment in: (1) Availability of New Age Courses, (2) Students' Hostel Facility, (3) Number of Volumes available in the library, (4) Number of titles available in the library, (5) Number of Journals available in the library, (6) Number of computers available in the college, and (7) Availability of Online Library Facility does not influence the college and student success outcomes including (1) Admissions, (2) Placements, (3) 1st Division Pass, and (4) Annual Salary Package.

It goes without saying that there are other clear indicators like lands, buildings, classroom equipment etc than the ones taken here but unfortunately the quality of data that would come from the respondents is not clearly dependable., and importantly this researcher has no control over what comes from the respondents.

Research Method

Data was collected from 70 engineering colleges in Telangana of India on the foregoing parameters. For comparability of data of one college with another, percentages and quotients were computed instead of absolute figure which vary from college to college, depending on the permitted intake of the college. Due to limitations in access to the data which originates from private entrepreneurs who hesitate to share their data even for right reasons, sample could not be larger. Shared data, for what it is worth, is used in the research. The data was accepted and used as it is, since the researchers have no control over the quality of the data.

To investigate into the influence of infrastructure on college success outcomes, analytical techniques used are as follows.

To check the influence of (1) Availability of New Age Courses, (2) Students' Hostel Facility, and (3) Number of Computers Available and (4) Availability of Online Library Facility on (1) Admissions, (2) Placements, (3) 1st Division Pass, and (4) Annual Salary Package, means were calculated and compared.

But, to find out the link between (1) Number of Volumes available in the library, (2) Number of titles available in the library, and (3) Number of Journals available in the library and (1) Admissions, (2) Placements, (3) 1st Division Pass, and (4) Annual Salary Package, correlation coefficients were calculated.

Findings and Discussion

Availability of New Age Courses

TABLE # 1 COMPARISON OF MEANS

Are New Age Courses Offered?		N	Mean
Percentage of Admissions in 2020 as against Intake Permitted	No	27	68.89
	Yes	43	79.47
First Division Quotient	No	27	0.115
	Yes	43	0.077
Placements Quotient	No	27	0.105
	Yes	43	0.072
Salary Quotient	No	27	614.145
	Yes	43	423.509

The mean scores of Graduate Admissions in the colleges offering New Age courses and those not offering New Age Courses are calculated and presented in Table # 1.

The mean scores of graduate admissions in the colleges offering New Age courses are higher than those not offering them, which means that colleges offering New Age courses are successful as far as Admissions are concerned. But, on other parameters like Placements, 1st Division Pass, and Annual Salary Packages, this investment in New Age courses does not make any difference.

So null hypothesis that New Age courses offered does not influence Admissions is not accepted but the remaining part of null hypothesis relating to other success parameters including Placements, 1st Division Pass and Annual Salary Package is accepted.

Students' Hostel Facility

TABLE # 2

Is there students' hostel in the campus?		N	Mean
Percentage of Admissions in 2020 as against Intake Permitted	No	15	81.800
	Yes	55	73.636
First Division Quotient	No	15	0.129
	Yes	55	0.081
Placements Quotient	No	15	0.120
	Yes	55	0.075
Salary Quotient	No	15	601.173
	Yes	55	468.640

The mean scores of Graduate Admissions, 1st Division Pass, Placements, and Annual Salary Package of colleges having Students' Hostel and those of colleges not having it are calculated and presented in Table # 2.

The mean scores of Graduate Admissions, 1st Division Pass, Placements, and Annual Salary Package of colleges having Students' Hostel are not greater than those of colleges not having this facility.

Hence, null hypothesis that there is no link between having Students' Hostel and the chosen success parameters, is accepted in full.

Library Resources

TABLE # 3

		Percentage of Admissions in 2020 as against Intake Permitted	Library Volumes Quotient	Library Titles Quotient	Library Journals Quotient	Computers Quotient
Percentage of Admissions in 2020 as against Intake Permitted	Pearson Correlation	1	.143	.113	.288*	.056
	Sig. (2-tailed)		.237	.352	.016	.643

The relationship between Graduate Admissions and the library resources including Volumes, Titles, Journals, and Computers is explored with Pearson Correlation. Correlation Coefficient is calculated and presented in Table # 3. It is found that a weak correlation (r (70) = 0.288, p = 0.016) exists between Graduate Admissions and Journals. Hence, null hypothesis, in part, is not accepted; it means that the number of Journals available in the library influences Occupancy Ratio (Admissions), but accepted in the case of 1st Division, Placements, and Salary Packages since correlation does not exist as reported in the above Table # 3. It may be noted that correlation coefficient does not indicate any causal link but just one variable moving with the other variable.

1st Division and Library Resources

TABLE # 4

		First Division Quotient	Library Volumes Quotient	Library Titles Quotient	Library Journals Quotient	Computers Quotient
First Division Quotient	Pearson Correlation	1	.285*	.255*	.560**	-.025
	Sig. (2-tailed)		.017	.033	.000	.839
	N	70	70	70	70	70

1st Division and Library Resources are correlated (Table # 4) as follows.

(1) Volumes and 1st Division (r (70) = 0.285, p = 0.017), (2) Titles and 1st Division (r (70) = 0.255, p = 0.033); (3) Journals and 1st Division (r (70) = 0.560, p = 0.000).

Interestingly, Journals have a moderate correlation with 1st Division, while Volumes and Titles are weakly correlated with Fist Division.

But there is no correlation between First Division and Computers.

Placements and Library Resources

TABLE # 5

		Placements Quotient	Library Volumes Quotient	Library Titles Quotient	Library Journals Quotient	Computers Quotient
Placements Quotient	Pearson Correlation	1	.290*	.294*	.580**	-.014
	Sig. (2-tailed)		.015	.014	.000	.907
	N	70	70	70	70	70

Placements and Library Resources show the correlations (Table # 5) as follows.

(1) Placements and Volumes (r (70) = 0.290, p = 015); (2) Placement and Titles (r (70) = 0.294, p = 0.014); (3) Placements and Journals (r (70) = 0.580, p = 0.000) . The Correlation coefficients and their p-values show that there is a moderate correlation between Placements and Journals, whereas a weak correlation exists between Placements, and Volumes and Titles. Computers have no correlation at all.

Salary Packages and Library Resources

TABLE # 6

		Salary Quotient	Library Volumes Quotient	Library Titles Quotient	Library Journals Quotient	Computers Quotient
Salary Quotient	Pearson Correlation	1	.241*	.236*	.427**	-.069
	Sig. (2-tailed)		.045	.049	.000	.570
	N	70	70	70	70	70

Salary Packages and Library Resources show correlations as follows (Table # 6).

(1) Salary Packages and Volumes (r (70) = 0.241, p = 0.045); (2) Salary Packages and Titles (r(70) = 0.236, p = 0.049); (3)Salary Packages and Journals (r (70) = 0.427, p = 0.000). The reported correlation results show that a moderate correlation exists between Salary Packages and Journals, while weak correlation exists between Salary, and Volumes and Titles. Computers have no correlation with Salary Packages.

The findings go against the null hypothesis that there is no relationship between success outcomes and library resources except in the case of Computers; Computers have no correlation with any of the success outcomes. But, all success outcomes and Journals are either moderately

correlated ; Volumes and Titles are weakly correlated with success outcomes. Hence, null hypothesis is not accepted in case of Journals, Volumes, and Titles, but accepted in the matter of Computers.

Online Library Facility Availability

TABLE # 7

Is online library available?		N	Mean
Percentage of Admissions in 2020 as against Intake Permitted	No	16	70.500
	Yes	54	76.833
First Division Quotient	No	16	0.109
	Yes	54	0.087
Placements Quotient	No	16	0.094
	Yes	54	0.082
Salary Quotient	No	16	596.717
	Yes	54	467.506

The influence of availability of Online Library facility on Admissions, 1st Division Pass, Placements, and Annual Salary Package was checked by calculating and comparing means of the colleges having Online Library and the colleges not having it, with regard to Admissions, 1st Division Pass, Placements, and Annual Salary Package. The results are presented in Table # 7.

It was found that Admissions of the colleges having Online Library is greater than those not having that facility. It means that Online Library influences Admissions. Thus, the hypothesis that there does not exist any relationship between Online Library and Admissions is not accepted. But, in respect of other parameters, i.e. 1st Division Pass, Placements, and Annual Salary Packages, Online Library facility makes no difference. Hence, this part of null hypothesis is accepted.

Summary &Conclusion

The conclusions that we can draw from the above research is as follows. Offering New Age courses moderately influence Occupancy Ratio (Admissions) of graduate students while Creating Hostel Facility for students does not influence any of the success outcomes chosen for research. Library resources, i.e., Journals, Volumes, and Titles have some modicum ofrelationship with success outcomes, but Computers have nothing to do with success outcomes. Importantly, Journals moderately influence the success outcomes, i.e., 1st Division, Placements, and Graduate Admissions. We can also conclude that Online Library facility moderately influences Occupancy Ratio (Admissions).

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