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CURRENT SCENARIO & CHALLENGES OF ICT INFRASTRUCTURE IN HIGHER EDUCATION INSTITUTIONS IN TIER 3 CITIES OF MAHARASHTRA, INDIA: A STUDY OF JALGAON, DHULE & NANDURBAR REGION

Mahendrasingh Ganpatsingh Chauhan[1*], Dr. Sameer Prallhad Narkhede[2]

[1]Research Scholar, School of Management Studies, KBC North Maharashtra University, Jalgaon, Maharashtra, India
[2]Professor & Guide, School of Management Studies, KBC North Maharashtra University, Jalgaon, Maharashtra, India

mahendrasingh191@rediffmail.com[1]
spn13371@gmail.com[2]

Abstract
Information and Communication Technology (ICT) has become integral to modern education, particularly in higher education institutions (HEIs). This study explores the status and challenges of ICT infrastructure in HEIs located in Maharashtra's tier-3 cities, focusing on Jalgaon, Dhule, and Nandurbar. Using a mixed-methods research design, data were collected through institutional surveys, faculty interviews, and student feedback. The findings highlight critical shortcomings in hardware availability, internet connectivity, digital literacy, and administrative support, which collectively limit effective ICT adoption. The study emphasizes the need for strategic interventions to bridge these gaps and strengthen technology-enabled learning environments. Policy recommendations are proposed to reduce the digital divide, improve access to reliable resources, and promote sustainable ICT integration. Enhancing infrastructure and support systems in these growing urban centers is vital to improving educational quality and preparing students for success in an increasingly digital world.

Keywords: ICT Infrastructure, Higher Education, Tier 3 Cities, Maharashtra, Jalgaon, Dhule, Nandurbar, Digital Divide, Network, Internet, Infrastructure

1. Introduction

Information and Communication Technology (ICT) has emerged as a cornerstone for quality teaching, research, and administration in higher education globally. In India, rapid digitalization and policy initiatives have pushed universities and colleges to integrate ICT into pedagogy, student services, and institutional management. Yet this transformation has been uneven, particularly in Tier-3 cities where systemic constraints hinder effective ICT deployment. This study focuses on the current scenario and challenges of ICT infrastructure in higher education institutions across the Jalgaon, Dhule and Nandurbar region of Maharashtra — a zone that typifies many semi-urban and rural educational ecosystems in India.

Higher education institutions (HEIs) in these districts face a complex mix of infrastructural, financial and socio-technical barriers. Physical ICT assets such as computer laboratories, campus networks and smart classrooms often exist in limited numbers or are outdated. Broadband connectivity — a prerequisite for synchronous online learning, access to digital libraries, and cloud-based services — remains inconsistent: many institutions rely on low-capacity links or shared mobile networks that cannot support high user loads. Power reliability and the cost of uninterrupted electricity further affect the availability and usability of ICT resources, especially for after-hours lab access and server hosting.

Human capacity is an equally critical challenge. Faculty and administrative staff frequently lack continuous training in digital pedagogy, learning management systems (LMS), and basic IT troubleshooting. This skills gap reduces adoption of ICT tools and limits the pedagogical shift from lecture-centred instruction to blended and student-centred learning. Moreover, technical support teams are understaffed or absent in smaller colleges, leading to long downtimes and poor maintenance of existing equipment.

Socioeconomic factors compound technical constraints. A substantial portion of the student population in these districts comes from rural and low-income backgrounds, with limited personal access to devices and home internet. Language barriers and low digital literacy impede effective use of e-resources. Institutional governance and funding models add another layer of difficulty: limited budgets, competing priorities, and slow procurement processes hinder timely upgrades and scalable ICT planning.

Recent shocks such as the COVID-19 pandemic exposed both the potential and the fragility of ICT ecosystems in Jalgaon, Dhule and Nandurbar: where digital readiness existed, continuity of learning was feasible; elsewhere, disruptions widened learning inequities. Addressing these challenges requires context-sensitive strategies — from affordable broadband solutions and reliable power backups to continuous faculty development, student digital inclusion programs, and participatory planning that aligns state policy with local realities. This study maps the present conditions, identifies key bottlenecks, and lays the groundwork for policy and institutional interventions tailored to Tier-3 HEIs in this region.

2. Literature Review

Research shows that ICT improves education by increasing access to resources, enabling interactive learning, and streamlining administration (Kumar & Reddy, 2019; Singh et al., 2021) However, smaller cities and rural areas often struggle with weak internet, outdated equipment and insufficient technical training (Patel, 2018). The digital divide in these regions negatively affects both students and educators (Sharma & Gupta, 2020). Government programs like Digital Indiaand NMEICT aim to reduce these gaps, but more localized research is needed.

3. Research Objectives

This study seeks to:

1. Evaluate ICT infrastructure in HEIs across Jalgaon, Dhule, and Nandurbar.
2. Identify key challenges for students, faculty, and institutions in using ICT.
3. Propose solutions to strengthen ICT adoption in tier 3 cities.

4. Methodology

4.1 Research Design

The study uses a mixed-method approach:

- **Quantitative data** comes from surveys with Likert-scale responses (Strongly Disagree to Strongly Agree).
- **Qualitative data** is gathered through open-ended feedback from college faculties.

The questionnaire comprised a total of 92 items, covering various dimensions of ICT infrastructure and its implementation in higher education institutions (HEIs).

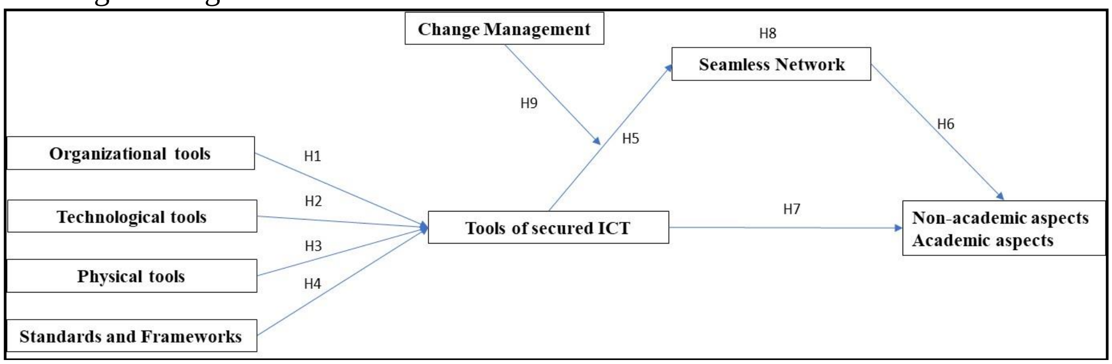
The primary objective of the research design was to examine the secured ICT facilities and seamless network infrastructure in HEIs. A total of 150+ responses were collected from a target population of over 200 HEIs, focusing on faculty members and IT administrators across selected institutions to ensure the accuracy of the research tool

- Reliability was tested using Cronbach's Alpha, which measured the internal consistency of the items.

- Validity was assessed through Exploratory Factor Analysis (EFA) to verify whether the instrument accurately captured the intended constructs.

The tool encompassed key variables including:

- Organizational Tools
- Technological Tools
- Physical Tools
- Standards and Frameworks
- Secured ICT Facilities
- Seamless Network Infrastructure
- Academic and Non-Academic Aspects in HEIs
- Change Management



Block Diagram No. 1: Conceptual Model for the Study

4.2 Sample Selection

- A total of 200+ higher education institutions (HEIs) located in the Jalgaon**,** Dhule, and Nandurbar regions were considered for this study.
- Data were collected from 150+ faculty members, with one representative response per institution to maintain sampling uniformity and reduce bias.

The sample size required for the complete analysis of the data is as follows:

- ✓ Populationsize (N): 200+)
- ✓ Confidence level: 95% → Z = 1.96
- ✓ Margin of error (e): 5% → 0.05
- ✓ Response distribution (p): 0.5 (for maximum variability)

$$n = \frac{N \cdot Z^2 \cdot p \cdot (1-p)}{e^2 \cdot (N-1) + Z^2 \cdot p \cdot (1-p)}$$

$$n = \frac{200 \cdot (1.96)^2 \cdot 0.5 \cdot 0.5}{0.05^2 \cdot (200-1) + (1.96)^2 \cdot 0.5 \cdot 0.5}$$

$$n = \frac{200 \cdot 3.8416 \cdot 0.25}{0.0025 \cdot 199 + 3.8416 \cdot 0.25}$$

$$n = \frac{192.08}{0.4975 + 0.9604} = \frac{192.08}{1.4579} \approx 131.76$$

As per the above calculations, a minimum sample size of approximately 132 respondents is required for a population of 200, with a 95% confidence level and a 5% margin of error.

4.3 Data Collection

The data collection process was carried out through a combination of the following methods:

- Surveys were administered to faculty members and students to assess the availability accessibility, and usage of ICT resources.
- Onlinequestionnaires were completed by institutional heads and ICT coordinators to gather administrative perspectives.
- Secondarydata were obtained from institutional annual reports, official ICT documentation, and relevant government policy records.

4.4 Data Validity, Reliability & Complete Analysis

Cronbach's Alpha was used to check the reliability of the research instrument in the present study. Cronbach's Alpha coefficient value ranges from 0 to 1 where a value close to 1 shows a greater reliability and internal consistency. However, the value of Cronbach's Alpha coefficient greater than 0.7 for the variables are acceptable. Cronbach's Alpha values for all the factors such as tools of secured ICT facilities (0.910), technological tools (0.837), physical tools (0.712), standards and frameworks (0.850), secured ICT facilities (0.917), seamless network infrastructure (0.922), academic aspects in HEI (0.960), non-academic aspects in HEI (0.911) and change management (0.892) were all values exceeded the acceptable threshold ($\alpha \geq 0.7$) confirming the instrument's high reliability as shown in below table 1 Cronbach's Alpha

	Cronbach's Alpha	**N of Items**
Tools of secured ICT facilities		
Organizational tools	0.910	10
Technological tools	0.837	11
Physical tools	0.712	6
Standards and Frameworks	0.850	5
Secured ICT facilities	0.917	12
Seamless network infrastructure		
Scalability	0.800	4
Reliability	0.889	5
Accessibility	0.818	3
Academic and non-academic aspects of secured IT and seamless network		
Academic aspects in HEI	0.960	17
Non-academic aspects in HEI	0.911	9
Change management	0.892	10

Table No.1:-Interpretation of Cronbach's Alpha Values

5. Findings and Discussion

The study of ICT infrastructure in higher education institutions across Jalgaon, Dhule, and Nandurbar reveals a mixed but concerning landscape. Most colleges maintain basic digital assets—computer labs, local area networks, and intermittent Wi-Fi—but these are unevenly distributed and frequently under-resourced. Primary challenges include limited bandwidth, unstable power supply, and aging hardware, which impede synchronous online instruction and remote research access. Faculty digital literacy varies widely: a core group effectively uses learning management systems and e-resources, while many remain reliant on traditional lecture methods due to inadequate training and workload pressures. Administrative issues—scarce funding, slow procurement, and weak maintenance—compound technical constraints. Positive signs include growing interest in cloud-based services and partnerships with regional NGOs and private vendors, which have introduced short-term upgrades and teacher training workshops. However, sustainability concerns persist because interventions often lack long-term planning, local capacity building, and measurable impact evaluation. Policy recommendations emerging from the findings emphasize prioritizing reliable power and connectivity, targeted faculty development, phased hardware renewal, and transparent budgeting to enable equitable digital learning. Addressing these interconnected technical, human, and managerial gaps is essential to transform ICT from a peripheral utility into an academic enabler in Tier-3 Maharashtra. Further longitudinal evaluation will guide scalable regional solutions.

5.1 ICT Infrastructure Availability

- Only 48% of the institutions had adequate computer labs.
- Internet bandwidth was insufficient, with 75% reporting frequent disruptions.
- Lack of updated software and learning management systems was common.

5.2 Usage and Digital Literacy

- 68% of faculty lacked advanced ICT training.
- Students showed moderate digital literacy but were constrained by infrastructure.
- E-learning resources were underutilized due to hardware and connectivity issues.

5.3 Administrative Support and Funding

- Budget allocations for ICT were minimal.
- Limited technical support staff hampered maintenance and upgrades.

5.4 Challenges Identified

- Frequent power outages and network instability.
- Resistance to change among some faculty members.
- Insufficient training programs on ICT usage.

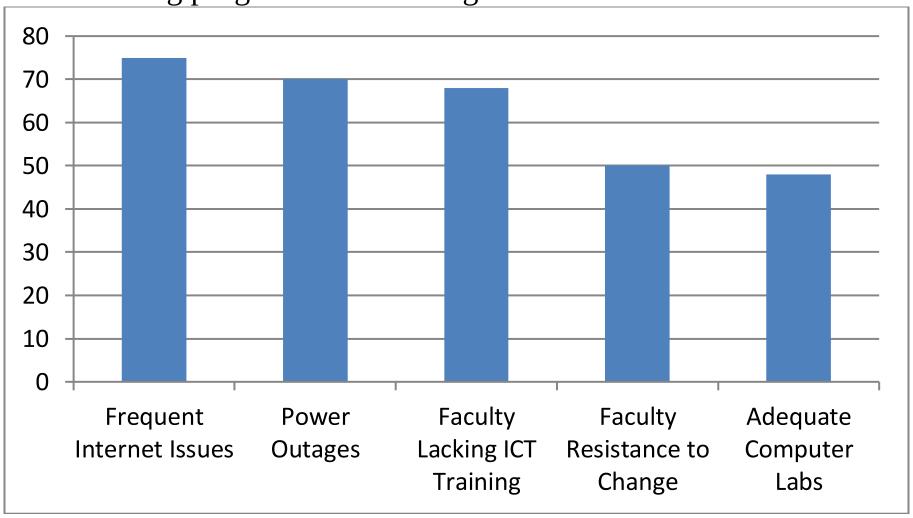


Figure 1: ICT Infrastructure and Challenges in Educational Institutions (Scale: 0-100%)

5.5 Implications for Quality Education

The current scenario of higher education in tier-3 cities such as Jalgaon, Dhule and Nandurbar presents both opportunities and constraints for quality education. Rising student aspirations and targeted policy initiatives have encouraged adoption of ICT-enabled teaching, blended learning, and remote collaborations, widening access to resources beyond local limitations. Despite this progress, major infrastructure challenges persist: intermittent electricity, limited high-speed internet, ageing computer labs, and scarce maintenance budgets restrict continuous online engagement and research. Human-resource constraints — shortage of trained faculty, inadequate ICT support staff, and low digital pedagogy skills — further weaken effective integration of technology. Additionally, socio-economic digital divides, language barriers in available content, and limited institutional linkages with industry and urban centers exacerbate inequities. These limitations dampen outcomes such as student employability, research output, and experiential learning opportunities. To improve quality, institutions must prioritise robust campus networks, reliable power backups, affordable broadband partnerships, and capacity-building programmes for faculty and technicians. Public–private collaborations, localized content in regional languages, and community digital centres can bridge access gaps. Addressing these infrastructure and skill challenges will be essential to transform ICT from an occasional tool into a dependable enabler of inclusive, quality higher education in these regions. Sustained funding and policy support.

6. Recommendations

Recommendations for Improving ICT Infrastructure in Higher Education Institutions in Tier 3 Cities of Maharashtra (Jalgaon, Dhule & Nandurbar)

- **Strengthen internet and power reliability** – Secure affordable high-speed internet connections and integrate solar energy with UPS systems to minimize downtime.
- **Develop regional ICT resource centers** – Pool institutional resources to set up shared facilities with servers, virtual labs, licensed software, and centralized technical teams.
- **Enhance digital competency of faculty and staff** – Conduct regular training on e-learning platforms, cybersecurity, digital pedagogy, and online evaluation methods.
- **Use inclusive and adaptable digital platforms** – Select lightweight, mobile-friendly tools with offline capabilities to support students with limited connectivity or basic devices.
- **Establish clear governance and financial planning** – Create structured IT policies, dedicated maintenance plans, and separate budget allocations for ICT infrastructure.
- **Tap into external funding sources** – Pursue state/central government grants and industry partnerships to meet capital investment requirements.
- **Reduce the digital access gap** – Introduce device loan schemes, subsidized internet packages, and multilingual digital content to ensure equal opportunities for all learners.
- **Review and update periodically** – Implement monitoring mechanisms, collect feedback from stakeholders, and revise strategies to ensure sustainable and effective ICT development.

7. Conclusion

In conclusion, the current ICT infrastructure in higher education institutions across Jalgaon, Dhule and Nandurbar reflects a mixed picture of progress tempered by persistent gaps. While basic connectivity and digital learning platforms have been adopted—accelerated by pandemic-era exigencies—inconsistencies in bandwidth, frequent power disruptions, limited campus-wide Wi-Fi, aging hardware, and inadequate technical support constrain effective teaching, research and administration. Human-capacity issues—insufficient ICT training for faculty, low digital literacy among some students, and few dedicated IT staff—compound these infrastructural shortfalls. Financial limitations and uneven policy implementation at institutional and district levels further widen the urban–rural digital divide. These challenges blunt the potential of blended learning, e-governance and research collaboration, and risk marginalising students from disadvantaged backgrounds. Addressing them requires coordinated investment in resilient connectivity (redundant links, power backups), phased hardware upgrades, targeted faculty development, and locally tailored ICT policies that prioritise maintenance and sustainable funding. Strengthening partnerships with state agencies, industry and community stakeholders can accelerate capacity building and resource sharing. Future studies should evaluate the impact of specific interventions and measure learning outcomes post-implementation. With strategic, context-sensitive action, tier-3 institutions in Maharashtra can transform current ICT weaknesses into foundations for inclusive, quality higher education.

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