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India's Digital Trade Readiness: Evaluating Human Capital and Skilling Ecosystems in the Post-Pandemic Era

[1]Dr. Arti Verma, [2]Dr. Asif Iqbal, [3]Dr. Smita Verma, [4]Dr. Nidhi Singh, [5]Dr. Shubham Mishra

[1]Assistant Professor, Institute of Management Sciences

University of Lucknow, India

[2]Corresponding Authors

Assistant Professor

Institute of Management Sciences

University of Lucknow, India

[3]Assistant professor

ICCMRT, Lucknow, India

[4]Assistant Professor

IMS, University of Lucknow, India

[5]Assistant Professor

National P.G. College, University of Lucknow, India

Abstract

The COVID-19 pandemic accelerated India's digital transition, transforming trade processes, services delivery, and workforce competencies. As digital trade expands through e-commerce, fintech, digital public infrastructure, and cross-border digital services, human capital and skilling ecosystems play a decisive role in shaping India's competitiveness. This study evaluates India's digital trade readiness by examining workforce capabilities, digital literacy programs, skill development initiatives, and post-pandemic policy efforts. Using secondary data, government reports, and recent surveys, the analysis highlights progress in digital inclusion, online skill platforms, and youth participation in digital jobs. Findings suggest that while India demonstrates strong momentum through initiatives like Digital India, Skill India, and DigiSaksham, major gaps persist in advanced digital skills, cybersecurity talent, and rural-urban digital capabilities. The paper offers policy recommendations to strengthen digital skilling pipelines, foster industry-academia partnerships, and enhance global digital trade competitiveness in the post-pandemic era.

Keywords: Digital trade; Human capital; Digital skills; Post-pandemic India; Workforce readiness

1. Introduction

The accelerated digitalization triggered by COVID-19 has reshaped the global trade architecture, emphasizing digitally enabled cross-border commerce, remote service delivery, and digital supply chains. India, one of the fastest-growing digital economies, has witnessed substantial expansion in internet penetration, digital payments, and digital public infrastructure, positioning itself as a potential global leader in digital trade. According to MeitY and World Bank estimates, India's digital economy is projected to contribute nearly 20% of GDP by 2026, supported by platforms such as UPI, Aadhaar, and ONDC.

However, digital trade readiness extends beyond technology—it fundamentally depends on human capital. With a young workforce and rising e-commerce and IT-enabled services exports, India faces the dual challenge of scaling foundational digital literacy while simultaneously strengthening advanced digital capabilities such as AI, cloud computing, cybersecurity, data science, and digital compliance. The pandemic magnified this urgency, demanding re-skilling and digital workforce adaptability for global competitiveness.

This study evaluates India's human capital readiness for digital trade in the post-pandemic era, focusing on skilling, education reforms, workforce participation, and policy readiness. This research contributes by integrating post-pandemic workforce data, government skill initiatives, and digital trade policy analysis to develop a comprehensive lens on India's digital human-capital readiness.

Unlike existing studies that primarily examine India's digital economy expansion or general workforce digitization, this paper specifically evaluates digital trade readiness through the lens of human capital and skilling ecosystems in the post-pandemic context. The study integrates digital workforce trends, skilling infrastructure, inclusion challenges, and emerging technology capabilities to provide a multidimensional assessment of India's preparedness for global digital trade competitiveness.

2. Literature Review

Digital trade has emerged as a core pillar of global economic growth, driven by digital infrastructure, cross-border data flows, and technology-enabled services (OECD, 2022). Scholars describe digital trade not only as online goods exchange but also the exchange of digital services, intellectual property, fintech, digital logistics, and digitally delivered professional services (UNCTAD, 2023). Post-pandemic recovery studies emphasize that digital adoption accelerated dramatically, reshaping global value chains, remote work, and digital enterprise creation (World Bank, 2023).

Human capital and skilling play a decisive role in enabling digital trade competitiveness. According to the World Economic Forum (2022), economies that invest in digital skills witness higher productivity, innovation capability, and trade integration. Research in Indian context stresses that technology infrastructure alone is insufficient—workforce readiness and skill depth determine sustainable digital competitiveness (NITI Aayog, 2023; ICRIER, 2022).

India has implemented several national programs to strengthen digital skills and inclusion, such as Digital India, Skill India Mission, PMKVY, Digital Saksharta Abhiyan (DISHA), and the National Education Policy (NEP) 2020. Studies highlight significant progress in digital inclusion, youth skilling, and online learning adoption, supported by platforms like SWAYAM, NPTEL, Coursera, NSDC e-Skill India, and DigiSaksham (NSDC Report, 2023). However, research also identifies persistent skill gaps in areas such as AI, data science, advanced analytics, cybersecurity, digital trade regulation, and cloud computing (McKinsey, 2023; Nasscom, 2023).

Post-pandemic studies emphasize India's rising significance as a provider of remote digital services and gig-economy workers. India's IT-BPM sector has contributed significantly to exports, employing over 5 million people and supporting digital trade expansion (NASSCOM, 2023). However, barriers such as urban-rural digital divide, limited female workforce participation, variable digital literacy levels, and access inequalities are documented as major challenges (UNESCO, 2022; World Bank, 2022).

Emerging literature also highlights the need for industry-academia collaboration, demand-driven curriculum design, micro-credentials, and lifelong learning systems to keep pace with disruptive technologies (PwC, 2023). Research increasingly advocates for digital-first skill frameworks, public–private partnerships, and regulatory capacity building to shape India's role in global digital trade governance (CUTS International, 2023).

Existing literature indicates that digital competitiveness increasingly depends on the interaction between technological infrastructure and adaptive human capital systems. Studies on emerging economies suggest that countries with strong digital public infrastructure may still experience capability asymmetries due to uneven

advanced skill formation, institutional coordination gaps, and labour-market mismatches. Consequently, scholars argue that sustainable digital trade leadership requires continuous workforce reskilling, lifelong learning ecosystems, and innovation-oriented educational reforms.

This literature collectively suggests that while India possesses strong foundational digital infrastructure and demographic advantages, transformational skilling, inclusive workforce participation, and advanced digital capability development remain central to achieving long-term global digital trade leadership.

3. Theoretical Foundation

This study draws from human capital theory, which emphasizes knowledge and skill accumulation as drivers of productivity and economic competitiveness (Becker, 1964). It also aligns with digital trade theory, which highlights the importance of digital infrastructures, cross-border data flows, and digitally delivered services in shaping trade performance (OECD, 2022). Integrating these frameworks, the paper examines how digital capabilities and employment ecosystems influence India's digital trade readiness in a post-pandemic context.

The study also draws upon the Capability Approach proposed by Amartya Sen, which emphasizes individuals' ability to access opportunities and convert resources into meaningful economic participation. In the context of digital trade readiness, this perspective helps explain how disparities in digital access, education, gender inclusion, and regional infrastructure influence participation in digital economic systems.

4. Research Gaps

Despite growing literature on digital transformation and workforce development in India, several gaps remain:

- Limited studies linking digital skills directly with digital trade readiness rather than general digital economy growth.
- Insufficient post-pandemic evidence on how new skilling programs and online learning have influenced employability in digital trade sectors.
- Scarcity of research examining regional disparities in digital skills and digital workforce participation, especially in rural regions and Tier-II/III cities.
- Gender-specific digital skill challenges remain under-examined, particularly for women in digital gig work and emerging tech roles.
- Lack of integrated evaluation combining human capital, policy reforms, and industry demand to assess India's preparedness for global digital trade systems.

This paper addresses these gaps by synthesizing latest policy reforms, workforce capability trends, and skilling ecosystems relevant to digital trade competitiveness.

5. Research Objectives

Primary Objective:
To assess India's human capital readiness and skilling ecosystem for digital trade in the post-pandemic era.

Specific Objectives:

i. To analyze workforce digital literacy and employment trends in key digital trade-driven sectors.

ii. To evaluate the effectiveness of national digital skilling initiatives introduced or expanded post-pandemic.

iii. To examine regional and gender digital skill patterns affecting equitable digital trade participation.

iv. To identify advanced digital skill shortages (AI, cybersecurity, cloud, data science) affecting global trade competitiveness.

v. To propose targeted policy recommendations to strengthen India's digital trade talent pipeline.

6. Methodology

Research Design

This study adopts a descriptive and analytical research design using secondary data and comparative policy analysis.

The study employs thematic policy analysis and trend-based comparative assessment to interpret secondary datasets related to digital workforce development and trade readiness. Data triangulation was applied by comparing findings across government reports, international databases, and industry publications to enhance analytical reliability and minimize source bias.

Data Sources

- Government reports: MeitY, NITI Aayog, NSDC, Ministry of Skill Development & Entrepreneurship (MSDE)
- International databases: World Bank, OECD, WEF, UNESCO, UNCTAD
- Industry analyses: NASSCOM, McKinsey, PwC, ICRIER
- Academic articles and digital skills surveys
- Post-pandemic labor market and online learning statistics

Data Collection Method

The research uses secondary data collection from official databases, reports, conference papers, journal articles, and digital skill assessments (2020-2024).

Scope

- Post-COVID digital workforce trends
- National policies and skilling programs
- Labour force participation in digital sectors
- Rural-urban & gender digital skill divide
- Emerging tech talent pipeline

Limitations

- Relies on secondary data; new field data can enhance future studies
- Digital trade is evolving; datasets may reflect transitional developments
- Cross-country comparison is limited to global benchmarks, not deep bilateral analysis

7. Conceptual Framework

Digital Trade Readiness =Digital Infrastructure + Human Capital + Policy Ecosystem + Industry Demand + Inclusion & Access

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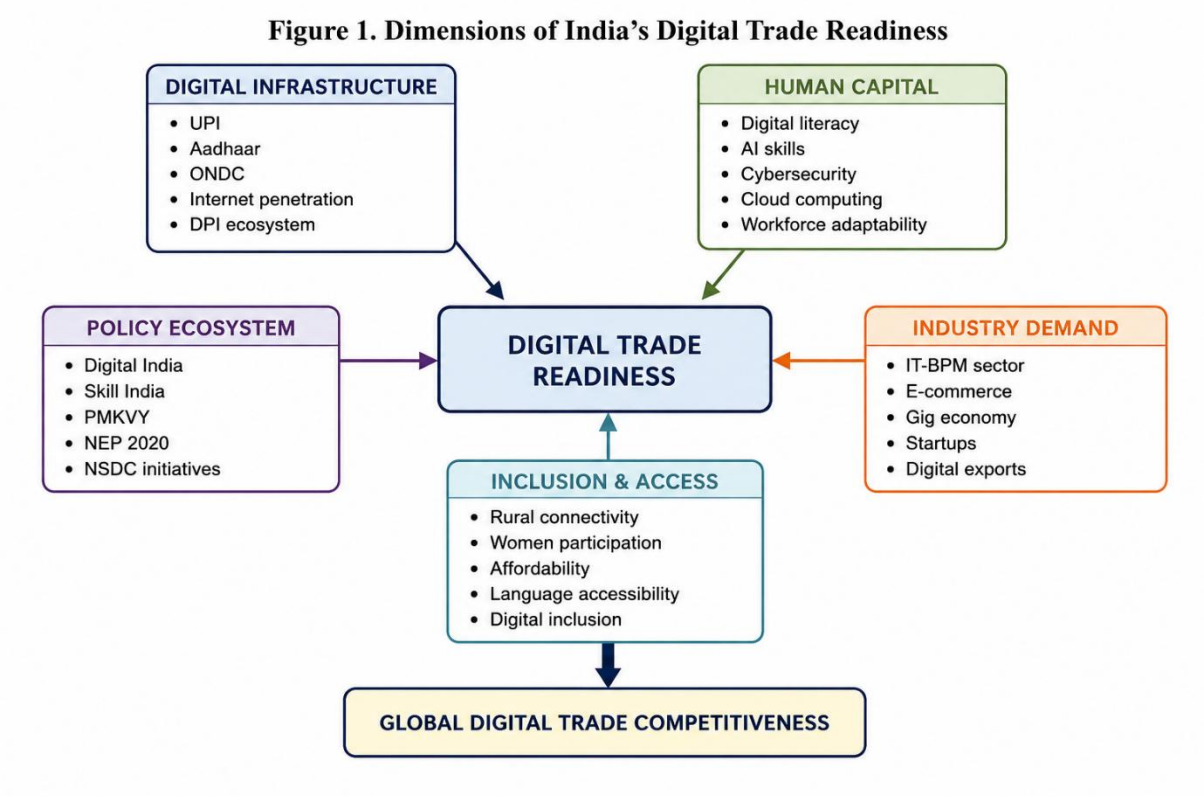
Key Indicators examined:

Figure 1: Dimensions of India's Digital Trade Readiness



Source: Developed by the author based on OECD (2022), NITI Aayog (2023), NSDC (2023), World Bank (2023), and related literature.

Table 1. Conceptual Framework for Digital Trade Readiness

Dimension	Key Elements
Digital Human Capital	Digital literacy, advanced tech skills, vocational training, online learning uptake
Skilling Infrastructure	Govt programs, industry platforms, training institutions, curriculum alignment
Inclusion	Female participation, rural–urban access, affordability, language & accessibility
Industry Readiness	IT/ITES workforce, digital gig economy, MSME digitization, startup ecosystem
Policy Support	NEP-2020, Digital India, Digital Trade Frameworks, NSDC initiatives, ONDC, DPI programs

8. Data Trends & Analysis

8.1 Growth of India's Digital Economy

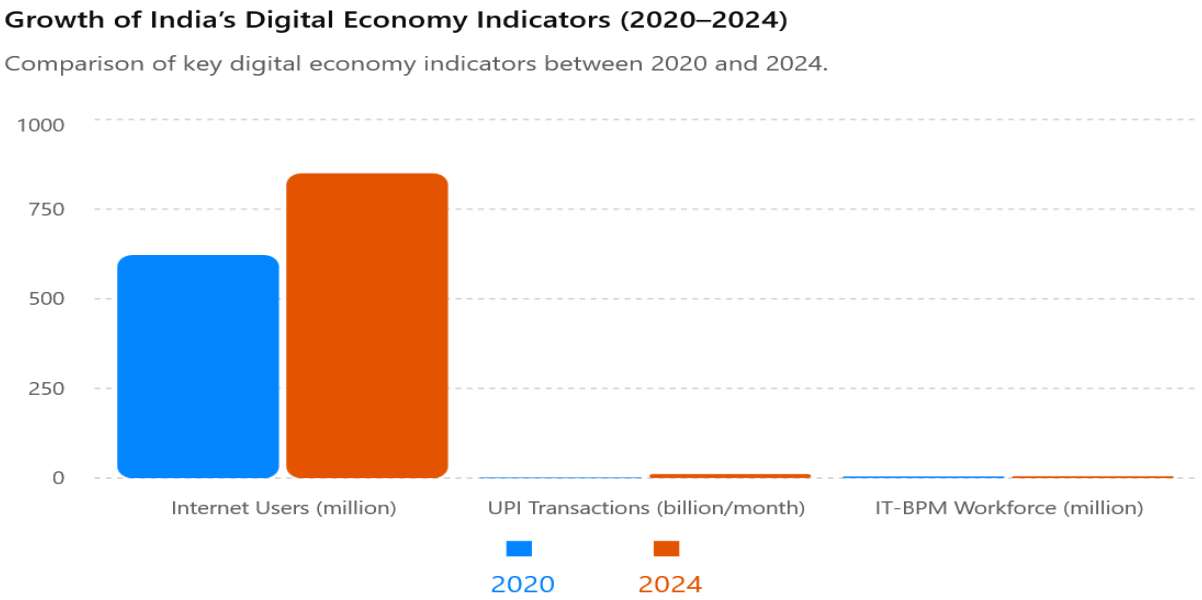
India has witnessed strong growth in digital adoption and online services post-pandemic. Government and industry assessments suggest the digital economy could contribute ~20% of GDP by 2026, compared to ~11% in 2020. Key growth drivers include digital payments, IT-BPM exports, e-commerce, ed-tech, and fintech.

Table 2: Digital Economy Growth Indicators in India (2020–24)

Indicator	2020	2023-24 Status	Trend
Internet users	~622 million	~850+ million	↑ Rapid expansion
Digital payment transactions (UPI monthly)	~2 billion	~10–12 billion	↑ 5x growth
IT-BPM workforce	~4.5 million	~5.4 million	↑ Skilled digital workforce
E-commerce share of retail	~4.7%	~7–8%	↑ Boost after COVID

Source: Compiled from *MeitY (2024), NITI Aayog (2023), World Bank (2023), and NASSCOM (2023)* reports on digital economy and ICT sector growth.

Graph 1. Growth of India's Digital Economy Indicators (2020–2024)



Source: Compiled from MeitY (2024), NITI Aayog (2023), World Bank (2023), and NASSCOM (2023).

India's DPI (Aadhaar-UPI-DigiLocker-ONDC) has become a global benchmark supporting MSMEs, freelancers, cross-border services, and digital entrepreneurship.

8.2 Digital Skilling & Workforce Readiness

Online learning surged during and after COVID-19, enabling skill access:

Table 3: Online Digital Learning Participation in India (Post-Pandemic)

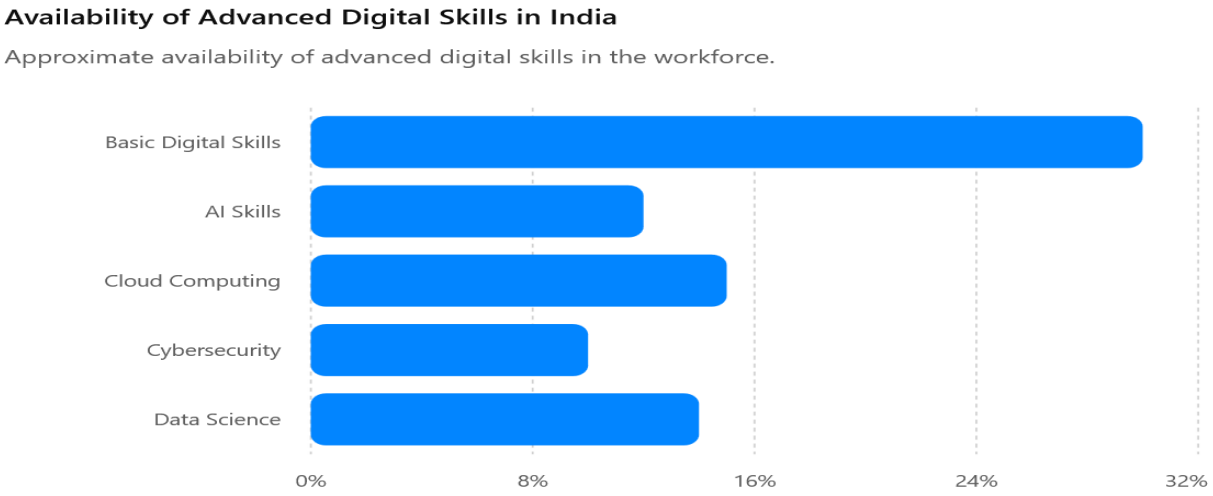
Platform/Initiative	Learners Engaged
SWAYAM/NPTEL	~2+ crore enrolments
Coursera/EdX India users surge	>2x growth post-pandemic
NSDC e-Skill India	>15 million trained
DigiSaksham (MSDE + Microsoft)	~11 lakh beneficiaries

Source: Data compiled from *NSDC (2023), Ministry of Skill Development & Entrepreneurship (2023), Coursera India Report (2023), and MeitY (2022)*.

However, skill depth gap persists:

- Only ~28–30% of India's workforce possesses basic digital skills
- Less than ~12% has advanced/industry-ready tech skills (AI/cloud/Cybersecurity)
- India needs ~3x more cybersecurity professionals to meet demand
- AI talent pool growing, but global competition remains intense

Graph 2. Availability of Advanced Digital Skills in India



Source: Based on NSDC (2023), NASSCOM (2023), and McKinsey & Company (2023).

8.3 Urban–Rural & Gender Digital Divide

Table 4: Urban–Rural and Gender Digital Access Indicators

Category	Urban	Rural	Insight
Internet penetration	High	Lower but rising	Digital Bharat momentum
Digital literacy	Relatively strong	Developing	Requires accelerated training
Female digital workforce share	~30%	Lower in rural regions	Gender gap in tech & gig work remains

Source: Based on *World Bank (2023), UNESCO (2022), NSO Household ICT Survey (2022), and NITI Aayog (2023)* datasets.

Women benefit from remote work trends, yet barriers include cultural constraints, broadband gaps, and limited access to advanced skill programs in small towns.

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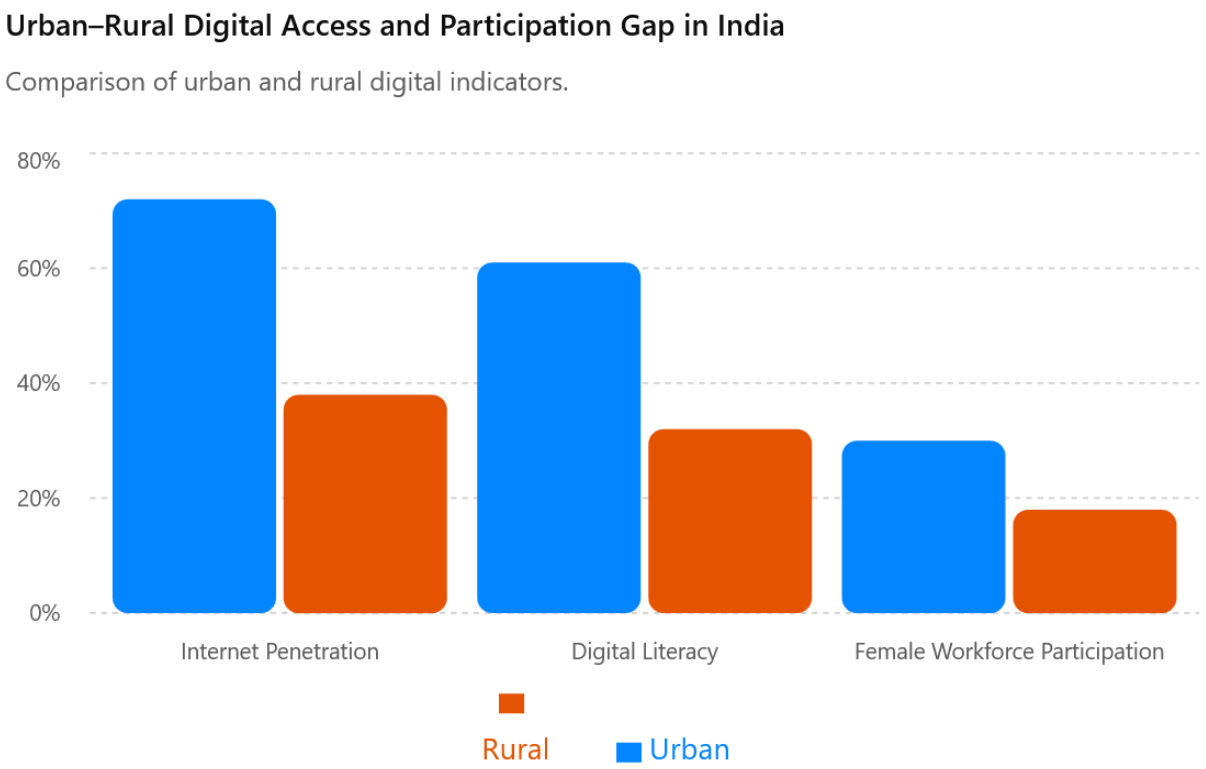
Graph 3. Urban–Rural Digital Access and Participation Gap in India



Source: Based on NSO ICT Survey (2022), UNESCO (2022), World Bank (2023), and NITI Aayog (2023).

8.4 Digital Employment & Gig Opportunities

Post-pandemic, India emerged as a leading global supplier of:

- IT-enabled services
- Remote business services
- Freelance tech workers
- Digital gig economy workers (content, design, coding, data labelers)

Gig workforce expected to reach ~23.5 million by 2030, supported by youth participation and platform-based work environments.

However, many workers operate in low-skill gig roles, highlighting the urgency for structured upskilling pathways.

8.5 Policy & Institutional Support

Major supportive reforms:

- NEP 2020 → digital curriculum, vocationalization, AI-ML training
- Skill India Mission, PMKVY 4.0 → job-linked skills, digital training focus
- ONDC → democratizing digital commerce for MSMEs
- National Digital India Skills Framework (2023) → future skills & certification focus
- Digital Trade policy dialogues → enhancing data governance & global digital integration

Despite progress, coordination challenges exist between education institutions, industry, and skilling agencies.

Summary of Findings

- India is progressing rapidly in foundational digital adoption and youth-driven digital participation.
- Strong digital infrastructure + young workforce = strategic advantage
- Major gaps remain in advanced digital skills, regulatory skills, and trade-tech capabilities.
- Rural-urban and gender divides persist, requiring targeted policy efforts.
- Private sector, academia, and government collaboration needs strengthening for future digital trade skill needs.

9. Discussion

India stands at a pivotal moment in its digital trade trajectory. The analysis indicates that strong digital infrastructure, youthful demographics, and growing online learning ecosystems have created a fertile environment for digital trade expansion. Public Digital Infrastructure (UPI, Aadhaar, ONDC) has democratized access, enabling MSMEs, startups, freelancers, and remote workers to participate in the global digital economy.

Yet, as global markets adopt AI-driven trade systems, cloud-based services, digital compliance norms, and cybersecurity frameworks, India's skilling ecosystem must shift from foundational literacy to advanced, job-ready digital capabilities. The talent gap in AI, cybersecurity, and cloud technologies shows that demand currently outpaces supply.

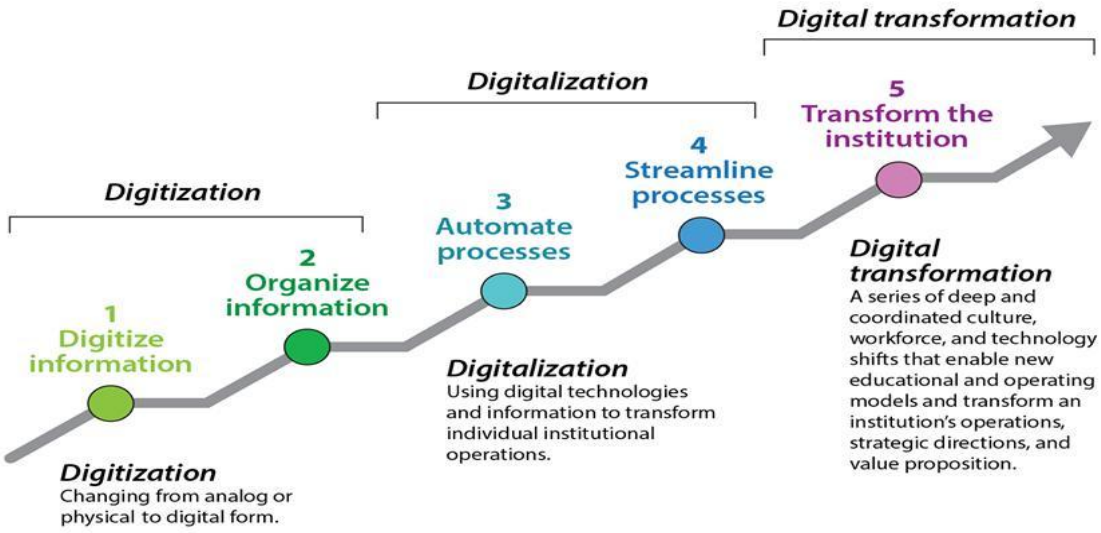
This reflects a structural mismatch between the pace of technological transformation and the responsiveness of conventional educational and training systems. While India has successfully expanded digital access and platform adoption, the transition from digital consumption to advanced digital capability creation remains uneven. As a result, India's digital trade ecosystem risks facing a shortage of globally competitive, innovation-oriented talent despite possessing significant demographic advantages.

Equity remains a challenge. Rural youth, women, and informal workers lag due to structural barriers, limited awareness, and access constraints. The pandemic enabled widespread remote learning, but digital opportunity still clusters in urban and IT-dominant regions. Moreover, industry requirements evolve faster than traditional academic programs, requiring agility and continuous learning frameworks.

India's policy push is strong, but alignment between government, industry, and academia will determine success. Integrated certification standards, industry-aligned curriculum, and skilling for digital trade compliance (data policies, digital IP, cybersecurity law) are emerging needs.

Compared with digitally advanced economies such as Singapore, South Korea, and Estonia, India demonstrates stronger scale advantages but comparatively weaker advanced digital skill intensity and institutional coordination. Bridging this gap will require long-term investments in specialized digital capabilities, regulatory readiness, and research-driven innovation ecosystems. Overall, India is digitally ambitious but skill-constrained, and the window to build global leadership in digital trade talent is now.

Figure 2. Post-Pandemic Digital Skill Ecosystem in India



Source: Author's framework based on secondary data and literature review.

10. Policy Recommendations

A. Strengthen Advanced Digital Skills Pipeline

- Expand AI, cloud, cybersecurity, and blockchain training under PMKVY & NEP
- Launch national **Digital Trade Skills Mission** aligned with global markets
- Incentivize digital apprenticeships and industry-led certification

B. Strengthen Industry–Academia Collaboration

- Sector Skill Councils to co-create job-ready curriculum
- University–corporate skill labs & virtual learning hubs
- Digital trade-focused MBA & vocational modules

C. Bridge Rural & Social Inclusion Gaps

- Rural digital skill labs through CSCs and ATLs
- Digital scholarships for women & rural youth
- Multilingual digital learning platforms & mobile-first modules

D. Innovations in Digital Employment Ecosystem

- Support gig worker skilling + digital worker welfare framework
- Enable MSMEs to access global e-commerce & digital services markets
- Promote export-ready digital freelancers & remote professionals

E. Digital Trade Governance & Regulatory Skills

- Develop training for data privacy, cross-border data flow rules, cybersecurity compliance
- Build India-specific **Digital Trade Certification Framework**

- Promote research hubs on digital economy policy & fintech trade

Table 5. Key Challenges and Strategic Policy Responses for India's Digital Trade Readiness

Challenge	Implication	Policy Response
Advanced skill shortage	Weak global competitiveness	AI/cloud/cybersecurity skilling
Rural digital divide	Uneven participation	Rural digital infrastructure
Gender gap	Low workforce inclusion	Women-focused digital programs
Industry-academia mismatch	Low employability	Industry-aligned curriculum
Cybersecurity talent deficit	Regulatory vulnerability	Specialized certification systems
Gig-work informality	Workforce instability	Digital labour protections

Source: Developed by the author based on literature review and policy analysis.

11. Conclusion

India has entered a defining phase of digital economic growth, driven by a tech-empowered population, robust public digital infrastructure, and an expanding services economy. Post-pandemic momentum has advanced digital learning and employment opportunities, but global digital trade leadership requires a future-ready talent ecosystem.

India must now deepen advanced skill development, strengthen industry-aligned learning, and expand inclusion pathways. With strategic investment in digital skilling, academic–industry cooperation, and regulatory capacity building, India can position itself as a global hub for digital talent and cross-border digital services in the coming decade.

India's transition from a digitally connected economy to a globally competitive digital trade power will depend not merely on technological expansion, but on its ability to cultivate adaptive, innovation-oriented, and globally deployable human capital. In the coming decade, strategic investments in advanced digital skills, inclusive workforce participation, and institutional coordination will determine India's position within the evolving architecture of global digital trade.

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