PREPARING STUDENTS FOR INDUSTRY 5.0 WITH A FOCUS ON ESSENTIAL SKILLS AND CURRICULUM REFORMS IN INDIA

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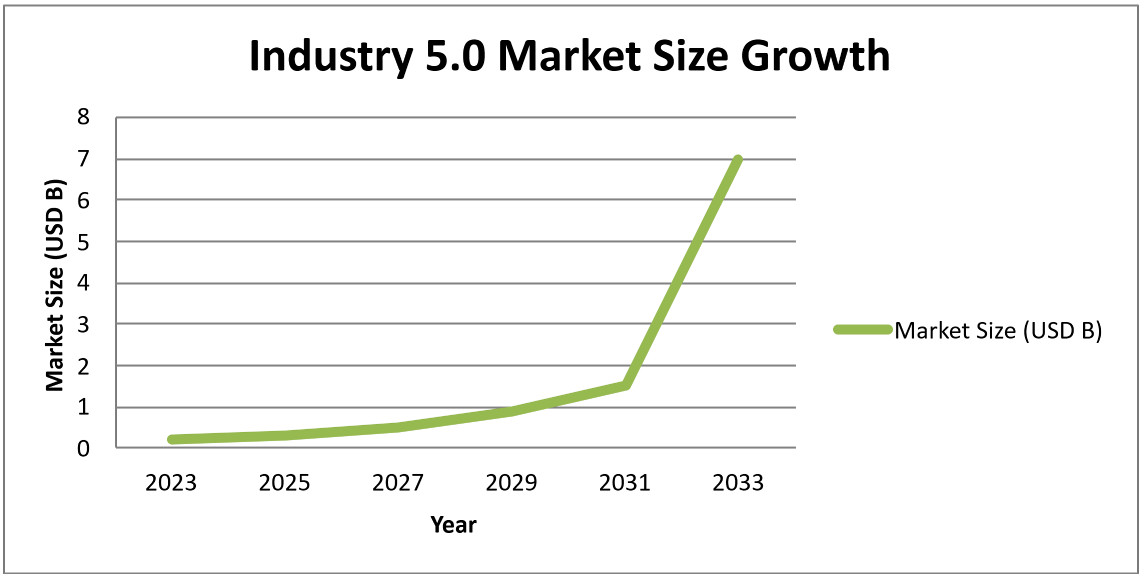
Abstract

Industry 5.0 represents a paradigm shift in the automation-focused approach of Industry 4.0 to a human-focused model where cooperation between intelligent machines and human operators is of primary concern. The current study aims to conduct an extensive analysis of how ready India is to undergo this transition through an evaluation of the existing educational reforms in India, skills-building programs, and the curricular changes that will be necessary to prepare students to enter the future workforce. It concludes that despite the country making major progress with initiatives like National Education Policy 2020 and a slew of skills-development initiatives, there is still a lot to be desired in terms of infrastructure, faculty training, and the quality of collaboration between academic institutions and the industry. As 93 % of Indian manufacturers already implement Industry 5.0 to ensure sustainability and revenue growth, and the global Industry 5.0 market is expected to reach USD 673.18 billion by 2032, it is critical to accelerate the transformation of Indian education to leverage the demographic dividend. Through a combination of theoretical, demographic, policy and technological insights, the paper provides a future-oriented evaluation of the preparation of India to Industry 5.0, including specific curriculum, pedagogical, and institutional capacity reforms through policy analysis, example cases, and skills-gap analysis.

Keywords: Industry 5.0, Educational Reform, Skill Development, Human-Machine Collaboration.

1. Introduction

Industry 5.0 represents a paradigm shift in the manufacturing and industrial system, dramatically changing the human-technology interface at the paradigm level [1, 6]. Unlike the previous Industry 4.0 that emphasized automation and productivity, Industry 5.0 lays focus on human-machine partnerships, sustainability, and individuality [7, 8]. Such a transitional framework requires the development of industrial workforces that consider interdisciplinary skills, emotional intelligence, and the ability to symbiotically interact with the new technologies of artificial intelligence, robotics, and the Internet of Things [6, 9].

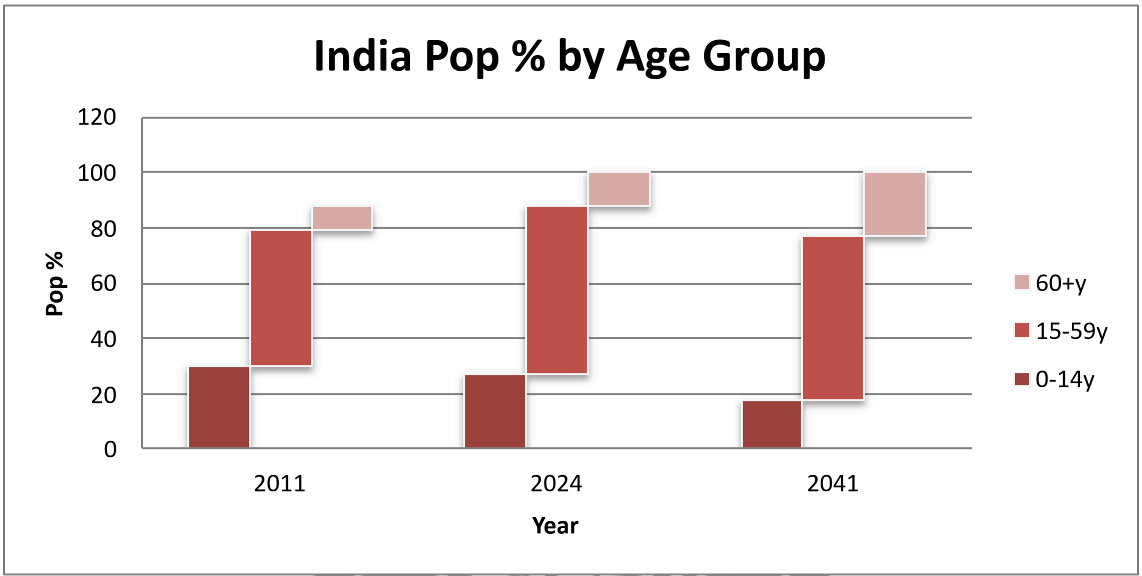


GRAPH 1: GLOBAL INDUSTRY 5.0 MARKET SIZE PROJECTIONS (2023-2032)

Source: https://www.prnewswire.com/news-releases/industry-5-0-market-to-reach-637-4-billion-globally-by-2032-at-17-3-cagr-allied-market-research-302081768.html?

Considering the strong demographic dividend and growing industrial base in India, the country has a particularly urgent need to prepare its future workforce to undergo a major shift. The population of the working age group (15-64 years) has surpassed the dependent population since 2018 and the estimates indicate that more than 800 million people will form the labour force by 2030[10]. To recognize this demographic advantage, however, requires thorough educational reforms and skills development programmes that align with the Industry 5.0 needs [12,11].

The NEP 2020 will be the most ambitious attempt of India to reimagine its education system, with a focus on multidisciplinary learning, digital literacy, and experiential learning [3,13]. At the same time, programs like the Pradhan Mantri Kaushal Vikas Yojana (PMKVY) and the Atal Innovation Mission have been initiated to reduce the existing skills gap and foster innovation among students [4,14]. Despite these efforts, there is still substantial room to improve in areas of implementation, expansion of infrastructure, and the more general industry-academia cooperation [15,16].



GRAPH 2: INDIA'S DEMOGRAPHIC TRANSITION (2011-2041): AGE GROUP DISTRIBUTION

Source: https://en.wikipedia.org/wiki/Demographics_of_India

Methodology:

The current discussion utilizes a descriptive-analytical approach by integrating information available in Government policy reports, industry white papers, scholarly literature, and programmatic evaluations. Triangulation of secondary sources of information was used to gain an insight into the India preparedness towards Industry 5.0.

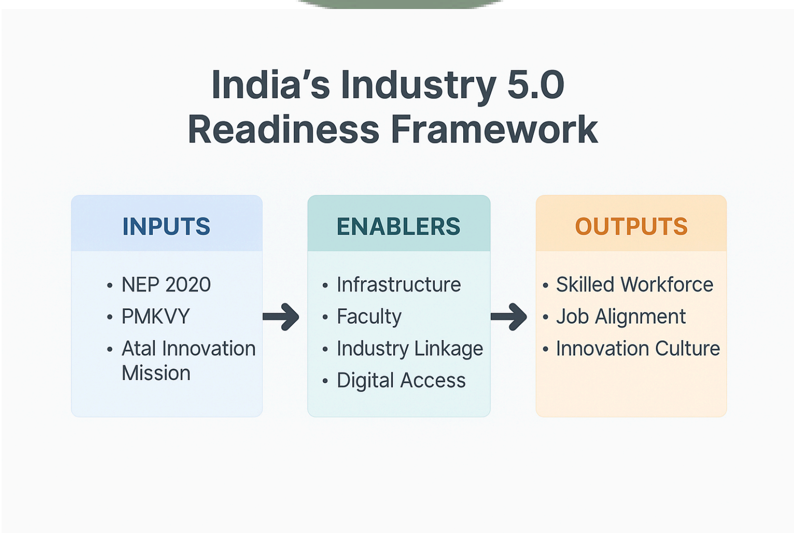


FIG 1: CONCEPTUAL FRAMEWORK FOR INDIA'S EDUCATIONAL TRANSFORMATION TOWARD INDUSTRY 5.0

2. Understanding Industry 5.0: The Human-Centric Revolution

The current research employs the socio-technical system theory, which emphasizes interdependence between people and technology in complex environments. This conceptual framework explains that Industry 5.0 must be viewed as a human-technology symbiosis instead of a purely technological evolution. Industry 5.0 proponents promote human-machine collaboration, which involves overcoming the automation-driven approach of Industry 4.0 [6, 17]. Three principles that characterize the paradigm are human-centricity, sustainability, and resilience [1, 8]. Although machines continue to excel in performing routine duties and processing data, human beings have uniquely invaluable abilities, such as creativity, empathy, ethical thinking, and solving complex problems [6, 9].

The Industry 5.0 market has a strong growth potential at the global level, with a projected industry size of USD 58.15 billion in 2023 and an expected value of USD 673.18 billion by 2032, representing a compound annual growth rate of 15.63 % [5]. This exponential growth is mostly driven by the increasing consumer demand to receive personalized products, use sustainable production methods, and implement state-of-the-art technologies, including collaborative robots (cobots), artificial intelligence, and digital twins [5][6].

The implementation of Industry 5.0 has gained significant traction within the Indian context, in the manufacturing industries. According to a detailed survey conducted by PwC, 93 percent of Indian manufacturers are adopting Industry 5.0 to achieve sustainable operations and generate 2-3x profitable growth over the next three to five years. The report also shows that more than 50 percent of manufacturers are increasingly investing in renewable energy, energy-efficient practices, and digital technologies to scale up operations [1][8].

A human-machine collaboration is one of the core aspects of Industry 5.0 and can be illustrated through a range of case studies across industries. One example is Ford, which has managed to implement collaborative robots in its production lines and has achieved a 50 percent increase in manufacturing efficiency and also allowed human workers to focus on more intricate assembly and quality control work. Similarly, BMW has introduced augmented reality systems to support employees in intricate assembly, resulting in a 20 % decrease in assembly time and in the quality of the products produced [9].

3. India's Demographic Advantage and Workforce Characteristics

The demographic landscape of India presents a unique context of the future spread of Industry 5.0. This demographic trend has created a favourable age structure; in 2024, 62 % of the population will fall within the working-age bracket (15-59 years), compared to 48 % in 2011[10]. It has been estimated that this demographic dividend will peak around the year 2041, when the proportion of the population that is in the working age will be 59 % [10].

India has a unique demographic asset, with a longevity of five decades covering 2005 06 to 2055 56- much longer than the same period in any other country [10]. In this long-term perspective, India will be able to achieve a long-run competitive advantage, as long as the human capital needed to do so is properly mobilized by means of particular educational and skills-formation policies [11].

Despite this opportunity, there are several obstacles that make the process of optimizing the demographic dividend problematic. Data collected by the National Skill Development Corporation in 201920 approximated 29 million skilled-worker vacancies in India [12]. In spite of the comparatively high labour force, aggregate unemployment has been close to 8 %, and youth unemployment, 12.4 % in 2022, is more than a decade higher than adult unemployment [12][11].

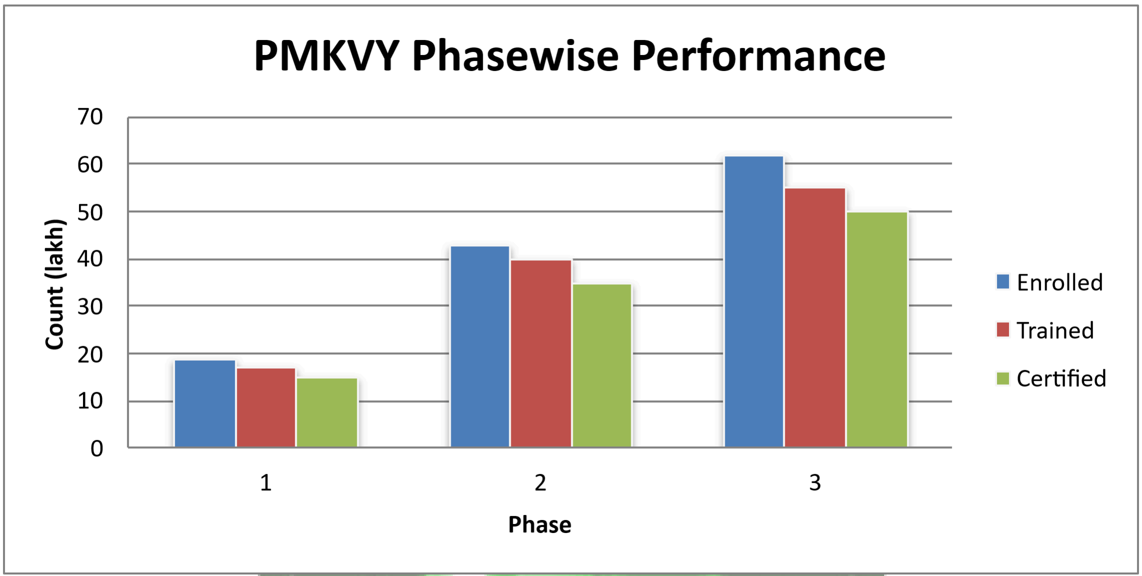
These difficulties are compounded by labour force composition. Nearly 82 % of workers hold jobs that are underemployed, which highlights the importance of implementing holistic measures that incorporate structural labour-market rigidities [12]. Moreover, the current low rate of women accessing the labour market, 37 % in 2023, against 19.7 % in 2011[10][11], underscores the urgency of gender-sensitive educational programs in STEM fields, alongside mentorship and incentive programs to target female students who choose technical careers.

All of these indicators verify the necessity of strong educational reform and continuum-wide skill-building to prepare the Indian workforce to meet the requirements of Industry 5.0.

4. Current State of Skill Development in India

The last 10 years have witnessed a significant change in the skill development scenario in India. To overcome the skill gap, a variety of government schemes have been launched, with the most obvious one being Pradhan Mantri Kaushal Vikas Yojana (PMKVY), which was unveiled in 2015 and became the core flagship program on skill development, expecting to educate millions of young people in different fields.

The PMKVY data review demonstrates both a success and a challenge record. Throughout four subsequent stages of program implementation, enrollment, training, and certification levels have fluctuated. Attrition is seen at each step, and placement is a major hurdle.



GRAPH 3: PMKVY PERFORMANCE ACROSS DIFFERENT PHASES - ENROLLMENT TO CERTIFICATION PIPELINE

Source: https://www.data.gov.in/resource/district-wise-enrolled-trained-assessed-certified-placed-under-pmkvy-21-april-2022?

The statistics of post training placement rates during the consecutive stages of the Pradhan Mantri Kaushal Vikas Yojana (PMKVY) support the persistent challenge of converting skills development into job-related results. In the initial cycle (PMKVY 1.0), the placement rate was 18.4 % which was marginally increased to 23.4 % in the second cycle (PMKVY 2.0) and 28 % in the third cycle (PMKVY 3.0). The latest scheme, PMKVY 4.0, has abandoned the reporting of placement data, further complicating any evaluation of its success in creating employment.

Simultaneously, there is a significant change in the dynamics of training modalities. The number of formal, institution based vocational programmes has increased only slightly, 1.8 % in 2017 to 4.1 % in 2023. In comparison, hereditary, self-learning, and on-the-job modalities have shown a staggering rise: hereditary training increased by 7.15 percentage points to 11.6 % between these two periods, self- learning increased by 5.43 percentage points to 7.1 %, and on-the-job increased by 7.26 percentage points to 9.3 %.

TABLE 1: COMPARATIVE ANALYSIS OF TRAINING TYPES IN INDIA (2017–18 VS 2022–23)

Training Type	2017-18 (%)	2022-23 (%)	Change (%)
Formal Training	1.8	4.1	2.3
Hereditary (Non-Formal)	1.45	11.6	10.15
Self-Learning	1.67	7.1	5.43
On-the-Job	2.04	9.3	7.26
No Training	92.59	65.3	-27.29

Source: https://idronline.org/article/livelihoods/skill-development-in-india-the-facts-behind-the-figures/?

The statistics presented indicate that there has been a significant change in the share of pathways to skills acquisition, whereby recognition of prior learning (RPL) has become one of the key determinants that have led to the witnessed increase in the extent of training [16].

5. National Education Policy 2020: Framework for Transformation

The National Education Policy 2020 is the most holistic education reform plan in India, which is aimed at overhauling the entire education system, including both the foundational and higher education sectors. It adopts a 5+3+3+4 system which replaces the conventional 10+2 system, focusing on holistic development and multidisciplinary learning and integration of skills at an early age.

Implementation of the NEP 2020 has been marked by a number of accomplishments. The PM SHRI (PM Schools for Rising India) scheme has identified 6448 schools to be upgraded, and the first instalment of Rs. 630.11 crore has already been released to 6207 schools in 27 states and union territories. The Samagra Shiksha Scheme has been thoroughly synchronized with the NEP 2020 recommendations, and its financial outlay is Rs. 2,94,283.04 crore.

TABLE 2: KEY ACHIEVEMENTS UNDER NEP 2020 INITIATIVES

NEP 2020 Initiative	Achievement	Unit	Status

PM SHRI Schools	6,448	Schools Selected	Ongoing
ATL Labs	10,000+	Labs Established	Achieved
Digital Literacy Beneficiaries	742	Lakh Beneficiaries	Achieved
Samagra Shiksha Budget	2,94,283	Crore Rupees	Allocated

Source: https://www.pib.gov.in/PressReleasePage.aspx?PRID=1988845

The NEP 2020 digital literacy framework has shown significant progress with the National Digital Literacy Mission enrolling over 7.42 crore beneficiaries to date in the 2023-24 fiscal year, up by around six times the initial enrolment of 1.18 crore in 2017-18[20]. Similarly, the overall number of certified participants has increased since it was 0.65 crore in 2017-18 and is now 4.83 crore in 2023-24, which proves the successfulness of the programme implementation [20].

However, a range of issues still hinders the implementation of the programme in several aspects [15]. Constant dearth of resources, the continued requirement of holistic faculty training and lack of adequate physical infrastructure, particularly in rural and semi-urban settings constrains the successful implementation of programmes [15]. Shifting the instructional models to multidisciplinary, technology-integrated models requires a lot of capacity building and institutional change management [15].

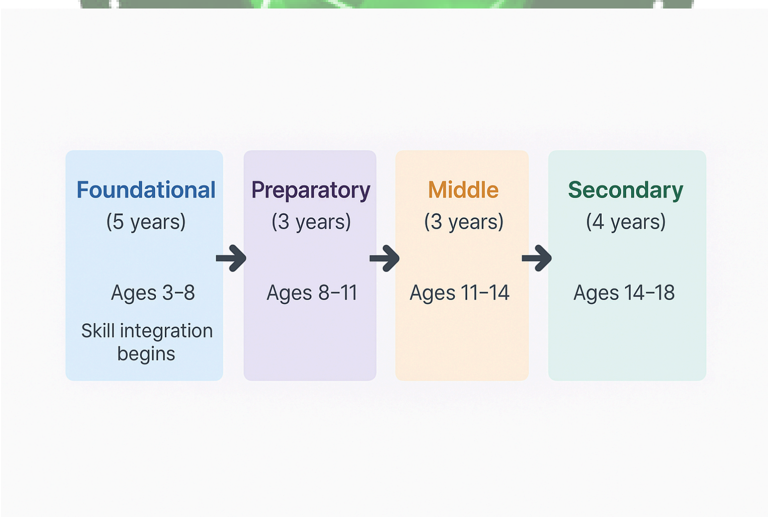


FIG 2: STRUCTURAL SHIFT IN INDIAN EDUCATION UNDER NEP 2020

6. Atal Innovation Mission: Fostering Innovation Culture

Atal Innovation Mission (AIM), initiated by NITI Aayog, has become a crucial tool in developing an innovation- and entrepreneurship-driven mindset among students [14][19]. The intervention by AIM is structured around a number of programmatic elements, with the most notable of these being the Atal Tinkering Labs (ATLs) program, which seeks to promote school-based innovation [14][21].

The scale of ATL has been significant, with over 10,000 labs having been set up in 35 states and union territories, thus covering 722 districts [14][19]. These centers serve more than a million students with an emphasis on practice-based Science, Technology, Engineering, and Mathematics (STEM) education [14]. Additionally, AIM has a strong sense of inclusivity; 96% of ATLs are located in government or government-aided schools and 96% operate in girls-only or co-ed schools [14].

The ATL framework embraces a four-level tinkering continuum, which guides learners through the process of generating ideas to prototyping [19]. Such continuum is characterized by design thinking and ideation on preliminary problem exploration, concept development to acquire new technologies, prototyping and physical computing that allows practical fabrication, and team-based inquiry in developing projects [19]. The labs are similarly equipped with modern tools like 3D printers, robotics kits, electronic components, and computers thus supporting experiential learning [21].

In addition to the ATLs, AIM also runs Atal Innovation Centres (AICs), which aim to empower the startup ecosystems, Atal New India Challenges (ANIC) addressing critical national problems, and Mentor India (MI) offering mentoring opportunities to budding innovators [22][21]. All these elements together have led to the development of hundreds of innovation projects; students have developed solutions in fields as diverse as healthcare, agriculture, and environmental sustainability [14].

7. Industry-Academia Collaboration: Bridging the Gap

The importance of industry-academia collaboration has become a central tenet in the preparation of future graduates to serve the needs of the Industry 5.0. Such collaborations in India have seen a significant acceleration in the past decade, which has been driven by government programs, emerging industrial needs and high-paced technological advancement.

Industry-academia partnerships have been supported heavily by the government. In the 2022-23 fiscal year alone, about Rs. 500 crore was approved by the Department of Science and Technology as matched funds to support joint academic-industry research projects. As a result of these budgetary provisions, more than 100 of these new products and technologies have been developed in India over the past three years.

The collaborative models vary both in number and quality across institutions and sectors. These are exemplified by the industry-integrated curriculums like AKTU Credit

Accumulation System (CAS), and the consortia like the RVCE and BMS with different industries. The aim of these arrangements is to match academic curriculum with industry demands, provide students with industry-related exposure and transfer knowledge between academia and industry.

Successful examples of human and machine collaboration in industrial settings present valuable insights on how to prepare educationally. A good example is DHL, which has introduced automated guided vehicles in warehouses, leaving humans to focus on more complicated tasks like inventory control and customer service, a move that has yielded a 30 percent decrease in operational expenses. Such case studies can be analyzed to inform curriculum development and allow students to understand the practical use of the principles of Industry 5.0.

8. EdTech Revolution and Digital Transformation

The Indian EdTech industry has experienced a significant growth, with COVID-19 pandemic being a major driver. The market size has been increasing, moving at a compound annual growth rate of 28.7%, with growth in 2020 reaching USD 2.8 billion and a projected growth to USD 33.2 billion in 2033[24]. This growth can be explained by the replacement of traditional teaching methods with digital and online educational platforms [24].

The digitalization of education has been impressive, with the penetration of digital educational tools increasing to over 70 % by 2022[25]. The leading EdTech companies have seen significant growth; Byju has grown its user base to over 150 million as of 2023 as compared to 45 million in 2019[24][25], and others like Unacademy and Vedantu have shown exponential growth over this time period [25].

Adoption trends reflect significant urban-rural gaps: 90 % of urban students took advantage of digital learning tools during the pandemic, and 40 % in rural settings [25]. Sixty-five percent of higher education institutions in India have adopted Learning Management Systems (LMS) such as Google Classroom and Microsoft Teams [25].

Other major factors contributing to the adoption of EdTech are the government policy like National Education Policy (NEP) 2020, and the Digital India Initiative, and economic considerations like affordability and accessibility. Growth has been supported by technological advances as well, such as AI-based learning systems and virtual laboratories [25]. Technical skills have also been developed in a massive way among the students: NASSCOM reported that 70 % of the Indian students enrolled in the online courses develop good technical competencies [25].

Global Context:

Within analytical discussions regarding the preparation of workforces, the dual-vocational systems embraced by Germany and Japan, and their strong university-industry connections are noted as examples to be considered. The transition of Germany to Industrie 5.0, which has been promoted by human-centred digital apprenticeships, covering cognitive, emotional, and physical aspects of competence-building, is particularly notable.

TABLE 3: COMPARATIVE READINESS FOR INDUSTRY 5.0 (INDIA VS GLOBAL LEADERS)

Country	Vocational Integration (%)	Digital Literacy Rate (%)	Industry-Academia Link Score (1–5)	Industry 5.0 Implementation Rate
Germany	80%	94%	4.5	High
Japan	72%	96%	4.7	Medium-High
South Korea	70%	98%	4.8	High
India	**3%**	**61%**	**2.8**	**Emerging**

Source: https://digital-skills-jobs.europa.eu/en/actions/national-initiatives/national-strategies/germany-digital-strategy-2025?

9. Skills Required for Industry 5.0

The concept of Industry 5.0 requires a combined skill set that combines technological expertise and a heavy emphasis on human-centric service delivery. These skills can be grouped into five major categories: technical and digital expertise, cognitive and problem-solving abilities, the soft skills and emotional capabilities, entrepreneurship and innovation, and the lifelong learning skills.

Technical and digital skills include skills in artificial intelligence/machine learning, data analytics, the Internet of Things, cybersecurity, and cloud computing. The Indian market is in particular need of AI-related skills: 42 percent of generative AI jobs necessitate machine-learning skills, and 40 percent necessitate Python programming expertise. They are also accompanied by artificial-intelligence core skills (36 %), natural-language processing (20 %), TensorFlow (19 %), and data science (17 %) as the other in-demand technical skills.

TABLE 4: TOP IN-DEMAND AI SKILLS AND JOB REQUIREMENTS

AI Skills in Demand	Percentage of Jobs Requiring
Machine Learning	42%
Python	40%
AI Core Skills	36%
Communication Skills	23%
Natural Language Processing	20%
TensorFlow	19%
Data Science	17%

Source: https://www.businessinsider.com/new-job-build-ai-skills-help-change-roles-employers-hiring-2025-1?

Cognitive/problem-solving ability includes creative problem solving, critical thinking, and complex reasoning skills, which are essential to effective interaction with AI systems and to decision making in human-machine collaborative environments [2][6]. Although the abilities to interpret the outputs of AI, derive contextual insights, and make ethical decisions remain uniquely human, the skills of teamwork, communication, empathy, and flexibility, collectively referred to as the so-called soft skills, have become central in Industry 5.0[2][6]. These qualities enable positive interaction between humans and machines and are essential in jobs that demand human control over automated processes [6][9].

FIG 3: SKILL PILLARS FOR INDUSTRY 5.0 – COMBINING HUMAN-CENTRIC AND TECHNICAL COMPETENCIES

10. Current Challenges and Barriers

Cutting across the historical backdrop of educational reform and the present landscape of skill-development programmes, India is grappling with an array of issues in preparing its students to meet the needs of Industry 5.0. The most significant barriers include infrastructural shortcomings and a lack of faculty: poor laboratory resources, access to modern equipment, and continuously low teacher-to-learner ratios reduce the efficiency of programme delivery. In addition, the gap between the industry and the academia remains acute, with low levels of employer satisfaction with graduate preparedness and partnerships between businesses and higher education institutions underdeveloped. In a recent survey, it has been found that a significant percentage of recruitment managers are of the view that fresh graduates are not sufficiently equipped to meet the demands of the industry, particularly within the realms of new technology.

Rural-urban inequality is also a very substantial obstacle, as there is unequal access to high-quality education and online infrastructure. While urban areas have reached high digital-learning adoption rates, rural areas are far behind, with only 40 percent of students having access to digital-learning tools in comparison to 90 percent in urban settings.

Moreover, there are deep-rooted psychological obstacles to increased access to vocational training and skills-based programmes. These career routes are often considered to be alternative to mainstream academic career paths as opposed to equivalent to them. The participation rate in vocational upper-secondary programmes is 3 % which is significantly lower than the international standards and the distribution of these programmes is also very sparse: about 6 800 schools currently offer 400 000 students access to a vocational programme using only 40 % of the full capacity that was allocated to vocational education.

At the same time, the demands of implementation that are unique to Industry 5.0 present further challenges. These can be the requirement to invest heavily in technological infrastructure, the exposure to a greater risk of cyber-security due to the greater connectedness, and the complexity of regulatory frameworks governing highly automated systems. The shift in modern manufacturing towards Industry 5.0 requires a complete organisational transformation and long-term training programmes.

11. Recommendations for Curriculum Reform

Moving toward Industry 5.0 requires a comprehensive overhaul of the curriculum that involves various disciplinary aspects [2][13]. STEAM (Science, Technology, Engineering, Arts, and Mathematics) aspects and AI modules, as well as digital literacies, social sciences, and ethics, must be integrated into all levels of education [2][13].

Pedagogies based on experience and projects must take center stage, prioritizing hackathons, internships, and laboratory-based classes that provide a first-hand experience of working with new technologies [2][13]. Special emphasis should be placed on real-world problem-solving and collaborative activities that reflect Industry 5.0 workplace arrangements [13].

More industry immersion programs should be created, including guest lectures by practitioners, uniform apprenticeships, and lab partnerships with manufacturing organizations [2][23]. These types of arrangements should introduce learners to real-world Industry 5.0 implementations and examples of human-machine collaboration [23][9].

At the same time, strong teacher professional development and capacity building are essential preconditions to curriculum reform [2][15]. Such wide-ranging fellowships and specialized AI/ML educator training pathways are thus essential, allowing faculty to teach to Industry 5.0-related subject matter and using pedagogies designed to work in human-centric technological conditions [15].

Infrastructural investment and policy must focus on increasing the infrastructure of smart classrooms and ATL to cover underserved areas [2][14]. Areas of priority should be increased connectivity, the implementation of modern equipment, and the integration of sustainable technological solutions that will support long-term educational change [14][19].

Case Study:

In the academic year 2018 19 at Indian Institute of Science Education and Research (IISER), a group of students developed a sustainable robotic arm in the context of an industry 5.0 project. Such a project can highlight the transformative potential of project-based learning embraced with the principles of human-machine collaboration.

12. The Path Forward: Strategic Recommendations

Industry 5.0 requires the coordinated action of a wide range of stakeholders operating on diverse timeframes to prepare India. Programs like carlation of Sector Skill Councils and

MOUs between educational institutions and industry are critical in ensuring the alignment of curriculum and that the student receives both theoretical and practical exposure.

The process of expanding access to vocational education demands addressing the existing misconceptions about the benefits of vocational education and improving the quality of vocational programmes and learning outcomes. The introduction of vocational expertise at a young age and its systematized combination with academic studies is essential in the normalization of skill-based career paths and the enhancement of employment opportunities.

There is a need to restructure assessment paradigms towards portfolio-based and competency-oriented assessment, instead of the examination-only approach, as it is more reflective of the demands in Industry 5.0 environments. An assessment framework should be made up of simulation-based testing, design challenges, and collaborative performance rubrics allowing students to show competency in both technical and soft skills required in modern workplaces.

To ensure sustained compatibility between the NEP 2020, skills development missions, and industry needs, it will be necessary to have a system of review and adaptation mechanisms that pay special attention to annual monitoring of changing skill needs based on industry input. This feedback loop will aid in the revision of curriculum and programme adjustments.

It is crucial to build a lifelong learning ecosystem, which includes MOOCs, Recognition of Prior Learning (RPL) and the National Skills Qualifications Framework (NSQF) to enable continuous skill building across career lives. This type of ecosystem should be able to support the high-speed technological evolution that is characteristic of Industry 5.0.

TABLE 5: INTEGRATED STRATEGY ROADMAP FOR PREPARING A FUTURE-READY WORKFORCE

Strategy Area	Key Action	Stakeholders
Curriculum Reform	Embed AI, STEAM, ethics	MoE, UGC, NCTE
Industry Integration	MOUs, apprenticeships, labs	MSMEs, MHRD, Start-ups
Digital Infrastructure	Expand ATLs, smart classrooms	Central & State Govts
Faculty Development	AI fellowships, pedagogical training	Universities, EdTechs
Assessment Reforms	Project-based and simulation evaluations	CBSE, NCERT

Source:
https://www.education.gov.in/shikshakparv/docs/Examination_and_Assessment_Reforms.pdf
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13. Conclusion

Industry 5.0 is not merely a small technological improvement, but a fundamental re-evaluation of the nexus between human and machine in the industrial and educational context. This paradigm preparation in India requires extensive reforms at the level of curriculum design, skills development, investment in infra-structural resources, and cultural adjustment.

India has an enormous demographic dividend- forecasted to include more than 800 million working-age citizens by 2030[10]. The fulfillment of this promise depends on a systemic change to education to prepare learners to engage in collaborations based on human-centered technologies.

Recent programs, especially NEP 2020, PMKVY, and Atal Innovation Mission have already laid significant groundwork, but their execution needs to be faster and constantly re-examined. Technical expertise alone will not suffice Industry 5.0 success, as it will require not only strong industry academia collaborations, but also the incorporation of human-focused skills [23][26].

The need to transform the education sector is urgent, with 93 percent of Indian manufacturing companies already adopting the principles of Industry 5.0 and the global market set to reach USD 673.18 billion by 2032[1][5]. The competitiveness of the future will depend on producing graduates who are able to interact fluidly with emerging technologies, but who also bring uniquely human skills to the table in the form of creativity, empathy, ethical judgment, and flexibility [2][6].

Government, industry, and educational institutions should therefore maintain their commitment on a long-term basis to build a comprehensive learning ecosystem that reflects the human-centric principles of Industry 5.0. India has a chance to build a future-ready workforce that can spearhead the human-centric industrial revolution through a holistic curriculum reform, improved skill-development programmes and stronger industry partnerships.

An important aspect is the creation of feedback loop between industrial trends and curriculum design, which is strengthened with regular labour-market analysis, to ensure alignment. The policies must encourage the use of public-private partnerships to co-design adaptive curriculum and invest in faculty development.

TABLE 6: PROJECTED JOB GROWTH IN HUMAN-MACHINE COLLABORATION ROLES (INDIA, 2024–2035)

Year	Projected Jobs in Industry 5.0 Roles (in million)
2024	1.2
2026	2.8
2029	5.0
2032	7.4
2035	10.1

Source: https://www.researchnester.com/reports/industry-50-market/3603?

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