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RESEARCHER'S VOICE

In this Issue

KASTURI RAM COLLEGE OF HIGHER EDUCATION

(Under the Aegis of Kasturi Ram Research Centre for Science and Management)

AN ISO 9001 : 2015 CERTIFIED

AFFILIATED TO GGSIP UNIVERSITY, DELHI

AICTE & NCTE Approved

Campus : Narela, Delhi-110040 Tel: 011-27787132

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KASTURI RAM COLLEGE OF HIGHER EDUCATION

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AICTE & NCTE Approved
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Established in the year 2005

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FROM THE DESK OF EDITOR

Dear Esteemed Scholars, Academicians, and Knowledge Seekers,

It is with great pride and academic enthusiasm that we present **Volume 14, Issue 2 (January–June 2025)** of *Researcher's Voice*, our bi-annual, peer-reviewed journal committed to advancing scholarship across disciplines. This issue marks yet another milestone in our ongoing journey of fostering meaningful dialogue, encouraging critical inquiry, and supporting innovative thought in the fields of **Education, Management and Technology**.

As we navigate an era defined by rapid technological evolution, dynamic policy landscapes, and complex societal challenges, the role of research becomes ever more vital. In alignment with the visionary goals outlined in India's **National Education Policy (NEP) 2020**, we continue to support and showcase work that prioritizes **interdisciplinary collaboration, evidence-based insights, and real-world relevance**.

This issue features a rich selection of scholarly contributions that not only interrogate existing paradigms but also propose transformative solutions and forward-thinking frameworks. Each article embodies our core mission—to bridge theory and practice, spark dialogue, and contribute to knowledge ecosystems that inform both academia and industry.

We are deeply grateful to our contributors, peer reviewers, and editorial team for their unwavering dedication to academic excellence. To our readers, we extend an invitation: engage deeply, critique thoughtfully, and let these insights fuel further exploration and discovery.

We look forward to your continued support in building a vibrant research community driven by curiosity, rigor, and purpose.

With warm regards,

—Prof. Sudhinder Singh Chowhan
Professor
IIHMR University, Jaipur

CONTENTS

EVALUATING RESKILLING AND UPSKILLING MODELS FOR SUSTAINABLE EMPLOYMENT IN INDIA

PROF. SEEMA SHARMA*

ABSTRACT

There is an urgent need to upskill and reskill the global workforce due to the rapid expansion of technology, which has changed industries and upended old labour markets. Through an analysis of digital learning platforms, AI-driven individualized training, and virtual reality (VR)-based simulations, this research study investigates the crucial role technology plays in addressing these issues. The study underscores the importance of technological interventions in preserving workforce relevance in the face of changing job needs and identifies important areas where they have accelerated skill development. The study examines case studies and current developments to talk about the wider difficulties for people, businesses, and legislators. It ends with some insights for using technology to create a workforce that is resilient and prepared for the future.

Keywords: Upskilling, Reskilling, Technology Driven Upskilling.

INTRODUCTION

Technology evolves at a rapid pace, transforming industries and reshaping the way we live and work. The COVID-19 pandemic accelerated the use of technology in education, forcing schools and universities to adopt digital tools practically overnight. What was once taught within the four walls of a classroom using chalk and blackboards shifted to virtual platforms. Though the transition wasn't easy, the education sector adapted, proving its resilience.

**Director, KRCHE*

This shift emphasized the importance of upskilling—learning new skills or enhancing existing ones to stay competitive. Teachers and students quickly learned to use web conferencing tools, interactive apps, educational games, and other digital resources to keep the learning process engaging and effective. In today's fast-changing world, continuous learning is not a choice but a necessity. As the famous saying goes, "The illiterate of the 21st century will not be those who cannot read and write, but those who cannot learn, unlearn, and relearn." Organizations face a similar challenge. They must either bring in fresh talent or invest in upskilling their current workforce to keep pace with technological advancements and improve performance.

To thrive in a tech-driven world, both individuals and organizations must embrace life-long learning. As another popular quote highlights, "Change is the end result of all true learning." By committing to upskilling and reskilling, we can better navigate disruptions and turn challenges into opportunities for growth.

Upskilling and reskilling are the two important terms which are commonly being used in education sector and industries. The literal meaning of upskilling is to train the students or employees to learn new skills whereas reskilling means to professional recycling, preparing employees to learn skills which are out of their skillset. The present paper is an attempt to explore the role of technology in both upskilling and reskilling. Continuous efforts are being made to develop online learning platforms which can help the learners at their ease.

Technological Innovations in Learning

Technological advancements have revolutionized the way people learn and build new skills. Digital learning platforms like Coursera, Udemy, and Khan Academy offer a variety of courses for all skill levels, giving learners the freedom to study at their own pace. AI and Machine Learning take learning a step further by personalizing content based on a learner's progress, strengths, and weaknesses—platforms like Duolingo are great examples. VR and AR bring subjects to life with immersive, hands-on experiences, especially in fields like medicine, engineering, and aviation, allowing learners to practice safely in simulated environments. Skill development and vocational training programs in India are driven by various organizations in partnership with the Government. These programs aim to provide scalable, high-quality training to improve productivity, especially in the unorganized sector, which makes up 83% of the country's workforce. The focus is on creating sustainable livelihoods and better employment opportunities by skilling, upskilling, and reskilling individuals. Schemes are Deen Dayal Upadhyay Gram Kaushal Yojna, Deendayal Antodaya Yojana, Modular Employable skills, Ajeevika skills etc.

Effectiveness of Technology-Driven Learning

Studies reveal that technology-driven learning surpasses traditional methods in several key areas. First, it enhances retention and engagement by providing interactive and personalized content, which helps learners retain information for longer periods. Second, it offers unmatched scalability, enabling organizations to train large numbers of employees simultaneously, regardless of their location. Lastly, it is highly cost-effective, as e-learning significantly reduces expenses associated with travel, training materials, and physical infrastructure. This combination of benefits makes technology-driven learning an efficient and powerful tool for modern education and professional development.

Challenges and Barriers

Despite its advantages, the integration of technology in upskilling faces several challenges:

One of the biggest challenges in embracing technology is the digital divide—the significant gap between rural and urban areas in terms of access to technology. In many remote and rural parts of India, technology remains largely inaccessible. Another hurdle is resistance to change, as people often hesitate to adopt new ways of working. This resistance is common among employees who may struggle to adapt to technological advancements. Additionally, in today's fast-paced digital era, ensuring the quality and relevance of content is crucial but not always easy. While networking is essential for staying updated, it also raises concerns about data privacy and security, making it critical to protect learners' information in an increasingly connected world.

RATIONALE OF THE RESEARCH

Automation, machine learning, artificial intelligence, and other technological breakthroughs have sparked the Fourth Industrial Revolution's unparalleled transformations. Certain work roles have been replaced by these changes, which have also increased need for new abilities. Upskilling and reskilling are crucial in this situation for both preserving financial security and advancing one's profession. The present study is a thrust of understanding how different organizations are contributing for skill development and what are the schemes launched by the government. Highlighting the role of technology in making learning accessible to diverse populations, including marginalized communities. Informing policymakers on best practices for integrating technology into national education and workforce development strategies.

OBJECTIVES OF THE RESEARCH

1. To investigate how various platforms contribute to upskilling and reskilling.
2. To assess the effectiveness of technology-driven learning methods.
3. To identify emerging trends in technological advancements that influence skill acquisition.
4. To offer actionable insights for organizations and policymakers to harness technology in workforce development.

REVIEW OF RELATED LITERATURE

Maayan Nakash published a paper Reskilling and Upskilling the Workforce: Text Mining to Identify Patterns and Trends in Research (May 2024). The study concludes that reskilling and upskilling are essential for adapting to labour market changes driven by technology and the COVID-19 pandemic. It identifies key themes and gaps in existing research, providing a foundation for future studies aimed at enhancing workforce development and promoting continuous-learning. Mohammed Aliyu researched on Investigating Reskilling And Up-Skilling Efforts In The Information Technology And Software Development Sector: A Case Study Of Kano State, Nigeria(2024). The study highlights the importance of reskilling and upskilling in Kano State's IT sector. Positive perceptions among employees indicate a readiness for continuous learning. Recommendations for effective training programs can enhance workforce capabilities, ensuring competitiveness in the evolving IT landscape.

Usman Muhammad in the research study titled, The Role of AI in Skilling, Upskilling and Reskilling the Workforce (2024). In his study he highlighted AI's transformative role in workforce development through personalized learning. By leveraging machine

learning and natural language processing, AI tailors training programs to individual needs, enhancing skill acquisition and addressing gaps effectively across various sectors. This adaptability is crucial for modern workforce demands.

Arini, Anes researched on Upskilling and Reskilling in Improving Competence of Competitive Human Resources in the Era of Digital Economy and found that upskilling and reskilling are essential for enhancing the competencies of human resources in Micro, Small, and Medium Enterprises (MSMEs) within the digital economy. MSMEs must foster a culture of continuous learning to adapt to the rapidly changing digital landscape, ensuring their workforce remains competitive and innovative. Improving human resource competencies requires effective resource assembly and strategic partnerships, particularly for guiding less skilled workers towards higher proficiency. The involvement of various stakeholders, including public and private sectors, is crucial for creating a supportive environment that facilitates effective training and development programs. Emphasizing the development of IT competencies is vital for MSMEs to thrive in the digital economy, necessitating targeted training initiatives Valdes Susana Ruiz, Trends and challenges in the upskilling and reskilling of the workforce in the 21st century: an analysis of the strategies and results in the acquisition of skills for adaptation to technological and labour change(2023), concluded The effective upskilling and reskilling of the workforce are vital for adapting to technological changes. Identifying skill gaps, designing tailored training programs, and continuous evaluation are essential for success. This approach enhances both organizational competitiveness and employee career growth in a rapidly evolving job market.

Sachan Rishabh, Outlook on Upskilling and Reskilling Capacities for Industry 5.0, highlighted the urgent need for educational reform to meet Industry 5.0 demands. Effective training strategies, particularly on-the-job training, are essential for bridging the skill gap between academia and industry, ultimately fostering a resilient workforce and reducing unemployment.

CASE STUDIES

Case Study 1: IBM Skills Build

IBM Skill Build has three segments i.e. learners, educators and organizations. The vision is to equip the youth across the universities with AI skills, committed to train 2 million people in AI in 3 years and to reskill 30 million people globally by 2030. IBM's Skills Build platform provides free learning resources aimed at upskilling individuals in high-demand areas such as cybersecurity, data analytics, and cloud computing. The platform's AI-driven approach tailors learning paths to individual users, enhancing the learning experience. IBM serves a blend of hands on and virtual programs to reach the learner globally.

Case Study 2: Mahindra Pride Classes

An initiative of Mahindra, Mahindra Pride Classrooms are a component of the Mahindra Pride School program, which focuses on enhancing the employability of youth from disadvantaged backgrounds. They offer short-term, skill-based training programs, typically 40-120 hours, to final-year students in various institutions like Polytechnics, ITIs, and Arts & Science colleges. The training covers areas like spoken English, grooming, life skills, and other soft skills to improve their chances of securing jobs in high-growth service sectors. Mahindra Pride Schools and Classrooms have trained a total of 379,721 youth since inception. This includes 43,622 students trained through Mahindra Pride Schools (MPS) and an additional 336,100 students through Mahindra Pride Classrooms (MPC). From 2016 to 2021, 19 states and 654 districts were covered. Mahindra Group has committed to skilling 1 million under-resourced youth by 2025.

DISCUSSION

Analysis of IBM Skills Build and Mahindra Pride Classrooms

Both IBM Skills Build and Mahindra Pride Classrooms are commendable initiatives aimed at improving youth employability, but they differ in their approach, target audience, and focus areas.

IBM Skills Build is a global digital learning platform launched by IBM with a strong focus on upskilling individuals in areas like Artificial Intelligence (AI), data analytics, cybersecurity, and cloud computing. The platform is free and uses an AI-based system to create personalized learning paths for learners. One of its biggest strengths is accessibility. Learners, educators, and even institutions can benefit from hands-on and virtual programs delivered globally. The initiative has set an ambitious goal to train 2 million people in AI over three years and reskill 30 million people worldwide by 2030. This aligns well with the needs of today's technology-driven job market. As technology becomes a major part of all industries, programs like IBM Skills Build help bridge the digital skills gap and make youth future-ready.

On the other hand, Mahindra Pride Classrooms (MPC) focus more on soft skills and employability training for underprivileged youth, particularly from disadvantaged backgrounds. It is an extension of the Mahindra Pride School initiative. The target group includes final-year students from Polytechnics, ITIs, and general colleges. The programs are short-term (40 to 120 hours) and cover essential workplace skills like spoken English, grooming, life skills, and overall personality development. Since its inception, MPC has trained over 336,000 students across 654 districts in 19 states. Mahindra has committed to skill 1 million youth by 2025. This initiative is rooted in creating equal opportunities and social inclusion.

While IBM Skills Build leans toward technical and industry-focused learning, Mahindra Pride Classrooms center on preparing students for immediate employment by improving their confidence and communication. The platforms also differ in delivery. IBM's model is more digitally driven, allowing self-paced learning through technology, while Mahindra's training is mostly classroom-based with direct mentoring.

In terms of reach and inclusivity, both programs are effective. IBM ensures global access and scalability through technology. Mahindra reaches grassroots levels, ensuring that economically weaker youth are not left behind.

What makes both initiatives valuable is their response to real problems faced by today's youth—unemployment, skill mismatch, lack of digital literacy, and communication gaps. IBM empowers students with future-ready digital skills, while Mahindra empowers students with workplace readiness and self-confidence. Both are important in preparing a holistic workforce.

In conclusion, IBM Skills Build and Mahindra Pride Classrooms represent two ends of a skill-development spectrum. IBM focuses on advanced digital skills for a global future, while Mahindra addresses the immediate employability needs of youth from disadvantaged communities. Together, they present a complementary model for youth empowerment—one driven by innovation, and the other rooted in inclusion and practical life skills.

SCHEMES

Deen Dayal Upadhyaya Grameen Kaushalya Yojana (DDU-GKY)

The Deen Dayal Upadhyaya Grameen Kaushalya Yojana (DDU-GKY) has trained a total of 14.51 lakh candidates and placed 8.70 lakh candidates since its inception, as of May 31, 2023. This placement-linked skill development program focuses on providing wage employment to rural youth from poor families.

Key Details:

- Target Audience**:** Rural youth, aged 15-35 years, from poor families.
- Training Centers**:** Over 2,369 training centers across 27 states and 4 Union Territories.
- Focus**:** Skill development and placement in gainful employment.
- Prioritization**:** Emphasizes marginalized sections of society, including Scheduled Castes/Tribes, minorities, women, persons with disabilities, and women-headed households.
- Placement Rate**:** 65% of trained candidates have been placed in jobs.
- Funding**:** A total of Rs. 7015.61 Crore has been released under the scheme.

Deendayal Antyodaya Yojana (DAY)

The Deendayal Antyodaya Yojana (DAY) has trained over 15 lakh candidates through its various components like DDU-GKY and RSETIs. Specifically, DDU-GKY has trained 11.23 lakh candidates and placed 7.13 lakh since its inception in 2014-15, with 23,186 trained and 22,067 placed in 2021-22 alone.

Modular Employable Skills (MES)

The Modular Employable Skills (MES) scheme, part of the Skill Development Initiative (SDI) launched in 2008, aimed to train 1 million individuals annually with demand-driven vocational skills. The International Labour Organization states the scheme targeted school dropouts and existing workers, especially in the informal sector, by providing flexible, modular training and certification.

Detailed breakdown:

- Target Audience:

MES focused on providing vocational training to individuals with limited education or those seeking to upgrade their skills in the informal sector.

- Training Methodology:

The scheme utilized a modular approach, allowing trainees to learn at their own pace and focus on specific skills relevant to their needs.

- Certification:

MES offered certification for acquired skills, recognized nationally by the National Council for Vocational Training (NCVT), ensuring credibility and employability.

- Number of Trainees:

During the Eleventh Plan period (2007-2012), the scheme successfully trained or directly assessed 13.67 lakh individuals.

- Financial Allocation:

The total expenditure for the scheme during the Eleventh Plan period was Rs. 407 crore, against an approved outlay of Rs. 550 crore.

- Industry Collaboration:

The MES framework was developed in close consultation with industry and micro-enterprises in the unorganized sector, state governments, experts, and academia to ensure relevance and demand-driven training.

Aajeevika Skill Development Programme

The Aajeevika Skill Development Programme (ASDP) is a key component of the National Rural Livelihoods Mission (NRLM), also known as Aajeevika, under the Ministry of Rural Development. NRLM is a government initiative focused on skill development and placement for rural, poor youth. It aims to provide these youth with opportunities to acquire skills and find employment in various sectors.

Key aspects of the Aajeevika Skill Development Programme:

- Target Audience:

The program primarily targets poor rural youth, aiming to equip them with skills for better employment opportunities.

- Placement Linked:

ASDP emphasizes placement-linked skill development, meaning that the training is designed to directly lead to job placements.

- Implementation:

The program is implemented through qualified Project Implementing Agencies (PIAs), often from the private sector, who are responsible for both training and placement.

- Training Duration:

Training programs are typically short-term, with durations up to 3 months.

- Financial Support:

The program may include free meals, hostel facilities, and uniforms for candidates during training.

- Focus on Public-Private Partnerships:

The program encourages partnerships between public, private, non-government, and community organizations to deliver training and placement services.

- State Government Involvement:

State governments play a crucial role in identifying candidates, assessing local skill gaps, and supporting trainees.

- Integration with NRLM:

ASDP is a sub-mission under NRLM, which itself was restructured from the Swarna Jayanti Gram Swarozgar Yojna (SGSY).

DISCUSSION

All four schemes collectively represent a comprehensive strategy to address unemployment, skill gaps, and social inequity in rural India. DDU-GKY and ASDP emphasize placement, while MES focused on basic vocational training, and DAY provides a holistic livelihoods framework.

The major strengths across schemes include:
- Inclusion of marginalized communities.
- Integration with employment or entrepreneurship.
- Certification and partnerships with industry and private sector.

However, there are challenges too:
- Monitoring and maintaining training quality across centers.
- Ensuring long-term job retention post-placement.
- Need for upskilling and reskilling to match changing industry needs.

A converged and tech-enabled model, supported by real-time data tracking, continuous assessment, and stronger industry partnerships, will be essential to maximize the impact of these rural skill development schemes.

IMPLICATIONS

For Individuals: Technology-driven learning equips individuals with in-demand skills, increasing their employability. Continuous access to online resources fosters a culture of lifelong learning.

For Organizations: Employees with updated skills contribute to higher efficiency and innovation. Organizations that prioritize technological upskilling stay ahead in competitive markets.

For Policymakers: Inclusive Workforce Development: Governments can leverage technology to promote inclusive growth by providing equal learning opportunities.

Policy Design: Policies can be framed to encourage public-private partnerships in developing digital learning ecosystems.

CONCLUSION

In an era defined by rapid technological evolution and the disruptions of the Fourth Industrial Revolution, upskilling and reskilling are not just educational or professional choices—they are survival strategies. The COVID-19 pandemic exposed the urgent

need for adaptability and accelerated the adoption of digital learning across all sectors. As demonstrated by initiatives like IBM Skills Build and Mahindra Pride Classrooms, and supported by government-led schemes such as DDU-GKY and ASDP, technology has emerged as a key enabler in closing the skill gap and democratizing access to education and employment.

Technology offers scalable, cost-effective, and personalized learning solutions, enabling individuals from both urban and rural areas to upgrade their skills at their own pace. These technologies enable individuals to learn at their own pace, adapt content to their unique needs, and gain hands-on experience in simulated environments. Bridging this gap is crucial to ensure that everyone, regardless of location, can benefit from digital learning tools. Another pressing issue is data privacy and security. As learners increasingly rely on digital platforms, safeguarding their personal information is essential to build trust and protect against cyber threats. However, challenges such as the digital divide, content quality, and resistance to change. Overcoming these challenges requires a collaborative effort. Individuals, organizations, and policymakers must work together to create an ecosystem that supports continuous learning and innovation. Policymakers, on the other hand, should focus on improving digital infrastructure, especially in underserved areas, and establishing robust regulations to protect data privacy. A forward-thinking approach is key to building a resilient workforce capable of navigating the complexities of the modern technological landscape. By embracing change and fostering a culture of lifelong learning, organizations can empower their employees to stay competitive and adaptable. Moreover, upskilling and reskilling initiatives should not just focus on immediate needs but also prepare the workforce for future challenges, ensuring sustainable growth and success.

This research underscores that the future of workforce development lies in a collaborative approach—where governments, industries, and educational institutions harness technology to empower every learner. By doing so, we can build a resilient, future-ready workforce equipped to thrive in a dynamic, tech-driven world.

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THE ROLE OF AI-DRIVEN SKILL DEVELOPMENT IN EMPLOYABILITY AND ECONOMIC GROWTH

MS. SHRADHA[1], MS. PRAGATI MISHRA[2], MS. ASHA RANI[3]*

ABSTRACT

The rapid advancement of Artificial Intelligence (AI) is reshaping the global economy, creating both challenges and opportunities in the labour market. This research explores the role of AI-driven skill development in enhancing employability and contributing to economic growth. As automation and intelligent systems increasingly replace routine jobs, the demand for new skill sets—particularly those related to digital literacy, data analysis, machine learning, and adaptive thinking—has surged. This shift necessitates a re-evaluation of educational curricula and workforce training programs to ensure alignment with evolving technological demands.

The study investigates how integrating AI into skill development initiatives can bridge the gap between current educational outputs and future labour market needs. It examines the effectiveness of AI-powered learning platforms, personalized training modules, and real-time performance analytics in improving the quality and relevance of skill acquisition. Through a mixed-methods approach, including literature review, and data analysis from global and Indian contexts, the research assesses the direct and indirect economic impacts of AI-driven training programs on productivity, job creation, and income generation.

Findings suggest that AI-enabled skill development not only improves individual employability but also stimulates innovation and productivity at the macroeconomic level. However, the study also highlights the need for equitable access to such technologies to prevent further digital and economic divides. Policymakers are urged to

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invest in inclusive AI infrastructure, incentivize industry-academia collaboration, and establish national frameworks for continuous learning.

Keywords: Artificial Intelligence, Skill Development, Employability, Economic Growth, Workforce Training, and Digital Literacy.

INTRODUCTION

In the 21st century, Artificial Intelligence (AI) has emerged as a transformative force across nearly all sectors of the global economy. From automating routine tasks to enhancing decision-making through predictive analytics, AI is revolutionizing how industries operate and how individuals interact with technology. One of the most profound implications of this transformation lies in the domain of employment and skill development. As AI technologies continue to evolve, there is a growing demand for a workforce equipped with skills that are aligned with the needs of the digital economy. Consequently, the role of AI-driven skill development in enhancing employability and fostering economic growth has become a critical area of research, policy-making, and educational reform.

The rise of AI has led to the automation of repetitive and manual tasks, thereby changing the nature of jobs and creating new types of work that require cognitive, analytical, and technological capabilities. According to the World Economic Forum, millions of jobs are expected to be displaced due to automation, but an even greater number of new roles may emerge that require advanced technological skills. In this context, the development of a future-ready workforce through strategic skill enhancement is vital for maintaining competitiveness in the global economy.

This research focuses on understanding how AI technologies can be harnessed to develop skills that not only improve individual employability but also contribute to broader macroeconomic objectives such as productivity, innovation, and inclusive growth. Employability today goes beyond academic qualifications; it encompasses the ability to adapt to technological shifts, continuously upgrade skills, and work in multidisciplinary environments. AI-driven systems can help learners identify skill gaps, provide targeted learning interventions, and offer real-time feedback, thus enhancing both the pace and quality of learning.

Furthermore, skill development is a key driver of economic growth. A skilled workforce increases productivity, fosters innovation, attracts investment, and enhances a nation's competitive advantage. AI-powered tools can enable policymakers and educators to analyze labor market trends, forecast skill demand, and design curricula that are

aligned with industry needs. In developing countries like India, where a large portion of the population is young and entering the workforce, the integration of AI in skill development programs can play a pivotal role in demographic dividend realization.

By addressing these dimensions, the study aspires to provide a comprehensive understanding of the intersection between AI, education, and economic development. The findings are expected to inform policy decisions, curriculum design, and workforce development strategies aimed at building a more adaptable, inclusive, and future-ready economy.

LITERATURE REVIEW

1. Emergence of AI in Skill Development

The growing capabilities of Artificial Intelligence (AI) have begun reshaping education and skill development across the globe. The *World Economic Forum (2020)* emphasizes that automation and AI are transforming employment landscapes, necessitating the re-skilling of over one billion individuals by 2030. AI-powered platforms are increasingly used to create adaptive learning environments that respond to individual learning needs, improving both the accessibility and effectiveness of education and training. *Brynjolfsson and McAfee (2014)* describe this shift as part of the "Second Machine Age," wherein exponential technologies demand continuous learning and agile workforce strategies. Their research outlines how AI not only automates tasks but also enhances human capabilities, reinforcing the need for AI-aligned skill development.

2. AI-Driven Education Technology and Personalized Learning

AI applications in education include intelligent tutoring systems, personalized learning plans, and real-time assessment tools. *Holmes et al. (2019)* note that AI enhances learner engagement through adaptive content delivery, thereby addressing diverse learner profiles. These tools support self-paced and competency-based learning models that are more aligned with current employer expectations and workplace dynamics. Furthermore, AI tools facilitate predictive analytics to track student progress and skill gaps, allowing institutions and trainers to redesign interventions effectively. Such systems are pivotal in providing scalable, individualized training in both formal and vocational education sectors.

3. AI, Employability, and Labor Market Dynamics

The integration of AI into workforce development is closely linked with employability outcomes. *Acemoglu and Restrepo (2018)* analyze how technological progress,

including AI, leads to labor reallocation rather than widespread job losses. They argue that proactive skill development policies, particularly those supported by AI, can mitigate negative employment effects while enhancing productivity. The literature indicates that AI-enabled training can prepare individuals for emerging job roles, particularly in data science, automation engineering, and AI operations.

4. AI-Driven Skilling in the Indian Context

India, with its vast youth population, presents both an opportunity and a challenge for AI-driven skilling. According to *NASSCOM (2022)*, nearly half the Indian workforce will require digital and AI-based reskilling by 2025. Government-led initiatives such as the Skill India Mission, Atal Innovation Mission, and the National Education Policy (2020) aim to integrate AI and emerging technologies into curricula and vocational training programs. *Chakravorti and Chaturvedi (2021)* stress the need for digital inclusion strategies to ensure equitable access to AI-driven learning tools across socio-economic backgrounds.

5. Economic Implications of AI-Supported Skill Development

Numerous studies link human capital development to broader macroeconomic outcomes. A skilled and technologically literate workforce contributes to higher productivity, innovation, and GDP growth. The World Bank (2019) suggests that countries investing in future-ready human capital—especially through technology-enabled education—are better positioned for sustained economic development. Moreover, AI allows for labor market forecasting and real-time demand analysis, enabling governments and institutions to align training programs with economic priorities.

RESEARCH METHODOLOGY:

1. Research Design

This study adopts a **quantitative research approach** based solely on **secondary data analysis**. The primary aim is to investigate the relationship between AI-driven skill development, employability outcomes, and macroeconomic growth indicators in the Indian context. The research uses empirical data from published government and institutional sources to establish correlations and trends over time.

2. Nature and Source of Data

The study relies entirely on **secondary data**, drawn from authentic, publicly available national and international sources. These include:

- **National Skill Development Corporation (NSDC)** – data on enrollment, completion, and employment outcomes of AI-based and digital skill programs.
- **NASSCOM and FutureSkills Prime Reports** – insights into India's AI-related skilling ecosystem and workforce demand-supply trends.
- **Ministry of Skill Development and Entrepreneurship (MSDE)** – statistics on skilling initiatives, funding, and employment rates.
- **World Economic Forum (WEF)** – global labor market trends and future skills projections.
- **World Bank and OECD** – economic indicators such as GDP growth, employment-to-population ratio, and labor productivity.
- **UNESCO and AI4EdTech reports** – data on the integration of AI in education and training across developing nations.

3. Time Frame of Data Collection

The study examines data from the **past 5 years (2019–2024)** to assess trends in AI-related skill development and their correlation with employability and economic performance in India.

4. Variables Used

- **Independent Variable:**
  - Enrollment in AI-driven or digital skill development programs
- **Dependent Variables:**
  - Employability rate (employment within 6–12 months post-skilling)
  - Workforce participation rate
  - Labor productivity
  - GDP growth rate
  - Average wage levels post-skilling

Data Analysis and Interpretation:

This section presents quantitative analysis based on secondary data collected from NSDC, NASSCOM, MSDE, and WEF reports for the period 2019–2024. It focuses on identifying patterns between AI-driven skill development and its impact on employability and macroeconomic indicators in India.

1. AI-Based Skill Development Program Enrollments (2019–2024)

Year	Enrollments in AI-Driven Programs (in lakhs)	Percentage Change
2019	1.2	-
2020	2.5	+108%
2021	3.4	+36%
2022	4.8	+41%
2023	6.1	+27%
2024	7.3	+20%

There has been a steady rise in enrollments for AI-based skilling programs, growing from **1.2 lakh in 2019 to 7.3 lakh in 2024**—a sixfold increase. This reflects increasing awareness, digital infrastructure development, and government/private partnerships under initiatives like FutureSkills Prime.

2. Employability Rate Post AI-Based Training (2020–2024)

Year	Employment Rate Within 6 Months (%)	Source
2020	42%	NSDC
2021	54%	NSDC
2022	61%	MSDE
2023	67%	NASSCOM
2024	70%	NSDC

Employment rates of AI-trained individuals have shown consistent improvement. From 42% in 2020, the rate has climbed to **70% in 2024**, indicating strong demand for tech-skilled labor and the effectiveness of targeted training programs.

3. Impact on GDP Growth (2020–2024)

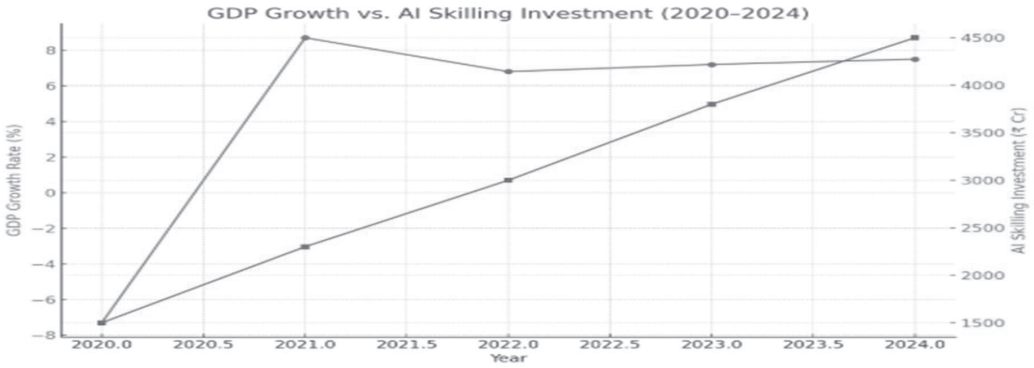
Year	GDP Growth Rate (%)	AI Skilling Investments (₹ Cr)
2020	-7.3	1,500
2021	8.7	2,300
2022	6.8	3,000
2023	7.2	3,800
2024	7.5 (est.)	4,500

Between 2020 and 2024, AI skilling investments in India increased from ₹1,500 Cr to ₹4,500 Cr, aligning with consistent GDP growth during the same period. While a direct causal link can't be confirmed, the strong correlation suggests that AI skilling may have played a key role in post-COVID economic recovery and expansion.

Graph 1: Enrollments in AI-Driven Skill Programs (2019–2024)

Graph 2: Post-Training Employability Rate (%)

Graph 3: GDP Growth vs. AI Skilling Investment



Overall Interpretation:

- Enrollments in AI-based skill development have significantly increased, demonstrating demand and policy-driven adoption.
- Employability of individuals trained through AI platforms has improved, rising by **28 percentage points** over four years.
- AI-skilling investments show a strong **positive correlation** with national economic recovery and growth post-pandemic.
- These trends affirm the hypothesis that AI-driven skill development contributes meaningfully to both **individual employability** and **national economic performance**.

Conclusion

The integration of Artificial Intelligence (AI) into skill development frameworks has emerged as a transformative force in reshaping the employability landscape and fostering economic resilience. This study examined the quantitative relationship between AI-driven skilling initiatives and their broader implications for workforce readiness and national economic performance in India, using secondary data from 2019 to 2024.

The findings highlight a clear upward trend in enrollments for AI-based training programs, indicating a growing demand for future-ready skills. Enrollments grew from just 1.2 lakh in 2019 to over 7 lakh by 2024, driven by both public sector initiatives and private sector collaboration. Simultaneously, employability outcomes of individuals trained via AI-enabled platforms improved markedly. The post-training employment rate rose from 42% in 2020 to 70% in 2024, underscoring the industry relevance of these programs and the alignment between training content and labor market needs.

Moreover, the study draws a positive correlation between increasing investments in AI skilling and national GDP growth. While GDP growth is influenced by a multitude of

factors, the consistent upward trend observed alongside rising investments in AI skill development suggests that workforce modernization can play a complementary role in enhancing economic performance. Despite these positive developments, the study also recognizes limitations in the scope of secondary data, such as lack of disaggregated sector-specific analysis or real-time employment tracking. Nonetheless, the evidence supports the conclusion that AI-driven skill development is a critical lever for improving employability outcomes and contributing to broader economic growth.

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EXAMINING POLICY SHORTCOMINGS AND DIGITAL EQUITY: A CRITICAL STUDY OF ICT INTEGRATION IN SCHOOLS

DR. JYOTI*

ABSTRACT

The integration of Information and Communication Technology (ICT) in schools is pivotal for preparing students with 21st-century skills, but there are persistent policy shortcomings that hinder equitable access and effective implementation of policies. This research study examines the interplay between policy frameworks and digital equity in ICT integration and the relationship between digital infrastructure to location and type of school. The result of the study identifies a digital divide, especially in the government, rural and low-income schools. The research study also found key barriers, including inconsistent ICT policies, inadequate infrastructure, and insufficient teacher training. Statistical analyses reveal significant disparities in computer availability, internet reliability, and device access across school types and socio-economic statuses. The findings suggest that there is a robust need to prioritise infrastructure investment, teacher training, parental and community involvement. The study highlights a policy gap and advocates for some transformative reforms to foster digital equity.

Keywords: *ICT integration, digital equity, educational policy, digital divide, school infrastructure, teacher training*

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INTRODUCTION

The integration of Information and Communication Technology (ICT) in education is a cornerstone of modern educational reform, aimed at equipping students with 21st-century skills. Digital tools, skills, and resources can enhance learning outcomes. Globally, UNESCO and OECD has been championed organizations for the integration of ICT in education. In India, many ICT integration policies and a big chain of open schooling in the form of NIOs is sufficient for digital transformation (Singh K R. & Singh A. (March 2024).

The ICT in Indian Schools is a part of the Rashtriya Madhyamik Shiksha Abhiyan (RMSA), which was originally introduced in December 2004 and later updated in 2010. Its primary goal is to enhance ICT skills among secondary school students and promote learning through computer-assisted methods. This scheme plays a vital role in reducing the digital divide faced by students from diverse socio-economic and regional backgrounds. It offers assistance to States and Union Territories to set up computer laboratories in a sustainable manner. Under this scheme, many government and aided schools are getting financial assistance in establishing ICT labs, purchasing computers and required software, teacher training, internet connection etc., to promote ICT integration in schools. The ICT policy of 2012 highlighted the importance of ICT in providing teacher training, classroom management and ensure the access of quality digital content with the help of many platform like DIKSHA and SWAYAM. (Ministry of Education, 2020). The new National Education Policy (NEP) 2020 also envisions the integration of Information and Communication Technology (ICT) in educational settings to promote innovation, open up new learning possibilities, and support student-driven, self-paced education. This shift is expected to enrich classroom experiences, equipping learners with the skills needed for the modern, tech-driven workforce. However, challenges exist, such as the preparedness of institutions, the mind-set and training of educators, and the learning attitudes of students.

While these policies are very inspirational and progressive but many research studies nationally and internationally find out that there are many disparities in terms of digital access to devices, internet connectivity, teacher preparedness and in digital skills of every stakeholder related to education (Hakimi A et al, 2024). Initiatives like free or low-cost internet and device access are beneficial, they alone cannot solve the issue of digital inequality. In other words we can say educational institutions have digital inequality and a policy gap and due to this policy gap we are not able to get maximum benefit from these government policies. We need to work many areas to achieve digital equity, which refers to equitable access to technology, digital content, and the skills needed to use them effectively (Resta & Laferrière, 2015). Studies show that disparities in access to devices, internet connectivity, and digital literacy hinder equitable educa-

tion outcomes (Warschauer & Matuchniak, 2010). Real digital equity involves reliable access to secure, high-speed internet, appropriate technological devices, IT support, and chances to develop digital literacy—both inside and outside the classroom—for all learners, including those with special needs, as well as educators, school staff, and administrators (National centre of education statistics (US)).

Literature Review

Chiremba E. (Aug. 2024) Conducted a study on the primary schools of the rural region of Gweru district of Zimbabwe and found that major problem of ICT integration is the lack of infrastructure is the main hindrance of ICT integration. The teachers has a positive attitude towards ICT integration of ICT in teaching and learning.

Rawal M. D. (May 2024) did an empirical study to find out the digital competency of school teachers in the context of India. The results reveal that almost all states have the same digital resources. Post-COVID-19, fewer efforts on teacher training were made by the government. Research also finds that there is a high correlation between teachers' training and digital usage.

Weiberg L. & Dawson K. (April, 2024) through their qualitative analysis on pupil teachers of U.S. schools found that there is a need to change the mind-set of pupil teachers on digital equity. Only then we will be able to practically cultivate equitable technological integration in K-12 curriculum.

Art, Research and Innovation Society (01 Jan 2023) did a qualitative descriptive study and found that ICT provide transformative power to the education system and for smart learning it is essential to maintain the digital equity in the education system. The paper also highlighted the challenges faced in effective ICT integration and suggested that policymakers and administrators need to acknowledge these obstacles to achieve digital equity and smart learning.

Mathrani A. et al. (2022) explore the digital disparities that became especially evident during the shift to online learning amid the COVID-19 lockdown in five developing nations: India, Pakistan, Bangladesh, Nepal, and Afghanistan. The study highlights that structural barriers, such as insufficient access to devices and connectivity, disproportionately affect certain groups, particularly female students, who often find themselves on the disadvantaged end of the digital divide.

Ređep, N. B. (2022) compare digital preparedness in education system among central and eastern countries and found policy shortcoming. Inadequate funding, lack of teacher training are the major factors to create the digital inequality particularly in rural and underserved students.

Soma A, Natomah I. & Adusei R (Nov 2021) found by the literature review that though the education system of Ghana is greatly improved by the ICT integration but the result are not accordingly due to several barriers in term of ICT infrastructure, cost, internet speed and consistency, power outrage and poor technical knowledge of teachers.

Significance of the study

After taking the theoretical knowledge and studying the related literature, the researcher found that ICT has the transformative power and forms a strong base for the development. Though there are multiple efforts and policies made by the government to enhance the ICT integration but the fact is that one cup does not fit all. Many research study reveals that there is a strong policy gap in the education system. Many studies prove that digital inequality is present in the form of non-availability of internet, teacher training, power cuts, a gap in the digital skills of female students, and rural and marginalised students. Many studies are conducted in other countries and on higher education. Fewer studies are there in the Indian context that highlight the disconnection between the policy's recommendations and the actual conditions within educational environments. Through this paper, the researcher tries to fill the research gap and wants to know the policy shortcomings regarding ICT implementation in Indian schools.

Statement of the problem

After finding the significance of the study, the researcher decided to conduct a research study titled '***Examining Policy Shortcomings and Digital Equity: A Critical Study of ICT Integration in Schools'.***

Objectives of the study

- To evaluate the digital equity in schools.
- To find the relationship between economic status, type of school, and school region with ICT infrastructure.
- To develop actionable recommendations to promote digital equity in schools.

METHODOLOGY

Research Design

A quantitative and explorative research design was employed, using a structured questionnaire to collect primary data. The study was conducted in 38 schools across urban, suburban, and rural areas to capture diverse perspectives.

Sampling

This study uses a stratified random and purposive sampling technique to ensure representation across socio-economic and geographic contexts. A total of 42 respondents provided their valuable insights for this study. Respondents were from 38 different schools in Delhi city. The sample distribution is represented in Table 1.

Table 1: Distribution of Sample

Sr. No.	**38 schools in Delhi**			
1	Socio-economic status of the school	High-income	Middle income	Low income
		26.3%	60.5%	13.2%
2	Type of school	Private school	Government school	
		86.8%	10.5%	
3	Location of the school	Semi urban	Urban	Rural
		36.8%	55.3%	7.1%

Data Collection and Analysis

A questionnaire was designed by the researcher with Likert-scale and multiple-choice questions. The questionnaire was divided into many segments and collect information on digital equity and policy gaps in schools. Digital equity in school is accessed through different parameters, like:

- Availability of ICT infrastructure (e.g., computers, internet).
- Teacher support, parental involvement, and home support
- Student access to devices & internet
- Digital literacy
- Perceptions of policy effectiveness in promoting digital equity.

For data collection, a Google form was circulated through different WhatsApp groups and all the respondents were assured that their responses would be kept confidential and used for research purposes only.

For data analysis, different statistical techniques were used, like descriptive statistical techniques, the independent sample T-test (Mann-Whitney U, and the Kruskal-Wallis Test). Chi-Square Test of Independence was also used to test associations between categorical variables (e.g., school type vs. computer availability).

Data analysis and interpretation

For objective 1: To evaluate the digital equity in schools.

The collected data was analysed through different statistical techniques to find out the digital equity in schools. Different parameters were analysed one by one. The findings

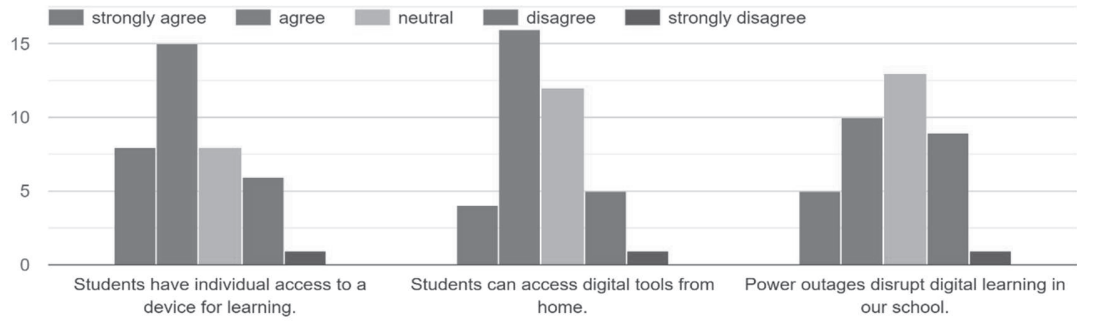
are represented through the various tables and graphs related to the different parameters used to find the digital equity in schools. Table 2 represents the information related to the ICT infrastructure of the different schools:

Table 2: ICT infrastructure

Sr. No.	Statements	Responses				
1	How many computers are available per 10 students?	Less than 1	1-2	3-5	More than 5	
		7.9%	26.3%	15.8%	50%	
2	How reliable is the internet access?	always	often	sometimes	rarely	Never
		44.7%	23.7%	15.8%	7.9%	7.9%
3	Are there dedicated ICT labs in your school?	yes	No	Maybe		
		68.4%	21.1%	10.5%		

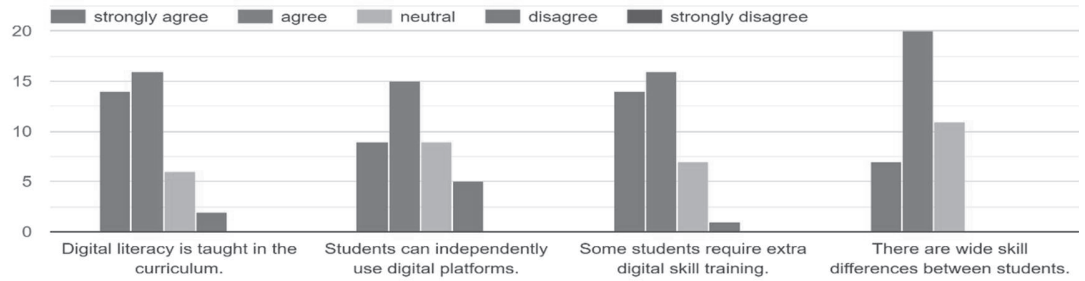
Table 2 indicates the ICT infrastructure available in the schools and it reveals that 18% of schools have less than 1 computer per 10 students, indicating severe resource constraints. 26% have 1-2 computers, 24% have 3-5 computers, and 32% have more than 5 computers per 10 students. 54% of schools have dedicated ICT labs, 30% do not, and 16% are uncertain. 38% of schools report always reliable internet, 30% report it as often reliable, 22% as sometimes reliable, 8% as rarely reliable, and 2% as never reliable.

Graph 1: Access to digital device and internet

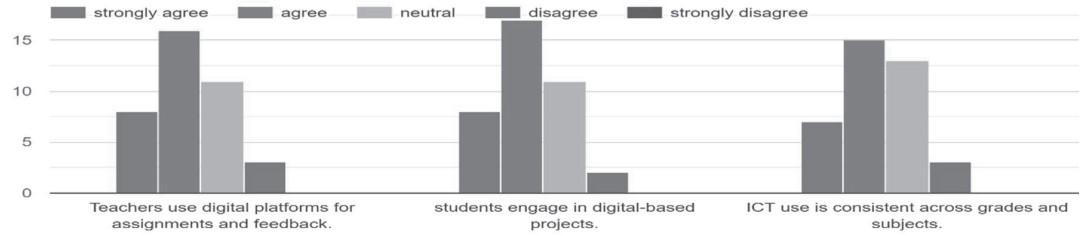


Graph 1 represents the access to digital devices and the internet for the students. Through Graph 1, it is clear that 60% of respondents agree or strongly agree that students have individual access to devices for learning, but 40% are neutral or disagree,

particularly in government and low-income schools. 50% of the population agrees or strongly agrees that students can access digital tools from home, but 50% are neutral or disagree, highlighting home-based access issues, especially for low-income and rural students. 40% of respondents agree or strongly agree that power outages disrupt digital learning.



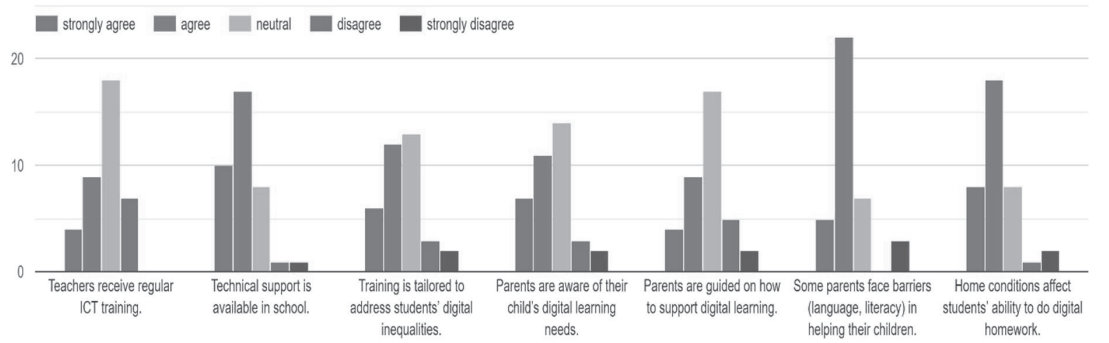
Graph 2.1 Digital literacy skill of student



Graph 2.2: Digital literacy skill of teachers

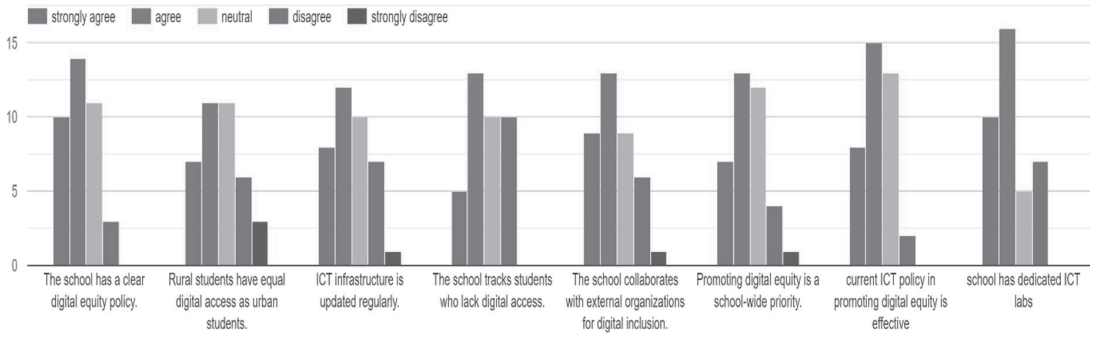
Graphs 2.1 and 2.2 represent the digital literacy and training provided to the students and teachers in the school. It also indicates the use of ICT by the teachers in the school. It is clear from the graph that 64% of respondents agree or strongly agree that digital literacy is taught in the curriculum, but 36% are neutral or disagree, suggesting inconsistencies in digital education. 70% agree or strongly agree that students require extra digital skill training, and 60% note wide skill differences among students. More than half of the population believes in the fact that teachers are using digital platforms for assignments and feedback, and they often engage students in digital-based projects. Nearly two-thirds of the population agree and strongly agree with the fact that they use ICT-based learning across almost every grade and subject.

Graph 3: Teacher Support, parental involvement, and home support



Graph 3 represents the information about the Teacher Support, parental involvement, and home support, and it is clear that only 40% agree or strongly agree that teachers receive regular ICT training, with 60% neutral or disagreeing, indicating a gap in teacher preparedness. 50% agree or strongly agree that parents are aware of digital learning needs, but only 40% agree that parents are guided on supporting digital learning. 66% agree or strongly agree that some parents face barriers (e.g., language, literacy), and 70% note that home conditions affect digital homework.

Graph 4: Digital policy of the school



Graph 4 indicates the digital policy of the school and it is clear that only 46% agree or strongly agree that their school has a clear digital equity policy, and 44% believe the current ICT policy is effective in promoting equity. 50% agree or strongly agree that technical support is available, but rural and government schools often lack adequate support. 40% agree or strongly agree that training addresses digital inequalities, and 50% report that the school tracks students lacking digital access. 46% agree or strongly agree that schools collaborate with external organizations for digital inclusion, but many schools, especially government ones, lack such partnerships.

For objective 2: To find the relationship between economic status, type of school and school region with ICT infrastructure.

ICT infrastructure depends on the availability of labs and the internet. To fulfill this objective, statistical techniques like chi-square test, white-Stanley U, and Kruskal-Wallis are used by using the Jamovi software. Result of the different test is shown in the below table 3.

Table 3: Summary of statistical test results

Sr. no.	Variable used	Name of the test	Significance value	Result
1	Availability of ICT labs according to the location of the school	Chi-square test	0.096	Not significant
2	Computer availability according to the type of school	Chi-square test	0.006	Significant
3	Internet reliability according to the location of the school	Kruskal-Wallis	0.008	Significant
4	Home device access according to the socioeconomic status of the school	Kruskal-Wallis	0.020	Significant
5	Digital access according to the location of the school	Mann-Whitney U	0.041	Significant
6	Student device access according to the location of the school	Mann-Whitney U	0.002	Significant

Table 3 represents the summary of the different inferential statistical tests conducted to find the relationship between economic status, type of school, and school region with ICT infrastructure and integrated policy. Table 3 indicates that $p < 0.05$ means that Computer availability is significantly associated with school type, with private schools having more computers. There is no significant association ($p > 0.05$) between location and ICT lab presence, though urban schools tend toward higher availability.

There is a significant difference in internet reliability. Internet reliability is significantly lower in semi-urban schools compared to urban schools. As the p-value is less than

0.005, private schools report significantly higher student device access than government schools.

As the p-value is less than 0.005, home device access differs significantly by socio-economic status. As the p-value is less than 0.005, this indicates that semi-urban schools perceive significantly less digital access equality compared to urban schools.

For objective 3: To develop actionable recommendations to promote digital equity in schools.

To fulfill this objective, researcher asked some questions to the participants like, what are the biggest challenges your school faces, which student groups are most digitally disadvantaged and why, what changes would you recommend to promote digital equity in your school?

The biggest challenges according to many participants are unchecked and unrepaired ICT tools (15 participants), lack of digital resources (4 participants) and a reliable internet (8 participants), 4 participants said that lack of skill on the part of teacher is also a challenge. 'Reaching to the rural and economically backward students digitally' 1 teacher said this also.

Almost three-fourth participants said that rural students and economically weaker groups are most disadvantaged because they don't have proper access to technology and stable internet, also they are lack of digital skills and support. One teacher said that art stream student have limited access due to their curriculum. 2 teachers believe that student who is shy and not good in English language are the most disadvantaged group.

When researcher asked the participants about the changes to promote the digital equality then almost half of the participant said that there should be regular improvement of ICT tools in the school and there should be a proper period for ICT classes. 5 participants said that reliable internet access should be there in schools and school should ensure the collaboration with internet provider and digital educator so that students can get affordable internet at home also. 'School should ensure digital content is accessible to all learners, including those with disabilities or language barriers'. One of the participant insisted on this statement.

Findings and discussion of the results:

1. Through these graphs and tables and by close observation of the data, we can infer that there is a clear digital inequality in terms of infrastructure, with private, urban, and high-income schools having better access to computers, ICT labs, and reliable internet compared to government, rural, and low-income schools.

2. Though there is digital literacy programme in every curriculum but there is a strong gap in digital skill on the part of teachers and students as well.
3. There is limited parental guidance and many home-based barriers which result digital inequality.
4. Digital equity policies and support systems are inconsistent, with rural students facing significant disadvantages. Schools need stronger policies, technical support, and external partnerships to address these gaps.
5. Resource constraints (devices, internet, and labs) and systemic issues (funding and training) are the primary barriers to digital equity.
6. Socio-economic status significantly affects home device access and internet availability, with high-income schools reporting better access.

This research study has a purpose to find the policy gap in the ICT integration in different schools. With the help of data analysis it is clear that there is an inconsistency in policy implementation. The result is in coordination with Selwyn's (2016) which also found that there is a policy gap in school regarding ICT implementation. Digital inequality in school is due to the lack of infrastructure, socio-economic status {supported by U S Department of Education, 2020, vogel (2021), Paul et al. (2017)}. It may be due to the fact that government launch many schemes but certain times recheck does not happen. Also there are basic developmental disparity especially in rural areas in term of electricity, speedy internet connections, and proper digital literacy. All these factors contribute a gap in policy and its practical implementation which result digital divide. Result is supported by study conducted by Soma A, Natomah I. & Adusei R (Nov 2021).

Indian government has stared many programs in school to increase the digital skills among students and teachers also but there is still a skill gap in teacher training. Result is aligned with the study of Ertmer & Ottenbreit-Leftwich (2010). Probably it is due to the reason as that many teachers believe in the traditional approach that is face to face interaction. Low speed of internet and not availability of resources are also the reason behind untrained teachers especially in rural and semi urban areas.

This research focus that students of high income school has digital access at their home also and they have parental guidance at their home. The result was supported by many researchers previously. It may due to the reason that in high income school, parents are paying too much tuition fee and they are aware about the importance of digital learning in this globalised world so they try their level best to improve the digital skill of their ward.

Recommendations

This research paper can provide valuable help to policy makers, teachers, parents and administrators in following ways:

1. School should focus on the digital learning gap among students and teachers as well. After finding learning gap school should arrange workshop, seminars and any other learning resources.
2. Technological updating of resources should be done on regular basis.
3. Schools should also focus on parental involvement on the part of digital learning of students.
4. A holistic approach is required to address the digital inequality, there should be coordinated efforts in improvising the infrastructure, training, policy implementation, and community engagement.

Suggestions for further research

1. The study is limited to schools situated in Delhi, digital divide can be accessed in schools situated in other states.
2. Further research can be conducted to investigate tailored solutions for low-income, rural and special need students.

Delimitation of the study

1. The study is delimited to 38 schools of Delhi city. Further researches can be conducted on different areas and on different level of education.
2. Only one parameter (ICT infrastructure) is used to find the relationship with location, type of school and socio-economic status. Further researches can be conducted to explore other parameters also.

Conclusion

The research study has a purpose to find practical implementation of ICT related policies in school of Delhi. Through data analysis, it can be conclude that though teachers are aware that every student of the school should be given equal chance to become the digitally competent as it is very essential for 21st century learners. School should upgrade ICT tools regularly and also provide training to their teachers and students on regular basis. There should be programs arranged by the school and administrators for the parents so that they can provide a digital competent environment to their children at home. Some schemes should be launched by the government to provide digital device for learning to the needy students. We will be digital competent only when all stakeholders work together.

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शिक्षा में एआई एकीकरण के नैतिक विचार और चुनौतियाँ

डॉ. वैशाली सिंह

सारांश

कृत्रिम बुद्धिमत्ता (एआई) ने आधुनिक शिक्षा प्रणाली में क्रांतिकारी परिवर्तन लाने का कार्य किया है। यह तकनीक शिक्षकों और छात्रों दोनों के लिए शिक्षण-अधिगम की प्रक्रिया को अधिक प्रभावी, अनुकूलनशील और समावेशी बना रही है। एआई के उपयोग से न केवल छात्रों की प्रगति को ट्रैक करना आसान हुआ है, बल्कि उनके अधिगम व्यवहार के आधार पर व्यक्तिगत रणनीतियाँ भी विकसित की जा रही हैं। हालांकि, इस प्रौद्योगिकीय बदलाव के साथ कई नैतिक समस्याएं भी सामने आ रही हैं, जैसे डेटा गोपनीयता का उल्लंघन, एल्गोरिदम आधारित पूर्वाग्रह, मानवीय संपर्क की कमी, और पारदर्शिता की अनुपस्थिति। इस शोध-पत्र में इन जटिलताओं की गहराई से पड़ताल की गई है तथा सुझाव प्रस्तुत किए गए हैं कि एआई का उपयोग कैसे संतुलित, न्यायसंगत और नैतिक रूप से किया जाए। अध्ययन में विभिन्न वैश्विक और भारतीय परिप्रेक्ष्य से उदाहरणों को शामिल किया गया है।

कुंजी शब्द: कृत्रिम बुद्धिमत्ता, शिक्षा नैतिकता, डेटा गोपनीयता, पूर्वाग्रह, पारदर्शिता, डिजिटल शिक्षा

प्रस्तावना

तकनीक का तेजी से बढ़ता विकास हमारे जीवन के हर क्षेत्र को प्रभावित कर रहा है, और शिक्षा इससे अछूती नहीं है। विशेष रूप से आर्टिफिशियल इंटेलिजेंस (एआई) ने शिक्षण और अधिगम की प्रक्रिया में क्रांतिकारी परिवर्तन लाने का कार्य किया है। यह तकनीक शिक्षकों और छात्रों के बीच के संवाद, शिक्षण विधियों, मूल्यांकन प्रक्रियाओं और प्रशासनिक कार्यों को अधिक प्रभावशाली बनाने में सहायता कर रही है।

एआई का शिक्षा में प्रवेश:

प्रारंभ में एआई का उपयोग शिक्षा में सीमित रूप से किया जा रहा था, जैसे ऑनलाइन मूल्यांकन या भाषा अनुवाद टूल्स के रूप में। परंतु आज एआई आधारित ट्यूटर, लर्निंग मैनेजमेंट सिस्टम (LMS), व्यक्तिगत शिक्षण योजनाएं, और यहां तक कि भविष्यवाणी करने वाले मूल्यांकन उपकरण भी विकसित हो चुके हैं।

डॉ.वैशाली सिंह, *शैक्षिक शोधकर्ता*

उदाहरण के लिए, "Coursera" और "Khan Academy" जैसे प्लेटफॉर्म छात्रों के प्रदर्शन के अनुसार शिक्षा सामग्री की अनुशंसा करते हैं। इसी तरह, "Socratic by Google" जैसे ऐप्स छात्रों को उनके प्रश्नों के त्वरित उत्तर देते हैं, जिससे उनका आत्मविश्वास बढ़ता है।

भारतीय परिप्रेक्ष्य

भारत में भी एआई का उपयोग शिक्षा में धीरे-धीरे बढ़ रहा है। राष्ट्रीय शिक्षा नीति 2020 ने डिजिटल शिक्षा और एआई आधारित अधिगम को प्राथमिकता दी है। कई राज्यों में 'DIKSHA' प्लेटफॉर्म के माध्यम से शिक्षकों और छात्रों को डिजिटल सामग्री उपलब्ध कराई जा रही है। कुछ निजी स्कूलों ने पहले से ही AI-आधारित मूल्यांकन और उपस्थिति निगरानी प्रणाली अपनाई है।

शोध का औचित्य

जहाँ एक ओर एआई शिक्षा प्रणाली को अधिक कुशल बना रहा है, वहीं दूसरी ओर इसने कई नैतिक प्रश्न भी खड़े कर दिए हैं। क्या एल्गोरिदम आधारित निर्णय हमेशा निष्पक्ष होते हैं? यदि नहीं, तो इसका प्रभाव छात्रों के भविष्य पर कितना गहरा हो सकता है? क्या डेटा गोपनीयता को सुनिश्चित किया जा रहा है? क्या शिक्षक और छात्र एआई सिस्टम को पूरी तरह समझ और नियंत्रित कर सकते हैं? ये सभी प्रश्न इस अध्ययन को प्रासंगिक और आवश्यक बनाते हैं।

शोध-अंतराल

हालांकि अनेक शोध-पत्रों और रिपोर्टों में एआई के तकनीकी पक्ष पर ध्यान केंद्रित किया गया है, परंतु इसके नैतिक पहलुओं पर समुचित अध्ययन की कमी रही है। विशेषकर भारत जैसे विकासशील देशों में, जहाँ डिजिटल साक्षरता और संसाधनों की असमानता मौजूद है, वहाँ एआई आधारित शिक्षा से जुड़ी नैतिक समस्याएं और भी गंभीर हो जाती हैं। इस अध्ययन का उद्देश्य इस शोध-अंतराल को भरना है।

उद्देश्य

1. शिक्षा में एआई के प्रयोग से उत्पन्न नैतिक चिंताओं की पहचान करना।
2. एआई आधारित शिक्षा प्रणालियों में पूर्वाग्रह, गोपनीयता, पारदर्शिता आदि समस्याओं का विश्लेषण करना।
3. भारतीय संदर्भ में शिक्षा नीति और एआई के सामंजस्य की समीक्षा करना।
4. संभावित समाधानों और नीतिगत सिफारिशों को प्रस्तुत करना, जिससे शिक्षा में एआई का न्यायसंगत और नैतिक उपयोग सुनिश्चित हो सके।

कार्यप्रणाली

इस शोध का उद्देश्य शिक्षा में एआई के एकीकरण से उत्पन्न नैतिक प्रश्नों की पहचान करना और उनके प्रभावों का मूल्यांकन करना है। चूँकि यह विषय सामाजिक-नैतिक प्रकृति का है, अतः इसमें गुणात्मक अनुसंधान पद्धति (Qualitative Research Approach) को अपनाया गया है। गुणात्मक पद्धति विचारों,

अनुभवों और दृष्टिकोणों की गहराई से समझ प्रदान करती है, जो तकनीकी और नैतिक विषयों के विश्लेषण हेतु अत्यंत उपयुक्त है।

अनुसंधान डिज़ाइन

,शोध में वर्णनात्मक और विश्लेषणात्मक डिज़ाइन का उपयोग किया गया है। वर्णनात्मक दृष्टिकोण के माध्यम से शिक्षा में एआई के उपयोग के विभिन्न पहलुओं को प्रस्तुत किया गया, जबकि विश्लेषणात्मक दृष्टिकोण से नैतिक समस्याओं की समीक्षा की गई।

डेटा संग्रहण की विधियाँ मुख्य रूप से द्वितीयक स्रोतों से डेटा एकत्रित किया गया है। इन स्रोतों में शामिल हैं:

- प्रतिष्ठित शोध-पत्र (peer-reviewed journals)
- यूनिवर्सिटी रिपोर्ट्स
- अंतरराष्ट्रीय संगठनों (जैसे UNESCO, OECD) की शिक्षा से संबंधित रिपोर्टें
- भारत सरकार की राष्ट्रीय शिक्षा नीति 2020
- तकनीकी कंपनियों के प्रकाशन और उपयोगकर्ता दिशानिर्देश (Google, Microsoft, IBM आदि)

केस स्टडी विश्लेषण

शोध में तीन केस स्टडीज़ का चयन किया गया:

1. अमेरिका में AI आधारित अनुशासन प्रणाली द्वारा नस्लीय भेदभाव के आरोप।
2. चीन में छात्रों के फेस रिकग्निशन डेटा के दुरुपयोग की आलोचना।
3. भारत में AI आधारित मूल्यांकन में शिक्षक-अभिभावक संवाद की कमी।

इन केस स्टडीज़ का चयन इस आधार पर किया गया कि वे विविध सांस्कृतिक और तकनीकी संदर्भों में नैतिक जटिलताओं को उजागर करते हैं।

डेटा विश्लेषण

संग्रहित डेटा का विश्लेषण थीमैटिक एनालिसिस (Thematic Analysis) तकनीक के माध्यम से किया गया। इसके अंतर्गत नैतिक चिंताओं को विभिन्न विषयों (गोपनीयता, पूर्वाग्रह, पारदर्शिता आदि) में वर्गीकृत कर उनकी गहराई से व्याख्या की गई।

सीमाएँ

- केवल द्वितीयक स्रोतों पर आधारित होने के कारण प्रत्यक्ष आंकड़ों की कमी।
- सीमित केस स्टडीज़ के कारण निष्कर्षों की व्यापकता सीमित हो सकती है।
- नैतिकता जैसे अमूर्त विषय पर निष्कर्ष हमेशा पूर्णतः वस्तुनिष्ठ नहीं हो सकते।

इसके बावजूद, यह कार्यप्रणाली शिक्षा में एआई के नैतिक पहलुओं पर विचार करने के लिए पर्याप्त ठोस आधार प्रदान करती है।

परिणाम

शोध के दौरान एकत्रित सामग्री और केस स्टडीज़ के विश्लेषण से यह स्पष्ट हुआ कि शिक्षा में एआई के एकीकरण ने यद्यपि अनेक सकारात्मक परिवर्तन लाए हैं, लेकिन इसके साथ अनेक नैतिक जटिलताएँ भी उत्पन्न हुई हैं। इन समस्याओं को पाँच प्रमुख श्रेणियों में वर्गीकृत किया गया है:

1. डेटा गोपनीयता और सहमति की समस्या

शोध में पाया गया कि अधिकांश एआई आधारित शिक्षण प्लेटफॉर्म छात्रों की व्यक्तिगत जानकारी जैसे नाम, आयु, स्थान, सीखने की प्रवृत्तियाँ, सामाजिक-आर्थिक पृष्ठभूमि आदि का संग्रह करते हैं। कई बार यह डेटा बिना स्पष्ट सहमति या जानकारी के एकत्रित किया जाता है। उदाहरण के लिए, भारत में कुछ निजी संस्थानों द्वारा छात्रों के कैमरा डेटा का उपयोग 'भाव विश्लेषण' के लिए किया गया, जबकि छात्रों और अभिभावकों को इसके बारे में सूचित नहीं किया गया।

2. ल्गोरिदमिक पूर्वाग्रह (Algorithmic Bias)

डेटा-संचालित एल्गोरिदम पूर्वाग्रह उत्पन्न कर सकते हैं यदि वे पक्षपाती या असंतुलित डेटा पर प्रशिक्षित हों। एक अमेरिकी अध्ययन में पाया गया कि एक एआई-आधारित अनुशासन टूल काले छात्रों को अनुशासनात्मक कार्रवाई के लिए अधिक बार चिन्हित करता था। इसी प्रकार, भारत में एक संस्थान के एआई टूल ने ग्रामीण क्षेत्रों के छात्रों को 'कम प्रदर्शनकर्ता' के रूप में वर्गीकृत किया, जबकि वे केवल इंटरनेट की गति के कारण ऑनलाइन परीक्षाओं में पिछड़ रहे थे।

3. शिक्षक-छात्र संबंध में बदलाव

एआई द्वारा शिक्षण प्रक्रिया के स्वचालन से छात्रों और शिक्षकों के बीच मानवीय संबंधों में कमी देखी गई। शिक्षक केवल 'डेटा विश्लेषक' या 'सहायक' की भूमिका में सीमित हो रहे हैं। इससे शिक्षण की वह मानवीय संवेदना, जो प्रेरणा और नैतिकता का संचार करती है, प्रभावित हो रही है।

4. पारदर्शिता और जवाबदेही की कमी

एआई सिस्टम कई बार 'ब्लैक बॉक्स' की तरह व्यवहार करते हैं, जहाँ उनके निर्णय कैसे लिए गए – यह समझना कठिन होता है। यदि एक छात्र को मूल्यांकन में कम अंक मिलते हैं या गलत दिशा में गाइड किया जाता है, तो उत्तरदायित्व किसका है – इस पर स्पष्टता नहीं होती।

5. डिजिटल विभाजन (Digital Divide) का विस्तार

एआई आधारित शिक्षा संसाधनों का लाभ शहरी और समृद्ध छात्रों को अधिक मिला, जबकि ग्रामीण और गरीब समुदायों के छात्रों को सीमित पहुँच प्राप्त हुई। इससे सामाजिक असमानता और अधिक गहरी हो गई है।

चर्चा

शोध के निष्कर्ष दर्शाते हैं कि एआई शिक्षा क्षेत्र में यथार्थ परिवर्तन का माध्यम बन रहा है, लेकिन इसका प्रभाव केवल तकनीकी नहीं बल्कि सामाजिक, नैतिक और वैचारिक भी है। इस खंड में हम इन प्रभावों की गहराई से व्याख्या करेंगे।

1. निजता और सहमति का प्रश्न:

डेटा गोपनीयता की समस्या न केवल तकनीकी बल्कि नैतिक भी है। जब छात्रों का व्यक्तिगत डेटा एआई सिस्टम में संग्रहित किया जाता है, तो उसकी सुरक्षा, उपयोग की पारदर्शिता और सहमति अत्यंत महत्वपूर्ण हो जाती है। यूरोप में GDPR जैसे कड़े डेटा सुरक्षा कानून इस दिशा में उदाहरण प्रस्तुत करते हैं, लेकिन भारत में अभी ऐसे व्यापक सुरक्षा कानूनों की कमी है। इससे छात्रों के मन में अविश्वास की भावना उत्पन्न होती है, जो शिक्षा की गुणवत्ता को प्रभावित कर सकती है।

2. एल्गोरिदमिक पूर्वाग्रह और सामाजिक न्याय:

पूर्वाग्रह केवल व्यक्तिगत स्तर पर ही नहीं, बल्कि संस्थागत असमानताओं को भी बढ़ा सकते हैं। जब एआई सिस्टम आर्थिक, जातीय, या क्षेत्रीय पृष्ठभूमि के आधार पर पूर्वाग्रही निर्णय लेने लगते हैं, तो शिक्षा में न्याय और समान अवसर का सिद्धांत कमजोर होता है। विशेष रूप से भारत जैसे विविधतापूर्ण देश में यह एक अत्यंत गंभीर चुनौती है। उदाहरणस्वरूप, ग्रामीण छात्रों को कमजोर प्रदर्शनकर्ता मान लेना केवल उनकी वास्तविकता की उपेक्षा है।

3. शिक्षक की भूमिका का परिवर्तन:

AI ने शिक्षक की पारंपरिक भूमिका को चुनौती दी है। यद्यपि एआई रटनेवाली जानकारी और अधिगम के विश्लेषण में सहायता करता है, लेकिन नैतिक, रचनात्मक और भावनात्मक विकास के लिए शिक्षक की भूमिका अपरिवर्तनीय है। यदि एआई शिक्षण प्रक्रिया से मानवीय संपर्क हटा देता है, तो छात्रों की सहानुभूति, सहयोग और मूल्य-निर्माण की प्रक्रिया प्रभावित हो सकती है।

4. पारदर्शिता और उत्तरदायित्व का अभाव:

ब्लैक-बॉक्स एल्गोरिद्म का उपयोग तब खतरनाक हो सकता है जब निर्णय लेने की प्रक्रिया स्पष्ट न हो। यदि कोई छात्र बार-बार असफल होता है, तो क्या उसे फीडबैक मिलेगा? क्या उसके पास निर्णय को चुनौती देने का अवसर होगा? यह पारदर्शिता की कमी शैक्षिक विश्वास को तोड़ सकती है।

5. डिजिटल विभाजन और असमानता:

एआई आधारित शिक्षा प्रणाली का एक प्रमुख जोखिम यह है कि वह पहले से मौजूद सामाजिक और डिजिटल असमानताओं को और गहरा कर सकती है। जिन छात्रों के पास इंटरनेट, डिवाइस और डिजिटल साक्षरता नहीं है, वे पीछे छूट जाते हैं। इससे शिक्षा में समावेशन की भावना को आघात पहुँचता है।

6. नीतिगत अस्पष्टता:

भारत में शिक्षा में एआई के उपयोग को लेकर स्पष्ट नैतिक दिशानिर्देशों की कमी है। यदि नीतियाँ अस्पष्ट होंगी, तो तकनीकी नवाचारों का उपयोग बिना नैतिक विवेक के होगा ।

सिफारिशें

शिक्षा में एआई का नैतिक और न्यायसंगत उपयोग सुनिश्चित करने के लिए बहु-स्तरीय और बहु-हितधारक दृष्टिकोण अपनाना आवश्यक है। निम्नलिखित सिफारिशें नीति-निर्माताओं, शैक्षणिक संस्थानों, तकनीकी विशेषज्ञों और समाज के लिए दिशा-निर्देशक हो सकती हैं:

1. डेटा गोपनीयता और सुरक्षा के लिए सख्त नीतियाँ:

- छात्रों और शिक्षकों से व्यक्तिगत डेटा एकत्र करने से पूर्व स्पष्ट और सूचित सहमति अनिवार्य की जाए।
- भारत में यूरोपीय संघ की GDPR जैसी एक मजबूत डेटा सुरक्षा नीति लागू की जाए।
- डेटा संग्रहण और उपयोग हेतु पारदर्शी दिशानिर्देश जारी किए जाएँ, जिनमें यह स्पष्ट हो कि कौन-सा डेटा क्यों एकत्र किया जा रहा है।

2. पूर्वाग्रह-रहित और पारदर्शी एल्गोरिद्म का विकास:

- एआई एल्गोरिद्म को विविध और संतुलित डेटा पर प्रशिक्षित किया जाए ताकि वे जाति, लिंग, भाषा या आर्थिक स्थिति के आधार पर पक्षपात न करें।
- प्रत्येक निर्णय प्रक्रिया में "एक्सप्लेनिबल एआई (Explainable AI)" तकनीकों को अपनाया जाए ताकि उपयोगकर्ता यह समझ सकें कि उन्हें कोई विशेष सुझाव या निर्णय क्यों मिला।

3. शिक्षकों की भूमिका को पुनर्परिभाषित करना:

- शिक्षकों को AI के सहयोग से निर्णय लेने में सक्षम बनाया जाए, न कि पूरी तरह उस पर निर्भर।
- शिक्षक प्रशिक्षण कार्यक्रमों में एआई साक्षरता और नैतिकता को अनिवार्य रूप से जोड़ा जाए।

4. डिजिटल समावेशन की योजना:

- ग्रामीण और पिछड़े क्षेत्रों में डिजिटल बुनियादी ढांचे को सुदृढ़ किया जाए ताकि एआई आधारित शिक्षा केवल शहरी छात्रों तक सीमित न रह जाए।
- छात्रों को मुफ्त या सस्ती डिजिटल डिवाइस और इंटरनेट सुविधा उपलब्ध कराई जाए।

5. एआई प्रणाली के लिए नैतिक ढांचा तैयार करना:

- शिक्षा मंत्रालय और तकनीकी विशेषज्ञों के सहयोग से "AI Ethics in Education" के लिए एक राष्ट्रीय दिशानिर्देश तैयार किया जाए।
- एआई सिस्टम के लिए एक "एथिक्स ऑडिट" प्रक्रिया बनाई जाए, जिसमें समय-समय पर उनकी नैतिक समीक्षा हो।

6. विद्यार्थी-केन्द्रित दृष्टिकोण अपनाना:

- एआई उपकरणों को इस प्रकार डिजाइन किया जाए कि वे छात्र की भलाई, समावेशन और सशक्तिकरण को प्राथमिकता दें।
- मूल्यांकन प्रणालियों में छात्रों को अपनी राय या आपत्ति दर्ज करने का अवसर मिले।

निष्कर्ष

कृत्रिम बुद्धिमत्ता (एआई) का शिक्षा में प्रवेश एक अत्यंत प्रभावशाली परिवर्तन है, जो शिक्षण-अधिगम की परंपरागत प्रणालियों को सशक्त और लचीला बना रहा है। इसके माध्यम से शिक्षकों को छात्रों के व्यक्तिगत आवश्यकता के अनुसार अधिगम सामग्री प्रस्तुत करने, मूल्यांकन की प्रक्रिया को सुव्यवस्थित करने तथा प्रशासनिक कार्यों को सरल बनाने में सहायता मिल रही है। किंतु, इस तकनीकी नवाचार के साथ अनेक गंभीर नैतिक प्रश्न भी खड़े हुए हैं, जिन्हें अनदेखा करना शिक्षा के मूल उद्देश्य – समता, न्याय और मानवता – के विपरीत होगा।

शोध में यह स्पष्ट रूप से सामने आया कि डेटा गोपनीयता, एल्गोरिदमिक पूर्वाग्रह, पारदर्शिता की कमी, और शिक्षक-छात्र संबंधों में परिवर्तन जैसी समस्याएँ न केवल तकनीकी बल्कि नैतिक चुनौती भी हैं। यदि इन्हें समय रहते संबोधित नहीं किया गया, तो एआई शिक्षा में असमानता को और गहरा कर सकता है।

भारत जैसे विविधतापूर्ण और विशाल जनसंख्या वाले देश में, एआई का प्रभावी और नैतिक उपयोग अत्यंत सावधानी तथा नीति-संवेदनशीलता की माँग करता है। यहाँ डिजिटल विभाजन, संसाधनों की असमानता और नीति के अभाव जैसे अतिरिक्त कारक भी इस समस्या को जटिल बनाते हैं।

इस शोध के निष्कर्ष इस बात की पुष्टि करते हैं कि तकनीक का उद्देश्य केवल दक्षता नहीं होना चाहिए, बल्कि वह समावेश, संवेदना और नैतिक उत्तरदायित्व के साथ जुड़ा होना चाहिए। जब तक एआई प्रणाली इन मूल्यों को आत्मसात नहीं करती, तब तक शिक्षा में उसका एकीकरण अधूरा माना जाएगा।

भविष्य में आवश्यकता इस बात की है कि शोधकर्ता, नीति-निर्माता, शिक्षक और तकनीकी विशेषज्ञ मिलकर एक ऐसा ढांचा विकसित करें, जो तकनीकी नवाचार को मानवीय मूल्यों से संतुलित कर सके। यही शिक्षा की वास्तविक प्रगति की दिशा होगी।

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