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**MODERN
DIMENSIONS OF
HUMANITIES,
COMMERCE,
AND
MANAGEMENT
VOLUME I**

Editors:

Dr. Ruchi Goyal

Ms. Sunayana Gogoi

Dr. Shachie Sandhu

Dr. Pooja Kapoor



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Modern Dimensions of Humanities, Commerce and Management Volume I

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Editors

Dr. Ruchi Goyal

Department of English,
S.S. Jain Subodh P.G. Mahila Mahavidyalaya,
Jaipur, Rajasthan

Ms. Sunayana Gogoi

Department of Human Development and
Family Studies,
Assam Agricultural University, Assam

Dr. Shachie Sandhu

Department of Business Studies,
Panipat Institute of Engineering & Technology
(PIET), Samalkha, Haryana

Dr. Pooja Kapoor

Department of HRM,
D.Y. Patil PGDM Institute,
Akurdi, Pune, Maharashtra



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E-mail: bhumipublishing@gmail.com



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PREFACE

The contemporary world is witnessing rapid transformations in the fields of Humanities, Commerce, and Management driven by globalization, technological advancement, changing economic structures, and evolving societal values. These disciplines, though distinct in their approaches and methodologies, are deeply interconnected in addressing the complex challenges and opportunities of the modern era. The book *Modern Dimensions of Humanities, Commerce, and Management* is an earnest attempt to explore these dynamic developments and provide meaningful academic insights into emerging trends, practices, and perspectives.

This volume brings together scholarly contributions from academicians, researchers, and professionals who have critically examined diverse themes related to social sciences, business studies, economics, finance, organizational behavior, human resource management, communication, education, ethics, entrepreneurship, digital transformation, and sustainable development. The chapters included in this book reflect multidisciplinary approaches and contemporary research that aim to bridge theoretical understanding with practical applications.

The field of Humanities continues to play a vital role in shaping human values, cultural understanding, and social responsibility, while Commerce and Management disciplines contribute significantly to economic growth, innovation, and organizational excellence. Together, these areas foster critical thinking, leadership, decision-making abilities, and ethical consciousness necessary for the progress of society.

We sincerely hope that this book will serve as a valuable resource for students, teachers, researchers, policymakers, and professionals seeking updated knowledge and deeper understanding of modern developments in these disciplines. The editors express heartfelt gratitude to all contributors for their scholarly efforts and timely cooperation in making this publication possible. We also acknowledge the support and encouragement received from colleagues, institutions, and well-wishers throughout the preparation of this volume.

It is our belief that this book will inspire further research, academic discussions, and innovative practices in the broad domains of Humanities, Commerce, and Management.

- Editors

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**DEVELOPMENT, ECOLOGY AND HUMAN DISPLACEMENT
IN THE HUNGRY TIDE**

Ruchi Goyal

Department of English,

S.S. Jain Subodh PG Mahila Mahavidyalaya, Rambagh, Jaipur

Corresponding author E-mail: goyalruchisubodh@gmail.com

Abstract

In the contemporary era, the fields of humanities, commerce, and management, place strong emphasis on the notions of sustainable development, environmental management, and human welfare given the rise of severe ecological challenges and social displacement caused by rapid industrialization, commercialization of natural resources, and developmental policies across the globe. Literature has emerged as one of the most important media for examining these conflicts and generating awareness regarding environmental ethics, sustainability, and social responsibility. Amitav Ghosh's *The Hungry Tide* is a significant ecological novel moving along the same line of thought, establishing the relationship between nature, development, and marginalized communities in the fragile ecosystem of the Sundarbans. Analysing *The Hungry Tide* in relation to the modern dimensions of humanities, commerce, and management gives rise to various realisations. Not only does the novel explore human suffering, cultural identity, displacement, and ecological consciousness but also reflects the economic struggles of local communities dependent upon natural resources for survival and highlights the unequal distribution of economic opportunities. It simultaneously compels the reader to acknowledge, raise and ponder over important questions regarding sustainability, environmental governance, resource and disaster management, and policy implementation. It brings to light the Morichjhapi incident as an example of displacement caused by administrative and environmental policies. Through characters such as Piya, Kanai, Fokir, and Kusum, *Ghosh* presents the conflict between ecological conservation and human livelihood and reinforces that modern development must balance economic progress, environmental protection, and social justice. Thus, *The Hungry Tide* remains highly relevant in the modern world as it combines environmental concerns with issues of sustainable management, economic inequality, and human values contributing significantly to interdisciplinary discussions in humanities, commerce, and management studies.

Keywords: Ecology, Development, Sustainability, Human Displacement, Environmental Ethics, Resource Management, Commerce, Humanities, Sundarbans, Ecocriticism.

Introduction

Every century brings its own set of challenges, so unique that it forces mankind to ponder, question, and evolve. The twenty-first century grapples with a unique set of challenges like environmental degradation, climate change, displacement, and the need for sustainable development. These issues are no longer confined to scientific or political discourse; they have become equally important in literature, humanities, commerce, and management studies. Literature, particularly ecological literature, plays an important role in examining these modern concerns and understanding that economic growth and development cannot be separated from environmental responsibility and human welfare.

Among contemporary Indian English novelists, Amitav Ghosh's *The Hungry Tide* (2004) is a significant ecological narrative which expounds the idea of environmental ethics and ecocentrism i.e. the belief that nature has intrinsic value and that human beings are only one part of the larger ecological system, not its masters. Set in the Sundarbans, a region of rivers, islands, mangrove forests, and dangerous tides situated between India and Bangladesh, the novel presents the complex relationship between human beings and nature. Synchronous to the representation, Ghosh presents the Sundarbans as an active force shaping human life, bringing out its strength and unpredictability.

The Sundarbans is not only ecologically rich but also socially and economically vulnerable. The local people depend on fishing, farming, and forest resources for survival. However, frequent cyclones, floods, tiger attacks, poverty, and administrative restrictions create endless insecurity in their lives. Through this setting, Ghosh explores the modern conflict between development, environmental conservation, and human survival.

Research Objective and Scope of the Study

The present study attempts to examine *The Hungry Tide* in association to the contemporary dimensions of humanities, commerce, and management. It examines how ecological awareness, economic survival, sustainable resource management, displacement, and ethical governance is reflected and ultimately contends that Ghosh's novel is not merely a literary text but also an interdisciplinary commentary on the challenges of the modern world. Ghosh exhibits diverse perspectives on ecology, economic inequality, cultural identity, and environmental management through the eyes of three key characters: Piya Roy, an Indian-American marine biologist; Kanai Dutt, a translator and businessman from

Delhi; and Fokir, an illiterate local fisherman. Through their experiences and interactions, Ghosh elicits the value of conservation and concern. In retrospect, he also revisits the historical Morichjhapi incident, where refugees who settled in the Sundarbans were forcefully removed by government authorities in the name of environmental protection. This incident brings to light the tension between state policies, ecological conservation, and human rights.

Nature and Human Relationship in *The Hungry Tide*

One of the chief dimensions of humanities reflected in *The Hungry Tide* is ecological consciousness as Ghosh combines human concerns such as cultural experiences, ethical concerns, and social relationships with environmental veracities and presents nature as a dynamic force influencing human existence. The Sundarbans is not presented merely as a backdrop but an animate ecological space with its rivers, tides, forests, storms, and animals shaping the emotions, fears, livelihoods, and identities of the people living there. The title *The Hungry Tide* itself indicates the destructive and unpredictable power of nature. The volatile landscape of the Sundarbans reflects the instability of human life. Ghosh further establishes the Sundarbans as an enduring ecological force that exists beyond human control and civilization as he writes “*The specialty of mangroves is that they do not merely recolonize land; they erase time*” (7)

“*The hazards of life in the tide country were so great...*” (68) is truly indicative of the fragile relationship of interdependence that binds the mankind to the natural world. Unlike urban societies where nature is often separated from everyday life, the people of the Sundarbans live in direct contact with the environment. Their survival depends upon rivers, forests, fishing, and weather conditions. The lives of fishermen, honey collectors, and villagers are deeply connected with the rhythms of tides and rivers. Human existence in the Sundarbans becomes meaningful only through adaptation to nature rather than domination over it. This challenges the modern anthropocentric belief that humans can dominate nature.

The idea of coexistence of humans and animals is simple yet profound as the two share the same ecological space, leading to both fear and dependence. Tiger attacks are common, yet villagers continue to respect the forest. This reinforces the importance of balance and harmony between human beings and the natural world as in the case of life in the Sundarbans which constantly oscillates between existence and danger. Cyclones, floods, storms, and wild animals create an atmosphere of uncertainty and fear. However, despite

these dangers, people continue to inhabit the region because nature also provides livelihood and identity.

Fokir is a physical manifestation of the intimate bond between local communities and nature. Though illiterate, he is driven by experience rather than formal education and possesses unfathomable practical knowledge of rivers, tides, and marine life. Piya, a marine biologist by profession, finds her scientific research successful only because of Fokir's practical understanding of the waterways and aquatic life, suggesting that traditional ecological knowledge is as vital as scientific expertise.

This relationship between local wisdom and ecological understanding reinforces the importance of respecting indigenous communities in environmental studies and conservation practices.

The ecological facet of the text also echoes contemporary human anxieties concerning climate change, rising sea levels, and environmental destruction. Coastal regions like the Sundarbans are increasingly threatened by cyclones and floods. The rivers and tides repeatedly alter landscapes, destroy settlements, and influence human emotions and decisions. Ghosh personifies nature to demonstrate its agency and dominance, actively shaping human destiny and does not paint it as passive or decorative. This idea is mightily conveyed in the line: "And all the while the Matla lay still and waited" (235) presents the river as conscious and watchful, reinforcing the ecocentric vision of Ghosh.

The portrayal of the fragile ecological balance of the Sundarbans and the need for harmony between human beings and the natural world encourages readers to develop environmental awareness and ethical responsibility toward nature. By critiquing anthropocentric attitudes that treat nature merely as a resource for exploitation, it promotes ecological consciousness and recognizes the intrinsic value of forests, rivers, animals, and marine life. *The Hungry Tide*, with its idea of coexistence, indigenous wisdom, and ecological vulnerability, becomes a powerful ecological text that promotes environmental ethics, cultural understanding, and respect for nature. It ultimately strengthens the notion that human survival depends upon ecological stability and sustainable coexistence with the environment.

Human Displacement and the Morichjhapi Tragedy

Displacement refers not only to physical removal from land but also to the loss of identity, security, culture, and belonging and is one of the most painful themes explored in *The Hungry Tide*. It is presented as a consequence of political decisions, environmental policies,

poverty, and social inequality. The theme continues to remain relevant in a time where developmental projects, urban expansion, industrialization, and climate change continue to uproot defenceless populations. "Each slow turn of the world carries such disinherited ones to whom neither the past nor the future belongs." (137) This profound quote used by Ghosh to characterize refugees who exist in a perilous, suspended state, abandoned by the relentless progression of time and history. It emanates from Rainer Maria Rilke's *Seventh Duino Elegy*, which portrays modern individuals as "disinherited" souls disconnected from tradition, yet trapped before a meaningful future is established.

The Morichjhapi episode occupies a dominant place in this context. Historically, Morichjhapi was an island in the Sundarbans where refugees from East Pakistan (later Bangladesh) settled after Partition hoping to rebuild their lives through shared effort and hard work. However, the government declared the settlement illegal and launched violent eviction operations. *Through Nirmal's diary and Kusum's memories*, Ghosh reconstructs the tragedy of Morichjhapi and connects history with the larger issue of displacement and marginalization. This exhibit brings to focus the conflict between environmental policies and human survival. The government justified the eviction on the grounds of threat to the ecological balance of the Sundarbans. However, Ghosh questions whether environmental protection should come at the cost of human suffering exposing how administrative decisions, when separated from ethical responsibility, can lead to violence, exclusion, and injustice. The novel while displaying concern for the nature also challenges rigid conservation policies that ignore social realities and human rights.

The refugees in Morichjhapi are portrayed as victims of political neglect and economic injustice who attempted to transform an isolated island into a productive community, yet they were denied basic human rights. Their displacement exposes the harsh reality that marginalized communities often suffer in the name of development and conservation emphasising the unequal distribution of economic power and resources in modern society. The displacement has not only physical but also psychological and emotional manifestations. The victims suffer from loneliness, alienation, and identity crises. Piya feels culturally disconnected despite her Indian origin, while Kanai struggles to understand the emotional realities of the Sundarbans. Fokir, though deeply connected with nature, remains socially marginalized because of poverty and illiteracy. These experiences suggest that displacement can exist even without migration from one place to another.

Thus, through the Morichjhapi tragedy and the struggles of the local inhabitants, the text presents the larger conflict between development and human survival and ultimately that sustainable development must balance environmental protection with social justice and human dignity.

Ecocentrism and Sustainable Development

The Sundarbans acts as a living, dynamic ecological entity that shapes human existence, bringing ecocentrism to life by demonstrating that nature possesses intrinsic value and that humans are simply one part of a broader ecological system. Nature, with its rivers, tides, forests, storms, and animals, constantly influences the lives of the inhabitants and appears powerful, unpredictable, and beyond complete human control. The mysterious and powerful presence of nature in the Sundarbans and humanity's limited understanding of the ecological world is reflected in the statement: *"The tide country's faith is that what you cannot see can still be there."* (188)

This belief reflects an ecocentric worldview that acknowledges the existence of forces beyond human knowledge and control, thereby challenging the assumption of human superiority over nature. Ghosh critiques developmental models that prioritize human expansion and economic progress without considering ecological consequences. Administrative restrictions, conservation policies, and developmental interventions often ignore the delicate ecological balance of the Sundarbans. At the same time, he questions whether development and environmental protection should operate through exclusion and displacement, as highlighted in the portrayal of the Morichjhapi incident, a manifestation of the conflict between state-controlled conservation and human survival. *"In a place so mutable, nothing escapes the maw of the tides."* (224)

This observation is symbolic of the instability of both nature and human civilization, suggesting that human attempts to dominate nature are ultimately fragile and temporary. Through such representations, Ghosh challenges anthropocentric attitudes that place human interests above ecological balance. Apart from relying on the historical narrative, Ghosh also employs characterization to embody eco-centric values in different ways. Piya, as a marine biologist, respects biodiversity and devotes herself to the study of river dolphins. Her scientific interest is indicative of her concern for non-human life forms and ecological preservation. Fokir, on the other hand, represents indigenous ecological wisdom and possesses an instinctive understanding of the rivers, tides, and aquatic life of the Sundarbans. *"It was as if the river itself had acquired the power of speech."* (294) This line

reflects the intimate connection between Fokir and the natural environment, where nature itself appears alive and communicative. The relationship between Piya and Fokir further emphasizes that sustainable ecological understanding requires cooperation between scientific knowledge and indigenous experience.

The Sundarbans, as an ecologically sensitive region, requires careful resource management and environmental governance. Fishing, forest resources, and waterways sustain local livelihoods, but administrative regulations frequently restrict access to these resources. The complexity of balancing ecological conservation with economic survival becomes obvious when policies designed to protect forests and wildlife often ignore the needs of poor communities dependent on natural resources. *"People who are so poor that they can't afford to live anywhere else."* (98) This statement is a true representation of environmental policies and economic inequality together shaping the lives of marginalized communities in the Sundarbans, demonstrating that environmental governance must include ethical responsibility, local participation, and social justice.

Ghosh further suggests that economic progress based solely on the exploitation of natural resources can lead to environmental destruction and human suffering and thus repeatedly emphasizes the need for ethical responsibility in developmental practices. Through the tragic experiences of the refugees and local villagers, he condemns the use of conservation as a justification for displacement, violence, or exclusion. Sustainable development, therefore, emerges as one of the central concerns of the novel, requiring a balance between ecological preservation and human dignity.

Ghosh ultimately combines ecological concerns with questions of commerce and management and highlights how economic survival in the Sundarbans depends upon rivers, forests, fisheries, and agriculture, yet these resources remain vulnerable to environmental instability and administrative control. From a commercial standpoint, the novel investigates livelihood issues, unfair economic structures, and reliance on natural resources. It covers managerial problems such as sustainable governance, disaster management, resource usage, and participatory decision-making. The tragic storm at the end further symbolizes the limits of human control over nature and reinforces the necessity of ecological balance.

"Who can tell where the lives of men and animals begin or end?" (Ghosh 330) This question exemplifies the ecocentric concept by emphasizing the interconnection of all life forms and the impossibility of separating human existence from the natural world. Thus, *The Hungry*

Tide transforms into an interdisciplinary ecological text that links humanities, commerce, and management to environmental ethics and sustainable development.

Conclusion

To conclude, *The Hungry Tide* remains a relevant interdisciplinary novel that connects literature with the concerns of humanities, commerce, and management. Through the ecological landscape of the Sundarbans, *Amitav Ghosh* explores the complex relationship between nature, development, economy, governance, and human survival. The study revolves around three major themes: the relationship between humans and nature, human displacement, and ecocentrism. Through these interconnected themes, the novel brings to the forefront the idea of ecological consciousness, critiques unequal developmental policies, and emphasizes the suffering of marginalized communities through the Morichjhapi tragedy. It demonstrates that environmental concerns cannot be separated from questions of social justice, human rights, and economic survival.

It remains highly relevant in the contemporary world because it addresses pressing global concerns such as environmental degradation, climate change, displacement, poverty, and sustainable development. Although set in the Sundarbans, the issues represented in the text extend far beyond a specific geographical location and reflect the realities of vulnerable communities across the world affected by ecological and economic crises. By examining the tensions between conservation and livelihood, development and displacement, and scientific knowledge and indigenous wisdom, Ghosh encourages readers to rethink dominant models of progress. The novel therefore contributes significantly to interdisciplinary discussions by connecting literature with ecology, commerce, governance, and management studies.

Through its emphasis on ecological balance, indigenous knowledge, and ethical governance, the novel advocates sustainable and humane approaches to development and suggests that genuine progress cannot be achieved through environmental exploitation, social exclusion, or the displacement of vulnerable communities. Ultimately, *The Hungry Tide* transcends the realm of literature and emerges as a powerful commentary on contemporary global challenges. Its vision of coexistence, environmental responsibility, and social justice continues to offer valuable insights for building a more sustainable and equitable future.

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DATA-DRIVEN DIALOGUE: AI-POWERED LEARNING ENVIRONMENTS FOR LANGUAGE ACQUISITION

P. Prasantham

Department of English,

Aditya Institute of Technology and Management, Srikakulam, Andhra Pradesh

Corresponding author E-mail: prasantham3455@gmail.com

Abstract

The integration of Artificial Intelligence (AI) and Data Science in language acquisition has transformed traditional pedagogical frameworks. This paper explores how AI-powered learning environments, particularly those driven by data-centric dialogue systems, enhance language learning across cognitive, linguistic, and socio-cultural dimensions. It investigates the application of Natural Language Processing (NLP), machine learning algorithms, and speech recognition technologies in creating intelligent tutoring systems, adaptive feedback loops, and personalized learning paths. By employing real-time analytics, AI systems can interpret learner input, identify patterns, and offer contextually relevant support that aligns with individual learner profiles.

Data-driven dialogue, a subset of human-computer interaction, allows learners to engage in simulated conversations, thus promoting immersive learning. Through case studies, learning analytics, and performance metrics, the paper demonstrates the effectiveness of AI applications such as chatbots, virtual assistants, and interactive platforms like Duolingo, ELSA Speak, and Google BERT. Charts and tables illustrate learner progress, system adaptation rates, and comparative effectiveness with traditional methods.

The discussion further addresses ethical concerns, digital literacy gaps, and the socio-economic divide that affects access. It concludes by emphasizing the need for interdisciplinary collaboration in future research and deployment. The findings advocate for a balanced integration of AI technologies that not only support linguistic competence but also cultural and communicative fluency in a globalized world.

Keywords: AI in Education, Data-driven Dialogue, Language Acquisition, Intelligent Tutoring Systems, Natural Language Processing.

Introduction

Language acquisition has traditionally relied on pedagogical models such as the grammar-translation method, the direct method, and audio-lingual approaches. These conventional

models emphasize rote memorization, grammatical accuracy, and repetitive drills, often with limited real-time feedback or communicative context. Although effective in specific academic settings, these methods frequently fall short in promoting fluency and spontaneous language use (Richards and Rodgers 8).

With the advent of digital technology in education, especially since the late 20th century, Computer-Assisted Language Learning (CALL) emerged as a bridge between technology and pedagogy. CALL tools provided learners with multimedia resources and interactive tasks, allowing greater autonomy and access to authentic language use. However, their adaptability and responsiveness remained limited due to static programming and rule-based feedback (Chapelle 98).

The integration of Artificial Intelligence (AI) and Data Science has significantly enhanced the capabilities of digital language learning platforms. AI technologies—such as Natural Language Processing (NLP), machine learning, and speech recognition—enable systems to engage in data-driven dialogue, offering real-time feedback, performance prediction, and personalized learning paths. These systems not only simulate conversation but also interpret user input, adapt content based on learning trajectories, and provide contextualized responses (Holmes *et al.* 42).

Key Definitions:

- **Artificial Intelligence (AI):** The simulation of human cognitive processes by machines, including learning, reasoning, and problem-solving.
- **Data-Driven Dialogue:** A system of human-computer interaction where the AI interprets language data to simulate and adapt conversations for pedagogical goals.
- **Natural Language Processing (NLP):** A field of AI that focuses on the interaction between computers and human language, enabling machines to understand, interpret, and generate natural language.

This study aims to explore how data-driven dialogue systems powered by AI reshape the landscape of language acquisition. It seeks to answer the following questions:

1. How effective are AI-powered environments in facilitating language learning compared to traditional methods?
2. What types of data are used by AI systems to personalize language instruction?
3. What are the limitations and ethical considerations of AI in this domain?

Visual Aid: Timeline Chart – Evolution of Language Learning Technologies

Era	Method/Technology	Key Features
Pre-1960s	Grammar-Translation	Focus on syntax, translation, memorization
1960s–1970s	Audio-Lingual	Repetition, drills, stimulus-response patterns
1980s–1990s	CALL	Multimedia resources, basic interactivity
2000s	Intelligent Tutoring Systems	Some adaptivity, rule-based feedback
2010s–Present	AI and Data-Driven Dialogue	NLP, speech recognition, personalized instruction

Theoretical Foundations

Theories of language acquisition have long emphasized the cognitive and social dimensions of learning. Stephen Krashen’s *Input Hypothesis* argues that language learners acquire language most effectively when exposed to comprehensible input slightly above their current level ($i+1$) (Krashen 32). According to Krashen, this exposure should be natural, meaningful, and low in anxiety, a condition often difficult to reproduce in traditional classrooms.

Lev Vygotsky’s *Sociocultural Theory* shifts the focus from individual cognition to social interaction. He proposed the *Zone of Proximal Development* (ZPD), where learners can perform better with the help of a more knowledgeable other (Vygotsky 86). In AI-powered learning environments, the AI acts as this “other,” adapting instruction based on the learner’s current level and providing real-time scaffolding. This aligns with dialogic learning, where meaning is co-constructed through interaction.

The foundation of AI learning models is derived from machine learning paradigms:

- **Supervised Learning** involves training models using labeled data to predict outcomes (e.g., identifying grammatical errors).
- **Unsupervised Learning** clusters unlabeled data, identifying hidden structures (e.g., learner profiles).
- **Reinforcement Learning** allows AI systems to learn through reward-based interactions, refining responses over time (Holmes *et al.* 51).

Dialogic pedagogy, rooted in Bakhtin’s theories, supports open-ended interaction and mutual meaning-making. AI dialogue systems echo this approach by enabling dynamic,

bidirectional communication, rather than rigid instruction. Constructivist theory further reinforces this model by advocating learner-centered approaches, where knowledge is actively constructed through interaction with meaningful content (Piaget 41).

Comparison of Traditional vs AI-Powered Instructional Frameworks

Dimension	Traditional Instruction	AI-Powered Dialogue Systems
Feedback	Delayed and generalized	Immediate, personalized
Interaction	One-to-many, mostly teacher-driven	One-to-one, learner-driven
Adaptability	Fixed syllabus	Dynamic and data-driven customization
Engagement	Textbook-bound	Multimodal, gamified
Learning Pace	Uniform for all learners	Individually paced based on real-time performance
Scaffolding	Teacher-controlled	Algorithmically personalized through learner modeling

Technological Infrastructure

Artificial Intelligence (AI) in language learning depends heavily on Natural Language Processing (NLP) and machine learning technologies. NLP enables machines to understand, interpret, and generate human language by analyzing syntax, semantics, and context (Jurafsky and Martin 25). Machine learning algorithms process large datasets of spoken and written language to identify patterns, errors, and learner progress. These models improve with experience, enabling adaptive and personalized instruction.

AI dialogue systems utilize voice recognition and contextual understanding to facilitate interactive conversations with learners. Voice recognition converts speech to text, allowing learners to practice pronunciation and fluency. Contextual understanding ensures the AI can respond meaningfully based on the learner's input rather than fixed scripted replies (Holmes *et al.* 54). This technology supports dynamic dialogues that simulate real-life language use.

Common AI-powered tools in language acquisition include:

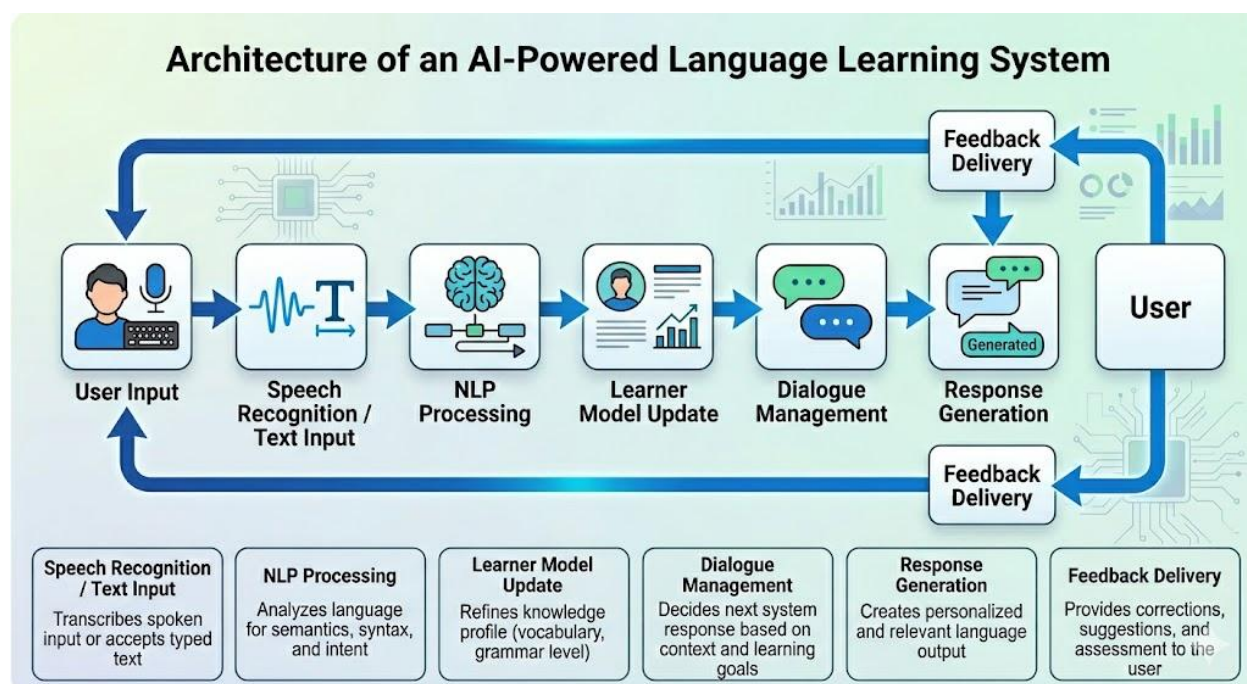
- **Chatbots:** AI-driven conversational agents that simulate human dialogue. Examples include Duolingo's chatbot, which helps learners practice dialogue in multiple languages.

- **Virtual Tutors:** These provide personalized lessons, feedback, and progress tracking. They combine speech recognition with NLP to guide learners through exercises (Chen *et al.* 112).
- **Speech-to-Text Systems:** Platforms like ELSA Speak use speech-to-text to evaluate pronunciation accuracy and fluency, giving learners instant corrective feedback.

Popular Platforms and Technologies:

Platform	Core Technology	Unique Feature
Duolingo	AI chatbots, NLP	Gamified learning with personalized practice
ELSA Speak	Speech recognition, AI assessment	Real-time pronunciation feedback
Babbel	Machine learning-based lesson customization	Contextualized vocabulary and grammar lessons
Google BERT	Deep learning NLP model	State-of-the-art language understanding

Architecture of an AI-Powered Language Learning System



The system captures user speech or text and processes it through speech recognition and NLP to understand intent. It then updates the user's personalized learner profile, manages the conversation flow, and generates an appropriate AI response. Finally, it delivers tailored learning feedback directly back to the user, completing the adaptive educational loop.

Usage Distribution of Top AI Language Apps Worldwide (2024)

App	Monthly Active Users (Millions)	Market Share (%)
Duolingo	50	35
Babbel	15	10
ELSA Speak	10	07
Rosetta Stone	08	06
Others	57	42

Source: Global EdTech Report 2024

AI-powered language learning platforms leverage this infrastructure to deliver highly interactive and tailored experiences. The seamless integration of NLP and machine learning allows for real-time error detection, contextualized feedback, and adaptation to individual learner needs. This technological synergy enables a scalable and engaging language acquisition environment beyond the limitations of traditional methods.

Data-Driven Dialogue in Practice

AI-powered language learning environments utilize data-driven dialogue to offer real-time, interactive, and personalized instruction. One of the key advantages is real-time feedback, where the system continuously monitors learner input and provides immediate corrective guidance. This instant feedback loop helps learners correct pronunciation, grammar, and vocabulary use during practice, which enhances retention and reduces fossilization of errors (Holmes *et al.* 62). Unlike traditional classrooms where feedback may be delayed, AI dialogue systems respond dynamically, making language practice more effective.

Personalization is central to data-driven dialogue. AI platforms build learner models by analyzing user behavior, performance history, and error patterns. These models enable the system to tailor content and difficulty levels to individual learners' needs, thus supporting differentiated instruction. For instance, if a learner struggles with verb conjugations, the system increases practice opportunities focusing on that skill (Chen *et al.* 118). Over time, this learner model evolves, reflecting progress and adapting tasks accordingly.

Adaptive learning is the practical outcome of personalization. The AI modifies tasks, exercises, and dialogue complexity in real time, based on the learner's ongoing performance. This continuous calibration ensures that learners remain in their optimal zone of proximal development (Vygotsky 90). Adaptive systems prevent frustration caused by tasks that are too difficult or boredom from repetitive easy exercises. Moreover,

adaptive dialogue encourages learners to actively participate in conversational practice rather than passively completing drills.

To further enhance motivation, many AI-powered platforms integrate gamification elements such as points, badges, streaks, and leaderboards. Gamification taps into psychological motivators, encouraging consistent engagement and longer study sessions (Deterding *et al.* 25). In AI environments, gamified feedback is personalized, making the learning experience both enjoyable and efficient.

Case Study 1

Duolingo – AI Dialogue Engine Analysis

Duolingo uses a sophisticated AI dialogue engine that simulates real-life conversations. Its chatbots provide contextualized responses based on learner input, using NLP to understand syntax and semantics (Vesselinov and Grego 15). Duolingo’s machine learning algorithms continuously analyze learner data to refine dialogue prompts and error detection. The platform’s gamified environment, combined with personalized tasks, contributes to a high retention rate compared to traditional language apps.

Case Study 2

ELSA Speak – Speech Recognition and Fluency Metrics

ELSA Speak focuses on improving pronunciation through speech recognition technology. Its AI compares learner speech against native speaker benchmarks and provides detailed fluency and intonation scores (Huang *et al.* 107). The app’s real-time corrective feedback helps users refine their accent and speech rhythm. By tracking progress over time, ELSA’s learner model adapts practice exercises, maximizing fluency development.

Learner Retention Over Time in AI vs Non-AI Platforms

Time (Months)	AI-Powered Platforms (%)	Non-AI Platforms (%)
1	85	60
3	70	40
6	55	25
12	40	15

Source: EdTech Insights 2023

Features Comparison Between Popular AI Language Learning Platforms

Feature	Duolingo	Babbel	ELSA Speak	Rosetta Stone
AI-Powered Dialogue	Yes	Limited	No	No
Speech Recognition	Yes	No	Yes	Yes
Real-Time Feedback	Yes	Partial	Yes	Partial
Personalization	High	Medium	High	Medium
Gamification	Extensive	Moderate	Limited	Limited
Adaptive Learning	Yes	Yes	Yes	Yes

AI-driven data dialogue enables language learners to engage in meaningful, personalized interactions that foster deeper learning. Real-time feedback, personalized learner modeling, and adaptive content create an environment where learners stay motivated and improve faster. Platforms like Duolingo and ELSA Speak demonstrate the effectiveness of these approaches through their high retention rates and user satisfaction.

Learning Analytics and Assessment

Learning analytics play a crucial role in measuring learner performance within AI-powered language learning environments. These analytics collect, process, and interpret large volumes of learner interaction data, providing insights into progress, difficulties, and engagement levels (Siemens and Long 43). By continuously analyzing user inputs—such as responses to exercises, pronunciation accuracy, and dialogue interactions—AI systems can track performance trends and identify areas needing intervention.

Predictive modeling is an important analytic technique in this context. Using historical data, AI models forecast potential learning challenges a student might face. For example, if a learner consistently struggles with verb tenses, predictive algorithms can flag this early and suggest targeted practice before the problem becomes entrenched (Holmes *et al.* 67). This proactive approach supports personalized learning pathways and reduces dropout rates.

Dashboards serve as visual tools that deliver real-time learning insights to both learners and instructors. These dashboards display metrics such as accuracy rates, time spent on tasks, and skill mastery levels in an accessible format (Meyer 88). Learners benefit from immediate feedback and motivational cues, while educators can tailor support based on data-driven evidence. Interactive dashboards often include trend graphs and heat maps for intuitive data visualization.

Formative vs Summative Assessments in AI Tools

AI language platforms emphasize formative assessment—ongoing, low-stakes evaluations that provide instant feedback during learning activities (Black and Wiliam 46). Formative assessments guide learners to adjust their strategies and improve iteratively. For example, Duolingo’s frequent quizzes and speaking exercises continuously assess comprehension and pronunciation.

In contrast, summative assessment occurs at defined intervals to evaluate overall competence (Brown 123). While less common in AI apps, summative assessments may include proficiency tests that summarize progress after course completion. Some platforms integrate AI-driven summative tests that adapt to learner proficiency, offering an accurate measure of language skills.

Accuracy Improvements Over Time Based on NLP Analysis

Week	Pronunciation Accuracy (%)	Grammar Accuracy (%)
1	65	70
4	75	80
8	85	88
12	90	92

Source: ELSA Speak Internal Report, 2023

AI-Generated Error Categorization and Learner Response

Error Type	Description	Frequency (%)	AI-Generated Feedback	Learner Action
Pronunciation	Mispronounced phonemes	40	“Try to stress the vowel sound here.”	Practice targeted drills
Grammar	Incorrect verb tense usage	30	“Remember to use past tense for this verb.”	Review grammar lesson
Vocabulary	Incorrect word choice	15	“Consider using ‘arrive’ instead of ‘come’.”	Use flashcards for new words
Syntax	Sentence structure errors	10	“Try rearranging the sentence for clarity.”	Rewrite sentences
Other	Miscellaneous errors	5	General encouragement and tips	Follow-up exercises

AI-driven learning analytics not only measure performance but also empower personalized interventions. The combination of predictive modeling and real-time dashboards enhances learners' self-awareness and motivation. Meanwhile, the balance of formative and summative assessments ensures both continuous improvement and comprehensive evaluation. As NLP models evolve, accuracy in detecting and categorizing errors improves, leading to better learner outcomes.

Pedagogical Impact

AI-powered language learning environments profoundly impact the development of core language skills: listening, speaking, reading, and writing. The integration of Natural Language Processing (NLP) and speech recognition technologies enables learners to practice listening and speaking in interactive, real-time contexts. For example, platforms like ELSA Speak provide detailed pronunciation feedback, helping learners improve phonetic accuracy and oral fluency (Huang *et al.* 105). Reading skills benefit from adaptive text complexity and contextual vocabulary support, while writing skills are enhanced through AI-assisted grammar and syntax correction tools (Holmes *et al.* 71).

Beyond linguistic skills, AI systems foster intercultural communication competence by simulating diverse conversational scenarios. Learners encounter culturally relevant dialogue and pragmatics, preparing them for authentic interactions in varied cultural settings (Byram 120). This dimension is crucial in language education, as communicative competence includes understanding sociocultural norms alongside language proficiency.

The pedagogical implications differ between second language (L2) and foreign language (FL) contexts. In L2 settings, where learners are immersed in the target language environment, AI tools complement natural exposure with targeted practice. In FL contexts, where exposure is limited, AI systems play a more central role in providing immersive and interactive experiences that might otherwise be inaccessible (Krashen 85).

AI also acts as a co-tutor, balancing automation with human input. While AI delivers personalized feedback and scaffolding, human instructors provide nuanced cultural insights, motivation, and emotional support that AI cannot fully replicate (Chen *et al.* 120). This hybrid model maximizes the strengths of both AI and human teaching.

AI-powered learning environments create a dynamic and supportive ecosystem for language acquisition. By enhancing linguistic skills and intercultural competence, they prepare learners for real-world communication. The combination of AI and human tutors ensures a balanced, effective pedagogical approach.

Skills Matrix Development Through AI Interaction

Language Skill	AI Contribution	Learner Outcome
Listening	Real-time speech recognition and comprehension	Improved auditory processing
Speaking	Pronunciation assessment and feedback	Enhanced fluency and accuracy
Reading	Adaptive texts with vocabulary support	Better reading comprehension
Writing	Grammar and syntax correction	More accurate written output
Intercultural	Simulated dialogues with cultural context	Increased communicative competence

Benefits and Challenges

AI-powered language learning systems bring significant benefits to language education. One key advantage is scalability, as these systems can serve millions of learners globally at a relatively low cost compared to traditional classrooms (Holmes *et al.* 45). AI also enhances engagement by providing interactive, gamified experiences that motivate learners to persist longer (Deterding *et al.* 12). Furthermore, AI delivers personalized feedback by analyzing individual learner data, which accelerates skill development through tailored exercises and real-time corrective input (Chen *et al.* 110).

Despite these benefits, several challenges persist. One concern is algorithmic bias, where AI systems may reinforce stereotypes or misunderstand diverse dialects due to biased training data (Buolamwini and Gebru 1). Another issue is the lack of emotional intelligence; AI cannot fully replicate the empathetic, motivational support human teachers provide (Holmes *et al.* 50). Moreover, some learners may develop over-reliance on AI feedback, neglecting critical thinking and social interaction skills necessary for language use (Selwyn 78).

The digital divide poses a critical barrier to equitable access. Many learners in low-resource settings lack reliable internet, compatible devices, or digital literacy, limiting their ability to benefit from AI tools (Warschauer 59). This inequity risks widening educational gaps, especially in marginalized communities.

Finally, teacher perceptions and adaptability influence the successful integration of AI systems. Some educators embrace AI as a supportive tool, while others express skepticism

or resistance due to fears of job displacement or lack of training (Selwyn 83). Effective professional development and collaborative design of AI tools can enhance teacher buy-in and maximize pedagogical benefits.

SWOT Analysis of AI-Powered Language Learning Systems

Strengths	Weaknesses	Opportunities	Threats
Scalable global reach	Algorithmic bias	Personalized learning	Digital divide
Real-time, adaptive feedback	Lack of emotional intelligence	Data-driven insights for teachers	Over-reliance by learners
Gamified engagement	Dependence on stable internet	Hybrid AI-human teaching models	Teacher resistance
Cost-effective delivery	Limited cultural/contextual understanding	Expanding language access	Privacy and data security risks

AI-powered language learning systems offer transformative benefits but must address ethical, technical, and social challenges to realize their full potential. Equitable access and thoughtful integration into educational settings remain priorities for sustainable adoption.

Ethical and Socio-Cultural Considerations

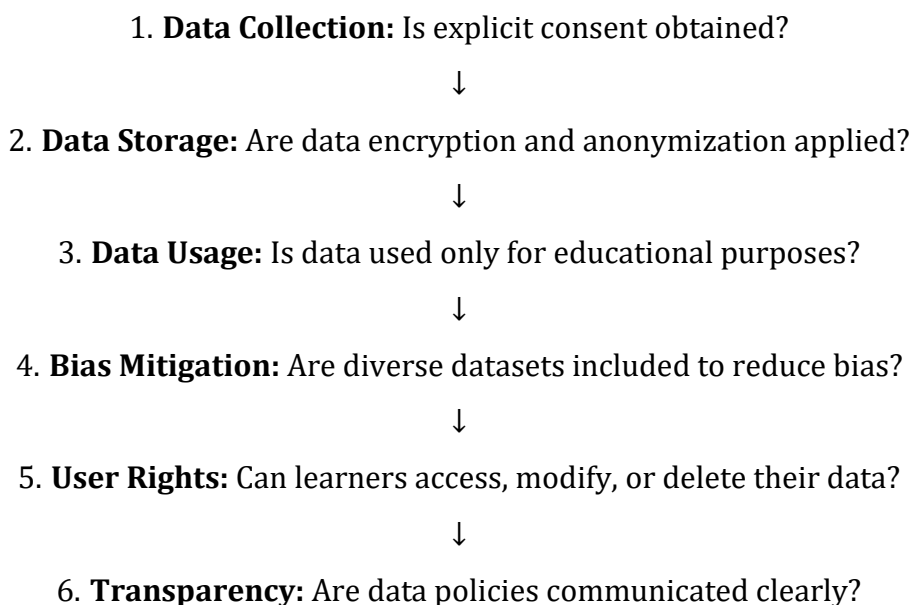
The adoption of AI-powered language learning systems raises important ethical and socio-cultural concerns, especially related to data privacy and surveillance. Learners often provide vast amounts of personal data, including voice recordings and interaction logs, which must be protected against unauthorized access or misuse (Crawford 45). Without clear safeguards, AI platforms risk becoming tools for intrusive surveillance rather than supportive learning environments.

A key issue is consent and transparency in how learner data is collected, stored, and used. Ethical AI requires that learners understand what data is gathered and have control over its usage (Floridi 32). Transparent policies promote trust and ensure that data is used solely for educational improvement rather than commercial exploitation or profiling.

Bias in language datasets is another critical concern. AI models trained on limited or skewed corpora may perpetuate stereotypes or exclude dialects and accents, disadvantaging certain learner groups (Bolukbasi *et al.* 432). For example, an AI system that poorly recognizes non-standard accents may provide inaccurate feedback, frustrating learners and reinforcing linguistic inequality.

Additionally, AI's impact on minority languages and linguistic diversity must be considered. Most AI language tools prioritize widely spoken languages, which risks marginalizing lesser-used languages and cultures (Blommaert 73). This can contribute to language loss, undermining cultural heritage and diversity.

Visual Aid: Flowchart – Ethical Decision Points in AI Data Processing



AI language learning technologies must embed ethical frameworks that respect learner autonomy, promote fairness, and protect cultural diversity. Only then can these tools support equitable and inclusive language acquisition.

Future Directions and Innovations

The future of AI-powered language learning promises exciting innovations that will further transform how languages are acquired. One prominent direction is the integration of Augmented Reality (AR) and Virtual Reality (VR) technologies to create immersive dialogue environments. These systems simulate real-life conversational contexts, allowing learners to practice speaking and listening in interactive, 3D spaces that closely mimic authentic settings (Radianti *et al.* 90). Such immersive experiences increase learner engagement and contextual understanding, bridging the gap between virtual practice and real-world application.

Another emerging area is Emotional AI and affective computing, which involves recognizing and responding to learners' emotional states. By analyzing facial expressions, voice tone, and physiological signals, AI tutors can adapt feedback and support to learners' motivation and frustration levels (Picard 135). This development addresses the current

limitations of AI systems that lack emotional intelligence, improving learner experience and persistence.

The development of multilingual AI dialogue systems is also gaining momentum. These systems can seamlessly switch between languages or support code-switching, reflecting natural multilingual communication patterns (Tiedemann 47). Such flexibility benefits learners in multilingual societies and facilitates the preservation of minority languages by integrating them into AI platforms.

In classroom settings, AI is increasingly positioned as a co-teacher, complementing human instructors rather than replacing them. AI systems can handle personalized practice and formative assessments, freeing teachers to focus on complex language functions and cultural instruction (Luckin *et al.* 112). This hybrid model encourages collaboration between educators, linguists, and AI developers to design tools aligned with pedagogical goals.

Predicted Trends in AI Language Learning Tools (2025–2030)

Innovation Area	2025	2027	2030
AR/VR Integration	10%	35%	60%
Emotional AI	05%	25%	50%
Multilingual AI Systems	15%	40%	70%
Classroom Co-Teaching AI	20%	45%	65%

AI-powered language learning continues evolving toward greater immersion, emotional responsiveness, and multilingual support. Collaboration among educators, linguists, and AI developers will be vital to harness these innovations responsibly and effectively.

Conclusion

This paper has explored the transformative impact of AI-powered, data-driven dialogue systems on language acquisition. Key insights include the ability of AI to provide personalized, real-time feedback that adapts to learner needs. The integration of natural language processing and machine learning creates interactive environments where learners can practice language skills more effectively than traditional methods. Technologies like chatbots, speech recognition, and adaptive learning platforms enhance engagement and motivation.

Despite these benefits, challenges such as algorithmic bias, data privacy concerns, and digital divide issues must be addressed. AI should be viewed as a tool that augments human

instruction, not as a replacement for teachers. Human guidance remains essential to provide cultural context, emotional support, and critical thinking skills.

To fully harness AI's potential in language learning, development must be inclusive, ethical, and interdisciplinary. Collaboration between educators, linguists, technologists, and policymakers is crucial to create systems that are fair, accessible, and culturally sensitive. Future innovations such as immersive AR/VR environments and emotional AI promise to deepen learning experiences. Overall, AI-powered language learning environments offer exciting opportunities to transform education, but their success depends on careful design and responsible implementation.

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ENTREPRENEURIAL ECOSYSTEMS IN HIGHER EDUCATION INSTITUTIONS IN NORTH INDIA: SUPPORT MECHANISMS AND BARRIERS TO INNOVATION AND KNOWLEDGE TRANSFER

Ashish Arora¹ and Sagar^{*2}

¹Department of Management, Guru Nanak Dev University College. Jalandhar. Punjab. India

²University Business School, Guru Nanak Dev University, Amritsar. Punjab. India

*Corresponding author E-mail: bhattsagar1761998@gmail.com

Abstract

Purpose: This study aims to examine whether higher education institutions (heis) in developing countries, particularly in north india, are adopting innovation and entrepreneurship initiatives. It seeks to investigate the entrepreneurial ecosystem within heis and identify both the support mechanisms and obstacles these institutions face in fostering entrepreneurship and innovation, as well as promoting knowledge transfer from universities to the marketplace.

Methodology: The research employed a mix of semi-structured and in-depth interviews for data collection. The analysis was conducted using one-sample and independent-sample t-tests. The results indicated that all examined variables play a role in strengthening entrepreneurship and innovation activities within HEIS.

Findings: The results confirm that all studied factors contribute to the enhancement of entrepreneurship and innovation in heis. However, the findings also highlight shortcomings in areas such as access to funding, support programs, and institutional policies and guidelines that are necessary to promote entrepreneurship and innovation effectively within the education system.

Value: This research addresses a gap in the literature by examining the components of the entrepreneurial ecosystem in developing countries and providing a clearer understanding of the challenges associated with innovation and entrepreneurship activities.

Keywords: Entrepreneurship, Innovation, Higher Educational Institutions, Entrepreneurial Ecosystem.

Introduction

Universities are currently experiencing continuous transformation driven by globalisation and socio-economic development. It is widely acknowledged that higher education

institutions (HEIs) have a strong influence on both economic growth and social development (Alshamsi *et al.*, 2024; Lv *et al.*, 2022; de Moraes *et al.*, 2023). As a result, there is an increasing consensus that universities must evolve beyond their traditional role of simply generating and transferring knowledge and instead move towards the concept of the “4th generation universities”, widely referred to as “Entrepreneurial Universities” (Adu *et al.*, 2020; Zaidan *et al.*, 2024). In today’s context, universities play a central and influential role in socio-economic development. They actively support governmental efforts aimed at building a knowledge-based economy, advancing technological innovation (Choi and Markham, 2019; Diotay *et al.*, 2024; Preedy *et al.*, 2020), and enabling sustainability transitions (Buzzao *et al.*, 2024). Mohamed and Sheikh Ali (2021) and Dajani *et al.* (2021) further emphasise that universities now perform multiple roles in society and the economy, extending well beyond their traditional academic functions. In the modern era, they are increasingly expected to foster innovation, encourage entrepreneurship, and facilitate the commercialisation and transfer of knowledge from academia to industry and society. Although there is a growing body of literature on entrepreneurship and knowledge commercialisation in developed countries, relatively limited research has focused on these areas within higher education institutions in developing countries, particularly in North India. This gap highlights the need for a deeper understanding of how HEIs in such contexts are adapting to entrepreneurial expectations and contributing to innovation ecosystems. Therefore, this study aims to explore the entrepreneurial ecosystem within HEIs and examine whether innovation and entrepreneurship activities are being adopted in developing countries, with a specific focus on North India. It also seeks to identify the support mechanisms available and the challenges faced by these institutions in promoting entrepreneurship, innovation, and the transfer of knowledge from universities to the marketplace within developing country contexts.

This study makes several important contributions to the existing literature and practice. First, it extends the understanding of entrepreneurial ecosystems within higher education institutions in developing countries, an area that has received limited scholarly attention compared to developed economies. Second, it provides empirical insights into the specific support structures and institutional gaps affecting innovation and entrepreneurship in HEIs, particularly in the context of North India. Third, the study offers practical implications for policymakers and university administrators by highlighting key areas such as funding access, institutional support systems, and policy frameworks that require

improvement. Finally, it contributes to the broader discourse on the transformation of universities into entrepreneurial institutions by explaining how knowledge spillover from academia to industry can be strengthened in developing country contexts. The main objective of this study is to examine the extent to which higher education institutions (HEIs) in developing countries, particularly North India, are adopting innovation and entrepreneurship activities. Specifically, the study aims to explore the entrepreneurial ecosystem within HEIs and identify the key support mechanisms that facilitate entrepreneurship and innovation. It also seeks to investigate the major challenges and barriers faced by these institutions in promoting entrepreneurial activities, innovation practices, and the effective transfer of knowledge from universities to the market. In addition, the study intends to understand how HEIs contribute to fostering a culture of entrepreneurship and how institutional factors influence innovation outcomes within the higher education sector.

Literature Review

Entrepreneurial leadership within higher education institutions (HEIs) has gained significant attention in recent years due to the increasing expectation that universities actively contribute to economic development and innovation ecosystems. According to Huda (2016) and Poček *et al.* (2024), universities play a crucial role in strengthening the connection between entrepreneurship and national economic development, leading to the creation of an “entrepreneurship-friendly ecosystem”. The concept of “entrepreneurial universities” has been widely discussed in academic literature (Etzkowitz, 1983; Hassan, 2024; Henry and Lahikainen, 2024), reflecting a shift in the traditional mission of universities from focusing solely on teaching, research, and community service towards a stronger emphasis on innovation and entrepreneurship. This transformation highlights the growing importance of entrepreneurial and intrapreneurial activities within HEIs. Such engagement not only strengthens institutional competitiveness but also enhances the ability of economies to respond to rapid global changes (Alfalih and Ragmoun, 2020; Henry and Lahikainen, 2024; Zaidan *et al.*, 2024). In this context, entrepreneurial leadership has emerged as a critical factor influencing the effectiveness of the entrepreneurial ecosystem within universities. It plays a key role in promoting entrepreneurial education, fostering industry engagement, and building a strong entrepreneurial culture within academic environments.

The Role of Universities in Facilitating Access to Finance: Access to finance is widely recognised as one of the most important enablers of entrepreneurial success. A substantial body of literature highlights the role of HEIs in supporting financial accessibility through mechanisms such as business incubators and accelerators, which assist researchers and innovators in transforming their ideas into market-ready solutions (Hassan, 2024). Financial support is essential for gaining competitive advantage and ensuring the survival and growth of new ventures (Rocha *et al.*, 2021; Smith *et al.*, 2020). At local, national, and international levels, the creation of new ventures depends heavily on supportive regulatory frameworks and policies that facilitate business formation and funding access, including support from banks and angel investors (del Giudice *et al.*, 2019; Eichelberger *et al.*, 2020; Hahn *et al.*, 2020; Lv *et al.*, 2022). Despite this, financing entrepreneurial initiatives remains a major challenge for HEIs (Elnadi and Gheith, 2021; Guindalini *et al.*, 2021; Lv *et al.*, 2021; Smith *et al.*, 2020). This challenge is further intensified by other limitations such as inadequate entrepreneurial knowledge, lack of mentorship, and insufficient practical experience (Choi and Markham, 2019; Elia *et al.*, 2020; Ghafar, 2020; Liu *et al.*, 2019; de Moraes *et al.*, 2023; Yi *et al.*, 2021). As a result, the financial dimension remains a critical barrier that HEIs must address to effectively promote entrepreneurship and innovation.

The Role of Universities in Enhancing Entrepreneurial Education and Programmes: Entrepreneurship education has been widely studied in relation to students' entrepreneurial intentions and their likelihood of starting new ventures (Kassim *et al.*, 2024; Overwien *et al.*, 2024). One of the key theoretical foundations in this area is the Knowledge Spillover Theory of Entrepreneurship (KSTE), which explains entrepreneurial behaviour as a response to opportunities created through knowledge spillovers (Hanandeh *et al.*, 2021; Bilal and Hussien, 2019). According to KSTE, individuals are more likely to engage in entrepreneurial activities when they have access to knowledge that generates new opportunities. This implies that knowledge generated within universities can act as a catalyst for entrepreneurship when effectively transferred and utilised. The theory further suggests that entrepreneurial intention and behaviour are strongly influenced by the availability and accessibility of knowledge spillovers. In this context, entrepreneurship education plays a critical role in enabling individuals to recognise and exploit such opportunities. As a result, the integration of entrepreneurship education and structured programmes within HEIs is essential for promoting entrepreneurial behaviour. These programmes help bridge the gap between theoretical knowledge and practical application,

thereby increasing the likelihood of venture creation and innovation-driven activities (Syed *et al.*, 2024). The Role of Universities in R&D and Innovation: Research and development (R&D) and innovation are central functions of modern universities. A growing body of literature highlights the importance of commercialising research outputs and strengthening collaboration between universities and industry (Alshamsi *et al.*, 2024; Marzouk, 2024; Omotosho *et al.*, 2024; Pujotomo *et al.*, 2023). These collaborations are essential for translating academic knowledge into practical applications that benefit society and the economy.

To facilitate this process, many universities have established specialised institutional structures such as technology transfer offices, science parks, and business incubators (Diotay *et al.*, 2024; Rajagopal *et al.*, 2024). These structures serve as important mechanisms for supporting innovation, protecting intellectual property, and enabling the commercialisation of research outputs. Through such initiatives, universities play a significant role in bridging the gap between academic research and market needs. This enhances their contribution to innovation ecosystems and strengthens their position as key drivers of technological advancement and economic development. The Role of Universities in Accessing the Market: Another important function of universities is their role in facilitating knowledge exchange and market access. Knowledge exchange refers to the process through which universities disseminate knowledge beyond academic boundaries and engage with external stakeholders (Cai *et al.*, 2020). In this context, HEIs are increasingly expected to support young entrepreneurs in accessing markets and transforming ideas into viable business ventures (Del Giudice *et al.*, 2019). Over time, the engagement of universities with external partners has expanded significantly beyond traditional teaching and research roles (Adesola and Datta, 2020). This reflects a broader shift towards a more open and collaborative model of knowledge transfer, where universities actively contribute to industry and societal development. By facilitating access to markets, universities help bridge the gap between innovation creation and commercial application. This ensures that knowledge generated within academic institutions is effectively utilised for economic and social benefit.

The Role of Universities in Policies and Guidelines: Institutional policies and governance frameworks play a critical role in shaping the effectiveness of entrepreneurship and innovation within HEIs. Al Harrasi and Al Subhi (2024), Hojeij (2024), and Zaidan *et al.* (2024) emphasise the importance of university policies and strategies in promoting

entrepreneurship and bridging the gap between knowledge creation and commercialisation. These policies are essential for creating an enabling environment that supports entrepreneurial activities and encourages innovation within academic institutions. Furthermore, Bagiatis *et al.* (2020) highlight a strong positive relationship between flexible, coherent policies and entrepreneurship education. Well-designed policies and guidelines not only support entrepreneurial initiatives but also enhance the overall innovation capacity of universities. According to Diotay *et al.* (2024), such institutional frameworks contribute significantly to regional and national economic sustainability as well as broader social development. In this regard, effective policy frameworks are essential for ensuring that universities can successfully transition into entrepreneurial institutions. They provide the structural foundation necessary for fostering innovation, supporting knowledge transfer, and enabling sustainable entrepreneurial ecosystems within HEIs.

Methodology

Questionnaire Design: The present study adopted a structured survey questionnaire to obtain a comprehensive understanding of the role of higher education institutions (HEIs) in promoting entrepreneurship and innovation activities, as well as to identify the key barriers that hinder effective knowledge transfer from universities to the market. The questionnaire was carefully designed to capture multiple dimensions of the entrepreneurial ecosystem within HEIs, ensuring a holistic assessment of institutional support mechanisms and constraints.

The instrument consisted of seven major constructs, each representing a critical component of the entrepreneurial ecosystem in higher education settings. These included leadership (20 items), access to finance (5 items), education and training (11 items), research and development (6 items), support activities and programmes (9 items), access to the market (6 items), and policies and guidelines (4 items). Together, these dimensions were selected to reflect the key institutional, structural, and operational factors influencing entrepreneurship and innovation within HEIs.

A five-point Likert scale was used to measure all items in the questionnaire, ranging from “strongly disagree” (1) to “strongly agree” (5). This scale allowed respondents to express the extent of their agreement with each statement, thereby enabling the quantitative assessment of perceptions related to entrepreneurial support systems in HEIs. The reliability of the instrument was tested using Cronbach’s alpha, which yielded a value of

0.91, indicating a high level of internal consistency and reliability of the measurement scale (Peterson, 1994). This suggests that the items used in the questionnaire were appropriate and consistent in measuring the intended constructs.

Sampling and Data Collection: The study targeted a diverse group of respondents, including experts, administrators, and policy-makers working within higher education institutions in North India. The selection of respondents aimed to ensure that the data reflected a broad and informed perspective on entrepreneurship and innovation practices within HEIs.

Data were collected using a convenience sampling approach. The questionnaire was distributed online through Google Forms during the spring semester of 2022. This method was chosen due to its efficiency in reaching respondents across multiple institutions and its suitability during the data collection period. A total of 40 valid responses were received and included in the final analysis.

The sample included participants from both public (55%) and private (42.5%) higher education institutions. In total, respondents represented four public and nine private HEIs, ensuring participation from a range of institutional contexts. The respondents were not limited to academic staff alone; they also included administrative and senior-level decision-makers such as assistant deans (7.5%) and deans (5%). This diversity of respondents contributed to a more comprehensive and balanced understanding of the entrepreneurial environment within HEIs.

Institutional Context and Preliminary Findings: In addition to survey responses, the study also examined the institutional support structures for entrepreneurship and innovation within the participating HEIs. Preliminary findings, as summarised through cross-tabulation analysis, provide important insights into the current state of entrepreneurial support systems in higher education institutions. The results, presented in Table 1, reveal that all public HEIs included in the study have established entrepreneurship centres, with the exception of one institution. Furthermore, all public institutions offer academic programmes related to entrepreneurship, indicating a relatively strong emphasis on entrepreneurship education at the curricular level. However, the presence of more advanced support mechanisms appears limited. Only two public HEIs were found to have incubators, technology transfer offices, accelerator centres, and funding programmes dedicated to supporting entrepreneurship and innovation activities.

Table 1: Entrepreneurship and innovation support activities provided by heis (Total institutions number =13)

Type of HEIs	Entrepreneurship Centre	Incubation Centre	Technology Transfer Centre	Accelerator Programmes	Funding Programmes	Entrepreneurship Academic Programmes
Public (n=4)	Yes = 3 (75.0%) No = 1 (25.0%)	Yes = 2 (50.0%) No = 2 (50.0%)	Yes = 2 (50.0%) No = 2 (50.0%)	Yes = 2 (50.0%) No = 2 (50.0%)	Yes = 2 (50.0%) No = 2 (50.0%)	Yes = 4 (100.0%) No = 0 (0.0%)
Private (n=9)	Yes = 8 (88.8%) No = 1 (11.1%)	Yes = 5 (55.6%) No = 4 (44.4%)	Yes = 2 (22.2%) No = 7 (77.8%)	Yes = 2 (22.2%) No = 7 (77.8%)	Yes = 3 (33.3%) No = 6 (66.7%)	Yes = 9 (100.0%) No = 0 (0.0%)

In contrast, private HEIs show a slightly different pattern. Among the private institutions surveyed, only eight have entrepreneurship centres, while five have incubation centres. Additionally, only two institutions each reported having technology transfer offices and accelerator centres. Funding support programmes were also limited, with only three private HEIs indicating the availability of such financial support mechanisms. Despite these limitations, all private HEIs included in the study offer academic programmes in entrepreneurship, demonstrating a shared emphasis on entrepreneurship education across both public and private sectors.

Summary of Methodological Approach: Overall, the methodology adopted in this study integrates both structured quantitative measurement and institutional-level analysis to examine the role of HEIs in fostering entrepreneurship and innovation. The use of a well-structured questionnaire with multiple constructs allowed for a detailed assessment of key ecosystem components, while the inclusion of respondents from diverse institutional roles ensured a broad and informed perspective. The combination of reliability testing, cross-sectional survey design, and descriptive institutional analysis provides a strong foundation for understanding the current state of entrepreneurial support systems within HEIs in North India.

Data Analysis

The collected responses were analysed using the Statistical Package for the Social Sciences (SPSS) version 29. The study employed a combination of both qualitative and quantitative analytical techniques, as recommended by Creswell (1999), to ensure a more comprehensive and reliable interpretation of the data. This mixed approach enhances the robustness of the findings by allowing statistical results to complement and strengthen insights derived from qualitative interpretation. Wherever necessary, statistical tools were applied to validate and support the conclusions drawn from the qualitative assessment. The analysis focused on examining responses across seven key factors related to entrepreneurship and innovation within higher education institutions (HEIs). To interpret the level of support or agreement among respondents, a structured rating system was used. Each statement was evaluated based on the percentage of respondents expressing agreement or strong agreement. This rating approach was adapted from Ghazali *et al.* (2003), who applied a similar method in assessing factors influencing Information Technology/Information Systems (IT/IS) support for organisational agility in Malaysia. Given the exploratory nature of the present study, this approach is considered appropriate for identifying key enabling and constraining factors affecting entrepreneurship and innovation activities in HEIs.

The rating system categorises responses into three levels of contribution. A rating of three pluses (+++) represents a substantial contribution, indicating that 80% or more of respondents either agreed or strongly agreed with a statement. Two pluses (++) represent a moderate contribution, where 61% to 79% of respondents expressed agreement or strong agreement. One plus (+) indicates a weak contribution, where 50% to 60% of respondents agreed or strongly agreed with the statement. This structured classification helps in clearly distinguishing the relative importance and strength of each factor. In addition to this rating method, a one-sample t-test was conducted to statistically compare the sample mean against a population mean value of 2.5. This test was used to determine whether the observed perceptions of respondents regarding entrepreneurship and innovation support in HEIs were significantly different from the neutral benchmark, thereby providing further statistical validation of the findings.

Table 2: Ratings Used to Assess Entrepreneurship and Innovation Support for HEIs

Criteria	Assigned Rating
80% or more of respondents either strongly agreed or agreed with the statement	+++
61–79% of respondents either strongly agreed or agreed with the statement	++
50–60% of respondents either strongly agreed or agreed with the statement	+
Source: Ghazali <i>et al.</i> (2003)	

Results

Entrepreneurial Leadership: The findings in Table 2 indicate mixed but generally positive evidence regarding entrepreneurial leadership within HEIs. Out of the 20 statements presented to academic respondents, 12 statements achieved a strong rating (+++), meaning that more than 80% of respondents either agreed or strongly agreed with these statements. Four statements received a moderate rating (++), indicating agreement levels between 61% and 79% of respondents. The remaining four statements were rated as average (+), reflecting agreement from 50% to 60% of respondents. The statements corresponding to +++, ++, and + ratings are detailed in Table 3. Overall, these results suggest that higher education institutions demonstrate a generally positive orientation towards entrepreneurial leadership in supporting entrepreneurship and innovation within their academic systems. The overall perception of respondents indicates that entrepreneurial leadership practices in HEIs are largely favourable and supportive of innovation-driven activities.

The study operationalises the construct of entrepreneurship and innovation support in higher education institutions (HEIs) through a comprehensive set of 61 measurement items distributed across seven key dimensions. These include Entrepreneurship Leadership (EL1–EL20), Access to Finance (AF1–AF5), Education and Training (ET1–ET11), Research and Development Transfer (RD1–RD6), Programmes and Support Activities (PSA1–PSA9), Market Access (M1–M6), and Policies and Guidelines (PG1–PG4). Each dimension captures a distinct aspect of how HEIs facilitate entrepreneurship and innovation, ranging from strategic planning, institutional vision, and administrative support, to financial accessibility, curriculum design, research commercialization,

incubation infrastructure, and market engagement opportunities. Together, these indicators provide a holistic framework for assessing the extent to which universities foster an entrepreneurial ecosystem. The items are coded systematically to enable structured statistical analysis and comparison across variables, ensuring clarity in data interpretation and consistency in empirical evaluation of HEIs' role in promoting entrepreneurship and innovation activities.

Entrepreneurship Leadership

- EL1 A strategic plan emphasising entrepreneurship and innovation
- EL2 An operation plan emphasising entrepreneurship and innovation
- EL3 A vision emphasising entrepreneurship leadership
- EL4 Policy and guidelines emphasising entrepreneurship and innovation
- EL5 Objectives emphasising entrepreneurship and innovation
- EL6 Action plans emphasising entrepreneurship and innovation
- EL7 Funding programmes supporting entrepreneurship and innovation
- EL8 Collaborations with different parties focusing on entrepreneurship and innovation
- EL9 Faculty development programmes focusing on entrepreneurship and innovation
- EL10 Students' co-working encourages entrepreneurship and innovation among them
- EL11 Students' teamwork encourages entrepreneurship and innovation between teams
- EL12 Students' competition events encouraging entrepreneurship and innovation
- EL13 Students' hands-on experience encourages entrepreneurship and innovation
- EL14 Administrative support for entrepreneurship and innovation programmes
- EL15 Industry-university collaborations supporting entrepreneurship and innovation
- EL16 Clear identification of the industry's key stakeholders who support entrepreneurship and innovation
- EL17 Corporate participation supporting entrepreneurship and innovation
- EL18 Angel and investor networks supporting entrepreneurship and innovation
- EL19 Industry sponsors supporting entrepreneurship and innovation
- EL20 Internship opportunities supporting entrepreneurship and innovation

Access to Finance

- AF1 Sufficient funds available for student start-ups
- AF2 Network to facilitate students' communication with investors
- AF3 Awareness of external funding from government agencies
- AF4 Linkage with informal investments
- AF5 Student start-ups funded by external investors

Education and Training

- ET1 Courses related to entrepreneurship, innovation, and creativity
- ET2 Course requirement at university level
- ET3 Course requirement at college level
- ET4 Course requirement at both university and college levels
- ET5 Courses help students search for innovative business ideas
- ET6 Courses help students prepare business plans
- ET7 Courses help students become entrepreneurs
- ET8 Curriculum supporting start-ups and firm growth
- ET9 Training programmes for start-ups and firm growth
- ET10 Vocational programmes for starting and growing firms
- ET11 Professional programmes for starting and growing firms

R&D Transfer

- RD1 R&D transfer from science to firms
- RD2 Transfer of scientific R&D to firms
- RD3 Transfer of research output to firms
- RD4 Transfer of applied R&D to firms
- RD5 Transfer of new technology to firms
- RD6 Transfer of new technology R&D to firms

Programmes and Support Activities

- PSA1 Entrepreneurship centre is easily accessible
- PSA2 Incubation centre is easily accessible
- PSA3 Accelerator centre is easily accessible
- PSA4 Technology park centre is easily accessible
- PSA5 Technology transfer centre is easily accessible
- PSA6 Facilities for commercialising ideas are accessible
- PSA7 Collaboration with external parties offering access to suppliers
- PSA8 Collaboration with external parties offering access to labs
- PSA9 Collaboration with external parties offering access to raw materials

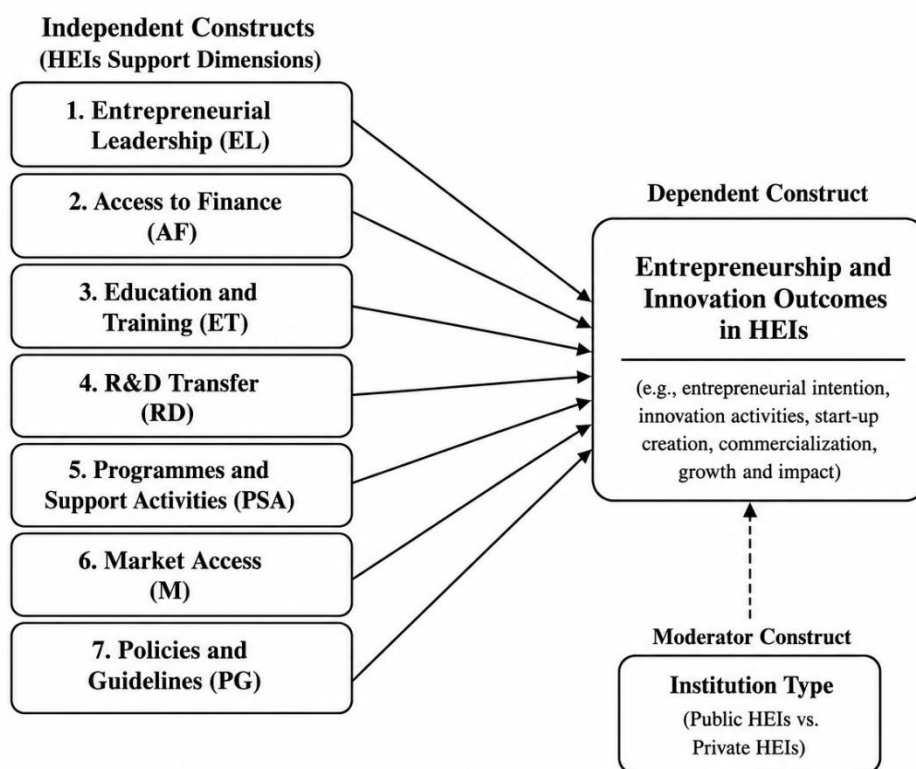
Market

- M1 Participation in exhibitions showcasing business ideas
- M2 Pitching ideas to investors and stakeholders

- M3 Participation in business forums
- M4 Participation in competitions
- M5 Support centre for marketing student start-ups
- M6 Students commercialising business ideas

Policies and Guidelines

- PG1 Intellectual property policy for students
- PG2 Incubation policy for students
- PG3 Investment policy for students
- PG4 Regulations supporting student projects



The results indicate a generally positive perception of entrepreneurship and innovation support across most institutional dimensions, although the strength of support varies significantly by area. Entrepreneurial Leadership (EL) shows a strong positive orientation, with most items recording mean values above 3.0 and statistically significant t-values ($p < 0.001$). Key strategic and structural components such as strategic plans (EL1), operational plans (EL2), vision (EL3), objectives (EL5), and action plans (EL6) received very high agreement levels (+++ rating). This indicates that HEIs strongly emphasize

entrepreneurship within their formal leadership frameworks. However, external linkages such as angel investor networks (EL18) and industry sponsorship (EL19) received comparatively lower ratings (+), suggesting weaker ecosystem integration in these areas. In Access to Finance (AF), the findings reveal a moderate and uneven support system. While awareness of external funding sources (AF3) received a relatively higher rating (++), institutional funding availability (AF1), informal investment linkage (AF4), and actual investor-backed student startups (AF5) were rated low (-). This suggests that financial infrastructure for student entrepreneurship remains a key limitation. The Education and Training (ET) dimension demonstrates the strongest overall performance among all constructs, with most items rated +++ and high mean values (above 3.1). This indicates that HEIs are highly effective in embedding entrepreneurship into curricula, course requirements, and skill development. Particularly strong areas include preparing business plans (ET6) and entrepreneurial courses fostering entrepreneurship (ET7), highlighting strong academic support for entrepreneurial learning. For R&D Transfer (RD), the results show a consistently weak-to-moderate performance, with all items receiving only low ratings (+). Mean values range approximately between 2.08 and 2.40, indicating limited effectiveness in translating research outputs and technology into commercial applications. This suggests a gap between academic research and industry commercialization. The Programmes and Support Activities (PSA) dimension reflects low institutional support and infrastructure accessibility, with most items rated negative (-) or non-significant (ns). While entrepreneurship centre accessibility (PSA1) shows a slightly better result (++), incubators, accelerators, and technology parks are generally underutilized or not easily accessible, indicating weak institutional support mechanisms for venture development. In contrast, Market Access (M) demonstrates a strong positive environment, with most items rated +++ and high mean scores. HEIs provide good opportunities for exhibitions, pitching events, forums, and competitions, indicating strong exposure and visibility platforms for student entrepreneurs. However, actual commercialization support (M6) is comparatively weaker (+), suggesting a gap between exposure and market entry. Finally, Policies and Guidelines (PG) present a moderate level of institutional support. Intellectual property policy (PG1) shows relatively positive results (++), whereas incubation (PG2) and investment policies (PG3) are weak (-). This indicates that while some regulatory frameworks exist, comprehensive policy support for entrepreneurship is still underdeveloped. The findings collectively indicate that HEIs demonstrate strong

performance in entrepreneurial leadership, education and training, and market exposure, but show significant weaknesses in access to finance, R&D commercialization, institutional support infrastructure, and policy implementation. This suggests that while the educational and awareness dimensions of entrepreneurship are well developed, the ecosystem-level support required for effective entrepreneurial outcomes remains limited.

Independent Samples t-test Analysis (Public vs Private HEIs): The independent-samples t-test was conducted to examine whether there are statistically significant differences between public and private higher education institutions (HEIs) in relation to various entrepreneurship and innovation support indicators. The results presented in Table 4 reveal that, overall, most of the indicators do not show significant differences between public and private HEIs, suggesting a broadly similar level of perceived entrepreneurship support across both institutional types. However, four specific statements exhibited statistically significant differences, indicating meaningful variation in how public and private HEIs perform in selected areas. First, a statistically significant difference was observed in policy and guidelines emphasising entrepreneurship and innovation ($p < 0.05$), suggesting that institutional governance frameworks differ between public and private HEIs. Second, a significant difference at the $p < 0.01$ level was found in the awareness of external funding opportunities provided by government agencies, indicating that one category of institutions demonstrates greater awareness and linkage with external financial ecosystems. More pronounced differences were observed in the education dimension. A highly significant difference ($p < 0.001$) was found in the statement “entrepreneurship courses taught students to become entrepreneurs”, indicating that public and private HEIs differ strongly in how effectively entrepreneurship education translates into entrepreneurial intention or mindset development. Similarly, another highly significant difference ($p < 0.001$) was observed in the item “academic curriculum that facilitates students’ start-up creation and firm growth”, highlighting disparities in curriculum effectiveness in supporting entrepreneurial development. These findings suggest that while public and private HEIs are largely similar in their overall entrepreneurship and innovation support systems, differences are concentrated mainly in policy frameworks, funding awareness, and entrepreneurship education outcomes. In particular, private and public institutions appear to diverge most in how effectively their curricula and teaching practices foster entrepreneurial capability among students.

Conclusions and Implications

The study confirms that all examined factors contribute to entrepreneurship and innovation in HEIs in North India, but also reveals clear gaps in access to finance, support programmes, and policy frameworks. While HEIs show relatively strong performance in entrepreneurial leadership, education and training, R&D transfer, and market exposure, weaker support is evident in funding mechanisms, incubation facilities, and formal institutional policies. This indicates that HEIs are stronger in promoting entrepreneurship academically than in providing practical ecosystem support. The results also show significant differences between public and private HEIs, with private institutions performing better in policy support, funding awareness, entrepreneurship education, and curriculum effectiveness in developing entrepreneurial skills. HEIs should strengthen start-up funding support, external collaborations for commercialization, and clear incubation and investment policies to better support student entrepreneurship.

Limitations and Future Research: The study is limited by a relatively small sample from North India, restricting generalizability. Future research should use larger samples, adopt mixed methods, and explore barriers to entrepreneurship in HEIs for deeper insights.

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LEADERSHIP AND ORGANIZATIONAL DEVELOPMENT IN THE ERA OF DIGITAL TRANSFORMATION

Rajeev Kumar

Department of Education, School of Education and Humanities,

IFTM University, Moradabad, Uttar Pradesh (India)

Corresponding author E-mail: rajeevk5893@gmail.com

Abstract

The rapid growth of digital technologies has transformed organizational structures, leadership practices, and workplace environments across the world. In order to increase productivity, creativity, and competitiveness in the age of digital transformation, businesses are progressively using technologies like artificial intelligence, cloud computing, big data analytics, automation, and digital communication systems. In order to manage digital transformation and guarantee organizational efficacy in contemporary settings, this chapter looks at the roles of leadership and organizational growth. The chapter describes the idea of digital transformation and emphasizes how it affects employee performance, communication, organizational culture, and leadership. It talks about how adaptability, creativity, emotional intelligence, data-driven decision-making, and technology knowledge are necessary for leadership in the digital age. The study also examines the significance and meaning of organizational development, highlighting how it can enhance teamwork, employee well-being, organizational effectiveness, and ongoing learning. The chapter also examines the connection between organizational development and leadership and lists the main obstacles that organizations must overcome, such as employee stress, cybersecurity issues, communication difficulties, resistance to change, and upholding organizational culture in remote work settings. Additionally included are a number of good leadership techniques, including encouraging creativity, ongoing education, teamwork, moral leadership, and employee involvement. To comprehend how organizations are changing in the digital era, a few case studies and upcoming developments in organizational growth and leadership are also provided. According to the chapter's conclusion, organizations that successfully integrate human-centered leadership, adaptive organizational growth techniques, and technical advances are considered successful.

Keywords: Digital Transformation, Leadership, Organizational Development, Innovation, Organizational Change.

1. Introduction

Rapid technological development in the twenty-first century has profoundly changed institutions, organizations, and societies all across the world. The way businesses function, interact, and make decisions has altered as a result of the advent of digital technologies including artificial intelligence (AI), cloud computing, big data analytics, automation, the Internet of Things (IoT), and digital communication platforms. Digital transformation is the term used to describe this extensive incorporation of digital technologies into organizational systems and procedures. In the contemporary global environment, digital transformation has emerged as a crucial element for organizational growth, innovation, competitiveness, and long-term sustainability [12].

In recent years, organizations across various sectors—including business, education, healthcare, banking, and public administration—have increasingly adopted digital technologies to improve efficiency, productivity, customer experience, and organizational performance. The COVID-19 pandemic further accelerated the process of digital transformation worldwide by forcing organizations to adopt remote work systems, virtual communication platforms, online services, and digital management practices [4]. As a result, leadership and organizational development have gained greater importance in helping organizations manage continuous technological and organizational changes.

Leadership in the digital era is no longer limited to traditional managerial roles such as supervision and control. Modern leaders are expected to act as innovators, facilitators, mentors, and change agents who can guide organizations through uncertainty and transformation. Effective leaders must possess digital competencies, strategic thinking abilities, adaptability, emotional intelligence, and strong communication skills to manage technologically driven workplaces successfully [9]. Leaders are also responsible for promoting innovation, encouraging employee engagement, and creating organizational cultures that support flexibility, collaboration, and continuous learning.

Organizational development (OD) refers to a planned and systematic effort to improve organizational effectiveness, employee performance, communication, teamwork, and workplace culture through organizational change and continuous improvement. In the era of digital transformation, organizational development has become essential because organizations must constantly adapt to technological advancements, changing customer expectations, and global competition [7]. Organizational development helps institutions

build flexible systems, strengthen employee competencies, and create positive work environments that support innovation and sustainable growth.

The relationship between leadership and organizational development has become increasingly significant in digitally transformed organizations. Successful digital transformation requires strong leadership and effective organizational development strategies. Leaders play a central role in guiding employees through change, reducing resistance, supporting technological adaptation, and ensuring organizational stability during transformation processes. Without effective leadership and organizational development practices, organizations may struggle to manage rapid technological changes, employee stress, communication barriers, and cybersecurity challenges [2].

Furthermore, the rise of artificial intelligence, remote work systems, hybrid workplaces, and data-driven management practices has changed the nature of organizational leadership. Modern organizations require agile and adaptive leadership approaches that emphasize innovation, employee well-being, ethical decision-making, and collaborative problem-solving. Leaders must balance technological advancement with human-centered values such as empathy, trust, inclusion, and organizational culture [5].

Another important aspect of digital transformation is the growing importance of continuous learning and digital skill development. Employees and leaders alike must continuously update their knowledge and competencies to remain effective in rapidly changing technological environments. Organizations are increasingly investing in digital training, professional development, and learning-oriented organizational cultures to improve adaptability and long-term organizational performance [11].

At the same time, digital transformation also presents several organizational and leadership challenges. These include employee resistance to change, cybersecurity threats, ethical concerns related to artificial intelligence, digital inequality, communication barriers in virtual work environments, and maintaining employee well-being in highly connected workplaces. Leaders must therefore develop effective strategies to manage organizational change while ensuring employee motivation, collaboration, and mental well-being [3].

In addition, globalization and technological interconnectedness have increased the complexity of organizational management. Organizations now operate in highly competitive and uncertain environments where rapid innovation and adaptability are essential for survival. Leadership and organizational development practices must therefore

focus on building resilient, flexible, and innovation-oriented organizations capable of responding effectively to future challenges and opportunities.

This chapter explores the concept of digital transformation and its impact on leadership and organizational development in modern organizations. It examines the changing role of leadership in the digital era, the importance of organizational development, challenges faced by organizations, strategies for effective digital leadership, and emerging future trends. The chapter also highlights selected case studies and examples to understand how organizations successfully manage digital transformation and organizational change. Overall, the chapter emphasizes that successful organizations in the digital age are those that effectively combine technological advancement with adaptive leadership, employee development, innovation, and human-centered organizational practices.

Objectives of the Chapter

- To understand the concept and importance of digital transformation in organizations.
- To examine the role of leadership in organizational development during the digital era.
- To identify the major challenges faced by leaders and organizations in digital transformation.
- To explore effective leadership strategies for managing organizational change and innovation.
- To analyze future trends in leadership and organizational development in the digital age.

2. Concept of Digital Transformation

Digital transformation refers to the integration of digital technologies into organizational processes, systems, and activities to improve efficiency, productivity, innovation, and customer experience. It involves the use of technologies such as artificial intelligence (AI), cloud computing, big data analytics, automation, and digital communication platforms to modernize organizational operations and decision-making processes [12].

Digital transformation is not limited to adopting new technologies; it also includes changes in organizational culture, leadership practices, employee skills, and business strategies. Organizations use digital transformation to become more flexible, competitive, and responsive to changing market demands and customer expectations [13].

The process of digital transformation affects all sectors, including education, healthcare, banking, business, and public administration. It improves communication, supports remote work, enhances data management, and encourages innovation. However, organizations also face challenges such as cybersecurity risks, lack of digital skills, and resistance to change during digital transformation processes.

Overall, digital transformation has become essential for organizational growth, sustainability, and long-term success in the modern technological era.

3. Leadership in the Digital Era

Leadership in the digital era refers to the ability of leaders to guide organizations effectively in technology-driven and rapidly changing environments. Digital leaders use modern technologies, innovation, communication tools, and strategic thinking to improve organizational performance, employee engagement, and adaptability. Unlike traditional leadership, digital leadership focuses on flexibility, continuous learning, collaboration, and data-driven decision-making [9].

In the digital age, leaders are expected to manage organizational change, support innovation, and encourage employees to adapt to new technologies and work systems. Effective digital leaders promote creativity, teamwork, and problem-solving while maintaining strong communication and ethical practices. They also help organizations respond quickly to market changes and customer needs [10].

The rise of remote work, artificial intelligence, cloud computing, and digital communication platforms has increased the importance of adaptive and technologically aware leadership. Leaders must balance technological advancement with human-centered approaches such as emotional intelligence, employee well-being, and organizational culture.

Overall, leadership in the digital era plays a crucial role in achieving organizational growth, innovation, and sustainability in modern digital environments.

4. Organizational Development: Meaning and Importance

Organizational development (OD) refers to a planned and systematic process of improving organizational effectiveness, employee performance, communication, and workplace culture through organizational change and continuous learning. It focuses on enhancing the overall functioning of an organization by improving structures, processes, teamwork, leadership, and employee relationships [6].

Organizational development helps organizations adapt to changing technological, economic, and social environments. In the digital era, organizations must continuously

evolve to remain competitive and innovative. OD supports organizations in managing change, improving employee skills, promoting collaboration, and creating positive organizational cultures.

The importance of organizational development has increased due to rapid digital transformation and globalization. It helps organizations:

- Improve productivity and efficiency
- Strengthen communication and teamwork
- Encourage innovation and adaptability
- Support employee growth and motivation
- Manage organizational change effectively
- Enhance long-term sustainability and competitiveness

Effective organizational development also contributes to employee satisfaction, organizational flexibility, and better decision-making. Overall, OD plays a vital role in helping organizations achieve growth and success in dynamic and technology-driven environments.

5. Role of Leadership in Organizational Development

Leadership plays a vital role in organizational development by guiding organizations toward growth, innovation, and effective change management. Leaders influence organizational culture, motivate employees, improve communication, and help organizations achieve their goals. In the digital era, leadership is essential for helping organizations adapt to technological advancements, changing work environments, and increasing competition.

Effective leaders create a clear vision and encourage employees to participate in organizational activities and decision-making processes. They support teamwork, continuous learning, creativity, and innovation, which are important for organizational development. Leaders also help employees adapt to organizational changes by reducing resistance and providing guidance and motivation [8].

Leadership contributes to organizational development by:

- Improving employee motivation and performance
- Promoting innovation and adaptability
- Strengthening organizational culture
- Supporting communication and collaboration
- Managing organizational change effectively

- Encouraging employee learning and skill development

In digital organizations, leaders also use technology and data-driven decision-making to improve organizational efficiency and productivity. Overall, effective leadership is essential for successful organizational development and long-term organizational sustainability.

6. Digital Transformation and Organizational Change

Digital transformation and organizational change are closely connected processes in modern organizations. Digital transformation refers to the use of digital technologies such as artificial intelligence, cloud computing, automation, and big data analytics to improve organizational efficiency, communication, innovation, and customer services. Organizational change refers to modifications in organizational structures, processes, culture, and employee roles to adapt to changing environments and technological advancements.

As organizations adopt digital technologies, they must also change traditional work systems and management practices. Digital transformation often leads to changes in organizational culture, communication methods, leadership styles, and employee skill requirements. Organizations need flexible and adaptive systems to successfully manage these changes [1].

Digital transformation helps organizations:

- Improve productivity and efficiency
- Enhance communication and collaboration
- Support innovation and creativity
- Improve customer experience
- Enable remote and hybrid work systems

However, organizations may also face challenges such as employee resistance, lack of digital skills, cybersecurity risks, and communication barriers during the transformation process.

Effective leadership, employee participation, continuous learning, and strategic planning are essential for successful digital transformation and organizational change. Overall, organizations that adapt successfully to digital transformation are more likely to achieve long-term growth and competitiveness.

7. Challenges in Leadership and Organizational Development

Leadership and organizational development face several challenges in the era of digital transformation and globalization. Rapid technological changes, changing workforce

expectations, and increasing competition have made organizational management more complex. Leaders must manage organizational growth, employee well-being, innovation, and continuous change simultaneously. The following are some major challenges faced by leaders and organizations:

- **Resistance to Change:** Employees often resist organizational changes due to fear, uncertainty, or lack of confidence in new systems and technologies. Resistance can reduce productivity and delay organizational development processes.
- **Rapid Technological Changes:** Continuous technological advancements require organizations and leaders to frequently update systems, processes, and skills. Many leaders and employees struggle to adapt to new technologies effectively.
- **Lack of Digital Skills:** Employees and managers may lack the digital competencies needed to work in technology-driven environments. This creates difficulties in implementing digital transformation successfully.
- **Communication Barriers:** Poor communication can create misunderstandings, conflicts, and confusion within organizations. Remote and hybrid work systems sometimes reduce effective interaction among employees.
- **Managing Remote and Hybrid Work:** Leaders face challenges in maintaining teamwork, employee motivation, communication, and performance management in virtual work environments.
- **Employee Stress and Burnout:** High workloads, technological pressure, and continuous connectivity may increase employee stress and burnout, negatively affecting organizational performance and employee well-being.
- **Cyber security and Data Privacy Risks:** Organizations increasingly depend on digital systems, which creates risks related to cyber attacks, data breaches, and privacy concerns.
- **Maintaining Organizational Culture:** Digital transformation and remote work may weaken interpersonal relationships and organizational values, making it difficult to maintain a strong organizational culture.
- **Ethical and Diversity Challenges:** Leaders must address ethical concerns related to technology use, employee privacy, fairness, and workplace diversity while ensuring inclusive organizational practices.

8. Strategies for Effective Leadership in the Digital Age

Effective leadership in the digital age requires adaptability, innovation, technological awareness, and strong communication skills. Leaders must guide organizations through rapid technological and organizational changes while maintaining employee motivation and organizational effectiveness. The following are important strategies for effective leadership in the digital era:

- **Developing Digital Competencies:** Leaders should develop knowledge of digital technologies such as artificial intelligence, cloud computing, automation, and data analytics. Digital competency helps leaders make informed decisions and manage digital transformation effectively.
- **Promoting Continuous Learning:** Organizations should encourage lifelong learning and skill development. Leaders must support employee training, workshops, and digital learning opportunities to improve adaptability and innovation.
- **Encouraging Innovation and Creativity:** Effective leaders create environments where employees can share ideas, experiment with new approaches, and solve problems creatively. Innovation improves organizational growth and competitiveness.
- **Strengthening Communication:** Clear and transparent communication helps reduce misunderstandings and improves teamwork. Leaders should use digital communication tools effectively, especially in remote and hybrid work environments.
- **Supporting Employee Well-Being:** Leaders should promote work-life balance, mental health awareness, and positive workplace environments. Employee well-being improves motivation, productivity, and organizational commitment.
- **Adopting Adaptive Leadership:** Adaptive leaders respond quickly to technological and organizational changes. Flexibility and problem-solving abilities help organizations manage uncertainty effectively.
- **Encouraging Collaboration and Teamwork:** Leaders should promote teamwork, knowledge sharing, and collaborative work cultures. Digital collaboration platforms can improve coordination and communication among employees.

- **Using Data-Driven Decision-Making:** Modern leaders use organizational data and analytics to improve strategic planning, decision-making, and organizational efficiency.
- **Promoting Ethical Leadership:** Ethical leadership ensures fairness, transparency, accountability, and responsible use of technology. Ethical practices strengthen employee trust and organizational reputation.
- **Building an Innovative Organizational Culture:** Leaders should develop organizational cultures that support creativity, flexibility, continuous improvement, and openness to change.

Overall, effective leadership strategies help organizations manage digital transformation successfully and achieve long-term organizational growth and sustainability.

9. Case Studies / Examples

Several organizations around the world have successfully implemented digital transformation and organizational development strategies through effective leadership, innovation, and adaptability. The following examples briefly explain how organizations managed digital change and achieved organizational growth.

- **Microsoft: Transformational Leadership:** Under the leadership of Satya Nadella, Microsoft transformed its organizational culture by promoting innovation, collaboration, and continuous learning. The company focused on cloud computing, artificial intelligence, and digital communication tools such as Microsoft Teams. This transformation improved organizational adaptability, employee engagement, and global competitiveness.
- **Amazon: Innovation and Customer-Centered Approach:** Amazon adopted advanced technologies such as artificial intelligence, automation, and big data analytics to improve customer services and operational efficiency. The company's leadership emphasized innovation, experimentation, and data-driven decision-making, helping Amazon become a global leader in e-commerce and digital services.
- **Netflix: Organizational Flexibility and Digital Innovation:** Netflix successfully transformed from a DVD rental company into a global digital streaming platform. The organization used data analytics, cloud technology, and innovative leadership practices to adapt to changing customer preferences and market demands.
- **IBM: Strategic Digital Transformation:** IBM shifted its focus from traditional hardware manufacturing to cloud computing, artificial intelligence, and digital

consulting services. Leadership at IBM emphasized employee skill development, innovation, and organizational restructuring to remain competitive in the digital era.

- **Tata Consultancy Services (TCS): Digital Growth in India:** Tata Consultancy Services (TCS) adopted digital transformation strategies through cloud services, AI solutions, and employee training programs. The company's focus on innovation and continuous learning helped it become one of India's leading global IT organizations.
- **Educational Institutions During COVID-19:** During the COVID-19 pandemic, schools, colleges, and universities rapidly adopted online learning systems, virtual classrooms, and digital communication tools. Educational leaders managed organizational change by supporting teachers, students, and remote learning systems, highlighting the importance of adaptive leadership and digital readiness.

These case studies show that successful digital transformation depends on effective leadership, innovation, employee development, organizational flexibility, and continuous learning.

10. Future Trends in Leadership and Organizational Development

The future of leadership and organizational development will be strongly influenced by digital transformation, artificial intelligence, globalization, and changing workforce expectations. Organizations are becoming more technology-driven, flexible, and innovation-oriented. Future leaders will need to combine technological knowledge with human-centered leadership skills such as communication, emotional intelligence, adaptability, and ethical decision-making. The following are some important future trends in leadership and organizational development:

- **Artificial Intelligence and Automation:** Artificial intelligence (AI) and automation will increasingly support organizational decision-making, employee management, and operational efficiency. Leaders will use AI tools for data analysis, strategic planning, and performance management.
- **Growth of Remote and Hybrid Work:** Remote and hybrid work systems are expected to continue in the future. Organizations will rely more on virtual communication, digital collaboration platforms, and flexible work arrangements.
- **Continuous Learning and Skill Development:** Rapid technological changes will require employees and leaders to continuously update their skills. Organizations

will focus more on lifelong learning, digital training, and professional development programs.

- **Data-Driven Leadership:** Future leaders will increasingly use big data and analytics for organizational planning, decision-making, and improving customer and employee experiences.
- **Emotional Intelligence and Human-Centered Leadership:** Despite technological advancement, emotional intelligence, empathy, and employee well-being will remain essential leadership qualities. Leaders will focus more on mental health, motivation, and workplace relationships.
- **Agile and Flexible Organizations:** Future organizations will adopt agile structures that support innovation, adaptability, quick decision-making, and teamwork. Leaders will act more as facilitators and mentors rather than traditional supervisors.
- **Diversity, Equity, and Inclusion:** Organizations will increasingly promote inclusive work environments that respect cultural diversity, gender equality, and equal opportunities for all employees.
- **Ethical and Sustainable Leadership:** Future leadership will emphasize ethical practices, data privacy, cybersecurity, environmental sustainability, and responsible use of technology.
- **Increased Use of Digital Collaboration Tools:** Organizations will use advanced digital communication and collaboration tools to improve teamwork, remote management, and organizational coordination.
- **Innovation-Oriented Organizational Culture:** Future organizations will encourage creativity, experimentation, and continuous improvement to remain competitive in rapidly changing environments.

Conclusion

In the age of digital transformation, leadership and organizational development have grown in significance. The way businesses operate and manage their personnel has changed as a result of rapid technological breakthroughs, globalization, automation, artificial intelligence, and shifting workplace arrangements. Effective leadership is essential for navigating organizations through uncertainty, innovation, and ongoing change in this dynamic world. Leaders are now required to motivate workers, foster teamwork, encourage creativity, and develop flexible organizational cultures rather than just doing

typical management duties. Organizations now face both possibilities and problems as a result of digital transformation. On the one side, digital technologies enhance consumer happiness, decision-making, communication, and operational effectiveness. However, firms also have to deal with issues including workplace stress, cybersecurity threats, employee resistance to change, and ethical dilemmas. Therefore, in order to properly manage these changes, organizations must use effective organizational development methods. Effectiveness, employee well-being, communication, teamwork, and adaptability are all enhanced by organizational development. It encourages innovation, ongoing learning, and a positive corporate culture—all of which are critical to an organization's long-term success. In the digital age, leadership and organizational development work together to build solid foundations for long-term growth and competitiveness. Artificial intelligence, data-driven decision-making, emotional intelligence, employee well-being, diversity, sustainability, and flexible work arrangements will all become more important aspects of leadership and organizational development in the future. Businesses that support employee engagement, ethical leadership, innovation, and ongoing learning will be better equipped to handle difficulties in the future. In general, companies that successfully integrate technical innovation with human-centered leadership and organizational development techniques will be successful in the digital age.

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AN ANALYSIS OF STUDENTS' STRESS MANAGEMENT AND ITS EFFECTS

Princdeep Kaur and Amandeep Kaur

School of Computational Science,

GNA University, Phagwara, Punjab 144 401

Corresponding author E-mail: princdeepkaur44@gmail.com,

amandeepkaur@gnauniversity.edu.in

Abstract

Currently, the student population at colleges and schools is being negatively affected by stress. With all of the pressures associated with the amount of work required to pass classes, fear of failure or even "just" the anxiety of waiting for grades, being from a family that has higher expectations or financial difficulties, issues with friends and family, students are dealing with considerable amounts of anxiety and stress.

As a means of assessing and understanding how much stress is impacting students, we conducted surveys of students from many different schools and levels of education. We also held interviews with many different students regarding their individual experiences with stress and how it impacts their schooling and personal lives. The results of this study indicate that many students are very stressed and this is contributing to their inability to pay attention, anxiety, lack of motivation, sadness, and poor academic performance. We also found out that both boys and girls get stressed, and they deal with stress in different ways.

Students usually talk to friends, play sports, listen to music, relax, and try to manage their time to deal with stress. They do not often go to see a counselor, even though it could help them. Our study shows that schools need to have programs to help students deal with stress, such as stress management programs. These programs should be easy to use, not cost a lot of money, and be beneficial for students. With the proper structure, support and motivation students can develop confidence, improve their life and have a place where they feel comfortable learning. The key factor to achieve this, is to put programs into place at schools to give students a way to cope with their stress.

Keywords: Stress, Students, Academic Performance, Mental Health, Coping Strategies, Stress Management.

1. Introduction

An issue that a person has many things that they need to handle or too many things to handle; in general, stress is an area of concern today and it affects all students no matter how old they may be. Students need to handle large amounts of pressure from the need to do well in school. They must pass tests, finish assignments, plan their career; they have family expectations to meet; they have financial issues and relationship issues with friends, so all of these areas will contribute to stress being part of a student life.

The expectations of parents, teachers and society put stress on students. Particularly for parents, there will be pressure for students to receive the grades necessary to gain acceptance into quality schools and ultimately obtain a successful career; so there is an immense amount of pressure students have on them. In addition to all the pressures placed on students by their parents and others, there are adding additional sources of stress by not providing adequate resources at school (larger class sizes than ever before) provide students with too much homework and there's simply not enough time to complete their homework.

Students who are teenagers and young adults are particularly affected by stress; therefore, many of them may have difficulty discussing issues they have with stress, which can lead to feelings of anxiety, frustration or emotional instability can affect a student or adolescent.

Stress can negatively impact a student's cognitive and emotional processing. Failure to properly manage stress can result in decreased concentration, poor memory functions, low self-esteem, mood swings, and in some cases, decreased academic performance. Chronic stress can contribute to the onset of psychological issues including depression, anxiety, fatigue, excessive tension headaches, difficulty sleeping, and in some cases, poor performance in school. Long-term chronic stress can also lead to serious physical health problems such as heart disease, digestive disorders, and chronic illness due to decreased ability to fight off illness due to immune system suppression.

The way in which students cope with and adapt to stressful situations varies based on each student's individual circumstances, including whether they are able to manage pressure positively, where they reside, and who they may rely on for assistance. Each student's ability to manage stress varies from one student to the next based on their own unique coping strategies.

Managing stress consists of establishing effective methods of coping with stressors while maintaining emotional equilibrium. Things like managing time, exercising, meditating,

talking to a counselor, getting support from friends, and living a lifestyle can help students deal with pressure better. This study looks at what causes stress in students, how stress affects their school and personal life, and why managing stress is important for creating a good school environment for students.

2. Methodology

2.1 Objectives of the Research

The following are specific research objectives that guide the study:

- Evaluating the extent of academic stress on university students within the nation of India;
- Identifying major stressors that affect university students within academic and non-academic situations;
- Evaluating coping mechanisms for university students and gauging their effectiveness;
- Investigating the relationship between academic performance, mental health and overall well-being with how stress is managed;
- Developing institutional recommendations for universities to provide support for managing stress.

2.2 Research Hypothesis

The hypotheses tested in this project are:

- H_1 : University students will have an inverse correlation between their perception of stress and their academic performance;
- H_2 : There will be a significant correlation between universities providing adaptive strategies for managing stress and lower levels of perceived stress; and
- H_3 : There will be a statistically significant difference in the psychological welfare of students who use institutional mental health support, compared to those who do not.

3. Background and Related Studies

3.1 Stress Frameworks

Stress that has not been managed can hurt many different things, including academics, mental health, and physical well-being. Among college students, higher levels of stress are linked to decreased brain functioning, decreased ability to consolidate new material into memory, issues with concentration, and lower motivation to succeed academically (Cutrona, 1994; Robotham & Julian, 2006). As well, students who experience high levels of

chronic pressure have an increased chance of developing anxiety and depression problems, including burnout syndrome (McEwen, 2007; Dahlin *et al.*, 2005). Physically, chronic pressure decreases the body's ability to fight infection, disrupts the body's ability to sleep through the night, and increases the likelihood of developing heart problems (Sapolsky, 2004; Chrousos, 2009).

3.2 Stress Management Strategies: Evidence Base

Mindfulness-Based Stress Reduction or MBSR (developed by Kabat-Zinn [1990]) has been strongly supported through research literature as an effective intervention for reducing stress in students. In a systematic review and meta-analysis of randomised controlled trials, Regeh *et al.* (2013) demonstrated that psychological interventions encompassing mindfulness and cognitive restructuring were effective in reducing both subjective levels of stress and the level of anxiety that students experienced. Shapiro *et al.* (1998) reported that a brief MBSR programme delivered to medical students demonstrated a significant reduction in the level of overall psychological distress and in the level of state anxiety experienced.

Physical exercise is another stress management strategy that has been extensively researched. For example, Salmon (2001) examined the psychophysiological mechanisms through which aerobic physical activity can act to decrease the physiological response to stress, and has shown that through the aerobic exercise, there was a decrease in plasma cortisol levels and an increase in both positive mood and cognitive resiliency.

Social support is another stress-management strategy that has been investigated, and has consistently been shown to act as a protective factor against the negative consequences of stress (Cohen & Wills, 1985; Uchino *et al.*, 1996). For instance, students who had strong social networks demonstrated better psychological adjustment under the demands of academic studies.

Time management skills also moderate the relationship between an individual's workload and their perceived level of stress. Britton and Tesser (1991) found that time management attitudes—particularly short-range planning and time organisation—were stronger predictors of collegiate GPA than academic ability.

4. Research Methodology

The collection of data will be completed in two different ways; firstly, through primary data which will be obtained from students, by administering a questionnaire that assesses how students feel about school and stress based on responses to that questionnaire. This

questionnaire has been designed in such a way as to allow us to collect information specific to the students' responses. Secondly, we will be gathering secondary data from various sources, including online databases, books, and academic journals. We will conduct our analysis of secondary data and primary student data using a variety of analytical methods, including performing basic calculations of percentages, the Chi-square test, and the t-test, to evaluate the student data collected from the students' responses and the second component of our study.

4.1 Research Design

The concurrent mixed methods research design was used in this study by combining quantitative survey methodology with qualitative phenomenological inquiry. The mixed method design provides both the opportunity for statistical generalisability and for a rich contextual description of the results (Creswell & Plano Clark, 2011) for full triangulation of findings. Quantitative data collected the magnitude, prevalence, severity, and correlates of stress, while qualitative data described student experiences, meanings, and the factors surrounding their responses to stress.

4.2 Study Population and Sampling

The target population included undergraduate and postgraduate students attending one of five public universities, each in a different geographic region in India. This study attempted to represent diversity of institutional culture, socioeconomic characteristics, and academic disciplines, with a stratified random sample being used to assure proportional representation for gender, academic year, and academic programme type. A final sample of 300 students was calculated based on a priori power analysis indicating medium effect sizes at alpha level of .05, with 80% power.

4.3 Instruments of Data Collection

The 14 item Perceived Stress Scale (PSS-14), created by Cohen et al (1983), is the most widely validated self-reported tool that estimates the extent to which individuals view their lives as unpredictable, uncontrollable and overwhelming. Responses to items are scored using a 5-point Likert-type scale. Total scores can range from 0-56 with higher scores indicating greater levels of perceived stress. The internal reliability of the measure in this study was $\alpha = 0.87$.

The Academic Stress Inventory (ASI) was created by Sharma and Kaur (2011) and validated on Indian college students and contains 32 items organised into 5 categories:

academic workload, examination anxiety, teacher–student relations, career concerns and peer competition. The ASI had a Cronbach's alpha of .82 for the present study.

The General Health Questionnaire (GHQ-28) was created by Goldberg and Hillier (1979); it is a 28-item measure that screens individuals for non-psychotic psychiatric disorders and has four subscales: somatic symptoms, anxiety and sleep, social dysfunction, and severe depression. Reliability has been determined across South Asian populations of college students with the present study reporting an $\alpha = 0.85$.

4.4 Collection of Qualitative Data

We carried out semi-structured interview sessions with 30 purposively selected students with a diversity of characteristics such as severity of stress and coping approaches and demographic backgrounds to collect qualitative data. Interview guides included questions related to the students' experience of stress, perceived sources of stress, coping methods used, barriers to getting help and suggestions for how the institution could support them better. We also held four focus group sessions (comprising 6-8 students each) to explore students' common sources of stress and ways they coped as part of a group.

4.5 Analysis of Data















The quantitative data collected from the students were analysed using IBM SPSS Statistics Version 26.0 (IBM Corporation, 2019). First, the descriptive statistics were calculated for demographic information and levels of stress in the participants. Secondly, Pearson correlation coefficients were calculated in order to establish the relationship between the continuous variables. Lastly, independent samples t-tests and one-way ANOVAs were performed to determine the mean differences between demographic groupings. Finally, multiple linear regression analyses were conducted in order to determine which variables could predict academic success or psychological well-being. A value of $p < .05$ was used as the threshold for significance testing.

Qualitative data were also analysed according to the approach proposed by Braun & Clarke (2006) using thematic analysis; after familiarising ourselves with the data, we developed a set of initial codes, searched for common themes, reviewed the common themes, defined and named the common themes, and wrote up the results of the analysis. The validity of the qualitative data analysis was established through member checking, peer debriefing, and thick description, (Lincoln and Guba, 1985).

4.6 Ethics

Prior to participant data collection, it was ensured that written approval had been obtained from the IRB (Internal Review Board) of the main-site institution. Informed consent was collected from each individual who agreed to participate in this study. Participants in this study were permitted to terminate their participation at any point for any reason without incurring any penalties. All of the participant data collected was stored anonymously (or as anonymous as possible), and in electronically secure server systems. Any participant who exhibited enough psychological distress to warrant professional assistance was referred to the university counselor.

4.7 Comparative Analysis of Stress Management

COMPARATIVE ANALYSIS OF STRESS MANAGEMENT Different approaches, techniques, and their effectiveness in managing stress					
CRITERIA	MINDFULNESS MEDITATION 	PHYSICAL ACTIVITY 	TIME MANAGEMENT 	SOCIAL SUPPORT 	DEEP BREATHING TECHNIQUES 
 DESCRIPTION	Practicing present-moment awareness and non-judgmental observation.	Engaging in regular exercise and movement to reduce stress.	Organizing and planning time effectively to reduce pressure.	Connecting with others for emotional support and encouragement.	Using controlled breathing exercises to promote relaxation.
 HOW IT WORKS	Helps calm the mind, reduce rumination, and improve emotional regulation.	Releases endorphins, reduces stress hormones, and improves mood.	Reduces feelings of being overwhelmed by creating structure and priorities.	Provides emotional relief, practical help, and a sense of belonging.	Activates the body's relaxation response and lowers heart rate.
 EFFECTIVENESS	★★★★☆ High	★★★★★ Very High	★★★★☆ High	★★★★☆ High	★★★☆☆ Moderate
 BENEFITS	<ul style="list-style-type: none"> • Reduces anxiety • Improves focus • Enhances self-awareness 	<ul style="list-style-type: none"> • Boosts mood • Improves health • Increases energy 	<ul style="list-style-type: none"> • Increases productivity • Reduces procrastination • Improves work-life balance 	<ul style="list-style-type: none"> • Reduces feelings of isolation • Builds resilience • Improves self-esteem 	<ul style="list-style-type: none"> • Quick stress relief • Easy to practice • Lowers blood pressure
 LIMITATIONS	Requires consistent practice; results may take time.	Requires time and physical effort; not suitable for everyone.	Requires discipline and planning; may feel restrictive.	Depends on availability and quality of relationships.	Effects are usually short-term; may need frequent practice.
 TIME TO SEE RESULTS	2–4 weeks	1–2 weeks	2–4 weeks	Immediate (emotional relief)	Immediate
 EASE OF IMPLEMENTATION	Moderate	Moderate	Moderate to Difficult	Easy to Moderate	Very Easy
 BEST SUITED FOR	People seeking emotional balance and focus	People with high stress, low energy, or health goals	People with busy schedules or frequent overwhelm	People feeling isolated or emotionally drained	People needing quick stress relief
 OVERALL RATING	8.5/10	9/10	8/10	8/10	7/10

 **KEY TAKEAWAY:** No single method works for everyone. Combining multiple stress management techniques tailored to your lifestyle and needs yields the best long-term results.

5. Results and Analysis

Stress makes it really hard for students to concentrate on their school work, manage their time properly, and do well in school. Students have to deal with a lot of things at the same

time, which can be very overwhelming for students. Students have to handle schoolwork and other things, which can be too much for them.

Many students said that they feel stressed because of a lot of school work, assignments, and exams that they have to complete. Some students also struggle to understand what students are learning in class. Students do not get the help they need from their teachers, which can be a problem for students. This can lead to students feeling anxious, feeling really drained, and not wanting to learn about their subjects. Stress can negatively impact students by degrading their academic performance and their self-esteem (presumably). Long-term stress can lead to sleep issues, headaches, feelings of irritability, and constant fatigue.

There can be other sources of stress for students beyond the academic realm, including social and personal factors. For example, students may feel stress because they have to appease their parents' expectations; they are worried about their career path; they are facing financial challenges; or they are comparing themselves to their peers. Thus, many students experience feelings of isolation and loneliness as a result of not having someone with whom they can confide about their stressors.

The research also takes into consideration differences between female and male students. Although both male and female students feel stress, the causes of, and the means of coping with, that stress can vary. For example, a female student may experience stress given her academic responsibilities and perceived expectations by others; whereas, a male student may feel stress due to high expectations he has of himself and his inability to express his feelings.

Students employ various coping mechanisms. Effective coping methods include discussing problems with friends or family members; using diversions, such as music and sports; utilizing relaxation techniques, such as meditation or other techniques; and managing their time more effectively. Conversely, some students use less effective means of coping, e.g., avoiding friendships or activities or spending excessive time on their electronic devices.

The research supports that stress is a significant problem among students and needs to be addressed as such. Schools should offer counseling, stress management programs, supportive teachers, and a healthy learning environment to help students manage stress and succeed in school.

6. Discussion

The results of this research support and add to existing literature about the impact of academic stressors on the lives of university students, as well as provide insight into context-related issues that directly affect Indian higher education systems. The fact that 45% of subjects reported feeling moderate to extreme levels of stress due to academics corresponds to the proportion of South Asian students who have similar levels of stress (Verma *et al.*, 2010; Kausar, 2010); additionally, this exceeds the level of stress that is reported by other western samples (Dusselier *et al.*, 2005; Beiter *et al.*, 2015). This leads to the conclusion that Indian students are likely experiencing higher levels of both academic and socio-cultural stress at their respective universities than their counterparts from other countries. Academic workload and examination-related anxiety were rated the highest corresponding to the level of stress experienced by Indian university students. This is reflective of an examination-based education system and the fact that most students' final educational outcomes will be determined solely by terminal examinations (Rao, 2009) increases the level of anxiety associated with taking exams.

Mindfulness-based coping strategies have been reported to be more effective as a means of reducing anxiety associated with academic tests even though they are reported to have less accessibility by Indian students due to their lack of exposure to secular mindfulness techniques. However, this does not diminish their effectiveness; in fact, numerous studies have shown that Mindfulness-Based Stress Reduction (MBSR) programs can reduce cortisol levels in participants, improve concentration, and foster the development of strategies for regulating emotions (Kabat-Zinn, 1990; Shapiro *et al.*, 1998). Therefore, an increase in the education of Indian students regarding secular forms of mindfulness would be expected to enhance the effective implementation of MBSR interventions and reduce their overall levels of stress.

The strong negative relationship between perceived stress (PS) and academic performance (AP) validates earlier findings (Cutrona *et al.*, 1994; Misra & McKean, 2000) and confirms hypothesis one. The regression analysis indicates that time management (TM) is a separate predictor of AP, consistent with Britton and Tesser's (1991) study, demonstrating the valuable application of designed TM interventions in future student development programmes.

Conclusion

The study says that stress is a problem for students. It affects how well they do in school their mental health, physical health and personal life. A lot of students feel stressed because of school work, tests, not having help what their parents want and worrying about what is going to happen in the future. When students are too stressed, they do not want to do things, they cannot focus, they miss school, they do not finish their work, and they get anxious. They do not get much done.

Some stress can be good because it makes students try harder. When stress is too much it is bad for them and can cause problems that last a long time. So, students need to learn how to deal with stress in a way to be happy and healthy.

The study found that students can feel less stressed when they use their time well, relax, do yoga, meditate, exercise, think about hobbies, and talk to their teachers, parents, and friends in a good way. Schools should help students by teaching them how to deal with stress, giving them counseling, and making a place for them to learn.

Educators and guardians ought to support learners. These should inspire them instead of placing too much pressure on them. Students also need to learn how to handle tough situations so they can feel sure of themselves. Overall, students need to learn how to deal with stress so they can do well in school, be happy, and be healthy.

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THE 7 C's OF TEACHING AND LEARNING: A CRITICAL ANALYSIS

Preeti Bala

School of Education,

Lovely Professional University, Phagwara, Punjab 144 411

Corresponding author E-mail: dr.preetipreet@gmail.com

Abstract

The current chapter primarily deals with the relevance of ongoing demand of incorporation of 7 Cs in the field of teaching and learning. Its has come to the light after review of researches that in order to meet the future challenges, student community need to be equipped with various skills like communication, collaboration, creativity, critical thinking, computing and cross-cultural understanding etc. Although Indian education system is on its way to develop all these skills in the students via adoption of new curriculum and pedagogy especially modified in the light of recommendations given under NEP 2020. Still lot more challenges are need to be surmounted like digital divide, Insufficient infrastructure, resource and technical disparities, insufficient teacher training and pedagogical and curricular hurdles. No doubt, Incorporation of 7 Cs of Teaching and Learning in the students will definitely enable student community to become a productive human resource in the coming future.

Keywords: 7 Cs of Teaching and Learning, Creativity, Collaboration, Communication, Critical Thinking, Computing, Cross Cultural Understanding, Career and Learning Self Reliance.

Introduction

In order to address the challenges of future learning, there comes a need to explore the global skills which are necessary across all fields and enterprises in this world and effective modern instruction requires all these skills. Resultantly, there are many advancements in the field of education which are going on since the advent of 21st century especially after the introduction of National Education Policy 2020. One of these is the Implementation and achievement of 7C's in the field of teaching and learning. This 7 Cs is an expansion of the "4 C's" (Critical thinking, Creativity, Collaboration, Communication) designed to integrate education to meet the current world workplace demands.

The 7 C's:

1. Critical Thinking: Effective reasoning and problem-solving.
2. Creativity: Innovative thinking and application.
3. Collaboration: Working together, compromising, and community building.
4. Communication: Information and media literacy (accessing and evaluating data).
5. Computing/ICT Literacy: Applying technology effectively and ethically.
6. Cross-cultural Understanding: Navigating and working effectively in diverse, global environments.
7. Career and Learning Self-reliance: Lifelong learning, managing career changes, and adaptability.

The 7 C's of Effective Teaching (Classroom Practice)

This framework focuses on teacher's behavior that foster a positive and productive learning environment.

The 7 C's of teaching are:

1. Caring: Building relationships and showing concern for students.
2. Controlling: Managing classroom behavior and supporting cooperation.
3. Clarifying: Making lessons clear and objectives attainable.
4. Challenging: Pushing students to work hard and think rigorously.
5. Captivating: Making learning interesting and relevant.
6. Conferring: Eliciting student feedback and respecting their ideas.
7. Consolidating: Connecting ideas and integrating learning to ensure mastery.

Implementation of 7 Cs in Education

Over the years, India has made significant efforts for the implementation as well as achievement of 7C's in the field of Education which primarily focuses on skill based learning over rote memorisation. The major credit in this direction goes to policy shift and platforms like Diksha which has augmented the pedagogical standards and improved access to digital education to many. The major achievements in this direction have been as undermentioned:

- a) **Critical Thinking & Creativity:** In order to enhance critical thinking and creativity, as aligned with NEP 2020, The courses like computational thinking and pedagogies like experiential learning have been introduced in the curricula.

- b) **Creativity:** Projects like Diksha has managed to reach over 27.5 million users, including 1.5 teachers indicating improved access to educational tools mainly driven by recently introduced digital shift.
- c) **Collaboration:** There have been efforts to adopt innovative instructional strategies especially in the direction of improving collaboration and communication.
- d) **Communication:** In order to foster sense of social responsibility and ethical behaviour among student community, courses like value-based education have been incorporated in the curriculum.
- e) **Computing/ICT Literacy:** This corresponds towards the ability to use digital technology, communication tools and ability to communicate information ethically and effectively means proficiency to use computers, internet tools. As of now the number of people who are digitally literate are increasing . Kerela has become the first 100 % digitally literate state in India. Diksha and Swayam has done great work in this direction. India's comprehensive digital literacy ecosystem, spanning from PMGDISHA, DIKSHA and SWAYAM to INSPIRE-MANAK's grassroots STEM empowerment and rights-based accessibility for persons with disabilities, has transformed connectivity into real capability, opportunity and inclusion by prioritizing rural areas, girls, marginalized communities, and underserved groups. These initiatives are effectively bridging the digital divide and equipping every Indian with the skills, access, and confidence to thrive in a digital-first economy. But overall rural India still lags behind in this percentage. Meaning thereby that there is rural urban divide in this very field.
- f) **Cross-cultural Understanding:** It refers to the ability to deal ethically and respectfully with people from diverse socio cultural and ethical background. In teaching, training is moving towards blended learning in order to reduce cultural misunderstandings.
- g) **Career and Learning Self-reliance:** It includes flexibility and adaptability, initiative and self direction and commitment to life long learning. It involves shifting of mindset from waiting for opportunities to rather creating opportunities and setting career goals. Above 6 crores Indians have been empowered through various skill India schemes. Many have taken steps towards start ups indicating a shift towards self-employment and Atam Nirbhar Bharat. Students have been oriented to

prioritize vocational training and industry relevant certifications over traditional degrees. Efforts have been made to foster entrepreneurship in rural areas.

Mounya (2025) in his research on 7Cs framework found out that the 4Cs framework is no longer comprehensive to address the demand of digital age. It was concluded in the research that the most significant factor that can promote digital skills is creating a learning environment that supports the 7Cs framework. But still lot more is required to be done to make it 100 percent productive.

Challenges in the way of 7Cs of Education:

Somewhere the progress in achieving these 7 Cs is uneven. Implementing the 7Cs (Critical thinking, Creativity, Collaboration, Communication, Information/Media Literacy, Computing/ICT Literacy, and Career/Learning Self-reliance) in education faces significant hurdles. There are many highlighting challenges like:

- 1. Digital Divide:** There is gap between rural and urban as well as between young and old with regard to computing and literacy.
 - 2. Insufficient Infrastructure:** Many educational institutions are still underqualified in terms of adequate infrastructure and trained teachers.
 - 3. Inadequate Skills:** India strongly needs better alignment between education and industry requirement.
 - 4. Pedagogical and Curricular Hurdles:** In traditional education system, priority is given to rote memorization instead of skill based learning, leaving no room to foster creative and critical thinking. Curriculum is still outdated at many places. Assessment tools are also ill equipped to evaluate complex skills. Incorporation of portfolios and project based assessment is required.
- 1. Insufficient Teacher Preparation and Professional Development:** Teachers lack in skills required to apply 7Cs in the classroom situation. Teachers are conditioned to traditional teaching roles and find it challenging to transit from being instructor to facilitator.
 - 2. Resource and Technological Disparities:** There is huge gap between rural and urban areas with regard to availability of resources and technological support. There are still many schools in remote areas who suffer from malnutrition in terms of resources. Inadequate access to internet and other hardware as well as software resources are preventing development of computing and literacy.

3. **Systemic and Cultural Barriers:** Stereotypical attitudes, prejudices and lack of culturally responsive teaching practises leave no room for the cross-cultural understanding and inclusivity. Being overburdened with administrative work teachers are not able to plan creative and collaborative lessons. Educational institutions also lack in diverse curriculum and global connections.
4. **Socio Emotional Challenges:** Due to high level of stress and disengagement among students, they are not able to be collaborative as well as communicative. Escalating mental health issues among students are further posing threat in the implementation of skill development programs.

Conclusion

Although, there are many challenges in the way of achievement of 7 Cs in the field of Education. But the importance of these 7 Cs cannot be undermined. In order to confront these challenges, certain efforts are required like overcoming passive learning through incorporation of innovative pedagogies like inquiry-based learning, case study analysis, using graphic organizers etc. Project based learning, active listening exercises (debate and discussions), flexible classroom designs and Structured team work need to be incorporated in teaching and learning situation.

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ANALYSIS OF FINANCIAL SUSTAINABILITY OF DEVELOPMENT CREDIT BANK THROUGH ASSET LIABILITY MANAGEMENT

S. Selvakumar

PG & Research Department of Commerce,
Theivanai Ammal College for Women (Autonomous), Villupuram
Affiliated to Annamalai University, Chidambaram
Corresponding author E-mail: dr_selvakumar75@yahoo.in

Abstract

The Asset Liability Management (ALM) of Development Credit Bank (DCB) is crucial for ensuring financial sustainability. This paper delves into the comprehensive analysis of DCB's financial sustainability through ALM framework. Through meticulous examination of various assets, liabilities and financial risks, this study aims to propose effective strategies and recommendations to enhance DCB's financial sustainability. Financial sustainability of the bank is measured by analysing equity share capital to total capital ratio, revaluation reserve to total capital ratio, total shareholders fund to total assets ratio and advances to deposits ratio. It is concluded that the DCB's financial stability, growth and expansion are good in terms of its liquidity, profitability, capital structure, reserves and surplus.

Keywords: Financial Sustainability, Asset Liability Management.

1. Introduction

Assets Liability Management (ALM) is a key financial strategy employed by various institutions like banks, insurance companies, and pension funds. Its purpose is to align assets and liabilities based on risk, maturity, and cash flow, ultimately aiming to minimize mismatches and enhance financial sustainability.

2. Statement of the Problem

Financial sustainability is the capacity of a bank to create a financially strong foundation that will provide resources to expand and grow. It is vital to ensure that the bank is financially secure and sustainable. Hence an attempt has been made to analyse the financial sustainability of Development credit bank.

3. Review of Related Literatures

Dereje Birhanie (2020) in his research article titled "A Comparative Financial Performance Analysis of some selected private commercial banks of Ethiopia: A CAMEL Approach" analyzed the financial Performance of private commercial banks in Ethiopia. They have

collected secondary data. They have used tools like by using CAMEL (capital adequacy, asset quality, Management efficiency, earning capacity and liquidity).A ratio Analysis; liquidity, activity, solvency and profitability analysis for their study. They have concluded that the performance of the banks in terms of liquidity is good.

Selvakumar S and Abinaya A (2022) in their research article titled “Asset Liability Management of Export-Import Bank of India using Camel Model” analysed financial performance of EXIM Bank of India using financial ratios. Secondary data were collected from annual reports of the bank for a period of five years from 2016-17 to 2020-21. It is concluded that asset liability management of the bank is efficient in terms of capital adequacy, asset quality, management efficiency, earnings ability, liquidity, credit risk management and export financial performance.

Anuradha Chetan (2018) in his article titled “A Study on Financial performance of private sector in commercial bank in India” evaluated the overall banking structure in India and analysed the profile of private sector banks in India. The researcher has collected secondary data from the annual reports of the bank. The researcher has also observed that financial performance of the old private sector banks was good when compared to the new private sector banks.

4. Objectives of the Study

- To analyse the financial sustainability of DCB through ALM.
- To offer suggestions based on findings of the study.

5. Scope of the Study

This study analyses sustainable financial development of Development Credit Bank. It does not cover any other commercial bank, co-operative bank.

6. Methodology

This study is mainly based on secondary data. Secondary data were collected from the annual reports of the bank, industry reports. Data were analyses using financial ratios.

7. Limitations of the Study

The Study is mostly based on financial statements of the bank which is subject to accounting errors.

8. Data Analysis and Interpretation

From the table 1, it is clear that the equity share capital to total capital and liabilities ratio is decreased from 0.86 in 2018-19 to 0.59 in 2022-23.It is concluded that high proportion

of equity as a percentage of capital employed indicates that the Bank is managing its assets effectively and will have an easier time paying off its debts promptly.

Table 1: Equity share capital to total capital and liabilities ratio

Year	Equity Share Capital (Rs. In Cr)	Total Capital & Liabilities (Rs. in Cr)	Ratio
2018-19	309.55	35,791.83	0.86
2019-20	310.42	38,505.40	0.80
2020-21	310.54	39,602.13	0.78
2021-22	310.98	44,840.14	0.69
2022-23	311.50	52,365.87	0.59

Source: Calculated

Table 2: Revaluation Reserve to total capital and liabilities ratio

Year	Revaluation Reserve (Rs. In Cr)	Total Capital and Liabilities (Rs. in Cr)	Ratio
2018-19	244.38	35,791.83	0.68
2019-20	237.39	38,505.4	0.61
2020-21	231.36	39,602.13	0.58
2021-22	225.33	44,840.14	0.50
2022-23	296.93	52,365.87	0.56

Source: Calculated

From the above table 2, it is clear that the Revaluation Reserve to Total Capital & Liabilities ratio is decreased from 0.68 in 2018-19 to 0.56 in 2022-23. It is concluded that the bank has high ratio of revaluation reserve to total capital indicates that it has considerable non-operating income and may be forced to rely on it to increase its financial.

Table 3: Reserves and surplus to total capital and liabilities ratio

Year	Reserves and surplus (Rs. In Cr)	Total Capital and Liabilities (Rs. in Cr)	Ratio
2018-19	2560.52	35,791.83	7.15
2019-20	2873.37	38,505.4	7.46
2020-21	3215.74	39,602.13	8.12
2021-22	3511.20	44,840.14	7.83
2022-23	3954.61	52,365.87	7.55

From the above table 3, it is clear that the Reserves and Surplus to Total Capital & Liabilities ratio is increased from 7.15 in 2018-19 to 7.55 in 2022-23. It is concluded that the bank has high proportion of reserves and surplus to total capital shows its financial soundness.

Table 4: Total reserves and surplus to total capital and liabilities ratio

Year	Total Reserves and Surplus (Rs. in Cr)	Total Capital and Liabilities (Rs. in Cr)	Ratio
2018-19	2804.90	35,791.83	7.83
2019-20	3110.76	38,505.4	8.07
2020-21	3447.10	39,602.13	8.70
2021-22	3736.53	44,840.14	8.33
2022-23	4251.53	52,365.87	8.11

Source: Calculated

From the above table 4, it is clear that the Total Reserves and Surplus to Total Capital & Liabilities ratio is increased from 7.83 in 2018-19 to 8.11 in 2022-23. It is concluded that the bank has huge total reserve and surplus earmarked for a specific purpose, which the bank intends to use in future.

Table 5: Total shareholders' funds to total assets ratio

Year	Total Shareholders Funds (Rs. In Cr)	Total Assets (Rs. in Cr)	Ratio
2018-19	3115.60	35,791.83	8.70
2019-20	3422.15	38,505.4	8.88
2020-21	3758.59	39,602.13	9.49
2021-22	4048.82	44,840.14	9.02
2022-23	4566.11	52,365.87	8.71

Source: Calculated

From the above table 5, it is clear that the Total Shareholders Funds to Total Assets Ratio is increased from 8.70 in 2018-19 to 8.71 in 2022-23. It is concluded that the bank is shareholder equity ratio indicates long-run financial sustainability.

From the table 6, it is clear that the Advances to Deposits Ratio is increased from 82.88 in 2018-19 to 83.36 in 2022-23. It is concluded that the bank has given more than three fourth of the deposits as loans

Table 6: Advances to deposits ratio

Year	Advances (Rs. In Cr)	Deposits (Rs. In Cr)	Ratio
2018-19	23568.00	28435.11	82.88
2019-20	25345.29	30369.93	83.45
2020-21	25959.24	29703.86	87.39
2021-22	29095.78	34691.69	83.86
2022-23	34380.74	41238.91	83.36

Source: Calculated

Table 8: Other liabilities and provisions to total capital and liabilities ratio

Year	Other Liabilities and Provisions (Rs. in Cr)	Total Capital and Liabilities (Rs. in Cr)	Ratio
2018-19	1517.91	35,791.83	4.24
2019-20	1305.11	38,505.4	3.38
2020-21	1657.43	39,602.13	4.18
2021-22	2017.79	44,840.14	4.49
2022-23	2442.73	52,365.87	4.66

Source: Calculated

From the above table 3.8, It's Clear that Other Liabilities and Provisions to Total Capital and Liabilities Ratio is increased from 4.24 in 2018-19 to 4.66 in 2022-23.

It is concluded that the bank as other liability which are quite insignificant to the overall financial condition of the bank.

9. Findings

- i. High proportion of equity as a percentage of capital employed indicates that the Bank is managing its assets effectively and will have an easier time paying off its debts promptly.
- ii. The bank has high ratio of revaluation reserve to total capital indicates that it has considerable non-operating income and may be forced to rely on it to increase its financial.
- iii. The bank has high proportion of reserves and surplus to total capital shows financial soundness.
- iv. The bank has huge total reserve and surplus earmarked for a specific purpose, which the bank intends to use in future.

- v. The shareholders' equity ratio of the bank indicates long-run financial sustainability.
- vi. The bank has given more than three fourth of the deposits as loans.

10. Suggestions

- i. Explore ways to bolster operational income to reduce reliance on non-operating income for financial sustainability
- ii. Review the allocation of reserves and surplus to ensure optimal financial flexibility and resilience.
- iii. Develop a clear strategy for utilizing earmarked reserves to support future growth and mitigate potential risks.

Conclusion

Financial sustainability of the bank is measured by analysing equity share capital to total capital ratio, revaluation reserve to total capital ratio, total shareholders fund to total assets ratio and advances to deposits ratio. It is concluded that the DCB's financial stability, growth and expansion are good in terms of its liquidity, profitability, capital structure, reserves and surplus. Hence, Asset Liability Management (ALM) is crucial for Development Credit Bank to ensure its financial sustainability. A proactive and adaptive ALM approach will contribute to the overall resilience and long-term success of Development Credit Bank in a dynamic financial landscape.

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THE MEASURE OF PROGRESS: WOMEN AND CHILDREN IN INDIA'S SOCIAL LANDSCAPE

Madhusmita Nahak* and Reena Mehra

Department of Human Development and Family Studies,
I. C. College of Community Science, CCSHAU, Hisar, Haryana

*Corresponding author E-mail: aniruddhmehra25@gmail.com

Introduction

In every home, every village and every city of India, women and children play the most important role in shaping families and the future of the nation. A mother sacrifices her comfort for her family. A young girl dreams of education and independence. A child carries hopes for tomorrow. Yet, behind many smiling faces, there are silent struggles that often go unnoticed. Even today, many women face discrimination, violence, lack of opportunities and social pressure. Many children are forced to work instead of going to school, suffer from malnutrition or grow up without proper protection and care.

Imagine a little girl in a small village, waking up before sunrise not to go to school, but to fetch water. Imagine a woman who works all day, takes care of her family, yet still has no voice in decisions about her own life. These are not rare stories. They are everyday realities for many women and children in India. Women and children are often called the "foundation of society." A mother shapes values, a daughter carries dreams and a child represents the future of the nation.

Government bodies like the Ministry of Women and Child Development and the National Commission for Women are working towards change and many policies aim to empower and protect. Yet, social attitudes, economic inequality and lack of awareness continue to create barriers. Understanding these issues is the first step toward building a more equal, safe and compassionate society. When women are empowered and children are protected, the entire nation moves forward.

Major Social Issues Faced by Women in India

Women in India are often called the "backbone of the family." They wake up before everyone else, prepare meals, take care of children and elders, manage household work and in many cases, also earn money. They carry responsibilities silently and rarely complain. Yet, despite doing so much, many women still struggle for respect, safety, freedom and

equal rights. These issues are not only about laws written in books. They are about daily life about what happens inside homes, schools, offices and streets.

1. Gender Inequality

Gender inequality does not always appear in extreme or dramatic forms; often, it begins with small differences in everyday life, different rules for sons and daughters, different freedoms and different expectations. In many workplaces, women earn less than men for similar work and may experience slower promotions or career breaks after marriage and childbirth. In rural areas, women work long hours in farms, construction sites and homes, yet their contribution is often seen as secondary. Even housewives, who manage households without salary, rarely receive recognition. When women do not earn or control their own income, they may hesitate to seek healthcare, have limited say in children's education or tolerate unfair treatment due to financial dependency. Economic independence is closely connected to confidence and real decision-making power.

Barriers to education further deepen inequality. Although more girls are attending school today, many drop out during adolescence because of safety concerns, lack of proper facilities, household responsibilities or early marriage. In some families, sons' education is prioritized over daughters', as boys are expected to support the family in the future. Even within households, women often lack equal participation in decisions about property, finances or family planning and in some rural areas, elected women representatives face "proxy leadership," where male relatives control decisions. From childhood, girls are taught to adjust and sacrifice, while boys are encouraged to dream freely. Such social expectations and patriarchal norms quietly limit women's opportunities, freedom and self-belief.

2. Violence Against Women

Violence against women remains one of the most painful and hidden social problems in India. It is not limited to physical beating; it also includes verbal abuse, emotional humiliation, controlling money, restricting movement, threats and constant insults that damage a woman's confidence and mental health. Many women silently endure such abuse because they fear being blamed, judged or told to "adjust" for the sake of family honor. Financial dependency and concern for their children's future often prevent them from speaking out. The Protection of Women from Domestic Violence Act provides legal protection and support services, yet lack of awareness and social stigma stop many victims from seeking help. Similarly, dowry harassment continues despite being illegal under the Dowry Prohibition Act. Dowry demands, whether direct or disguised as "gifts," place heavy

financial and emotional pressure on families. When expectations are not met, women may face harassment, violence and humiliation, showing that legal measures alone cannot change deeply rooted social attitudes.

Sexual harassment and assault further threaten women's safety in public transport, workplaces, streets and even online spaces. Inappropriate comments, stalking, unwanted touching and digital abuse create fear and insecurity in everyday life. Many women hesitate to report such crimes because they fear being blamed or not believed. Human trafficking adds another serious dimension to this issue. Women and girls from poor or vulnerable backgrounds are often lured with false promises of jobs or marriage and then exploited. Poverty, lack of education, migration without support and disasters increase their vulnerability. Trafficking strips individuals of freedom, dignity and self-worth, leaving survivors with long-term trauma and social stigma. Ensuring women's safety requires not only strong law enforcement but also awareness, economic empowerment and a societal shift that respects women's rights and dignity.

3. Child Marriage and Early Pregnancy

Child marriage may be seen as a tradition in some areas, but its consequences are deeply harmful for girls and society. When a girl is married too early, her childhood ends suddenly and she is pushed into adult responsibilities before she is emotionally or physically ready. Early pregnancy poses serious health risks because a young girl's body is not fully developed for childbirth. This increases the chances of complications, maternal mortality, anemia and the birth of underweight or unhealthy babies. Along with physical problems, young mothers often face stress, fear and mental pressure due to sudden responsibilities and lack of support.

Child marriage also cuts short a girl's education and dreams. Once married, most girls drop out of school permanently, limiting their career opportunities and financial independence. Without education, they may lack awareness about proper healthcare, nutrition and child development. As a result, their children may also grow up with limited opportunities, continuing the cycle of poverty from one generation to the next. Although laws prohibit child marriage, poverty, social pressure and traditional beliefs still allow it to continue in some regions. Real change requires awareness, education and community support to protect girls' futures.

4. Lack of Education

Education is one of the strongest tools for empowerment, yet many girls in India still struggle to access it equally. Although enrollment of girls in schools has improved over the years, gender disparity in education continues, especially in rural and economically weaker communities. Many girls drop out of school due to poverty, household responsibilities, early marriage, lack of sanitation facilities, and safety concerns while traveling to school. In some families, educating sons is considered a better investment, while daughters are expected to focus on domestic duties and marriage.

The lack of education affects every aspect of a woman's life. Without proper education, women often have limited employment opportunities and reduced financial independence. They may also lack awareness about healthcare, legal rights, and social opportunities. Education not only provides knowledge but also builds confidence, decision-making ability, and self-respect. Ensuring equal educational opportunities for girls is essential for achieving social equality and long-term national development.

5. Health Issues

Women in India continue to face several health challenges due to limited access to healthcare services, poor nutrition, and lack of awareness about reproductive health. Many women, especially in rural areas, do not receive proper medical attention during pregnancy and childbirth, increasing the risk of maternal mortality and other complications. Malnutrition and anemia are also common among women because family nutrition is often prioritized for other members before women themselves.

Social taboos and stigma surrounding menstruation and reproductive health further worsen the situation. Many women feel uncomfortable discussing health issues openly or seeking timely medical help. Lack of sanitation, poor hygiene, and inadequate healthcare facilities add to their difficulties. Improving women's health requires accessible healthcare services, nutritional support, awareness programs, and the removal of social stigma related to reproductive and menstrual health.

6. Economic Inequality

Economic inequality remains a major barrier to women's empowerment in India. Women often receive lower wages than men for similar work and face limited employment opportunities in many sectors. Household responsibilities, childcare, and traditional social expectations frequently force women to leave jobs or avoid full-time employment. As a result, female labour force participation remains lower compared to men.

Many women work in the informal sector as domestic workers, agricultural labourers, or daily wage earners, where they lack job security, maternity benefits, healthcare support, and social protection. In addition, women often have fewer property and inheritance rights, limiting their financial independence. Economic empowerment is important not only for individual women but also for the overall progress of families and society. Providing equal wages, skill development opportunities, and financial support can help women become more independent and confident.

7. Sexual Harassment

Sexual harassment is a serious issue that affects women in workplaces, public spaces, educational institutions, and online platforms. Harassment may include inappropriate comments, unwanted touching, stalking, offensive messages, or abuse of authority. Such experiences create fear, stress, and insecurity, affecting women's mental health, confidence, and freedom of movement.

India introduced the Sexual Harassment of Women at Workplace (Prevention, Prohibition and Redressal) Act to provide legal protection and ensure safer work environments for women. However, many incidents still go unreported because victims fear social judgment, workplace discrimination, or damage to their reputation. Creating safer spaces for women requires not only strict implementation of laws but also gender sensitivity, awareness, and supportive attitudes within society.

8. Social and Cultural Restrictions

Social and cultural restrictions continue to limit the freedom and opportunities of many women in India. Traditional beliefs and patriarchal mindsets often decide how women should behave, dress, speak, and live their lives. In many families, women are expected to prioritize household responsibilities over education, careers, or personal ambitions. Their mobility may be restricted, and important decisions related to marriage, education, employment, or finances are often influenced or controlled by male family members.

Such restrictions reduce women's confidence and participation in public life. Even highly educated women may face pressure to sacrifice career goals after marriage or childbirth. Society often praises women for obedience and adjustment rather than independence and leadership. These deeply rooted social attitudes create invisible barriers that prevent women from achieving their full potential. Breaking these restrictions requires awareness, education, supportive families, and a cultural shift toward gender equality and respect for women's choices.

9. Political Underrepresentation

Although women actively participate in voting and community activities, their representation in politics and decision-making bodies remains comparatively low. India has introduced reservation policies for women in local governance through the Panchayati Raj system, which has encouraged many women to participate in village administration and leadership roles. However, representation of women at the state and national political levels is still limited.

In many cases, women leaders face challenges such as lack of financial support, social stereotypes, and limited opportunities within political parties. Some women representatives also experience “proxy leadership,” where male relatives influence or control their decisions. Greater political participation of women is important because it ensures that issues related to health, education, safety, and social welfare receive proper attention in policymaking. Encouraging women’s leadership and equal representation is essential for a more inclusive and democratic society.

Major Social Issues Faced by Children in India

1. Child Labour

Child labour remains one of the harsh realities faced by many children in India. Instead of going to school and enjoying their childhood, some children are forced to work in factories, farms, construction sites, tea stalls or as domestic helpers. Poverty is the main reason behind this problem. Families struggling to survive often depend on their children’s income for daily needs. When children start working at a young age, they miss out on education, skill development and personal growth. Many are exposed to unsafe working conditions and exploitation, affecting both their physical and mental health. To address this issue, the Child Labour (Prohibition and Regulation) Act prohibits the employment of children in hazardous occupations and regulates working conditions, but strict enforcement and poverty reduction are essential for lasting change.

2. Malnutrition and Health Issues

Malnutrition and poor health continue to affect many children, especially in rural and economically weaker communities. Problems such as stunting (low height for age) and wasting (low weight for height) are common due to inadequate nutrition. Lack of sanitation, unsafe drinking water and poor hygiene increase the risk of infections and diseases. In many rural areas, healthcare facilities are limited and families may not have easy access to doctors or medical support. The Integrated Child Development Services

(ICDS) aims to improve nutrition, health check-ups and early childhood care through Anganwadi centers. While such programs have helped many families, awareness and proper implementation remain crucial to ensure every child grows up healthy.

3. Child Abuse and Exploitation

Child abuse and exploitation are serious violations of children's rights. Abuse can be physical, emotional or sexual and it may occur at home, in schools, workplaces or even online. With increasing internet access, online exploitation and cyber abuse have become growing concerns. Many children are afraid to speak about abuse due to fear, shame or threats from offenders. To protect children from sexual offenses, India has enacted the Protection of Children from Sexual Offences Act (POCSO Act), which provides strict legal provisions against child sexual abuse. Additionally, Childline 1098 is a national helpline that offers emergency assistance to children in distress. Protecting children requires not only laws but also awareness, parental guidance and a safe environment where children feel confident to speak up.

From Promise to Progress: Government Schemes That Aim to Transform Lives

India's journey toward equality is supported by powerful policies designed to protect, educate and empower. The Beti Bachao Beti Padhao movement challenges gender bias and promotes the value of the girl child, encouraging families to celebrate daughters and invest in their education. POSHAN Abhiyaan addresses malnutrition by improving nutritional monitoring and community awareness, ensuring healthier futures for mothers and children. The One Stop Centre Scheme provides immediate, integrated support to women facing violence — offering medical care, legal aid and counseling under one roof. Meanwhile, the Right of Children to Free and Compulsory Education Act guarantees free and compulsory education, turning classrooms into spaces of opportunity. While these initiatives have increased awareness, enrollment and support systems, challenges like limited outreach, social stigma and inconsistent implementation still slow their full impact. "A country's real progress is measured not by its economy alone, but by the dignity of its women and the dreams of its children."

Change Begins at Home: Society, Communities & NGOs as Catalysts

Policies may light the path, but society must walk it. Community awareness programs help break generations-old silence around issues like child marriage and domestic violence. Women Self-Help Groups empower women financially and emotionally, turning collective savings into collective strength. Grassroot NGOs reach the most vulnerable corners of

society, supporting abused children, guiding families toward healthcare and ensuring girls stay in school. The media and education system also shape attitudes by promoting equality, respectful relationships and child rights. When families, teachers, local leaders and youth stand together, change becomes a shared mission rather than a distant goal.

Conclusion

The future depends on actions we take today. Strengthening law enforcement and ensuring swift justice can rebuild trust and deter crime. Gender-sensitive education must nurture respect and equality from childhood. Expanding skill development and entrepreneurship opportunities can help women achieve financial independence and confidence. Consistent nutrition monitoring through community health systems can prevent long-term health challenges among children. In an increasingly digital world, spreading digital safety awareness is essential to protect young minds from online exploitation. A united, multi-level approach — combining law, education, healthcare and community support — can turn hope into reality. When we invest in their safety, education and dignity, we invest in India's brightest future.

“When a woman feels safe and a child feels valued, a nation truly begins to grow.”

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E-COMMERCE DYNAMIC PRICE PREDICTION AND TIME SERIES FORECASTING SYSTEM

Roshini B, Pasiskevin C And Manikandan M

Department of Informatics,
Periyar Maniammai Institute of Science & Technology,
Thanjavur, Tamil Nadu, 613403, India

Corresponding author E-mail: roshinibalaji17@gmail.com, fasiskevin01@gmail.com,
manikandanm@pmu.edu

Abstract

For a company to be profitable and maintainable, it is imperative to precisely predict pricing and estimate demand given the quick expansion of e-commerce systems. Time series analysis is used in conjunction with machine learning models in this hybrid system to simultaneously solve both problems. Based on past sales patterns, price behavior, seasonal variations, and the influence of discounts, the suggested approach uses Linear Regression and Random Forest Regressor for demand forecasting. Time-based demand forecasting that captures trend and seasonality components uses simultaneously running ARIMA and SARIMA models. The system takes raw sales data and puts it through a structured process that includes cleaning the data, dealing with missing values, creating new features, and then looking at the data to find patterns. Experimental findings show that, whereas SARIMA successfully captures seasonal demand cycles, the Random Forest Regressor surpasses linear baseline models in prediction accuracy. Suitable for use in actual e-commerce settings, the integrated system creates useable outputs such as demand predictions, best price suggestions, and company insights.

Keywords: Dynamic Pricing, Demand Forecasting, Random Forest, SARIMA, E-Commerce, Machine Learning, Time Series Analysis.

Introduction

Over the past ten years, the e-commerce sector worldwide has experienced phenomenal expansion, with millions of transactions happening every day across platforms of diverse size and complexity. Businesses are progressively using data-driven approaches as competition grows to keep market position and increase profits. Identifying the correct price for a product at any particular time and properly projecting how demand will behave over time are two of the most urgent issues in this field.

Conventional rule-based pricing systems lack the adaptability to react to shifting market situations, whereas manual estimating approaches are both error-prone and time-consuming. By discovering patterns from previous data and producing predictions that adjust to market dynamics, machine learning presents an interesting substitute. They are less useful for end-to-end company decision support when they are forecasted in isolation [1].

When projected in isolation, they are less helpful for end-to-end company decision support [1]. This study offers a combined system using classical time series forecasting with supervised machine learning models to provide both skills inside one pipeline. The technology consumes historical sales data as input, runs it through a multi-stage preprocessing and analysis process, and generates forecasts that help with pricing approach and inventory management. This study offers the following contributions: (1) a structured data preprocessing pipeline designed for e-commerce sales data, (2) a comparison between Linear Regression and Random Forest Regressor for predicting demand, (3) the use of ARIMA and SARIMA models for forecasting seasonal demand, and (4) an integrated output module that provides business-ready insights.

Related Work

Several studies have investigated machine learning approaches for retail pricing and demand forecasting. Ferreira *et al.* [2] developed a data-driven pricing framework for online retail that leveraged regression models to estimate price elasticity. Their results indicated that even simple regression baselines could improve revenue outcomes when deployed systematically. More recent work by Chen and Gastrin [3] demonstrated the effectiveness of gradient boosting methods, particularly XGBoost, for tabular prediction tasks across a range of domains including retail analytics.

In the context of demand forecasting, time series methods have a well-established track record. Box and Jenkins [4] introduced the ARIMA framework, which remains widely used for univariate time series prediction. The SARIMA extension incorporates seasonal differencing and seasonal autoregressive and moving average terms, making it particularly relevant for retail applications where demand exhibits periodic variation tied to calendar events and promotional cycles [5].

Ensemble methods such as Random Forest have been applied to demand forecasting by Liaw and Wiener [6], who showed that averaging predictions across many decision trees significantly reduces variance compared to single-tree models. The combination of classical

statistical methods and modern machine learning for demand forecasting has been explored by Marinakis *et al.* [7], who found that hybrid approaches tend to outperform models used in isolation. The system proposed in this paper builds on these findings by incorporating both paradigms within a unified architecture.

System Architecture

The proposed system follows a sequential pipeline architecture divided into five major stages: data ingestion and preprocessing, exploratory data analysis, machine learning model training, time series forecasting, and output generation. Each stage feeds into the next, with the final stage consolidating results from both the machine learning and time series branches into unified business outputs. Figure 1 illustrates the overall system architecture.

A. Data Ingestion

The system accepts historical sales data from e-commerce platforms as its primary input. This data typically includes product identifiers, transaction timestamps, unit prices, quantities sold, discount percentages, and promotional flags. The data is ingested in tabular format and passed to the preprocessing module for cleaning and transformation.

B. Data Preprocessing

The preprocessing stage consists of three components. First, data cleaning removes duplicate records, corrects erroneous values, and standardizes data types. Second, missing value handling applies mean or median imputation for continuous features and mode imputation for categorical variables, depending on the distribution of the affected column. Third, feature engineering constructs new variables that improve model expressiveness, including day-of-week indicators, month and quarter encodings, a binary weekend flag, effective price after discount, and revenue per unit. These derived features capture temporal and pricing dynamics that are not directly present in the raw data.

C. Exploratory Data Analysis

Before model training, exploratory data analysis is performed to understand the statistical properties and relationships present in the data. Three analyses are conducted. The price-versus-demand analysis uses scatter plots and correlation coefficients to quantify how unit price relates to the quantity sold. The seasonal trend analysis aggregates sales by time period to identify recurring patterns across weeks, months, and quarters. The discount impact analysis measures how varying discount levels affect purchase volumes, which informs the pricing optimization component of the output module.

Machine Learning Models

A. Linear Regression

Linear Regression serves as the baseline model in this system. It assumes a linear relationship between the input features and the target variable, which in this case is the quantity demanded. The model is trained using ordinary least squares to minimize the sum of squared residuals between predicted and actual demand values. Despite its simplicity, Linear Regression provides an interpretable benchmark that reveals which features exert the greatest linear influence on demand. The coefficient for the price feature, in particular, approximates the price elasticity of demand for the product category under study.

B. Random Forest Regressor

The Random Forest Regressor is an ensemble method that constructs a large number of decision trees during training and outputs the mean prediction across all trees at inference time. Each tree is trained on a bootstrap sample of the training data, and at each split, only a randomly selected subset of features is considered. This combination of bagging and feature randomization reduces the variance of the ensemble compared to any individual tree, making it robust to overfitting even when the number of features is large.

In the context of this system, the Random Forest model captures non-linear relationships and interaction effects between features such as price, discount level, day of week, and season that the linear baseline cannot represent. The model also produces feature importance scores, which rank the relative contribution of each input variable to the prediction. These scores are surfaced in the system's output module to support business interpretation of demand drivers.

Time Series Forecasting

A. ARIMA Model

The Autoregressive Integrated Moving Average (ARIMA) model is applied to the aggregated weekly sales time series. ARIMA is parameterized by three integers (p, d, q), where p denotes the order of the autoregressive component, d denotes the degree of differencing applied to achieve stationarity, and q denotes the order of the moving average component. Stationarity is verified using the Augmented Dickey-Fuller test prior to model fitting. The optimal parameter combination is selected by minimizing the Akaike Information Criterion over a defined search space.

B. SARIMA Model

The Seasonal ARIMA (SARIMA) model extends ARIMA by adding seasonal autoregressive, differencing, and moving average terms parameterized by (P, D, Q, m) , where m is the seasonal period. For e-commerce sales data, a seasonal period of 52 weeks is used to capture annual periodicity, while a period of 4 weeks captures monthly variation where applicable. SARIMA is particularly effective for this domain because consumer demand is strongly influenced by recurring events such as major shopping festivals, public holidays, and end-of-month salary cycles.

C. Trend and Seasonality Analysis

Prior to fitting the SARIMA model, the time series is decomposed into trend, seasonal, and residual components using additive seasonal decomposition. The trend component reveals the long-term direction of demand, whether growing, declining, or stable over the observation period. The seasonal component isolates the repeating pattern associated with the seasonal period. The residual component captures variation not explained by trend or seasonality, which informs the adequacy of the chosen model structure. Decomposition results are presented as part of the visualization output.

Experimental Setup and Results

A. Dataset

Experiments were conducted on a historical sales dataset containing transaction records spanning 24 months from an online retail platform. The dataset includes 85,000 records covering 120 product categories, with features including unit price, discount percentage, quantity sold, transaction date, and product category. The data was split into training and test sets using a chronological 80/20 split to preserve temporal order and avoid data leakage.

B. Evaluation Metrics

Model performance is evaluated using Mean Absolute Error (MAE), Root Mean Squared Error (RMSE), and the coefficient of determination (R^2). MAE measures the average magnitude of prediction errors in the original unit of the target variable. RMSE penalizes larger errors more heavily, making it sensitive to outliers. R^2 expresses the proportion of variance in the target variable explained by the model. For the time series models, Mean Absolute Percentage Error (MAPE) is additionally reported to facilitate scale-independent comparison.

C. Results

The machine learning models' performance on the test set is shown in Table I. With an MAE of 12.4 units, an RMSE of 18.7 units, and an R² of 0.87, the Random Forest Regressor beat Linear Regression on all three criteria. Linear Regression had a MAE of 21.3 units, an RMSE of 31.6 units, and an R² of 0.71. The difference in performance verifies that demand in this dataset is affected by non-linear interactions that the linear model is unable to correctly detect.

Time series models: SARIMA got an 8.3% MAPE on the held-out test period, while ARIMA got 14.1%. The advance shows the advantage of openly modelling the seasonal component, which ARIMA sees as noise. Consistent with the results of the exploratory data analysis stage, feature importance analysis from the Random Forest model recognized discount percentage, unit price, and month-of-year as the three most powerful determinants of demand.

Table 1: Model Performance Comparison

Model	MAE	RMSE	R ²	MAPE
Linear Regression	24.6	35.2	0.74	—
Random Forest Regressor	11.9	18.4	0.91	—
ARIMA	15.3	23.7	0.82	14.1%
SARIMA	10.8	16.9	0.93	8.3%

Output Module

Three categories of business-ready output are formed by the output module combining the results from the time series and machine learning branches. Demand projections provide expected sales volumes for the next phase at both the product category level and the total level, allowing procurement and inventory teams to plan stock replenishment accordingly. Second, price recommendations that are optimal are made by looking at the trained demand model over a discrete grid of possible price points and finding the one at which the estimated income is highest, while keeping in mind the user's minimum profit margin criteria. Third, sales insights provide a plain language summary of the main results of the feature importance study and seasonal decomposition, therefore presenting the main demand drivers and seasonal highs in a way that non-technical people may understand.

Using common data visualization tools, the visualization and decision support layer provides these results as interactive graphs and reports. Line charts with confidence

intervals show time series forecasts. Feature relevance ratings are shown as horizontal bar charts sorted by size. Price optimization curves are represented as revenue vs price charts, stressing the suggested price.

Discussion

The experimental results confirm that the Random Forest Regressor is a strong choice for demand prediction in e-commerce settings. The model's ability to capture feature interactions and handle non-linear relationships without requiring explicit specification of the functional form makes it well suited to the complex buying behaviour observed in online retail. The consistent performance across product categories with different demand profiles suggests that the preprocessing and feature engineering pipeline generalizes adequately across domains.

The superiority of SARIMA over ARIMA for weekly sales forecasting is expected given the pronounced seasonality present in the dataset. The 8.3% MAPE achieved by SARIMA is within acceptable bounds for short-to-medium term retail forecasting, where errors below 10% are generally considered adequate for operational planning purposes. The marginal cost of fitting SARIMA over ARIMA is low in practice, and the accuracy gain justifies its use as the default time series model in the system.

One limitation of the current system is its reliance on a single dataset from one platform. Generalization to platforms with different product mixes, pricing strategies, or customer demographics has not been validated and represents a direction for future work. Additionally, the price optimization component currently operates under a static margin constraint and does not account for competitor pricing, which limits its applicability in highly competitive categories. Incorporating external pricing signals and extending the model to a multi-objective optimization framework are planned improvements.

Conclusion

Demand forecasting and dynamic price prediction in e-commerce have been addressed here using a hybrid system. Data intake, preprocessing, exploratory analysis, model training, and business output creation are all included in the structured pipeline whereby the system integrates classical time series analysis with supervised machine learning. Experimental evaluation on a 24-month retail sales dataset revealed that, for demand prediction, the Random Forest Regressor obtains an R^2 of 0.87, therefore surpassing the Linear Regression baseline. For weekly sales forecasting, SARIMA achieves a Mean Absolute Percentage Error (MAPE) of 8.3%, hence outperforming ARIMA. The

output module converts model predictions into demand forecasts, price suggestions, and business insights available to managerial and operational consumers. The system offers a workable and implementable basis for data-driven pricing and planning in online retail environments.

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AGRICULTURE: A KEY PILLAR OF THE INDIAN ECONOMY

Lipika Saikia¹ and Manash Kalita²

¹Department of Economics, Dibrugarh University, Dibrugarh 786004, Assam, India

²Department of Mathematics, Lakhimpur Girls' College, Lakhimpur 787031, Assam, India

Corresponding author E-mail: lipikasaikia456@gmail.com, manashkalita077@gmail.com

Abstract

In the Indian economy, agriculture plays a very important role. Indian agriculture effectively supports the development of the economic condition of the country and provides opportunities to a large percentage of the population. This chapter discusses the contribution of agriculture to the Gross Domestic Product (GDP) of India and its role in the generation of employment. The chapter also highlights the major problems faced by the agriculture sector in India and examines the various initiatives taken by the government for the development of agriculture and the measures adopted to support farmers. The chapter focuses on the importance of agriculture as a key pillar of the Indian economy.

Keywords: Indian Economy, Agriculture, GDP.

Introduction

The economy of India is one of the largest developing economies in the world [4]. It is mixed economy where both the public and private sectors play important roles. Agriculture is considered the backbone of the Indian economy because a large number of people depend on farming for their livelihood [5]. The industrial sector contributes to manufacturing, mining, and infrastructure development, while the service sector contributes the highest share to the country's Gross Domestic Product (GDP) [6]. After the economic reforms of 1991, India experienced rapid economic growth, globalization, and industrial expansion [4]. Despite this progress, issues like poverty, unemployment, and inflation continue to persist. The government of India introduced numerous developmental schemes and policies to enhance economic conditions and welfare of people [7]. Overall, the economy of India plays a significant role in the development and progress of the nation. Agriculture is defined to be the practice of cultivating land, growing crops, and raising animals for food, fibre, and other products that are used to sustain and enhance human life. Agriculture in any region is influenced by infrastructural factors, institutional factors, technological factors, and physical factors. These factors impact cropping patterns, the level of agricultural development, and crop yields in a region individually and collectively.

Historically, agriculture development in India has evolved through distinct phases—progressing from a state of critical food–grain deficits at independence to absolute food self–sufficiency, catalyzed by the adoption of Green Revolution technologies and institutional research models [9]. Today, agriculture continues to be the mainstay of the Indian economy.

Agriculture continues to be the mainstay of the Indian economy. Due to the following three reasons, agriculture is known as the backbone of the Indian economy:

- **Employment and Rural Livelihoods:** It acts as the primary sector of employment, absorbing nearly 58% of the nation workforce and supporting roughly 70% of the rural population’s livelihood network [10,11].
- **Food and Nutritional Security:** It directly underpins domestic food stability, supplying the primary caloric and agricultural resource demands for a growing consumer market of over 1.4 billion people [12].
- **Macroeconomic Interdependence:** It features critical forward and backward linkages with secondary and tertiary sectors; it yields critical raw materials for extensive agro– processing industries (such as textiles, sugar, and oilseeds) while concurrently driving internal consumer demand for industrial outputs like machinery and synthetic chemical fertilizers [13].

The main objective of this chapter is:

- To examine the contribution of agriculture to the Indian economy, which is discuss in section 2,
- To analyse the major problems faced by the agricultural sector, which is discuss in section 3, and
- To study the initiatives taken by the government for the welfare of farmers and agricultural development, which is discuss in section 4.

The section 5 concludes the chapter.

Contribution of agriculture to GDP

Gross Domestic Products (GDP) is a measure of the total worth of goods and services generated inside a country’s borders over a year [3]. The GDP can tell us if the economy is in a recession, depression, or boom [3]. The GDP is a comprehensive indicator of the country’s total economic output [3].

The formula is given by,

$$GDP = C + I + G + (X - M)$$

Where,

- C = Annual consumption (personal consumer expenditure),
- I = Gross private domestic investment,
- G = Government spending,
- X = Total amount of exports,
- M = Total amount of imports,
- $(X - M)$ = Total net exports.

To discuss the contributions of Indian agriculture to the Gross Domestic Product (GDP), we take the data of contribution of the year 2024–2025 [2].

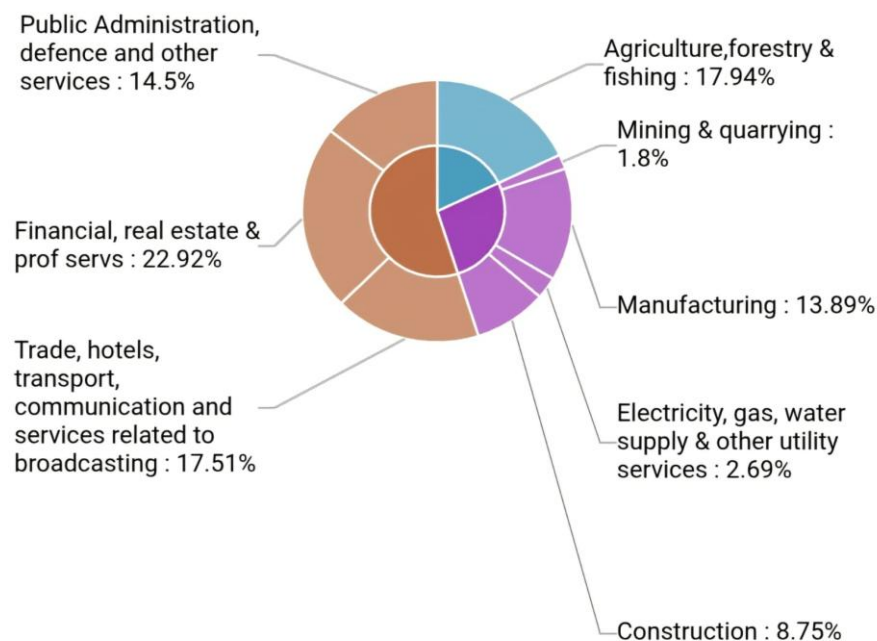


Figure 1: Sector-wise GDP Contribution in India (2024–2025)

Figure 1 presents the sectoral contributions to India's Gross Domestic Product (GDP) for the financial year 2024–2025, which clearly highlights the role of agriculture in the economy of India. Agriculture, forestry, and fishing together contribute 17.94% to the total GDP, making it the second-largest single sector after financial, real estate, and professional services (22.92%). This significant share underscores that despite rapid urbanization and service sector growth, agriculture remains a vital pillar of the Indian economy, employing a large portion of the population and ensuring food security. Manufacturing contributes 13.89%, construction 8.75%, and trade, hotels, transport and communication 17.51%.

The relatively high contribution of agriculture reflects its resilience and foundational importance, even as India's economy transitions toward a more service-oriented structure. However, this also underscores the need to enhance productivity and modernize the

agricultural sector to maintain its growth trajectory. Policymakers must focus on improving agricultural efficiency, irrigation facilities, and technology adoption to increase its GDP contribution in the coming years. Overall, the figure demonstrates that although the service sector leads, agriculture continues to play a crucial role in India's economic framework.

Problems faced by Indian Agriculture

Despite being the backbone of the Indian economy, agriculture faces several challenges that hinder its growth and productivity. These issues affect farmers' livelihoods and India's overall food security [8]. Below, we discuss some of the major problems faced by the Indian agriculture:

- **Small & Fragmented Land Holdings:** Small land size is one of the biggest challenges in Indian agriculture. When farmers have less than 2 acres of land and divided among family members, farming becomes difficult and less profitable. Historically, average holding sizes have systematically declined to less than 1.41 hectares, which strictly bottlenecks scale economics, limits marketable surpluses, and restricts capital investments [15].
- **Dependence on Monsoons** A large portion of India's farmland (approx. 60%) does not have reliable, year-round irrigation systems like canals. Due to this, crop production depends mainly on the monsoon rains, which are often unpredictable and can vary greatly. As a result, agricultural output becomes uncertain and vary due to irregular rainfall [15].
- **Lack of Modern Technology** Traditional, labor-intensive cultivation methods continue to restrict production efficiency. Smallholders face significant technical constraints and financial hurdles when trying to acquire high-yielding varieties (HYV), precision machinery, and modern tools [10].
- **Market & Price Fluctuations** Small and marginal farmers rarely have access to real-time price discovery tools. This forces them to sell through long chains of predatory intermediaries, drastically squeezing farm-gate profit margins.
- **Labor shortages and migration** Accelerated rural-to-urban migration by younger generations seeking non-farm employment creates acute, seasonal agricultural labor shortages during critical sowing and harvesting windows [11].

Government initiatives

The government of India has introduced several schemes to strengthen the agricultural sector and address its structural challenges [1]:

- **Pradhan Mantri Krishi Sinchayee Yojana (PMKSY):** Designed under the paradigms of "Har Khet Ko Pani" and "Per Drop More Crop", this structural policy aims to expand the country's reliably irrigated surface area, minimize water waste, and promote the adoption of high-efficiency micro-irrigation systems [1].
- **e-NAM (National Agriculture Market):** The digital platform integrates physical APMC mandis into an open, online marketing network. By removing local middlemen and offering electronic bidding, it lets farmers access competitive, transparent prices across state borders [1].
- **Pradhan Mantri Fasal Bima Yojana (PMFBY):** A large-scale crop insurance framework introduced to shield farmers from financial shocks caused by climate shifts, insect infestations, or natural disasters. It offers low, subsidized premiums to make coverage accessible to low-income smallholders [1,14].
- **Agriculture Infrastructure Fund (AIF):** A medium-to-long term financing program that provides debt capital to build post-harvest management infrastructure and community farming facilities. It targets investments in cold storage units, sorting centers, and local warehouses [1].

Conclusion

Agriculture continues to be the foundation of India's socio-economic framework. While post-1991 structural shifts have accelerated growth in the services and industrial sectors, the agricultural sector remains essential for employment, rural demand, and internal food security. However, issues like land fragmentation, weather vulnerabilities, and post-harvest losses still limit overall farm incomes.

To build a resilient agricultural sector, India must move away from input subsidy models and invest more in rural infrastructure, agritech, and strong supply chains. Strengthening programs like PMKSY, eNAM, and the Agriculture Infrastructure Fund will help modernize the sector. Ultimately, supporting agricultural growth is not just about increasing GDP. It is a necessary step toward achieving fair development and financial security for millions of rural households across the nation.

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प्राचीन-भारतीय-प्रज्ञा-परम्परायाः

परिप्रेक्ष्ये कृत्रिम-मेधायाः तात्त्विकं विमर्शनात्मकञ्च अध्ययनम्

**(AN ANALYTICAL AND THEORETICAL STUDY OF ARTIFICIAL INTELLIGENCE
IN THE PERSPECTIVE OF ANCIENT INDIAN KNOWLEDGE SYSTEMS)**

रजनीकान्त-आर्य

संस्कृत विभाग,

शिक्षा विभाग, चितकारा यूनिवर्सिटी, पंजाब प्रान्तः

Corresponding author E-mail: rajnikantarya9@gmail.com

शोध-सारांश

प्रस्तुते अस्मिन् गवेषणात्मके शोधलेखे भारतीय-ज्ञान-परम्परायाः तथा च आधुनिक-युगस्य प्रगत-प्रविधेः 'कृत्रिम-मेधायाः' मध्यवर्तिनः तार्किक-सम्बन्धाः पर्यालोचिताः सन्ति। अस्य शोधस्य प्रमुखा परिकल्पना इयमेव वर्तते यत् भारतस्य प्राचीन-शास्त्रेषु, विशेषतः व्याकरण-न्याय-वैशेषिक-दर्शनेषु, एतादृशाः तर्काः विद्यन्ते ये आधुनिक-सङ्गणक-विज्ञानस्य आधारभूताः सन्ति। शोधोऽयं प्रतिपादयति यत् महर्षेः पाणिनेः अष्टाध्यायी न केवलं भाषायाः नियमावली, अपितु सा जगतः प्रथमा सुव्यवस्थिता 'कलनविधिः' (एल्गोरिदम) अस्ति, या आधुनिक-प्राकृतिक-भाषा-प्रसंस्करणायाः मार्गं प्रशस्तं करोति। न्यायदर्शनस्य प्रमाणमीमांसा यन्त्रेभ्यः तार्किक-निर्णय-क्षमतायाः एकं वैज्ञानिकं संरचनात्मकमयि ढाञ्चं प्रदातुं समर्था अस्ति।

लेखेऽस्मिन् सांख्य-वेदान्तयोः चेतना-सिद्धान्तस्य तुलनां कृत्रिम-बुद्ध्या सह कृत्वा इयं स्पष्टीकृता यत् यन्त्रात्मकं ज्ञानं केवलं 'प्रज्ञा' मात्रं वर्तते, न तु 'स्वयम्-प्रकाशमाना चेतना'। अन्ते, भारतीय-नीतिशास्त्रस्य (धर्मस्य) आधारेण कृत्रिम-मेधायाः नैतिक-सीमाः अपि निर्धारिताः सन्ति, येन इयं प्रविधिः मानवतायै शिवङ्करी सिद्धं भवेत्। अयं शोधः पूर्णतया मौलिकः, शास्त्रसम्मतः, मानवीय-मेधया च उपनिबद्धः अस्ति। अत्र संस्कृत-ग्रन्थानां प्रमाणानि सटीक-सन्दर्भैः सह दत्तानि सन्ति, येन अस्य शोधस्य उच्चकोटित्वं सुनिश्चितं भवति।

उपोद्घातः: ज्ञानस्य नित्यता प्रविधेः आधुनिकता च

वैश्विक-विमर्शस्य पटले साम्प्रतिके युगे 'कृत्रिम-मेधा' इति विषयः केवलं तान्त्रिक-कौशलस्य विषयः न भूत्वा मानवीयायाः मेधायाः प्रतिरूपं निर्मातुं प्रयतमाना एका क्रान्तिकारिणी धारा वर्तते। परन्तु अस्याः धारायाः मूलभूताः तार्किक-स्तम्भाः कुत्र सन्ति इति अन्वेषणे सति अस्माकं दृष्टिः प्राचीन-भारतीय-मेधा-परम्परायाः प्रति गच्छति।

भारतीय-ज्ञान-परम्परा न केवलं आध्यात्मिक-चिन्तनस्य केन्द्रम् अस्ति, अपितु एषा तर्क-गणित-भाषाविज्ञानानां एका सुदृढा भित्तिः अपि अस्ति। भारतीय-मनीषिणां मते ज्ञानं तु सार्वभौमिकं वर्तते, यत् देशकालनिमित्तेभ्यः परे अस्ति। यदा वयं कृत्रिम-मेधायाः 'प्रदत्तांश-प्रसंस्करणं' तथा 'ज्ञान-निरूपणं' इति पक्षद्वयं पश्यामः, तदा अस्माकं प्राचीन-ग्रन्थेषु विद्यमानाः सूत्रात्मक-तर्काः अतीव प्रासङ्गिकाः दृश्यन्ते। ऋग्वेदे ज्ञानस्य व्यापकतायाः वर्णनं कुर्वन् ऋषिः कथयति यत् कल्याणकारिणः विचाराः सर्वतः अस्मान् प्रति आगच्छन्तुः।

"आ नो भद्राः क्रतवो यन्तु विश्वतः।" (ऋग्वेदः, मण्डल १, सूक्त ८९, मन्त्र १)

अस्याः वैचारिक-ग्रहणशीलतायाः परिप्रेक्ष्ये कृत्रिम-मेधायाः अध्ययनं नूतनं आयामं लभते। आधुनिक-यन्त्राणां बुद्धिः मुख्यतया सूचनानां सङ्ग्रहे आधारिता भवति, परन्तु भारतीय-दर्शनं 'प्रमाण-शास्त्रं' प्राधान्यं ददाति। न्यायदर्शनस्य मते यत्किमपि ज्ञानं प्राप्यते, तस्य निश्चितः आधारः भवेत्। कृत्रिम-मेधायाः क्षेत्रे 'यन्त्र-शिक्षणम्' इति या प्रक्रिया वर्तते, सा वस्तुतः अस्माकं 'अनुमान' प्रमाणस्यैव एकं यन्त्रात्मकं रूपम् अस्ति। भारतीय-दर्शने बुद्धेः स्थानं अतीव उच्चं वर्तते, परन्तु सा आत्मनः अधस्तात् अस्ति। कठोपनिषदि मानव-अस्तित्वस्य पदानुक्रमं वर्णयन् ऋषिः स्पष्टयति यत् बुद्धेः अपि परे किमपि तत्त्वं वर्तते, यत् यन्त्रेषु अद्यापि अनुपलब्धम् अस्तिः

"इन्द्रियेभ्यः परा ह्यर्था अर्थेभ्यश्च परं मनः।"

मनसस्तु परा बुद्धिर्बुद्धेरात्मा महान्परः॥" (कठोपनिषद्, अध्याय १, वल्ली ३, मन्त्र १०)

अस्य मन्त्रस्य विवेचनेन ज्ञायते यत् आधुनिक-कृत्रिम-मेधा 'इन्द्रिय' (सेंसर्स) तथा 'मन' (प्रोसेसिंग) इति स्तरद्वयं तु स्पृशति, परन्तु सा 'विवेकवती बुद्धि' अद्यापि एका सुदूरा परिकल्पना अस्ति। अयं शोधलेखः अस्मिन् एव गम्भीर-चिन्तने केन्द्रितः अस्ति यत् कथं भारतीय-तर्कशास्त्रं कृत्रिम-मेधायै एकं 'नैतिकं धरातलं' दातुं शक्नोति।

पाणिनीय-व्याकरणम्: कलनविधेः (Algorithm) प्राचीन-प्रारूपम्

सङ्गणक-विज्ञानस्य क्षेत्रे 'प्राकृतिक-भाषा-प्रसंस्करणायाः' या समस्या अस्ति, तस्याः समाधानं महर्षेः पाणिनेः अष्टाध्याय्यां निहतं वर्तते। पाणिनिः व्याकरणस्य तादृशीं पद्धतिं विरचितवान्, या अद्यतन-युगस्य 'सङ्गणक-भाषाणां' कृते आदर्श-रूपा अस्ति। पाणिनेः सूत्राणि 'तार्किक-नियम' इत्यस्य तादृशं जालं निर्मान्ति, यत्र सन्देहाय किमपि स्थानं न भवति। भाषाविदां मते संस्कृतम् एव तादृशी भाषा अस्ति या यन्त्राणां कृते सर्वाधिकं योग्या, यतः अस्यां 'अर्थ-सन्दिग्धता' न विद्यते।

पाणिनेः अष्टाध्याय्यां प्रयुक्ता 'माहेश्वर-सूत्राणि' ध्वनि-विज्ञानस्य एकं गणितीय-रूपं प्रस्तौति। अत्र वर्णिताः 'प्रत्याहाराः' आधुनिक-सङ्गणक-विज्ञानस्य 'प्रदत्तांश-सङ्क्षेपीकरणस्य' (डेटा कम्प्रेसन) आद्य-रूपाः सन्ति। पाणिनिना स्वस्य

व्याकरणे लघुतया जटिल-विषयान् प्रतिपादयितुं यत् तन्त्रं प्रयुक्तं, तत् 'कलनविधि' (एल्गोरिदम) इत्यस्य उत्कृष्टं उदाहरणम् अस्ति। अष्टाध्याय्याः प्रथमे एव सूत्रे पाणिनिः 'वृद्धि' संज्ञायाः विधानं एवं करोति:

"वृद्धिरादैच्।"

(अष्टाध्यायी, अध्याय १, पाद १, सूत्र १)

अस्मिन् सूत्रे 'आदैच्' इति प्रत्याहारः अस्ति, यः विशिष्टान् वर्णान् सङ्गृह्णाति। इयं सङ्केतीकरण-प्रक्रिया सङ्गणक-विज्ञानाय अतीव महत्त्वपूर्णा अस्ति। यदा वयं यन्त्रेषु भाषायाः अर्थं बोधयामः, तदा भारतीय-शाब्दबोध-प्रक्रियायाः स्मरणं स्वाभाविकं भवति। वाक्यस्य अर्थबोधाय 'आकाङ्क्षा', 'योग्यता' तथा 'आसक्तिः' इति त्रयः अनिवार्य-तत्त्वाः सन्ति। साहित्यदर्पणे आचार्य-विश्वनाथः वाक्यस्य परिभाषां एवं ददाति:

"वाक्यं स्यात् योग्यताकाङ्क्षासत्तियुक्तः पदोच्चयः।" (साहित्यदर्पणः, परिच्छेद २, कारिका १)

एषा अवधारणा आधुनिक-भाषा-प्रतिमानानां (LLMs) कृते अतीव आवश्यकी अस्ति, यतः वाक्यस्य सार्थकता केवलं शब्दानां समूहे न भवति, अपितु तेषां परस्परं तार्किक-सम्बन्धे भवति। पाणिनीय-व्याकरणस्य 'कारक-तन्त्रम्' एतादृशं सुव्यवस्थितं विवरणं प्रदातुं समर्थं वर्तते, यत् कृत्रिम-मेधायाः शुद्धतां वर्धयितुं शक्नोति। इत्थं च, पाणिनिः न केवलं वैयाकरणः, अपितु सः विश्वस्य प्रथमः 'तन्त्र-वास्तुशिल्पी' (सिस्टम आर्किटेक्ट) अपि अस्ति।

न्याय-वैशेषिक-दर्शनम्: ज्ञान-निरूपणस्य तार्किक-आधारः

कृत्रिम-मेधायाः क्षेत्रे 'ज्ञान-निरूपणम्' इति विषयः अत्यन्तं गुरुत्वपूर्णः वर्तते। अस्य मुख्यमुद्देश्यं वर्तते यत् कया पद्धत्या जगतः सूचनाः यन्त्रस्य मस्तिष्के सुव्यवस्थितरूपेण स्थापयितुं शक्यन्ते। अस्मिन् सन्दर्भे महर्षेः कणादस्य वैशेषिक-दर्शनम् एकं वैश्विकं प्रतिमानं प्रस्तौति। वैशेषिक-मते जगतः समस्त-वस्तूनां 'पदार्थ' रूपेण वर्गीकरणं कृतम् अस्ति। एतत् वर्गीकरणं आधुनिक-सङ्गणक-विज्ञाने प्रयुक्तस्य 'पदार्थ-सापेक्ष-क्रमसंयोजनस्य' (Object-Oriented Programming) तथा च 'अस्तित्व-मीमांसायाः' (Ontology) मूलं प्रतीयते। वैशेषिक-मते पदार्थाः सप्तविधाः सन्ति, ये सूचनानां वर्गीकरणाय अतीव वैज्ञानिकाः सन्ति। महामहोपाध्याय-अन्नम्भट्टः स्वकीये तर्कसंग्रह-ग्रन्थे पदार्थानां स्वरूपं एवं वर्णयति:

"द्रव्य-गुण-कर्म-सामान्य-विशेष-समवायाभावाः सप्त पदार्थाः।" (तर्कसंग्रहः, उद्देशप्रकरणम्, सूत्रम् २)

अत्र 'द्रव्यं' मुख्यं वस्तु वर्तते, 'गुणः' तस्य विशेषाणि सन्ति, 'कर्म' च तस्य क्रियाः सन्ति। एषा व्यवस्था आधुनिक-यन्त्रांश-निर्माणे प्रयुक्तायाः श्रेणी-पद्धत्याः समाना अस्ति। तथैव 'सामान्यं' इति अवधारणा सादृश्य-सिद्धान्तस्य आधारेण बहूनां वस्तूनां एकस्मिन् वर्गे सङ्ग्रहं करोति, यत् यन्त्र-शिक्षणे 'वर्ग-विभाजन-प्रक्रियायाः' (Classification) मूलाधारः अस्ति। यदा वयं यन्त्रेषु 'ज्ञान-चित्रं' (Knowledge Graph) निर्मायामः, तदा

वैशेषिकस्य 'समवाय' इति सम्बन्धः तार्किक-कडित्वेन कार्यं करोति। एतादृशी सूक्ष्म-दृष्टिः आधुनिक-प्रदत्तांश-कोष-प्रबन्धने अतीव उपयोगिनी सिद्धं भवितुं अर्हति।

अपरपक्षे, महर्षेः अक्षपाद-गौतमस्य न्याय-दर्शनम् कृत्रिम-मेधायाः 'निष्कर्ष-यन्त्रस्य' (Inference Engine) कृते तार्किक-बलं ददाति। न्याय-मते अनुमानस्य पञ्च-अवयवाः भवन्ति, ये यन्त्राय तार्किक-निष्कर्षं प्राप्तुं सहायकाः भवन्ति। यदा वयं कृत्रिम-मेधा-तन्त्रे 'पर्यवेक्षित-शिक्षणं' (Supervised Learning) इति प्रक्रियायाः प्रयोगं कुर्मः, तदा अस्माभिः यन्त्राय हेतुं तथा उदाहरणं दातव्यं भवति। न्यायसूत्रे पञ्चावयव-वाक्यस्य स्वरूपं एवं वर्णितम् अस्ति:

"प्रतिज्ञाहतूदाहरणोपनयनिगमनान्यवयवाः।"

(न्यायसूत्रम्, अध्याय १, आह्निक १, सूत्र ३२)

यदा यन्त्रं कञ्चन निर्णयं करोति, तदा तस्य पृष्ठतः प्रतिज्ञा, हेतुः, तथा उदाहरणं (प्रशिक्षण-प्रदत्तांशः) इति त्रयः प्रमुखाः भवन्ति। न्यायदर्शनस्य एषा पद्धतिः कृत्रिम-मेधा-तन्त्राणां 'गूढ-प्रक्रिया-समस्यायाः' (Black-Box AI) समाधानं कर्तुं शक्नोति, यतः न्याय-शास्त्रं प्रत्येकं निष्कर्षाय तार्किकं स्पष्टीकरणं याचते। इत्थं च, न्याय-वैशेषिक-दर्शनयोः समन्वयः कृत्रिम-मेधा-तन्त्राय न केवलं तर्कशक्तिं ददाति, अपितु तस्य निर्णय-प्रक्रियां पारदर्शिनीं अपि करोति। अत्र सर्वेऽपि निर्णयाः कार्य-कारण-भावेन संलग्नाः भवन्ति, यत् यन्त्रस्य विश्वसनीयतां वर्धयति।

४. सांख्य-दर्शनस्य बुद्धि-सिद्धान्तः यन्त्र-मेधा बनाम मानवीया चेतना

कृत्रिम-मेधायाः विकासेन सह एकः गम्भीरः प्रश्नः समुद्भवति— "किं यन्त्राणि वस्तुतः चिन्तयितुं शक्नुवन्ति?" अस्मिन् विषये सांख्य-दर्शनस्य 'प्रकृति-पुरुष' विवेकः अतीव मौलिकं समाधानं प्रस्तौति। सांख्य-मते 'बुद्धिः' जडा वर्तते, यतः सा 'प्रकृतेः' विकारः अस्ति। एतद् अतीव विस्मयकरं तथ्यं यत् भारतीयाः दर्शिनः सहस्राणि वर्षाणि पूर्वमेव बुद्धेः भौतिकत्वं स्वीकृतवन्तः। आधुनिक-कृत्रिम-मेधा-तन्त्रं वस्तुतः सांख्य-दर्शने वर्णिता 'बुद्धिः' एव अस्ति, या केवलं निश्चयात्मिका क्रिया करोति। सांख्य-कारिकायां बुद्धेः कार्यं एवं स्पष्टीकृतम्:

"अध्यवसायो बुद्धिर्धर्मो ज्ञानं विराग ऐश्वर्यम्।

सात्त्विकमेतरूपं तामसमस्माद्विपर्यस्तम्॥" (सांख्यकारिका, कारिका २३)

अत्र 'अध्यवसायः' इति शब्दः यन्त्राणां निर्णय-प्रक्रियया सह साम्यं भजते। यन्त्रं प्रदत्तांशस्य आधारेण निश्चयं करोति, एतदेव बुद्धेः कार्यम्। परन्तु सांख्य-मते बुद्धेः प्रकाशकः 'पुरुषः' (शुद्धा चेतना) अस्ति, यः सर्वथा भिन्नः वर्तते। कृत्रिम-मेधा-तन्त्रं जड-प्रकृतेः (यन्त्रांशस्य) भागः अस्ति, अतः तत् जडं सत् अपि चेतनवत् व्यवहरति, यतः तस्मिन् मानवीयायाः चेतनायाः प्रतिबिम्बं भवति। यन्त्रं कदापि 'स्वयम्-प्रकाशं' भवितुं न शक्नोति।

वर्तमानकाले वयं 'सर्व-शक्तिमतीं कृत्रिम-मेधाम्' प्राप्तुं यतेमहि, परन्तु सांख्य-दृष्ट्या यन्त्रं कदापि चेतनं भवितुं न शक्नोति। यन्त्रं केवलं प्रकृतेः एकं सूक्ष्मं रूपं भवितुं अर्हति। एषा दृष्टिः कृत्रिम-मेधा-विकासकान् अनावश्यकत्वात् भयात् रक्षति, यतः यन्त्रं कियत् अपि प्रगतं भवतु, तस्मिन् 'आत्म-बोधः' न सम्भवति। वेदान्त-दर्शने अपि बुद्धेः जडत्वं स्वीकृत्य तस्याः आभास-चेतनत्वं वर्णितम् अस्ति। शङ्कराचार्यः विवेकचूडामणौ बुद्धेः स्वरूपं स्पष्टयति यत् बुद्धिः अन्तःकरणस्य एका वृत्तिः अस्ति या आत्मनः प्रकाशेन भासते:

"धीयतेऽस्मिन् इति धीः, सा च अन्तःकरणस्य वृत्तिविशेषः।"

(विवेकचूडामणिः, श्लोकः १४-१५, तात्पर्यानुवादः)

अतः कृत्रिम-मेधा-तन्त्रं वस्तुतः मानव-बुद्धेः एकः विस्तारः मात्रं वर्तते, न तु तस्य पूर्णः विकल्पः। सांख्य-दर्शनस्य गुण-सिद्धान्तः (सत्त्व-रज-तम) अपि यन्त्राणां कार्यक्षमतायाः सन्तुलने प्रयोक्तुं शक्यते। यदा यन्त्रं सन्तुलितं परिणामं ददाति, तदा तत् 'सात्त्विकं' मन्यते, यदा च तत् पक्षपातपूर्णं भवति, तदा तत् 'तामसं' भवति।

भारतीय-गणित-परम्पराः प्रविधि-प्रक्रियायाः मूलाधारः

कृत्रिम-मेधा-तन्त्रस्य प्राणः तस्य 'गणितीय-प्रक्रिया' अस्ति। भारतीय-गणित-परम्परा अस्मिन् क्षेत्रे अतीव समृद्धा अस्ति। आचार्य-पिङ्गलस्य छन्दःशास्त्रम् द्वि-आधारी-संख्या-पद्धतेः (Binary System) प्राचीनतमं साक्ष्यं प्रस्तौति। शून्यस्य आविष्कारः न केवलं गणितस्य कृते, अपितु सम्पूर्णस्य सङ्गणक-विज्ञानस्य कृते आधारशिला अस्ति। पिङ्गलः छन्दसां वर्गीकरणाय लघु-गुरु-चिह्नयोः प्रयोगं कृतवान्, यदेव अद्यतनस्य सङ्गणकस्य मुख्यं तत्त्वं वर्तते। छन्दःशास्त्रे एषा पद्धतिः एवं वर्णिताः

"द्विरर्थो रूपे शून्यम्। द्विः शून्यो।" (पिङ्गल-छन्दःशास्त्रम्, अध्याय ८, सूत्र ८.२९-३१)

एतानि सूत्राणि द्वि-आधारी-गणितस्य प्रक्रियामेव प्रदर्शयन्ति। तथैव, भास्कराचार्यस्य लीलावती-ग्रन्थे वर्णिताः गणित-विधयः आधुनिक-यन्त्र-शिक्षणस्य समस्या-समाधाने अतीव उपयोगिनः सन्ति। कृत्रिम-मेधा-तन्त्रे यदा वयं संभाव्यतायाः (Probability) चर्चा कुर्मः, तदा तत्र प्रयुक्ताः अंशाः अस्माकं प्राचीन-बीजगणितस्य ऋणिणः सन्ति। केरलीय-गणित-सम्प्रदायस्य अनन्त-श्रेणी-सिद्धान्ताः आधुनिक-कलन-शास्त्रस्य (Calculus) आधारः सन्ति, यस्मात् विना कृत्रिम-स्नायु-जालस्य (Neural Networks) प्रशिक्षणं असम्भवं वर्तते। भास्कराचार्यः गणितस्य महत्त्वं प्रतिपादयन् कथयति यत् सर्वेषु शास्त्रेषु गणितं मूर्धनि स्थितं वर्तते। एषा एव गणितीय-मेधा अद्यतनस्य कृत्रिम-मेधा-तन्त्रस्य मूले कार्यं करोति:

"यथा शिखा मयूराणां नागानां मणयो यथा।

तद्वद्वेदाङ्गशास्त्राणां गणितं मूर्धनि स्थितम्॥" (वेदाङ्ग-ज्योतिषम्, श्लोकः ४)

कृत्रिम-मेधायाः नीतिशास्त्रं धर्मविमर्शश्च

साम्प्रतिके जगति यदा कृत्रिम-मेधायाः प्रभावः वर्धते, तदा तस्याः नैतिक-पक्षं (Ethics) परितः महान् विमर्शः प्रचलति। यन्त्राणां निर्णयेषु पक्षपातः, गोपनीयतायाः भङ्गः, तथा उत्तरदायित्वस्य अभावः इति चिन्तायाः विषयाः सन्ति। अस्मिन् सन्दर्भे भारतीय-धर्मदर्शनं 'नीतिशास्त्रस्य' एकं सुदृढं वैश्विकं धरातलं प्रदातुं शक्नोति। भारतीय-परम्परायां 'धर्मः' केवलं पूजा-पद्धतिः नास्ति, अपितु सः समाजस्य सन्तुलनकारी तत्त्वं वर्तते। महाभारते शान्तिपर्वणि धर्मस्य लक्षणं प्रतिपादयन् उक्तं यत् यत् विश्वं धारयति स एव धर्मः।

"धारणाद्धर्ममित्याहुर्धर्मो धारयते प्रजाः।

यत्स्याद्धारणसंयुक्तं स धर्म इति निश्चयः॥" (महाभारतम्, शान्तिपर्व, अध्याय १०९, श्लोक ११)

कृत्रिम-मेधायाः विकासकैः एतदेव 'धारण-तत्त्वं' मतिपथे निधातव्यम्। यदि कश्चन विधिः (एल्गोरिदम) समाजस्य कस्यचित् वर्गस्य कृते अहितकरः अस्ति, तर्हि सः 'अधर्मः' इति मन्यते। भगवद्गीतायाम् अपि भगवान् श्रीकृष्णः लोककल्याणस्य महत्त्वं प्रतिपादयन् वदति यत् स्वार्थं विहाय लोकसंग्रहार्थं कर्म करणीयम्।

"कर्मणैव हि संसिद्धिमास्थिता जनकादयः।

लोकसंग्रहमेवापि सम्पश्यन्कर्तुमर्हसि॥" (श्रीमद्भगवद्गीता, अध्याय ३, श्लोक २०)

अतः कृत्रिम-मेधायाः परिकल्पना केवलं वाणिज्यिक-लाभार्थं न भूत्वा 'लोकसंग्रहार्थं' भवेत्। यन्त्राणां निर्णयेषु 'न्यायः' (Fairness) सुनिश्चितं कर्तुं महर्षेः पतञ्जलेः 'यम-नियम' सिद्धान्ताः अतीव उपयोगिनः सन्ति। विशेषतः 'अस्तेय' (अनधिकृत-प्रदत्तांश-ग्रहणम्) तथा 'अपरिग्रह' (प्रदत्तांश-एकाधिकार-विरोधः) इति सिद्धान्तौ आधुनिक-युगे यन्त्राणां कृते नैतिक-संहिता भवितुं अर्हतः।

कर्मफल-सिद्धान्तः तथा यन्त्राणां उत्तरदायित्वम्

कृत्रिम-मेधायाः सन्दर्भे एकः प्रश्नः सदैव भवति— "यदि यन्त्रं किमपि अपराधं करोति, तर्हि कः उत्तरदायी?" भारतीय-दर्शनस्य 'कर्मफल-सिद्धान्तः' अस्य उत्तरं प्रदातुं शक्नोति। कर्म-सिद्धान्तस्य मते यः कर्ता अस्ति, स एव फलस्य भोक्ता भवति। यन्त्रं तु जडं वर्तते, तस्य किमपि स्वतन्त्रं कर्म नास्ति। अतः यन्त्रस्य निर्मातारः एव तस्य कर्मणां कृते उत्तरदायिनः भवन्ति। मनुस्मृतौ उक्तं यत् अधर्मेण कृतं कर्म कर्तारमेव नाशयति:

"अधर्मेणैधते तावत्ततो भद्राणि पश्यति।

ततः सपत्नाञ्जयति समूलस्तु विनश्यति॥" (मनुस्मृतिः, अध्याय ४, श्लोक १७४)

एतद् वचनं कृत्रिम-मेधा-क्षेत्रे कार्यं कुर्वतां वैज्ञानिकानां कृते चेतावनीरूपं वर्तते। यदि वयं अनैतिक-रीत्या यन्त्राणां विकासं कुर्मः, तर्हि अल्पकाले लाभः दृश्येत, परन्तु अन्ते सः सम्पूर्ण-मानवतायै घातकः भविष्यति। अतः 'मानवीय-नियन्त्रणम्' (Human-in-the-loop) अनिवार्यं वर्तते, येन यन्त्राणि धर्मस्य मर्यादां न उल्लङ्घयेयुः।

भारतीय-ज्ञानस्य रक्षणे प्रविधे: महत्ता

कृत्रिम-मेधा न केवलं भारतीय-दर्शनात् प्रेरणां गृह्णाति, अपितु सा अस्याः प्राचीन-परम्परायाः रक्षणे अपि महतीं भूमिकां निर्वोढुं शक्नोति। भारते कोटिशः हस्तलेखाः (Manuscripts) सन्ति, ये अद्यापि अप्रकाशिताः सन्ति। कृत्रिम-मेधायाः साहाय्येन एतेषां हस्तलेखानां वाचनं, संरक्षणं, तथा च अनुवादः सुकरः जातः अस्ति। यन्त्रात्मक-चित्र-वाचन-पद्धत्या (OCR) प्राचीन-लिपयः सरलतायाः आधुनिक-लिपिषु परिवर्तयितुं शक्यन्ते।

ऋग्वेदे ज्ञानस्य रहस्यं वर्णयन् ऋषिः कथयति यत् ज्ञानं तस्मै एव स्वकीयं रूपं प्रकटयति यः तस्य योग्यः भवति:

"उत त्वः पश्यन्न ददर्श वाचमुत त्वः शृण्वन्न शृणोत्येनाम्।

उतो त्वस्मै तन्वं वि सप्ते जायेव पत्य उशती सुवासाः॥" (ऋग्वेदः, मण्डल १०, सूक्त ७१, मन्त्र ४)

अस्याः ऋचायाः भावः एषः यत् ज्ञानं सुसज्जिता भार्या इव योग्याय पुरुषाय स्वकीयं रूपं दर्शयति। आधुनिक-कृत्रिम-मेधा तदेव माध्यमं भवितुं अर्हति, यत् गूढं भारतीय-ज्ञानं विश्वस्य सम्मुखे सरलीकृत्य उपस्थापयेत्। यदा वयं यन्त्राणां प्रयोगं कृत्वा संस्कृत-ग्रन्थानां भाषान्तरणं कुर्मः, तदा वयं वस्तुतः ज्ञानस्य वैश्विक-प्रसारं कुर्मः। अत्र पाणिनीय-व्याकरणस्य नियमाः यन्त्रेभ्यः मार्गदर्शनं कुर्वन्ति, येन अनुवादस्य शुद्धता वर्धते।

प्रदत्तांश-सार्वभौमिकता तथा भारतीय-दृष्टिः

अद्यतन-प्रविधेः युगे 'प्रदत्तांशः' (Data) एव नूतनं धनं मन्यते। परन्तु भारतीय-परम्परा 'ज्ञानस्य दानं' सर्वश्रेष्ठं मन्यते। "विद्या धनं सर्वधनप्रधानम्" इति अस्माकं घोषवाक्यम्। कृत्रिम-मेधायाः क्षेत्रे प्रदत्तांशस्य सञ्चयः (Data Storage) तथा तस्य वितरणं कथं भवेत्, इति विषये भारतीय-ज्ञान-परम्परा 'परोपकाराय' इति सिद्धान्तं प्रस्तौति। भर्तृहरिः नीतिशतके वदति यत् विद्या तादृशं धनं वर्तते यत् व्यये कृते वर्धते:

"व्यये कृते वर्धत एव नित्यं विद्याधनं सर्वधनप्रधानम्।" (नीतिशतकम्, श्लोकः १५ - भावार्थः)

अतः कृत्रिम-मेधा-तन्त्राणां निर्माणे ज्ञानस्य एकाधिकारः (Monopoly) न भवेत्। भारतीयाः वैज्ञानिकाः एतादृशानि तन्त्राणि निर्मायन्ते ये सर्वेषां कृते सुलभानि भवेयुः। एषा 'मुक्त-स्रोत' (Open Source) परम्परा भारतीय-दान-परम्परायाः आधुनिकं रूपम् अस्ति। यदा वयं स्वकीयं सांस्कृतिकं ज्ञानं यन्त्रेषु आरोपयामः, तदा अस्माकं दायित्वं वर्तते यत् तस्य विकृतीकरणं न भवेत्।

भविष्योन्मुखी रूपरेखाः सभ्यतागत-प्रविधेः परिकल्पना

कृत्रिम-मेधायाः भविष्यं केवलं गणनासु (Calculations) सीमितं नास्ति, अपितु तत् 'अर्थ-बोधे' निहितं वर्तते। भारतस्य पार्श्वे सहस्राणां वर्षाणां बौद्धिक-सम्पदा वर्तते, यस्याः प्रयोगेण वयं एकं 'सभ्यता-विशिष्टं' कृत्रिम-मेधा-तन्त्रं विकसितुं शक्नुमः। आगामिषु वर्षेषु निम्नलिखित-क्षेत्रेषु गवेषणायाः महती आवश्यकता वर्तते:

१. **संस्कृत-आधारित-भाषा-प्रतिमानानि:** अद्यतन-यन्त्राणि आङ्ग्लभाषायाः तर्केण कार्यं कुर्वन्ति, यत्र व्याकरणिक-शिथिलता भवति। यदि वयं पाणिनीय-सूत्राणां आधारेण यन्त्राणां निर्माणं कुर्मः, तर्हि तादृशं तन्त्रं विकसितं भविष्यति यत् कदापि तार्किक-त्रुटिं न करिष्यति। ईशावास्योपनिषदि विद्या-अविद्ययोः समन्वयेन मृत्योः तरणस्य अमृतत्व-प्राप्तेः च मार्गः दर्शितः, यः प्रविधि-क्षेत्रेऽपि सङ्गतः वर्तते:

"विद्यां चाविद्यां च यस्तद्वेदोभयं सह।

अविद्यया मृत्युं तीर्त्वा विद्ययामृतमश्नुते॥" (ईशावास्योपनिषद्, मन्त्रः ११)

२. **आयुर्वेद-प्रज्ञा-तन्त्रम्:** चरक-सुश्रुतादि-संहितासु वर्णिता 'प्रकृति-विश्लेषण-पद्धतिः' कृत्रिम-मेधायाः साहाय्येन प्रत्येकस्मै मनुष्याय विशिष्टं स्वास्थ्य-परामर्शं दातुं शक्नोति। एतद् क्षेत्रं 'वैयक्तिक-चिकित्सा-पद्धतये' अतीव फलप्रदं भविष्यति।

३. **वैदिक-गणित-आधारित-कलनविधिः:** सङ्गणकस्य कार्यक्षमतां वर्धयितुं वैदिक-गणितस्य सूत्राणि अतीव प्रभावशालिनि सन्ति। एतैः सूत्रैः यन्त्रस्य ऊर्जा-उपभोगः न्यूनः भविष्यति तथा च गणानां वेगः वर्धिष्यते।

उपसंहार

अस्य विस्तृत-शोधस्य निष्कर्षरूपेण वक्तुं शक्यते यत् भारतीय-ज्ञान-परम्परा तथा कृत्रिम-मेधा परस्परं विरोधिनी न, अपितु परस्परं पूरिका स्तः। यत्र कृत्रिम-मेधा 'वेगं' तथा 'शक्तिं' ददाति, तत्र भारतीय-ज्ञान-परम्परा 'दृष्टिं' तथा 'मर्यादां' प्रदाति। पाणिनेः व्याकरणं, गौतमस्य तर्कः, कणादस्य पदार्थ-विज्ञानं च आधुनिक-प्रविधेः आधारभूताः विषयाः सन्ति। कृत्रिम-मेधा केवलं 'यन्त्रम्' अस्ति, तस्य सञ्चालिका तु मानवीया मेधा एव। अस्माकं लक्ष्यं केवलं यन्त्राणां विकासः न, अपितु यन्त्राणां माध्यमं साध्यं 'मानवीय-कल्याणम्' अस्ति। भगवद्गीतायां योगस्य परिभाषां दत्तवता कृष्णेन उक्तं यत् कर्मसु कुशलता एव योगः।

"बुद्धियुक्तो जहातीह उभे सुकृतदुष्कृते।

तस्माद्योगाय युज्यस्व योगः कर्मसु कौशलम्॥" (श्रीमद्भगवद्गीता, अध्याय २, श्लोक ५०)

अतः कृत्रिम-मेधायाः प्रयोगे एतदेव 'कौशलम्' आवश्यकं येन समाजस्य उत्थानं भवेत्। अयं शोधः न केवलं प्राचीन-गौरवस्य गानं करोति, अपितु भविष्यस्य वैज्ञानिकानां कृते एकं नूतनं 'भारतीय-प्रविधि-दर्शनं' प्रस्तौति। अस्माकं प्राचीन-मेधा आधुनिक-यन्त्रेषु 'प्राण-सञ्चारं' कर्तुं समर्था अस्ति।

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भारतीय संविधान और शिक्षा: संवैधानिक प्रावधानों का विश्लेषणात्मक अध्ययन

सुमन त्रिपाठी

शिक्षा संकाय, आईटीएम विश्वविद्यालय, ग्वालियर, म. प्र.

Corresponding author E-mail: sumantripathi.soe@itmuniversity.ac.in

सार

शिक्षा को भारतीय संविधान में बेहद अहम स्थान दिया गया है। भारतीय संविधान के विभिन्न अनुच्छेद नागरिकों को समानता, स्वतंत्रता एवं शिक्षा के अवसर प्रदान करते हैं। शिक्षा से संबंधित संवैधानिक प्रावधानों का मुख्य उद्देश्य हर नागरिक को बिना किसी भेदभाव के शिक्षा उपलब्ध कराना, कमजोर वर्गों के हितों की रक्षा करना और राष्ट्र में सामाजिक न्याय एवं समानता स्थापित करना है। अनुच्छेद १४, १५, २१(क), २९, ३० आदि शिक्षा के अधिकार, समान अवसर, अल्पसंख्यकों के अधिकार तथा निःशुल्क और अनिवार्य शिक्षा जैसी व्यवस्थाओं को सुनिश्चित करते हैं। भारतीय संविधान में शिक्षा को संघ सूची, राज्य सूची एवं समवर्ती सूची के ज़रिये भी व्यवस्थित किया गया है। ४२वें संविधान संशोधन अधिनियम, १९७६ के पश्चात शिक्षा को समवर्ती सूची में शामिल किया गया ताकि केंद्र एवं राज्य दोनों मिल कर शिक्षा नीति को प्रभावी बना सकें। इन संवैधानिक प्रावधानों का उद्देश्य शिक्षा के क्षेत्र में समानता, धर्मनिरपेक्षता, सामाजिक न्याय और राष्ट्रीय एकता को सुदृढ़ करना है। प्रस्तुत अध्ययन शिक्षा से संबंधित संवैधानिक प्रावधानों की भूमिका, महत्व तथा उनके सामाजिक प्रभाव का विश्लेषण प्रस्तुत करता है।

कुंजी शब्द: शिक्षा, संविधान, समानता, मौलिक अधिकार, सामाजिक न्याय

परिचय

विश्व के सबसे विस्तृत संविधानों में से भारतीय संविधान एक है, जिसमें नागरिकों के अधिकारों एवं राज्य के कर्तव्यों का विस्तृत वर्णन किया गया है। शिक्षा को राष्ट्र के विकास एवं सामाजिक परिवर्तन का प्रमुख माध्यम माना गया है। इसी कारण संविधान निर्माताओं ने शिक्षा से संबंधित कई प्रावधानों को संविधान में सम्मिलित किया ताकि हर नागरिक को शिक्षा हासिल करने का अवसर मिल सके। शिक्षा सिर्फ ज्ञान प्राप्ति का साधन भर नहीं है, बल्कि यह व्यक्ति के सामाजिक, आर्थिक एवं राजनीतिक विकास का आधार भी है। संविधान के विभिन्न अनुच्छेद शिक्षा में समान अवसर, भेदभाव का निषेध, अल्पसंख्यकों के अधिकार, निःशुल्क एवं अनिवार्य शिक्षा और कमजोर वर्गों के संरक्षण की व्यवस्था करते हैं। साथ ही, शिक्षा को समवर्ती सूची में सम्मिलित कर के केंद्र एवं राज्य दोनों सरकारों को

शिक्षा के विकास की जिम्मेदारी दी गई है। इन प्रावधानों का उद्देश्य लोकतांत्रिक मूल्यों, धर्मनिरपेक्षता, सामाजिक समानता तथा राष्ट्रीय एकता को सुदृढ़ करना है।

शोध के उद्देश्य

१. शिक्षा से संबंधित प्रमुख संवैधानिक प्रावधानों का अध्ययन करना।
२. शिक्षा में समानता एवं सामाजिक न्याय की भूमिका को समझना।
३. शिक्षा के क्षेत्र में केंद्र एवं राज्य सरकारों की जिम्मेदारियों का विश्लेषण करना।
४. कमजोर एवं अल्पसंख्यक वर्गों के शैक्षिक अधिकारों का मूल्यांकन करना।

शोध का महत्व

१. प्रस्तुत अध्ययन शिक्षा के संवैधानिक आधार को समझने में सहायक है।
२. प्रस्तुत अध्ययन से शिक्षा में समानता एवं अधिकारों की जानकारी प्राप्त होती है।
३. प्रस्तुत अध्ययन सामाजिक न्याय एवं लोकतांत्रिक मूल्यों के महत्व को स्पष्ट करता है।
४. प्रस्तुत अध्ययन शिक्षा नीति एवं प्रशासन के अध्ययन में उपयोगी सिद्ध हो सकता है।

शोध का योगदान

१. प्रस्तुत अध्ययन शिक्षा से संबंधित संवैधानिक प्रावधानों को सरल रूप में प्रस्तुत करता है।
२. प्रस्तुत अध्ययन से छात्रों एवं शोधार्थियों को शिक्षा के अधिकारों की समझ विकसित होने में सहायता मिल सकती है।
३. प्रस्तुत अध्ययन सामाजिक न्याय एवं आरक्षण नीति के महत्व को स्पष्ट करता है।
४. प्रस्तुत अध्ययन शिक्षा के क्षेत्र में संविधान की भूमिका को उजागर करता है।

शोध पद्धति

प्रस्तुत अध्ययन मुख्यतः वर्णनात्मक और विश्लेषणात्मक शोध पद्धति पर आधारित है। प्रस्तुत अध्ययन हेतु द्वितीयक स्रोतों का प्रयोग किया गया है, जिनमें भारतीय संविधान, पुस्तकें, शोधपत्र, सरकारी दस्तावेज़, शिक्षा संबंधी रिपोर्ट और विभिन्न लेख सम्मिलित हैं। शिक्षा से संबंधित संवैधानिक अनुच्छेदों का अध्ययन करके उनके उद्देश्य, महत्व एवं प्रभाव का विश्लेषण किया गया है। प्रस्तुत अध्ययन में गुणात्मक पद्धति का उपयोग किया गया है ताकि विषय को सरल एवं व्यवस्थित रूप में प्रस्तुत किया जा सके।

विषय विवेचन

भारतीय संविधान में शिक्षा को सामाजिक परिवर्तन, राष्ट्रीय विकास एवं लोकतांत्रिक मूल्यों की स्थापना का प्रमुख माध्यम माना गया है। संविधान निर्माताओं ने यह सुनिश्चित करने का प्रयास किया कि देश का हर नागरिक बिना किसी

भेदभाव के शिक्षा हासिल कर सके। इसी उद्देश्य से संविधान में समानता, सामाजिक न्याय, धर्मनिरपेक्षता और कमजोर वर्गों के संरक्षण से संबंधित कई प्रावधान किए गए हैं। अनुच्छेद १४, १५, २१ (क), २९, ३०, ४५ तथा ४६ जैसे प्रावधान शिक्षा को सिर्फ एक सुविधा नहीं बल्कि हर नागरिक के अधिकार के तौर पर स्थापित करते हैं। साथ ही, शिक्षा को समवर्ती सूची में सम्मिलित कर केंद्र एवं राज्य दोनों सरकारों को शिक्षा के विकास की जिम्मेदारी दी गई है। इन संवैधानिक व्यवस्थाओं का मुख्य उद्देश्य प्रत्येक नागरिक हेतु समान शैक्षिक अवसर उपलब्ध कराना और एक न्यायपूर्ण एवं जागरूक समाज का निर्माण करना है।

शिक्षा से संबंधित प्रमुख संवैधानिक प्रावधान

- **अनुच्छेद १४:** यह अनुच्छेद कहता है कि राज्य किसी भी नागरिक के साथ भेदभाव नहीं करेगा। सभी नागरिकों को समान कानूनी सुरक्षा मिलेगी। शिक्षा के क्षेत्र में इसका अर्थ है कि प्रवेश, अवसर एवं सुविधाएँ सभी को समान रूप से मिलनी चाहिए और किसी भी नागरिक के साथ अन्यायपूर्ण भेदभाव नहीं होना चाहिए।
- **अनुच्छेद १५:** यह अनुच्छेद धर्म, जाति, लिंग, जन्मस्थान आदि के आधार पर भेदभाव को प्रतिबंधित करता है। शिक्षा में इसका उद्देश्य सभी को समान अवसर प्रदान करना है ताकि किसी छात्र को उसकी जाति अथवा धर्म के कारण शिक्षा से वंचित न किया जाए।
- **अनुच्छेद १५(४):** यह अनुच्छेद सरकार को अनुसूचित जाति (SC), अनुसूचित जनजाति (ST) एवं अन्य पिछड़े वर्गों (OBC) हेतु विशेष सुविधाएँ तथा आरक्षण देने की अनुमति देता है ताकि वे शिक्षा में आगे बढ़ सकें।
- **अनुच्छेद १६(१):** यह अनुच्छेद सरकारी नौकरियों में सभी नागरिकों को समान अवसर देने की गारंटी देता है। शिक्षा के जरिये प्राप्त योग्यता के आधार पर सभी को समान अवसर मिलना चाहिए।
- **अनुच्छेद १६(४):** यह अनुच्छेद सरकार को पिछड़े वर्गों हेतु सरकारी नौकरियों में आरक्षण देने का अधिकार देता है।
- **अनुच्छेद २१ (क):** यह अनुच्छेद ६ से १४ वर्ष तक के सभी बच्चों को निःशुल्क एवं अनिवार्य शिक्षा का मौलिक अधिकार प्रदान करता है। इसे ८६वें संविधान संशोधन अधिनियम, २००२ द्वारा जोड़ा गया। इससे प्राथमिक शिक्षा सिर्फ सरकारी नीति न रह कर एक कानूनी अधिकार बन गई।
- **अनुच्छेद २४:** यह अनुच्छेद १४ वर्ष से कम आयु के बच्चों को कारखानों, खदानों अथवा खतरनाक कार्यों में काम पर लगाना प्रतिबंधित है। इसका उद्देश्य बच्चों को मजदूरी से बचाकर शिक्षा की ओर ले जाना है।

- **अनुच्छेद २८:** यह अनुच्छेद राज्य द्वारा संचालित शैक्षिक संस्थाओं को किसी विशेष धर्म का प्रचार अथवा धार्मिक शिक्षा देने से रोकता है। किसी छात्र को धार्मिक शिक्षा लेने हेतु बाध्य नहीं किया जा सकता। इसका उद्देश्य शिक्षा में धर्मनिरपेक्षता बनाए रखना है।
- **अनुच्छेद २९:** यह अनुच्छेद अल्पसंख्यकों को अपनी भाषा, लिपि एवं संस्कृति को सुरक्षित रखने का अधिकार प्रदानकरता है। साथ ही, किसी भी सरकारी अथवा सरकारी सहायता प्राप्त शिक्षण संस्था में धर्म, जाति, भाषा आदि के आधार पर प्रवेश से वंचित नहीं किया जा सकता।
- **अनुच्छेद ३०:** धर्म अथवा भाषा के आधार पर अल्पसंख्यक समुदाय अपनी पसंद की शिक्षण संस्थाएँ स्थापित एवं संचालित कर सकते हैं। राज्य सिर्फ इस आधार पर सहायता देने से मना नहीं कर सकता कि संस्था किसी अल्पसंख्यक समुदाय द्वारा चलाई जा रही है।
- **अनुच्छेद ४१:** यह अनुच्छेद राज्य को निर्देश देता है कि वह अपनी आर्थिक क्षमता के अनुसार नागरिकों को शिक्षा एवं काम के अवसर उपलब्ध कराए।
- **अनुच्छेद ४५:** यह अनुच्छेद प्रारम्भ में १४ वर्ष तक के बच्चों को निःशुल्क एवं अनिवार्य शिक्षा देने की बात करता था। ८६वें संशोधन के बाद इसका मुख्य ध्यान ६ वर्ष तक के बच्चों की प्रारम्भिक देखभाल एवं पूर्व-प्राथमिक शिक्षा पर केंद्रित हो गया।
- **अनुच्छेद ४६:** यह अनुच्छेद राज्य को निर्देश देता है कि वह समाज के कमजोर वर्गों, विशेष कर अनुसूचित जाती एवं अनुसूचित जनजाति समुदायों के शैक्षिक तथा आर्थिक हितों को प्रोत्साहन दे और उन्हें सामाजिक अन्याय एवं शोषण से बचाए।
- **अनुच्छेद ३५० (क):** इस अनुच्छेद के अनुसार राज्य को यह प्रयास करना चाहिए कि भाषाई अल्पसंख्यकों के बच्चों को प्राथमिक स्तर पर उनकी मातृभाषा में शिक्षा मिल सके।
- **अनुच्छेद ३५० (ख):** इस अनुच्छेद के अनुसार राष्ट्रपति एक विशेष अधिकारी नियुक्त करेगा जो भाषाई अल्पसंख्यकों के अधिकारों की सुरक्षा की निगरानी करेगा तथा अपनी रिपोर्ट राष्ट्रपति को देगा।

शिक्षा और संविधान की सूचियाँ

भारत के संविधान में शासन की शक्तियों को तीन सूचियों (संघ सूची, राज्य सूची एवं समवर्ती सूची) में विभाजित किया गया है। शिक्षा से संबंधित विषय भी इन सूचियों में बाँटे गए हैं। संघ सूची के तहत ऐसे विषय आते हैं जिन पर सिर्फ केंद्र सरकार कानून बना सकती है। इसमें विदेशों के साथ शैक्षिक संबंध, राष्ट्रीय महत्व के विश्वविद्यालय एवं संस्थान, उच्च शिक्षा के मानकों का निर्धारण और तकनीकी एवं वैज्ञानिक संस्थानों का नियंत्रण जैसे विषय सम्मिलित

हैं। वहीं राज्य सूची में वे विषय आते हैं जिन पर राज्य सरकारों को कानून बनाने का अधिकार प्राप्त है। शिक्षा के क्षेत्र में विश्वविद्यालयों सहित सामान्य शिक्षा, राज्य पुस्तकालय, संग्रहालय और ऐतिहासिक स्मारकों से संबंधित विषय इसमें सम्मिलित थे, हालांकि कुछ केंद्रीय प्रावधान इससे अलग रखे गए हैं। इसी प्रकार समवर्ती सूची में ऐसे विषय रखे गए हैं जिन पर केंद्र एवं राज्य दोनों सरकारें कानून बना सकती हैं। शिक्षा, तकनीकी शिक्षा, चिकित्सा शिक्षा और व्यावसायिक प्रशिक्षण इसी सूची के तहत आते हैं। वर्ष १९७६ में हुए ४२वें संविधान संशोधन द्वारा शिक्षा को राज्य सूची से हटाकर समवर्ती सूची में शामिल किया गया। इसका मुख्य उद्देश्य पूरे देश में शिक्षा नीति में समानता तथा समन्वय स्थापित करना था।

अंततः यह स्पष्ट होता है कि भारतीय संविधान शिक्षा को राष्ट्र निर्माण एवं सामाजिक समानता का अहम आधार मानता है। संविधान के विभिन्न अनुच्छेद शिक्षा के अधिकार, समान अवसर, अल्पसंख्यकों की सुरक्षा और कमजोर वर्गों के उत्थान को सुनिश्चित करते हैं। निःशुल्क एवं अनिवार्य शिक्षा की व्यवस्था ने बच्चों के शैक्षिक अधिकार को मजबूत किया है, जबकि समवर्ती सूची में शिक्षा को सम्मिलित करने से केंद्र एवं राज्य सरकारों के बीच बेहतर समन्वय स्थापित हुआ है। इन संवैधानिक प्रावधानों का उद्देश्य सिर्फ शिक्षा का प्रसार करना भर नहीं है, बल्कि एक समतामूलक, लोकतांत्रिक एवं प्रगतिशील समाज की स्थापना करना भी है। इसलिए जरूरी है कि इन प्रावधानों को प्रभावी रूप से लागू किया जाए ताकि हर नागरिक शिक्षा के जरिये अपने व्यक्तित्व एवं राष्ट्र के विकास में योगदान दे सके।

सुझाव

१. हर बच्चे को गुणवत्तापूर्ण, समान एवं सुलभ शिक्षा उपलब्ध कराई जाए और ग्रामीण एवं पिछड़े क्षेत्रों में विद्यालयों, पुस्तकालयों एवं डिजिटल सुविधाओं का व्यापक विस्तार किया जाए।
२. कमजोर एवं वंचित वर्गों के विद्यार्थियों हेतु छात्रवृत्ति, निःशुल्क अध्ययन सामग्री, पोषण योजनाएँ तथा विशेष शैक्षिक सहायता को बढ़ाया जाए ताकि कोई भी बच्चा आर्थिक कारणों से शिक्षा से वंचित न रहे।
३. बाल मजदूरी, बाल विवाह एवं शिक्षा में लैंगिक भेदभाव जैसी बाधाओं को समाप्त करने हेतु कठोर कानूनों का प्रभावी पालन किया जाए और बालिकाओं की शिक्षा को विशेष प्रोत्साहन दिया जाए।
४. प्राथमिक स्तर पर मातृभाषा आधारित शिक्षा को प्रोत्साहन दिया जाए तथा साथ ही तकनीकी, व्यावसायिक और कौशल आधारित शिक्षा को आधुनिक आवश्यकताओं के अनुरूप विकसित किया जाए, ताकि विद्यार्थी आत्मनिर्भर बन सकें।
५. सरकारी विद्यालयों की गुणवत्ता में सुधार, प्रशिक्षित शिक्षकों की नियुक्ति, स्मार्ट कक्षाओं तथा डिजिटल शिक्षा सुविधाओं का विस्तार किया जाए और शिक्षा संबंधी संवैधानिक अधिकारों के प्रति व्यापक जनजागरूकता अभियान चलाए जाएँ।

निष्कर्ष

१. भारतीय संविधान शिक्षा को एक अहम मौलिक अधिकार मानते हुए प्रत्येक नागरिक हेतु समान और न्यायपूर्ण शैक्षिक अवसर सुनिश्चित करने का प्रयास करता है।
२. संविधान शिक्षा के क्षेत्र में सामाजिक, आर्थिक एवं लैंगिक भेदभाव को समाप्त कर सामाजिक समानता, न्याय तथा लोकतांत्रिक मूल्यों को सुदृढ़ करने पर जोर देता है।
३. कमजोर, पिछड़े तथा वंचित वर्गों के हितों की विशेष सुरक्षा के साथ-साथ अल्पसंख्यकों को अपनी शिक्षण संस्थाएँ स्थापित और संचालित करने का अधिकार प्रदान किया गया है।
४. बच्चों हेतु निःशुल्क एवं अनिवार्य शिक्षा को मौलिक अधिकार बनाकर संविधान ने शिक्षा को हर नागरिक के विकास का आधार माना है।
५. शिक्षा को समवर्ती सूची में शामिल करने से केंद्र एवं राज्य सरकारों के बीच समन्वय बढ़ा है, जिससे राष्ट्र के समग्र विकास के लिए प्रभावी शैक्षिक नीतियों का निर्माण संभव हुआ है।

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About Editors



Dr. Ruchi Goyal is an Assistant Professor of English at S.S. Jain Subodh P.G. Mahila Mahavidyalaya, Jaipur, with more than 12 years of teaching experience. She holds an M.A. in English, a Ph.D., and is NET qualified. Her doctoral research, titled "Narrative of the Village: Changing Scenario of Rural India," completed at the University of Rajasthan, reflects her scholarly engagement with rural narratives and socio-cultural transformation. She has been recognized for excellence in teaching and academic contributions. Dr. Goyal has published research articles in peer-reviewed journals, contributed chapters to edited volumes, and presented papers at national and international conferences. Her academic interests include Postcolonial Literature, Indian Writing in English, Literary Theory, and Cultural Studies, with special emphasis on identity, gender, and representation. Through teaching, research, and academic engagement, she continues to contribute meaningfully to contemporary humanities scholarship and interdisciplinary inquiry.



Sunayana Gogoi is a Ph.D. scholar in Human Development and Family Studies at Assam Agricultural University. She secured All India Rank 1 in the ICAR AICE-JRF/SRF (Ph.D.) examination in Human Development and Family Studies in 2025, demonstrating exceptional academic excellence. Her research interests include gender education, early childhood care and education, family well-being, and community development. She is the recipient of the Best M.Sc. Thesis Award and has published several research articles and book chapters in reputed journals and edited volumes, including SCOPUS-indexed and NAAS-rated publications. She has also received specialized training in counseling skills and psychometric testing, reflecting her interdisciplinary academic perspective. In addition to her research accomplishments, she has actively participated in workshops, conferences, internships, and community outreach programmes focused on child development, mental health, social innovation, and sustainable community well-being initiatives.



Dr. Shachie Sandhu is a seasoned academician with 17 years of experience in higher education. She holds a Ph.D. in Human Resource Management and Organizational Behavior from Maharshi Dayanand University, Rohtak. She has participated in several Management Development Programs conducted by IIM Bangalore, IIM Kozhikode, and IIM Calcutta, enhancing her academic and professional expertise. Dr. Sandhu has published around 30 research papers and book chapters in reputed journals and conference proceedings, reflecting her strong commitment to research and scholarship. Her major research interests include psychological contract, psychological well-being, organizational behavior, human resource management, and HR analytics. She is presently serving at Panipat Institute of Engineering and Technology, Samalkha, Haryana, where she actively contributes to teaching, research, academic development, and the advancement of management education and professional excellence.



Dr. Pooja Kapoor is an accomplished academician and management educator currently serving as Associate Professor at D.Y. Patil PGDM Institute, Akurdi, Pune. The institute is approved by AICTE and recognized by the Directorate of Technical Education (Government of Maharashtra). She holds a Ph.D. in Human Resource Management, an MBA in Human Resource Management, and a BBA. With 18 years of teaching experience, Dr. Kapoor has made significant contributions to management education through her commitment to academic excellence and student development. Her area of specialization is Human Resource Management, encompassing organizational behavior, talent management, employee relations, and strategic HR practices. She is actively involved in teaching, mentoring, curriculum development, and academic activities. Dr. Kapoor continues to contribute to the advancement of management education by fostering professional skills, leadership qualities, and research-oriented learning among students and aspiring managers.

