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ACHIEVING SUSTAINABILITY IN MANAGEMENT AND TECHNOLOGY



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Achieving Sustainability in Management and Technology

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About the Book

“Achieving Sustainability in Management and Technology” is an edited book that explores the integration of sustainable practices within the realms of management and technology. The book provides a comprehensive overview of strategies, methodologies, and case studies that illustrate how sustainability can be achieved in various sectors. It covers topics such as sustainable development, Intervene of technology in Management for strategic management practices, corporate social responsibility, and the role of innovation in driving sustainable practices. The book is an in-depth exploration of how technology and management practices can contribute to achieving the United Nation’s Sustainable Development Goals (SDGs). By compiling diverse perspectives through research papers, the book aims to foster a deeper understanding of how technology and management can be leveraged to address pressing global challenges and promote a sustainable future. By offering a blend of theoretical insights and practical applications, it aims to analyse in-depth that how emerging areas of technologies and Management can be used as catalysts for achieving SDGs. Through elucidating the possibilities of digital innovation, the book presents a revolutionary route towards a more sustainable global community.

This book navigates through the sustainable shifts of paradigm, exploring the future landscape by elaborating the relationship of Technology and Management in sustainable development, revealing the potential, difficulties, and practical solutions that lie ahead. It serves as a beacon of hope highlighting the ways in which digital technologies like blockchain, Artificial Intelligence (AI), and the Internet of Things (IoT) may transform Future, close the access gap, and open the door to resource-efficient methods. More than a book, this is a complete roadmap for policymakers, academicians, business leaders, and change makers who are dedicated to promoting sustainable development through effective technological and managerial interventions and aligned with the SDGs.

About the Editors

Dr. K. Nirmala Kumaraswamy is the Director of D.Y. Patil Institute of MCA and Management, Pune, recognized among the Top 10 Best Colleges Managed by Women-2021. Holding MCA, MBA, and Ph.D. degrees, she is a Ph.D. Guide at Savitribai Phule Pune University with 26 years of academic and 4 years of industry experience. She has published numerous research papers, participated in national and international development programs, and received the Outstanding Academic Leader Award from CEGR. Additionally, she serves as Vice President of CEGR Maharashtra State Council and National Adviser, and is a Board of Studies member at Savitribai Phule Pune University.

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Dr. Roshan Kazi is the Director and Head of the Research Centre at Allana Institute of Management Sciences, Pune, and Dean of Commerce and Management at Dr. P A Inamdar University. He specializes in applied statistics and is a renowned trainer in SPSS software. With a Ph.D. in Business Administration and a Post-Doctoral Fellowship from IIM Indore, he has numerous national and international publications, including in Scopus-indexed journals. Dr. Roshan is known for his SPSS workshops and serves as a research guide for doctoral students at the University of Pune.

Dr. Priya Tiwari, an accomplished professional with over 12 years of experience in academia and corporate, holds a Doctorate in Financial Management. Skilled in data analysis and case study design, her interests include finance, behavioral finance, investment, and research. She has published a patent, is a certified Yoga Trainer, and holds memberships in various professional organizations. Dr. Tiwari has won awards, served on editorial boards, and contributed to curriculum development and book co-authoring. She mentors students, prepares academic materials, and delivers research methodology sessions, with numerous published research papers in national and international journals and conferences.

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Preface

In an era defined by rapid technological advancement and increasing global interconnectedness, the pursuit of sustainability has emerged as a paramount challenge and opportunity for both management and technology sectors. This edited volume, *Achieving Sustainability in Management and Technology*, brings together a diverse array of perspectives and insights from leading scholars and practitioners across these fields. At its core, this book endeavors to bridge the gap between theory and practice, offering practical strategies, innovative solutions, and critical analyses that address the complexities of sustainability in today's dynamic landscape. Through a series of meticulously curated chapters, we explore how organizations can integrate sustainability principles into their core strategies, operations, and decision-making processes.

This edited volume, *Achieving Sustainability in Management and Technology*, encompasses a wide spectrum of critical topics shaping contemporary discourse. From an examination of the fundamental properties of concrete using recycled glass to a review of data mining techniques for predicting teachers' teaching performance in higher education, the book navigates through the evolution of technology in outcome-based education, emphasizing sustainability development. Sustainable shifts in green consumerism and environmental responsibility are explored alongside changing paradigms in higher education and student satisfaction with e-learning. The footprint of artificial intelligence in achieving the UN's Sustainable Development Goals is scrutinized, highlighting the role of digital technologies in inclusive and sustainable industrialization, particularly in India. The technological revolution towards sustainable business practices under Industry 4.0 is examined, alongside an insightful exploration of the Indian software industry's present realities, challenges, and upcoming IT trends. Each contribution reflects the contributors' deep commitment to advancing sustainability goals while navigating the challenges posed by a rapidly changing world.

We extend our gratitude to all the authors who have contributed their expertise and dedication to this project, as well as to the readers who share our vision of a more sustainable future. Together, let us embark on this journey towards achieving sustainability in management and technology.

Editors

Dr. K. Nirmala Kumaraswamy

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Dr. Roshan Kazi

Dr. Priya Tiwari

Acknowledgments

The creation of this edited volume, *Achieving Sustainability in Management and Technology*, has been a collaborative endeavor made possible by the dedication and support of numerous individuals and organizations.

First and foremost, we extend our heartfelt gratitude to all the authors who contributed their expertise, time, and insights to this project. Their commitment to advancing knowledge in sustainability, management, and technology has been instrumental in shaping this book into a comprehensive resource.

We are deeply thankful to the members of editorial team and review board whose meticulous efforts ensured the scholarly rigor and relevance of each chapter. Their constructive feedback and guidance have greatly enriched the content and coherence of this volume.

Special thanks go to Journal Press India for their professional support throughout the publication process. Their expertise and commitment to academic excellence have been invaluable.

We truly acknowledge the support received from the Management of Dr. D Y Patil Educational Complex, Akurdi towards providing all the possible resources to facilitate the development of this book.

Last but not least, we express our appreciation to our families, friends, and colleagues who have offered encouragement and understanding during the often intense periods of editing and revision.

Together, these contributions have culminated in a publication that we hope will inspire and inform future endeavors in achieving sustainability in management and technology.

Editors

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CHAPTER 1

Sustainable Shifts: Exploring the Future Landscape of Green Consumerism and Environmental Responsibility

Saumitra Sawant¹ and Gayatri Nayak²

ABSTRACT

Carbon emissions threaten ecosystems worldwide, making it imperative for individuals and producers to embrace sustainable practices. Environmental responsibility requires conscientious consumerism and selection of products that champion sustainability. The symbiotic relationship between environmental well-being and the health of the planet highlights the urgency of collective efforts. A paradigm shift towards sustainability is necessary for a sustainable future. This research delves into the dynamic landscape of green consumerism, scrutinizing the multifaceted dimensions of environmental responsibility. With an emphasis on the future, our investigation encapsulates the evolving trends in sustainable shifts, examining the factors that drive and impede the adoption of eco-conscious practices. The study employs a comprehensive methodology, amalgamating qualitative and quantitative approaches to discern patterns and nuances in consumer attitudes, preferences, and purchasing behavior. By dissecting the intricate web of green consumerism, this research aims to provide nuanced insights for policymakers, industries, and consumers alike. It not only identifies the existing challenges in fostering environmental responsibility but also proffers potential strategies for a more sustainable future. As a researcher committed to advancing knowledge in the realm of sustainability, this study serves as a timely contribution to the ongoing discourse on Preserving the environment for coming generations.

Keywords: Sustainable, Green Consumerism, Environmental Responsibility.

1.0 Introduction

“भुक्त्वा यान्ति च पञ्चत्वं, दुष्प्लास्टिकमजैविकम् ।
पशवोऽनुर्वरा भूमिर्जायते ज्वालिते विषम् ॥”

The deleterious consequences of ingesting inorganic plastic lead to dire outcomes, rendering the Earth infertile, while its incineration yields nothing but toxic byproducts.

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The staggering emission of carbon poses an imminent threat to global ecosystems, underscoring the imperative for sustainable practices—particularly among producers—to safeguard the environment. Our symbiotic relationship with the environment necessitates a reciprocal commitment to its preservation. As custodians of this delicate equilibrium, we bear the responsibility of mitigating our impact. Embracing conscientious consumerism and prioritizing the acquisition of environmentally friendly products are pivotal aspects of our role in this stewardship.

In the dynamic tapestry of modern consumerism, a significant and transformative thread has emerged, making its way through the minds of all of us. – The rise of Green Consumerism. With the world facing severe environmental problems, a paradigm shift is underway, giving birth to a sustainable ethos that transcends mere product choices. On a journey as delve into the unfolding narrative of “Sustainable Shifts: Exploring the Future Landscape of Green Consumerism and Environmental Responsibility.”

This exploration invites us to navigate the evolving landscape where conscious choices meet ecological mindfulness, shaping a future where sustainability is not just a choice but a way of life. Researcher advocate for the urgency of these measures. The time is ripe for concerted action, and procrastination is a luxury we can ill afford. Commencing a paradigm shift towards responsible environmental practices is not merely a choice but an inexorable mandate. The nexus between environmental responsibility and the well-being of our planet demands our unwavering attention and concerted efforts.

The clarion call for action echoes louder than ever. It is incumbent upon us, as stewards of the Earth, to marshal our resources and instigate transformative change. The nexus between the well-being of our planet and our environmental responsibility demands that we transcend rhetoric and embrace tangible, sustainable practices. More than ever, our collective legacy weighs on our actions, determining the course of the environment and, consequently, our shared future.

Green consumerism refers to a conscious and deliberate pattern of consumer behavior where individuals make choices with a primary consideration for the environment and sustainability. It entails choosing and purchasing products and services that have a minimal negative impact on the environment, promote social responsibility, and align with ethical and ecological values. Green consumers seek to minimize their ecological footprint by supporting businesses and practices that prioritize environmental conservation, resource efficiency, and the overall well-being of the planet. This type of consumerism promotes the use of environmentally friendly products, the reduction of waste, and the support of businesses that demonstrate a commitment to environmentally sound practices.

Green Consumerism involves raising public consciousness about urgent environmental concerns. Green marketers aim to leverage this awareness by creating strategies that enable consumers to incorporate incorporating ecologically friendly goods into their daily lives. Numerous initiatives by green marketers have achieved

significant success. For instance, the “organic” sector focuses on marketing organically derived foods, health and wellness products, and other items promoting a green lifestyle.

1.1 Green consumer purchase behaviors

Consumer behavior, within the realm of green purchasing, encompasses the intricate study of individuals or organizations’ actions in acquiring, utilizing, and discarding materials, products, and services. The focus extends beyond the mere act of purchase to include the comprehensive understanding of how these commodities are employed and ultimately disposed of. This multifaceted process, intricately woven into the consumer’s decision-making journey, holds particular significance for marketers. Notably, the examination of product utilization becomes a pivotal point of interest, as it not only shapes optimal product positioning but also informs strategies to stimulate heightened engagement in green consumption practices.

2.0 Review of Literature

Mahlawat, (2021). Growing concern about environmental issues has prompted firms to use green marketing as a means of making money while protecting the environment. Governments and cultures around the world are becoming more conscious of these challenges, resulting in a surge in green marketing. The purpose of this study is to investigate and assess the environmental consequences and activities of Indian enterprises in the field of green FMCG products, using published materials such as literature studies, periodicals, websites, and annual reports. Green projects were identified through product packaging, labeling, and marketing in various media. The study discovered that FMCG companies have launched several green initiatives to make their products more environmentally friendly. These initiatives include the use of renewable resources in production, such as solar energy, biogas plants, and rainwater collection methods; Extended Producer Responsibility (EPR) for waste collection and recycling; recyclable, reusable, or biodegradable packaging; educational and promotional campaigns; paper consumption reduction; and environmental pollution prevention. Companies have made major changes to their products, adding natural and Ayurvedic substances such as clove, mint, almond, melon, amla, neem, and arnica. They have also turned to recyclable and reusable packaging, as well as manufacturing chemical-free products rich in minerals and vitamins. These initiatives demonstrate a strong commitment to environmental sustainability in the FMCG industry¹.

Yue *et al.*, (2020). This study fills a research gap by investigating the impact of consumers’ environmental responsibility on green consumption, as well as the mediating role of environmental concern and the moderating effect of price sensitivity. According to the findings of a survey of 680 Chinese consumers, environmental responsibility has a positive influence on environmental concern,

which promotes green consumption. Notably, environmental concern helps to mediate the relationship between environmental responsibility and green consumption intention. Furthermore, price sensitivity modifies the relationship between environmental responsibility, environmental concern, and green consumption intention, offering significant understanding for both theory and practice in promoting sustainable consumer behaviour².

Durmaz & Akdogan (2024): This study investigates the outcomes of environmental responsibility on green consumption intention, with a focus on the mediating influence of environmental concern as well as price sensitivity's moderating effect. While earlier studies have mostly concentrated on determinants of green consumption, this study offers novel viewpoints. Via an online questionnaire with 418 responses. The findings show that environmental responsibility has a significant influence on both green consumption intention and environmental concern. In contrast to expectations, environmental concern does not act as a mediator between environmental responsibility and green consumption intention. Notably, price sensitivity is identified as a key moderator in shaping the relationships between environmental responsibility, environmental concern, and green consumption intention³.

Vijaya (2014). Green marketing is a comprehensive approach that considers the interaction between the firm, its goods, and the environment. It highlights a strategic link between the corporation, the environment, and marketing, putting environmental and social responsibility ahead of solely profit-oriented communication. Customers, investors, parent businesses, directors, employees, communities, lawmakers, pressure groups, suppliers, and the media are among the most important stakeholders.

This article investigates green marketing and green consumerism, which hold producers accountable for developing ecologically friendly items that will protect the environment for future generations. It also addresses the factors and ethical dilemmas surrounding green marketing⁴.

Kirmani & Khan (n.d.).(July 2016) The main aim of this study was to investigate the characteristics of green consumerism research and create a future research agenda. A total of 200 research papers were accessed using relevant keywords from various sources, however only 70 of them were relevant to the study's objectives. The majority of the selected research focused on American customers, with students frequently serving as respondents. The findings revealed that Regression Analysis and Structural Equation Modeling were the most widely employed statistical approaches. Based on these findings, a number of environmental and non-environmental determinants of green consumerism were found. The report also suggested areas for future research into green consumerism⁵.

Damar-Ladkoo (n.d.) (April 2016) The purpose of this exploratory study was to acquire insights about the guerilla marketing of fresh organic agricultural products from the viewpoints of farmers, marketers, and customers in Mauritius, a prospering

island in the Indian Ocean and an African success story. The study sought to determine if guerilla marketing, a creative and unusual method defined by creativity, imagination, and surprise components, may penetrate the market for fresh organic agricultural products. Responses from both the supply and demand sides revealed that many consumers are hesitant to acquire fresh organic agricultural products. However, guerrilla marketing was thought to be a potentially helpful way to promote these products. Despite this, traditional marketing strategies remained highly valued. As a result, it was critical to identify the appropriate key performance metrics to assess the efficacy of promoting fresh organic agricultural products through guerilla marketing against traditional marketing strategies⁶.

3.0 Variables of the Study

Understanding the relationships between these independent and dependent variables will contribute to a thorough examination of the dynamics of Green Consumerism and provide insights into the factors influencing sustainable consumer behavior.

Dependent variables	Independent variables
<p>A) Green purchases</p> <ul style="list-style-type: none"> • Familiar with Green Consumerism. • Motives to choose environment friend product. • Frequency of green purchases. • Factor influencing your decision in purchasing green product. • Prioritize choosing environment Friendly Options. 	<p>A) Demographic variable</p> <ul style="list-style-type: none"> • Age • Gender • Occupation • Income levels • Educational background
<p>B) Motivator for Green Purchase</p> <ul style="list-style-type: none"> • Perceived environment impact. • Desire to contribute to environment conservation. • Trust in Eco-Friendly labels. • Awareness of corporate Sustainability initiatives. • Influence of Recommendation from Friends/Family. • Positive experiences with previous Green Purchases. • Lack of clear Information on Product Sustainability. 	<p>B) Information & Education</p> <ul style="list-style-type: none"> • Level of awareness about green practices. • Source of information on sustainable products. • Educational background and its correlation with green knowledge. • Influence of educational campaigns on consumer behavior.
<p>C) Barriers to Green Purchase</p> <ul style="list-style-type: none"> • Higher cost of Green products. • Lack of clear Information on product Sustainability. • Doubt Regarding the effectiveness of Green products. • Limited Availability of Green products in local stores. • Inconvenience in Accessing Green Alternatives. • Lack of trust in the Accuracy of Green claims. 	

4.0 Significance of the study

- The study can help policymakers develop effective regulations and policies that promote green consumerism and sustainable practices intention.
- Understanding the motivators and barriers to green purchases can guide educational campaigns, promoting awareness and influencing customer behavior with regard to decisions that are environmentally friendly.
- Businesses benefit from understand the current trends in Green Consumerism, enabling them to adapt strategies that align with consumer preferences for sustainable products.
- The study contributes to the broader understanding of how individual behaviors, influenced by demographics and education, can collectively impact the environment, providing a basis for sustainable practices.
- Insights into green purchasing patterns and consumer motivations can guide businesses in developing and marketing eco-friendly products, potentially creating new market opportunities.
- The study may shed light on the potential health and well-being benefits associated with green consumerism, as environmentally responsible choices can contribute to a healthier and more sustainable living environment.
- This study contributes to the scholarly conversation surrounding sustainable consumer behavior, laying groundwork for future research in the realm of environmental accountability and eco-friendly consumption.

5.0 Research Problem

To what extent do demographic variances, current trends in Green Consumerism, motivators and barriers to Green Purchases, and how does information and education impact the uptake of sustainable practices and environmentally conscious consumer behavior?

6.0 Research Based Objectives

1. To study the demographic distribution of variables across the Study.
2. To examine the correlation between demographic factors and the inclination towards purchasing green products at a premium.
3. To assess the correlation between obstacles hindering green purchases and the drive for green purchases, moderated by the influence of green consumerism.

7.0 Research Based Hypothesis

The study attempted to test the following hypotheses:

H01: There is no significant association between Age, Gender, Occupation, Income,

Education and willing to pay a premium for products labeled environmentally friendly or sustainable.

H11: There is a significant association between Age, Gender, Occupation, Income, Education and willing to pay a premium for products labeled environmentally friendly or sustainable.

H02: There is a strong negative correlation between Green Consumerism and Motivation for Green Purchases.

H12: There is a strong positive correlation between Green Consumerism and Motivation for Green Purchases.

8.0 Research Methodology

8.1 Research Design

Types: A mixed-methods approach combines qualitative and quantitative research techniques.

Exploratory Research: Qualitative researches were studied to understand consumer perceptions, motivations, and barriers.

Confirmatory research: Quantitative research was used to test hypotheses and examine relationships.

8.2 Sampling

Convenient sampling method: The data was collected using convenience sampling.

Sample size: Data was collected from 255 respondents.

Sample area: Thane city, Maharashtra.

Time period: April 2023- December 2023

8.3 Data collection

Qualitative phase: In-depth interviews focus group discussions, and content analysis.

Variables: Include demographic information, motivators, barriers, purchasing behaviors, and attitudes towards corporate initiatives.

Scale: Utilized Likert scales and closed-ended questions for standardized responses.

8.4 Variables and measures

Dependent variable: Motivation towards green purchase.

Independent variables: Barriers towards green purchase, green consumerism, demographic factors, information sources, and corporate initiatives.

8.5 Instrument validation

Reliability: Assess internal consistency using measures such as Cronbach's alpha.

8.6 Data Analysis:

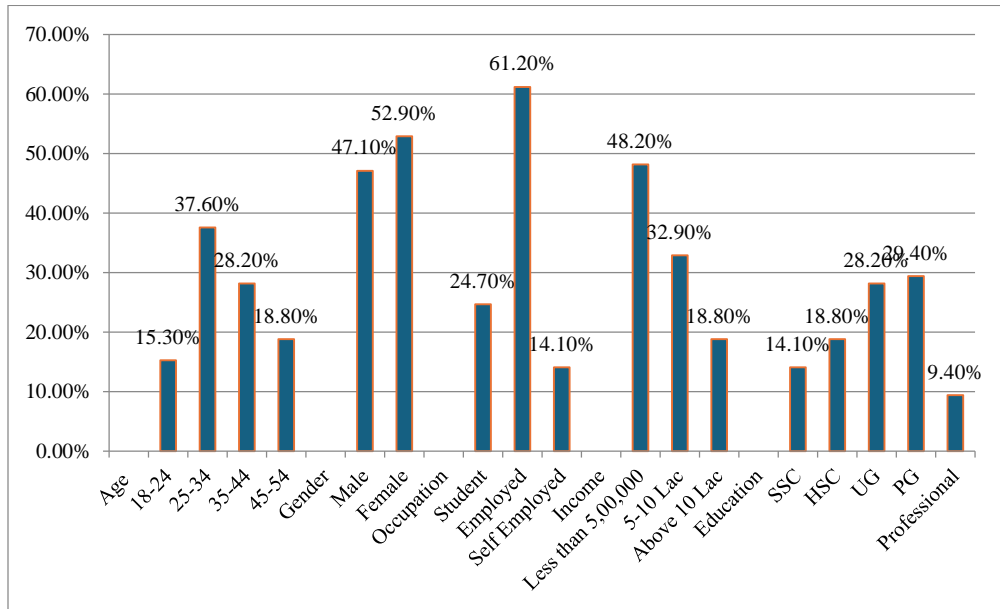
Test applied: Bar chart, Chi-Square Tests, Correlations, ANOVA, Coefficients.

9.0 Data Analysis and Testing of Hypothesis

9.1 Objective one based: The respondent’s demographic profile

Interpretation & Findings: The provided demographic profile demonstrates the demographics of respondents by age, gender, occupation, income, and education.

Figure 1: The Respondent’s Demographic Profile



Sources: Author compilation

Age Distribution: The majority of respondents are in the 25-34 age range. (37.60%) and 35-44 age range (28.20%). This state that individuals in the prime of their working years are well-represented. The prime working-age group (25-34) is prominently represented. This group often has purchasing power and can significantly impact market trends.

Gender: The gender distribution is relatively balanced, with slightly more females (52.90%) than males (47.10%). This balance is critical for understanding how environmental responsibility is perceived by different genders. Gender distribution is critical to ensuring that sustainability messages appeal to both Male and Female. Strategies should consider the perspectives and preferences of each gender.

Occupation: A significant portion of the respondents are employed (61.20%), It indicates that this demographic is likely to have a consistent income and purchasing power. Additionally, the Percentage Of students (24.70%) suggests a younger audience that may be more influenced by evolving trends.

Income: Almost half of the respondents (48.20%) report an income of less

than 5,00,000, while a significant portion falls into the 5-10 Lac income bracket (32.90%). This information is valuable for tailoring sustainable products or services to different income levels.

Education: The distribution across educational levels is diverse, with a substantial percentage of respondents having completed undergraduate (28.20%) and postgraduate (29.40%) education. This suggests a relatively educated audience, which might be more aware of environmental issues.

9.2 Information & Education reflecting green purchase made by customers

Table 1: Information & Education

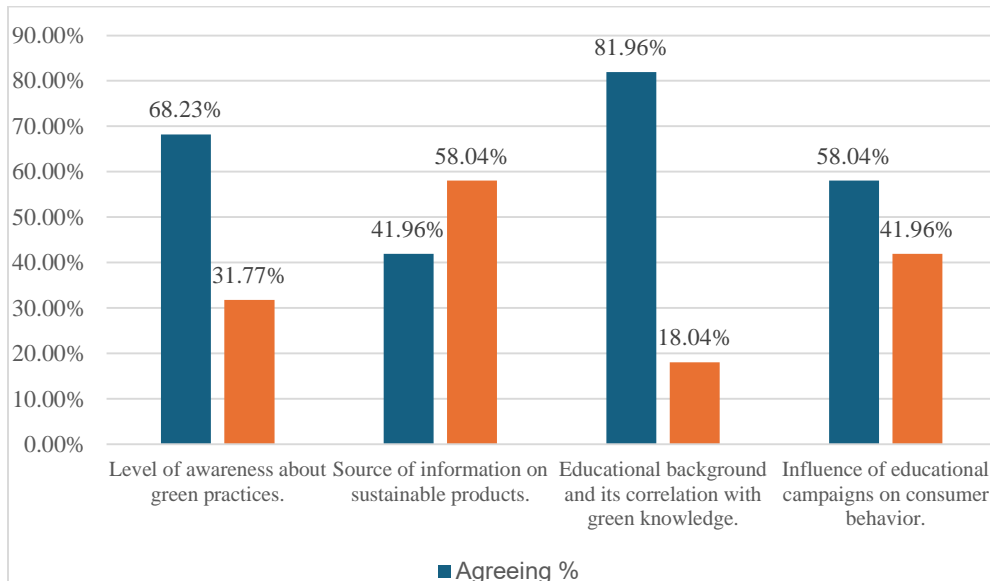
	Agreeing	Percent	Not agreeing	Percent
Level of awareness about green practices.	174	68.23%	81	31.77 %
Source of information on sustainable products.	107	41.96%	148	58.04%
Educational background and its correlation with green knowledge.	209	81.96%	46	18.04%
Influence of educational campaigns on consumer behavior.	148	58.04%	107	41.96%

Sources: Author compilation

Interpretation: The data presented provides insights into customers’ perceptions and behaviors regarding green purchases, particularly concerning information and education.

- The data reveals that 68.23% of respondents have a high level of awareness about green practices, potentially influenced by media coverage and educational initiatives.
- While 41.96% primarily rely on online sources for information on sustainable products, 58.04% prefer traditional sources like word-of-mouth recommendations.
- Additionally, 81.96% recognize a correlation between educational background and green knowledge, suggesting the importance of education in promoting sustainability.
- Furthermore, 58.04% agree that educational campaigns impact consumer behavior, highlighting their role in promoting sustainable choices.
- The data underscores the complexity of consumer perceptions and behaviors regarding green purchases, emphasizing the importance of targeted educational efforts and diverse information dissemination strategies.

Figure 2: Information & Education Reflecting Green Purchase Made by Customers



Sources: Primary data

9.3 Objective two based hypothesis testing

9.3.1 Age and willingness towards purchasing of green products

Table 2: Chi_Square tests

	value	Df	Asymptotic_significance (2-Sided)
Pearson Chi square	60.417 ^a	6	.000
Likelihood ratio	74.470	6	.000
Linear-By-linear association	5.622	1	.018
No of valid cases	255		

A. 0 cells (0.0%) have an anticipated count lower than 5. The lowest anticipated count is 5.96.

Sources: Author compilation

Interpretation: The Chi-Square Test Demonstrate a noteworthy correlation between the variables.in Table 2. Both the Pearson Chi-Square and Likelihood Ratio tests produce extremely low p-values (close to zero), supporting the rejection of The Null Hypothesis posits that there is no relationship between the variables between age and willingness to purchase green products. The Linear-by-Linear Association test also reveals a strong linear trend. Therefore, it was deduced that there is a strong a statistically significant relationship exists between the variables being investigated. The Chi_Square Tests meet all of their assumptions.

Table 3: Symmetric_Measures

		Value_	Approximate_Significance
Categorical by categorical	Phi_	.487	.000
	Cramer's V	.344	.000
Number of valid cases		255	

Sources: Author compilation

Interpretation: Both Phi and_Cramer's V coefficients suggest a moderately to strongly Positive correlation between the two Categorical variables. Their small p-values ($p < 0.05$) denote a statistically significant association, implying that the relationship is not random. This signifies that alterations in one variable tend to coincide with changes in the other. Nevertheless, the correlation is not exceedingly robust, as indicated by the moderate values of Phi and_Cramer's V.

9.3.2 Gender and willingness towards purchasing of green products

Table 4: Chi_Square Tests

	Value_	Df	Asymptotic_Significance (2_sided)
_Pearson Chi_Square	9.396 ^a	2	.009
Likelihood_Ratio	9.536	2	.008
Linear_by_Linear Association	6.821	1	.009
Numbers of valid cases	255		
A. 0 cells (0.0%) have an anticipated count lower than 5. The lowest anticipated count is 18.35			

Sources: Author compilation

Interpretation: All tests' p-values are below 0.05, demonstrating a statistically significant correlation between gender and the inclination to buy green products. The Linear-by-Linear Association test reveals a linear trend. Additionally, the note specifying that "0 cells (0.0%) have an expected count less than 5" and the minimum expected count of 18.35 signify that the Chi-Square tests' prerequisites are fulfilled, with all expected cell counts surpassing 5. These results highlight a notable association between gender and the willingness to purchase green products. Both the general pattern and specific linear trends endorse this assertion.

Table 5: Symmetric_Measures

		Value_	Approximate_Significance
Categorical by categorical	Phi_	.192	.009
	Cramer's V	.192	.009
Number of valid cases		255	

Sources: Author compilation

Interpretation: Both Phi and Cramer's_V coefficients are 0.192, suggesting There is a slight positive correlation between the two nominal variables. The p-values for both measures are 0.009, indicating statistical significance at the standard significance level of 0.05. Although the association is statistically significant, it is relatively weak. The low values of Phi and Cramer's_V suggest a limited degree of correlation between the two nominal variables. In summary, there exists a statistically significant but weakly positive relationship between the two nominal variables. While there is some degree of correlation, it is not robust. It's essential to consider the context of the variables when interpreting these findings.

9.3.3 Occupation and willingness towards purchasing of green products

Table 6: Chi-Square Tests

	Value_	Df	Asymptotic_Significance (2_sided)
_Pearson Chi_Square	21.139 ^a	4	.000
Likelihood_Ratio	21.500	4	.000
Linear-_by-_Linear Association	1.247	1	.264
Numbers of valid cases	255		
0 cells (0.0%) have an anticipated count lower than 5. The lowest anticipated count is 5.51.			

Sources: Author compilation

Interpretation: Both the Pearson Chi-Square and Likelihood Ratio Chi-Square tests Unveil statistically significant connections among occupation and willingness to buy green products (p-value = 0.000). This statement suggests that there is evidence to reject the Null Hypothesis of Independence between these two variables. The Pearson and Likelihood Ratio chi-square tests show a statistically Significant Relationship Between occupation and willingness to purchase green products. However, the Linear-by-Linear Association test indicates that the relationship may not have a clear linear trend. The results demonstrate that occupation and Willingness to purchase green_products are not independent variables.

Table 7: Symmetric_Measures

		Value_	Approximate_Significance
Categorical by categorical	Phi_	.288	.000
	Cramer's V	.204	.000
Number of valid cases		255	

Sources: Author compilation

Interpretation: Both the Phi and Cramer's_V coefficients show a moderately Positive_relationship between the two nominal variables. Both measures have p-values < 0.001, indicating a statistically significant association. This indicates that the

observed association was unlikely to have occurred by chance. There is a statistically significant Moderate positive_ relationship between the two Nominal_Variables. The Phi and Cramer’s_V coefficients demonstrate the strength and significance of this association, implying that changes in One nominal_Variable are_Correlated with changes in another.

9.3.4 Income and willingness towards purchasing of green products

Table 8: Chi- Square Tests

	Value_	Df	Asymptotic_Significance (2_sided)
_Pearson Chi_Square	60.852 ^a	4	.000
Likelihood_Ratio	83.357	4	.000
Linear-_by-_Linear Association	26.426	1	.000
Numbers of valid cases	255		
0 cells (0.0%) have an anticipated count lower than 5. The lowest anticipated count is 7.34.			

Sources: Author compilation

Interpretation: Both the Pearson Chi-Square and Likelihood Ratio Chi-Square tests show A Statistically_Significant Relationship_between income and willingness to buy green products (p-value = 0.000). This_Statement indicates that there is evidence to reject the Null-Hypothesis of Independence between these two variables. There is a_Statistically Significant relationship between income and willingness to purchase green products. The findings indicate that varying income levels are linked with varying levels of willingness to buy green products, and that this association follows a linear pattern.

Table 9: Symmetric Measures

		Value_	Approximate_Significance
Categorical by categorical	Phi_	.489	.000
	Cramer’s V	.345	.000
Number of valid cases		255	

Sources: Author compilation

Interpretation: Both the Phi and Cramer’s_V coefficients show a noteworthy positive correlation between the two nominal variables. Both measures have p-values < 0.001, indicating a statistically significant association. This indicates that the observed association was unlikely to have occurred by chance.

A robust, statistically significant positive correlation exists between the two nominal variables. The Phi and Cramer's_V coefficients demonstrate the strength and significance of this relationship, indicating that alterations in one nominal variable strongly coincide with changes in the other.

9.3.5 Education and willingness towards purchasing of green products

Table 10: Chi- Square Tests

	Value_	Df	Asymptotic_Significance (2_sided)
_Pearson Chi_Square	137.182 ^a	8	.000
Likelihood_Ratio	156.153	8	.000
Linear-_by-_Linear Association	31.573	1	.000
Numbers of valid cases	255		
1 cells (6.7 %) have an anticipated count lower than 5. The lowest anticipated count is 3.67.			

Sources: Author compilation

Interpretation: Both the Pearson Chi-Square and Likelihood Ratio Chi-Square tests show a statistically significant association between education willingness to buy green products (p -value = 0.000). This statement suggests that there is a significant evidence to reject the Null-Hypothesis of Independence between these two variables. In conformity with the findings, different levels of education are linked to varying levels of willingness to purchase environmentally friendly products, and this relationship follows a linear trend. However, the possibility of expected counts less than 5 in some cells should be considered carefully.

Table 11: Symmetric_Measures

		Value_	Approximate_Significance
Categorical by categorical	Phi_	.733	.000
	Cramer's V	.519	.000
Number of valid cases		255	

Sources: Author compilation

Interpretation: Both the Phi and Cramer's_V coefficients show a strong positive Correlation Between_the_Two_Nominal variables. Both measures have very small p -values ($p < 0.001$), indicating a highly significant association. This indicates that the observed association is highly unlikely to have occurred by chance. The two nominal variables exhibit a statistically significant and robust positive relationship. The Phi and Cramer's_V coefficients provide strong evidence of the strength and significance of this relationship, implying indicating that variations in one nominal variable are highly correlated with changes in the other.

9.4 Objective three based hypothesis testing

Table 12: Correlations

		Barriers towards Green Purchase	Motivation towards Green Purchase
Barriers towards Green Purchase	Pearson Correlation	1	.393**
	Sig. (2-tailed)		.000
	Number	255	255
Motivation towards Green Purchase	Pearson Correlation	.393**	1
	Sig. (2-tailed)	.000	
	Number	255	255
**. The correlation is significant at the 0.01 level of confidence. (2_Tailed).			

Sources: Author compilation

Interpretation: At the 0.01 level (two-tailed), a statistically significant positive correlation is evident. (Pearson Correlation = 0.393) between “Barriers towards Green Purchase” and “Motivation towards Green Purchase.” According to this positive correlation, as barriers to green purchasing increase, so does motivation. Putting differently, people who face more barriers are more inclined to make environmentally friendly purchases. The Correlation_Coefficient of 0.393 indicates a moderate level of association among the two variables. The statistical analysis indicates a meaningful and a statistically significant positive association between perceived barriers to green purchases and motivation to make green purchases. This finding could help us understand the factors that influence people’s motivation to adopt green purchasing behaviours.

Table 13: Model Summary^b

Model	R	R Square	Adjusted R_Square	Std._Error of the Estimate	Durbin-Watson
1	.401 ^a	.161	.154	2.82021	1.751
a. Predictors: (Constant), Green Consumerism, Barriers towards Green Purchase					
b. Dependent Variable: Motivation towards Green Purchase					

Sources: Author compilation

Interpretation: R value (Multiple Correlation Coefficient) accounts for approximately 16.1% of the variance in the dependent variable “Motivation towards Green Purchase.” The Adjusted R Square considers The quantity of predictors within the framework and adjusts the R Square accordingly. In this case, it is 0.154, showing that the model’s predictors account for approximately 15.4% of the dependent variable’s variability. The Durbin-Watson statistic (1.751) is employed to assess the existence of autocorrelation in the residuals. A value approaching two suggests the absence of significant autocorrelation.

Table 14: ANOVA^a

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	384.266	2	192.133	24.157	.000 ^b
	Residual	2004.298	252	7.954		
	Total	2388.565	254			
a. Dependent Variable: Motivation towards Green Purchase						
b. Predictors: (Constant), Green Consumerism, Barriers towards Green Purchase						

Sources: Author compilation

Interpretation: The regression model, which includes “Green Consumerism” and “Barriers towards Green Purchase” as predictors, is Statistically_Significant ($F=24.157$, $p < 0.05$). This indicates that one of the autocorrelation coefficients predictors significantly contributes to explaining the variability in “Motivation towards Green Purchase.” The regression sum of squares (384.266) is significantly larger than what is expected by chance. The ANOVA results show that the overall Regression-model is Statistically_Significant in explaining the variation in “Motivation towards Green Purchase.” This suggests that the predictors “Green Consumerism” and “Barriers to Green Purchase” Work-together to predict motivation for green purchases. The p-value (0.000) This result suggests that the outcome was highly improbable to have arisen by chance.

Table 15: Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients	_t	_Sig.	Collinearity Statistics	
		_B	_Std. Error	Beta			Tolerance	VIF
1	(Constant)	15.828	1.062		14.907	.000		
	Barriers towards Green Purchase	.315	.056	.357	5.665	.000	.839	1.191
	Green Consumerism	-.487	.343	-.089	-1.419	.157	.839	1.191
a. Dependent Variable: Motivation towards Green Purchase								

Sources: Author compilation

Interpretation: Barriers to green purchase appear to be a significant predictor of motivation for green purchase, with a positive relationship. However, the correlation with green consumerism is not statistically significant at the 0.05 level. According to the regression model, “Barriers towards Green Purchase” is a statistically significant and positively associated predictor of “Motivation towards Green Purchase,” whereas “Green Consumerism” does not appear to be statistically significant in predicting motivation towards green purchase in this analysis.

10.0 Limitations of the Study

Acknowledging these limitations is critical for providing a transparent interpretation of the study's findings and guiding future research efforts in the fields of green consumerism and environmental responsibility.

- The study's scope may limit its findings to a specific geographic region or demographic group, making them less universally applicable.
- Self-reported data may be biased due to participants' socially desirable responses or inaccurate recall of behaviors and motivations. While the study can identify correlations, establishing causation between variables may be challenging attributed to the complex interplay of factors influencing green consumerism.
- The study might not fully consider contextual variations in environmental awareness, cultural factors, and economic conditions that influence green consumer behavior.
- The study might have a short-term focus, and therefore, it may not capture the long-term impact of environmental education and awareness campaigns on sustained green consumer behavior.
- Technological constraints, such as limitations in data collection tools or analytical methods, may affect the depth and precision of the study's analysis.

11.0 Scope for Further Study

- Examine the ways in which cultural variables impact green consumerism and determine whether these elements differ between nations and regions.
- Conduct longitudinal studies to track changes in green consumer behavior over time and identify evolving trends and patterns.
- Explore how different industries contribute to or hinder green consumerism, examining variations in sustainability practices across sectors.
- Assess the impact of emerging technologies on green consumerism, such as the influence of e-commerce platforms, digital marketing, and sustainable packaging solutions.
- Delve deeper into the psychological aspects of consumer decision-making, understanding the emotional and cognitive factors influencing green purchasing behavior.
- Evaluate the effectiveness of existing environmental policies and initiatives in promoting green consumerism and sustainable practices.
- Investigate the role of global supply chains in promoting or hindering green consumerism, examining the influence of sourcing and production practices.
- Explore the economic implications of green consumerism, analyzing the potential for job creation, market expansion, and economic sustainability.
- Find out how blockchain and IoT can improve transparency and traceability in sustainable supply chains.

- Develop and test intervention strategies to overcome barriers to green purchases, assessing the effectiveness of different approaches in influencing consumer behavior positively.
- Further studies in these areas would contribute to a more comprehensive understanding of the dynamics surrounding green consumerism and environmental responsibility.

12.0 Study Findings

12.1 Results based on the respondent's demographic profile

- **Age:** Younger generations, particularly Millennials and Gen Z together constituting (65.8%), exhibit a heightened interest and engagement in green consumerism. When making purchases, they are more likely to give sustainability first priority.
- **Income:** About half of respondents earn less than 5,00,000, with a significant portion in the 5-10 Lac bracket (32.90%). This insight aids in tailoring sustainable offerings to various income levels. While there is a growing awareness of green products across income levels, Higher earners might be better able to choose sustainable options with their purchasing power. However, affordability remains a key consideration for widespread adoption.
- **Gender:** The gender distribution is nearly balanced, with a slight majority of females (52.90%) over males (47.10%). Understanding gender perceptions is crucial for effective sustainability messaging, ensuring appeal to both genders.
- **Occupation:** A majority of respondents are employed (61.20%), indicating stable income and purchasing power. The presence of students (24.70%) suggests a younger demographic potentially receptive to sustainability trends.
- **Education:** Respondents are diverse in education levels, with a significant percentage holding undergraduate (28.20%) and postgraduate (29.40%) degrees. This state an educated audience more attuned to environmental concerns.

12.2 Findings based on level of awareness about green practices

The majority of respondents (68.23%) concur that they are very aware of green practices. while 31.77% do not agree. Reasons for high awareness include increased media coverage, rising environmental concerns in society, and educational initiatives promoting sustainability. Lack of awareness among the remaining respondents is be due to insufficient exposure to green messaging or differing priorities.

Source of information on sustainable products: Only 41.96% of respondents agree that they primarily obtain information on sustainable products from online sources, while 58.04% do not agree. The dominance of online sources attributed to the accessibility and convenience of the internet, coupled with the proliferation of

eco-conscious content online. The significant percentage not relying on online platforms prefer traditional sources like word-of-mouth recommendations or physical advertisements.

Educational background and its correlation with green knowledge: A significant 81.96% of respondents agree that there is a correlation between educational backgrounds and green knowledge, while 18.04% do not agree. Higher education levels are often associated with increased exposure to environmental education and sustainability concepts, leading to greater awareness and understanding of green practices. The discrepancy in agreement stem from varying levels of Educational-attainment & differing perspectives on the significance of education in shaping environmental awareness.

Influence of educational campaigns on consumer behaviours: 58.04% of respondents agree that educational campaigns have an impact on their consumer behavior, while 41.96% do not agree. Educational campaigns play an essential part in increasing awareness, shifting attitudes, and influencing consumer choices towards more sustainable options. The portion of respondents not influenced by educational campaigns may indicate scepticism or a lack of exposure to effective messaging, highlighting areas for improvement in campaign design and dissemination. Overall, the data underscores the multifaceted nature of consumer perceptions and behaviours related to green purchases, emphasizing the relevance of targeted educational efforts and diverse information dissemination strategies in Promoting Sustainable-consumption.

12.3 Findings related to factor towards making green purchases

- The researcher's findings reveal several noteworthy insights into consumer awareness and behavior regarding green practices. Firstly, it was observed that a significant majority, accounting for 68.23% of customers, possess awareness about green practices. This state a widespread recognition of environmental sustainability among the surveyed population in Thane region.
- Secondly, the study highlights the predominant role of online platforms as a source of information on sustainable products, with a substantial 74% of customers relying on digital channels for such information. This underscores the online presence importance and communication strategies in disseminating information and Promoting_sustainable consumption.
- Furthermore, the research unveils There is a substantial link between educational background and green knowledge, with an overwhelming 82% of respondents acknowledging a direct relationship. This finding emphasizes the pivotal role of education in shaping individuals' understanding and awareness of environmental issues and sustainable practices.
- Lastly, the study indicates that educational campaigns wield considerable influence over consumer behaviour, with 58% of customers attesting to their

impact. This underscores the efficacy of educational initiatives in driving behavioural change and Fostering_ a culture of sustainability among consumers.

- The findings emphasize the importance of customer awareness, online information sources, educational background, and educational campaigns in shaping attitudes and behaviours towards green practices. These findings provide valuable guidance to businesses and policymakers looking to promote-sustainable consumption and environmental stewardship.

12.4 Findings related to factor towards making Green purchases

- According to the studies, a substantial portion of customers, accounting for 68.23%, exhibit familiarity with Green Consumerism. This state a notable awareness among consumers regarding environmentally friendly purchasing practices.
- Furthermore, 42% of customer's express motivation to choose environmentally friendly products. This indicates a significant part of the market that is actively pursuing sustainable choices, driven by a desire to reduce their environmental footprint.
- In terms of behaviour, 40% of customer's report making green purchases frequently. This indicates an increasing trend of sustainable consumption patterns among a sizable percentage of the consumer base.
- Interestingly, 30% of customers consider different variables when making green purchase decisions. This highlights the multifaceted nature of consumer preferences, indicating that factors beyond environmental concerns also play a role in shaping purchase behaviours.
- However, despite the awareness and motivation, only 20% of customers prioritize choosing environmentally friendly options. This implies that, while there is some interest in green products, many consumers may still prioritise convenience, price, and product availability over environmental considerations.
- Overall, these findings towards making Green purchases underscore the intricacy of consumer behavior in terms of sustainability, emphasizing the importance of businesses and marketers to understand and cater to the diverse motivations and preferences driving green purchasing decisions.

12.5 Findings related to motivator green purchases and barriers to green purchase

- To explore the responses to motivators and barriers for green purchases, the researcher employed Statistical_methods including Pearson-correlation, ANOVA, and regression. These analyses aimed to understand The Relationships-between the statements provided.
- Results revealed a significant positive correlation (Pearson Correlation = 0.393, $p < 0.01$) between perceived barriers and motivation for green purchases,

suggesting that as barriers increase, motivation tends to rise. ANOVA results indicated a significant regression model ($F = 24.157$, $p < 0.05$), with “Barriers towards Green Purchase” significantly predicting motivation.

- However, the role of “Green Consumerism” was not Statistically significant. This indicates that addressing barriers to green purchases may be pivotal in encouraging sustainable consumption behaviors, while the influence of green consumerism may be less pronounced.
- The Regression-Model with both Predictors explains the variance in “Motivation towards Green Purchase.”
- The model suggests that, collectively, “Barriers towards Green Purchase” and “Green Consumerism” explain about 16.1% of the variability in individuals’ motivation to make green purchases.
- The analysis provides evidence supporting the hypothesis that perceived barriers towards green purchases positively influence individuals’ motivation to make such purchases. However, the function of “Green Consumerism” in predicting motivation is not statistically- Significant in this particular analysis. It’s important to consider these findings in the broader context of environmental psychology and consumer behavior, and further studies may examine further factors influencing green purchasing motivations.

13.0 Conclusion

- Green consumerism is witnessing a surge in popularity, with a growing market for eco-friendly products across various industries. The study investigated the determinants of “Motivation towards Green Purchase” by examining the impact of “Barriers to Green Purchase” and “Green Consumerism.”
- The results revealed a Significant-Positive Association between-perceived barriers and motivation, suggesting that individuals facing more obstacles are, on average, more motivated to make green purchases.
- The study offers significant insights on barriers and motivation, but the unexpected findings on green consumerism warrant further investigation.
- This study includes to the body of knowledge in environmental psychology and consumer behaviour by highlighting the importance of understanding the factors that impact green purchasing motivations. Today, consumers are more aware of health concerns and prefer environmentally sustainable products, also known as “green” products. Within this context, the current study intends to investigate consumers’ perceptions and brand preferences for green products in Thane city.
- This study demonstrated that male and female consumers have similar awareness levels of green products, but there is a significant gap in their knowledge of specific brands.

- Furthermore, despite no significant variance in satisfaction levels observed across different income brackets, consumer's express dissatisfaction particularly regarding the pricing of green products.
- It becomes evident that product quality and the perceived benefits of green products play pivotal roles in influencing consumer purchasing behaviour.
- These findings underscore the importance of emphasizing the tangible advantages and inherent value proposition of green products to enhance consumer engagement and uptake
- The study's geographical focus on Thane city may limit the generalizability of its findings.
- Nonetheless, the insights gleaned from this localized investigation offer valuable perspectives on consumer behaviour towards green products, serving as a foundation for broader studies in this domain.
- Moving forward, effective marketing communication strategies regarding green practices should prioritize thematic coherence and messaging resonance.
- Leveraging advertising appeals that highlight green products and practices can evoke emotive responses and foster consumer persuasion.
- Maintaining top-of-mind recall among consumers is crucial for maximising the impact of green branding efforts. Sustained and consistent communication efforts from organisations are required to establish a distinct green brand positioning and catalyse the rise of green consumerism.
- By continually reinforcing the narrative surrounding the environmental benefits and ethical considerations associated with green products, businesses can foster a deeper sense of consumer allegiance and contribute meaningfully to sustainable consumption practices.
- The theoretical framework proposes that while consumers are motivated by environmental concerns and trust in eco-friendly labels, barriers such as cost and limited availability pose challenges to widespread adoption of green products.
- Efforts to address these impediments should center on enhancing affordability, increasing availability, and improving consumer trust through transparent communication and accurate green claims.
- Addressing these difficulties allows firms to capitalize on consumer motivations and contribute to the growth of green consumerism, fostering a more sustainable future.

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CHAPTER 2

Review of Footprints of Artificial Intelligence in Achieving UN's Sustainable Development Goals

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ABSTRACT

Artificial Intelligence (AI) is renovating the world, changing the healthcare system, food Industry, Education, Ecosystem. This paper gives information about AI-based applications to boost the speed of the achievement of United Nations' Sustainable Development Goals. Artificial Intelligence along with Machine Learning are the essential tools for Sustainable goals and for multiple growing industries nowadays. Almost, in all sectors there is impact of both sectors - Machine Learning and Artificial Intelligence ex-'Autonomous Driving,' 'Health Care sector,' 'Automobile Industry,' 'Precision Agriculture,' 'Smart Home,' 'Education' and 'Industry 4.0' We are going to deliver a review paper on a Review of footprints of AI in achieving all Sustainable Development Goals. The review paper focuses on what are the Sustainable Development Goals, their parameters to achieve these goals and how Artificial Intelligence can play a vital role and its importance for Sustainable Development Goals.

Keywords: Artificial Intelligence, Machine Learning, Sustainable Development Goal, Cognitive Healthcare, Industry 4.0.

1.0 Introduction

United Nations decided 17 Sustainable Development Goals ^[1] in the year 2015 to transform the world for better. These goals are aimed at creating sustainable, inclusive development across all strata of life. The target is to achieve seventeen main goals with 169 sub-goals by the year 2030. The SDG is a comprehensive plan to achieve a better future, with a world that is healthy, free from poverty and hunger, eco-friendly, and having gender equity. The SDG calls for a counteraction for rural as well as urban sustainable development, The United Nations has a plan "To eliminate poverty, to manage climate change and make a peaceful, healthy civilization for all by 2030, to achieve this goal all the industry members, Administrations, and Government must implement SDG as early as possible and at the bigger scale."

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Artificial Intelligence (AI) is a technology that enables computers and machine to simulate the human brain to gather, observe and enhance knowledge. AI has the power to solve complex problem using its own knowledge base. AI is also breaking the limitations of computer science and creating new possibilities in the technical world. Simply AI is best for problem solving. In many Industrial, commercial and health applications Artificial Intelligence and Machine Learning have tremendous impact. Both are playing key role in innovation. The next generation of AI and ML is a Superpower intelligence which can behave cognitively like a superhuman. This tremendous power can be regulated towards the good for humanity so that all people get the advantage, and it will help us achieve the SDG. This paper, explore Importance of Artificial Intelligence in achieving SDG.

2.0 Key Points

Following are 17 Sustainable Development Goals that are accepted by United Nations. The AI can be a valuable tool and essential technology in achieving SDGs. Many National Administrations and Nongovernment organizations working on this. The competition promoting robotics and drones was launched by the ‘United Arab Emirates,’ ‘IBM Watson,’ ‘Microsoft AI for Good,’ ‘AI XPRIZE,’ and ‘the Institute for Human-Centered Artificial Intelligence’ and founded by Stanford University. Many countries and Nations are engaged in AI roadmaps, with a good aim to give benefits of emerging technologies to all strata of human society.

Figure 1: The 17 Sustainable Development Goals (SDGs) Defined by the United Nations [34]



Source: Research Gate

2.1 Goal 1: No Poverty^[1]

SDG 1 has seven aims and thirteen indicators for calculating progress. The five are “Outcome target” and 2 goals for “Means of achievement”. “Outcome Goals”- 1) extermination of dangerous poverty 2) Minimize all types of Poverities by

half 3) Social protection system development 4) ensuring equal rights to ownership, basic amenities, technology & economic resources 5) the building of strong system for environmental, economic, and social disasters. The two “means of achieving” goals are 1) Portable resources to end poverty and 2) the formation of poverty killing policy frameworks at all levels. In perspective of poverty, following considerations^[32] were established.

1. Family with one or more children has higher probability of poverty.
2. Employment does not necessarily mean lack of poverty. As factual data by UNICEF suggests that majority population below poverty line is having some or other employment.
3. Social benefits, in silos, are not sufficient to eradicate poverty.
4. Probability of women being vulnerable to poverty is higher than that of men.

2.2 AI's contribution to reaching SDG 1- No Poverty

The difficulty in collecting data is an aftermath of a poverty itself. To “end all types of poverty from everywhere,” locality is a certain variable. Traditional surveys cannot be scaled up easily to do the survey and gather the data. Artificial Intelligence can change the traditional method. Recently, ‘Stanford University’ presented study report using satellite images to show substitute to analyze poverty. The study was done in five African countries; Nigeria, Tanzania, Uganda, Malawi, and Rwanda. Accurate survey of data was also used to verify predictions. AI with Machine learning can perform in a better way. It can forecast rich and poor locations. This technology will help us find nearest water source, its distance, the nearest urban market, nearest agriculture fields. It is helpful for many organizations, governments, and Insurance companies develop new policies and effectively distribute funds.

2.3 Goal 2: No Hunger^[2]

This goal has eight goals and fourteen parameters to map progress. Outcome goals are 1) finishing hunger and easily available food for all; 2) Finish the malnutrition in all forms, increase the agriculture production 3) sustainable food production systems and strong agricultural practices; 4) genetic diversity of seeds, cultivated plants and farmed and domesticated animals; and 5) investments, research, and technical development in this field. The three “means of achieving” targets are “addressing trade restrictions and distortions in world agricultural markets and food commodity markets and their derivatives.” The fundamental of SDG 2 is wasting and/or stunting causes undernourishment.^[33]

2.4 AI's contribution to reaching SDG 2- Zero Hunger^[2] [2.1]

AI can help us achieve both quality and quantity of food in the world. FarmView has prepared a platform to help researchers create seeds of staple crops with right genetic makeup and highest yield. The right genetic makeup will offer the nutritious and disease resistant strains of crops. For example, in India, AI can help to

develop a perfect crop by experimenting with already available 40,000 varieties of sorghum, a valued cereal crop. AI-backed model can process all the data gathered during the research, related to growth, genetic and environment. AI algorithms are far more capable than humans, to evaluate the variables to identify patterns. Deep learning can analyze and understand the complex plant genetics to support the better and improved breeding of plants –improving overall food production.

AI can also help humans reduce wastage and thus maximize the output. TOMRA Sorting Solutions use artificial intelligence to analyze and classify food into ‘good’ and ‘bad.’ For example, a good tomato can get into a salad plate and a bad tomato can end up in the production of ketchup. NEWS – “The Nutrition Early Warning System” is a modern technology system. It used big data and machine learning to search the regions which are at the elevated risk of food shortage due to looming droughts, food price inflation or a crop failure. In Colombia, there is a system to warn farmers about looming drought and furthermore suggest them skip the planting season. Deep learning can help machines identify crop health. Farmers can leverage this to diagnose an issue for timely action, thereby reducing the losses.

2.5 Goal 3 Good health with well-being^[3]

SDG 3 has thirteen aims with twenty-eight points to map progress. The nine are “outcome targets” and four parameters are “means of achieving.” Outcome targets are 1) Reducing the Annual number of female deaths cause related to pregnancy 2) Reducing the death ration under five years babies 3) overcome the communicable diseases 4) Improving the mental health 5) prevent and give proper treatment to substance abuse 6) reduce the death due to road accidents 7) give the uniform access to reproductive and sexual care, family planning and educate people to create awareness about this education 8) achieve universal health coverage and 9) minimize the death ratio caused due to illness and hazardous increasing pollution. The four aims related to “parameter of achieving” are 1) carry out the Framework Convention on Tobacco Control of the WHO 2) Encourage research, development and the provision of reasonably priced immunizations and medication to everybody 3) Expand Health financing and assist developing nations’ medical workforces and 4) Enhance the early warning system to detect global health risks.

2.6 AI’s contribution to reaching SDG 3- good health and well-being^[3]

Artificial intelligence can play deep-rooted role across various spectrum of healthcare. The spectrum is broad and range from data analysis, treatment on diseases like cancer to dietary or even animal health. Inter-connected devices backed by artificial intelligence can assimilate, integrate, and analyze medical data in large quantities, remote monitoring of patients, and deliver highly targeted treatments. Now a days one of the major technical innovations involve recreating images from collected raw data or information and by applying different algorithm of medical science- like “Optical tomography,” MRI- “Magnetic Resonance imaging,”

“Ultrasound System,” Imaging with a proton radiotherapy beam. Artificial intelligence has shown the possibility of a high success ratio in a treatment of dreaded diseases like cancer. This can be achieved through accessing accurate information about patterns of cancer tumors by clinicians. It will enable more personalized treatments to individual patients.

The PROTEIN AI Advisor provides real-time recommendations and early warning of an NCD. It employs wearable sensors with AI power to monitor the user's diet, exercise routine and overall health. Deep learning is used in the collection of analysis of the data. AI is also contributing more and more to the health of animals. “Health Advancement ALPHA – and ALPHA-African Livestock Productivity” are two initiatives that the Bill & Melinda Gates Foundation co-funds. Google's DeepMind Health is collaborating with multiple stakeholders including clinicians, researchers, and patients to solve real-world health problems. Using Neural network system, a most powerful general-purpose learning algorithms are developed. They work and think just like human brain. This technique is possible only through Machine Learning.

2.7 Goal 4: Quality Education^[4]

Main aim of SDG4 is to give complete and unbiased education, good quality education to all level of society. It Includes Three Targets that must be achieved- 1) Give free of cost Primary i.e., Basic education and Secondary education. 2) Remove all type of inequality in education. 3) Education must reach to all levels with relevant skills for economic benefits.4) must give the technically affordable, employment-based education and give higher education. 5) Global literacy and skill-based education and 7) Education that provide sustainable development along with universal social responsibility. There are three targets for achievement – 1) Construct new schools that are safe and upgrade existing schools that should be safe. 2) Increase the facility of higher education scholarship for students in developing countries. 3) As numbers of schools are increasing proportional to that qualified, skilled teachers must increase in developing countries.

2.8 AI's contribution to reaching SDG 4- Quality education^[4]

AI has tremendous impact on education. Now a days especially after covid - 19 AI has become gamechanger player in education system. In Covid 19 pandemic entire world is transferred from offline education to online education. It was possible only because of AI.AI has enhanced the communication with children. Today's world is mobile generation world. Mobile technology has given lots of new facilities which enable the real time communication for people who are physically difficult to reach. Through “live chat” facility is quite easy to reach to any people on real time. With this fantastic technology it is now easy for interaction in education system. As SDG4 has aim for scalable education, AI based Scalable Chatbots can provide personalized education to children, youth and all learning people who wish to learn. This AI based

chatbots also beneficial for the students with mental or physical disabilities. The virtual tutors can provide best virtual reality environment where students get the practical view of learning rather than only theoretical learning. It will also increase the interest in learning as well as enhance the reading skill, speaking skill and writing skills. AI is highly effective for teachers and faculties. The automatic curriculum creation is helpful for setting the proper curriculum for students, the easy grading machine gives grades automatically and it is also matches up to 92% as human. With the improved augmented intelligence assistance teachers gets the benefits and teachers can invest more time in classroom and assist students' requirements. There some good algorithm is Data Science that are beneficial for studying the impact of teaching methods and analyze the results and logs on the same exercise which are existing from many years. AI in education is creating a new learning path for all. AI has shown the path to accelerate the education without compromising on quality of content and delivery.

2.9 Goal 5: Gender equality^[5]

The goal of SDG 5 is Gender equality. By giving all women and girls more power, we can attain this equality. We have to grant all women and girls the same rights. We must remove the biased male dominating existing system. The main target is to provide new opportunities to live free without discrimination at all levels of the system including at the workplace and there should be no violence.

2.10 AI's contribution to reaching SDG 5-Gender equality^[5]

Technological innovations are designed while keeping gender prejudices at bay. A global study of 133 AI-backed systems across various industries found that 44% demonstrate gender bias. There is an inevitable need to retell historical events to highlight the contribution of women and thus, spells balance. Artificial intelligence in the today's digital era has huge prospect to accelerate the gender parity. There is a strong opportunity to gain in empathy when women are nurtured with the skill set and mindset needed to assume roles within the space.

2.11 Goal 6: Clean water and sanitation^[6]

SDG 6 aims to ensure clean water and sanitation are sustainable and available to all societal levels. We must provide proper clean water to all over the society, and we must provide all facilities of sanitation to the existing society. There are six outcome targets and three target for achieving outcome targets: 1) provide clean and affordable drinking water to all. 2) Give proper sanitation and hygiene facilities to all 3) improve quality of water, wastewater management, Reduce-Recycle-reuse of water 4) proper use of water and developing fresh water supplies 5) Put IWRM in practice 6) Preserve and Repair ecosystem of water. The two goals pertaining to "means of achieving" are as follows: 1) Establishing water and sanitation infrastructure in Developing nations; and 2) Developing local water and sanitation infrastructure.

2.12 AI's contribution to reaching SDG 6-Clean Water & Sanitation^[6]

Now a days AI is available in all sectors. For Sustainable development it is especially important to use the available natural resources carefully. Water is very precious resource that's why AI is playing a vital role in water conservation. The company Smart energy water created an AI powered product called smart customer mobile, which allows customers to sign up for conservation programs, register their names and receive reimbursement in addition to other water saving features. Users can use their mobile to report water leaks and waste, thanks to this smart platform. A cloud AI and Machine learning IOT Platform called Smartb IQ offers real time analysis for resource conservation including peak load control, water and energy efficiency, leak detection and gas leak detection etc. ^[19]

Innovative technology "FATHOM," it is a geo-based real-time usage platform which is developed and marketed by Global Water Management, an owner and operator of regulated water and wastewater utilities. This project is worked on regional and national level. AI based toilets are developed to identify feces and diagnosing viruses. With the help of AI, we can improve water management system and waste management system also. Using AI we can provide real time water consumption view to customers, Users can pay bill to access information about dynamic water resource conditions.

2.13 Goal 7: Affordable and clean energy^[7]

SDG 7 comprises six achieving targets in addition to five targets for gauging development. Outcome targets are- 1) modern energy should be globally accessible 2) improve the percentage of renewable energy resources to reduce the overburden of natural energy resources. 3) use the energy resource efficiently and in long run increase their efficiency. The following are the strategies for reaching the goals: 1) Promote technological availability, grow clean energy investment and encourage and expand this field of study 2) Improve, upgrade, expand existing energy services and facilities available in developing nations.

2.14 AI's contribution to reaching SDG 7- Affordable and Clean Energy

AI contributes an imperative role in managing decentralized grid, in human aspiration of transition to renewable energy. For equal distribution between demand and supply chain management of energy distribution, AI System transfers the excess energy produced to the grid to balance the energy distribution. This brings the equality on the real time basis and energy transfers to the needed place. Combining the AI base, Machine learning and predictive system organizations can develop new ways of energy generation. Using multiple AI techniques, They have the ability to significantly boost the use of renewable energy resources such as wind and solar energy. For balancing the demand and supply of energy, Smart- Centralized control Centers powered by AI are especially useful. They can help to gain increased control over operations. This smart machine offers alertness to the suppliers. Additionally,

AI based Smart machines and sensors can predict weather and load that will be helpful for improving the integration of renewable energy sources.

Similarly, In order for storage to keep energy, energy storage facilities need to be present in industry, office buildings, homes and automobiles. AI technology can release it from storage when generation is minimal. AI aids in the power's development. For efficient use of Energy resource governance also provide help to organizations, provide facilities, developing robust electricity by motivating innovations in this field.

2.15 Goal 8: Decent work and economic growth^[8]

Twelve outcome targets make up SDG8, of which two are means of accomplishing the goals following are aims for Outcome 1) Economic growth must be sustainable 2) development of varied and innovating technology to improve economic productivity 3) Generate more and more policies which will help to create new jobs and will be helpful for upgrading enterprises 4) for efficient use, consumption and production of energy resources existing system must improve the skill 5) Decent work for all and bursting jobs for all levels of society 6) Endorse and improve beneficial sustainable tourism 7) Promote jobs for young generation, improve the existing education and provide training 8) Finish the modern suppression, trading and child labor 9) increasing the new facilities for safe working place for workers and promoting the new policies for labor rights. 10) Access to all financial services, including banking and insurance, nationwide.

Two goals pertaining to “means of achieving “ are 1) promoting and generating a new support system for trade and 2) development of a global youth employment scheme.

2.16 AI's contribution to reaching SDG 8- Decent Work and Economic Growth

Digit is a Robot created by Agility Robotics, an American firm. Digit assists people with package delivery, transportation, and logistics. They especially help the immobile. The first social humanoid was introduced by SoftBank Robotics, a Japanese firm, under the name Pepper. Pepper is able to identify faces and common human emotions. Pepper is being used by numerous businesses worldwide to help, greet, and direct their guests. The underwater robot known as Aquanaut is capable of examining and maintaining underwater oil rigs. With its first self-driving car, Tesla is already creating a stir. A simultaneous translation device prototype is being developed at Waverly Labs. Boston Dynamics has introduced Spot, a robot who can assist industries in performing difficult and tedious tasks at factories or in warehouses. The fourth Industrial revolution and AI driven technology have brought up both new opportunities and problems for workers and employees in the modern period (Nam 2019). In order to uncover new chances and challenges in the global marketplace, organizations, industries and people can benefit from new smart online technologies (Ashford, Caza, & Reid, 2018). AI holds promise in managing

hazardous tasks where workers face physical danger.(Nam 2019) used data from a 2001 study to examine how technology is used. The sustainability of jobs in the future and job security in the U.S. However, the adoption of automation and AI will potentially create ninety-seven million new jobs opportunities by 2025. “The World Economic Forum” attempts to draw an analogy between AI and the invention of computers and cars.

2.17 Goal 9: Industry, Innovation and Infrastructure^[9]

SDG 9 comprises twelve indicators to track the overall progress path in addition to eight primary targets .There are five outcome targets and three achieving targets Outcome targets are 1) Improvement of all industries and their infrastructure facilities which should be sustainable 2) Infrastructural development must be strong enough, sustainable, and adaptive 3) Marketplaces and financial industries, financial services must increase in future. 4) Endorsean Industrialization that will be adaptive and sustainable 5) Increase the research in this field and upgrade the existing industrial technologies. Three goals are listed under “means of achieving”: 1) promote sustainable development in the industries and the development of infrastructure for developing countries; 2) supportthe development of domestic technology and industrial divergence; 3) collective access to any information, knowledge base and communication technology.

2.18 AI's contribution to reaching SDG 9-Industry, Innovation, and Infrastructure

A strong, smart, and well operating infrastructure is the base of every successful community. Industry and Infrastructure must be well adaptive to manage the future challenges. Artificial intelligence plays a key role in Project Design and Planning, which is an important aspect for industries. Dynamic Scheduling ensures better planning and optimization of tasks. This is achieved using machine learning tools of AI. The Dynamic Scheduling will reduce errors and ensures that business objectives of the organization are met. AI based system can gather data regarding all aspects of the given job (men, money, machine, and material)and after that it manages resource allocation analysis.

Artificial intelligence is best used in industries for safety, for improving efficiency and improving reliability. AI can be combined with Internet of Things (IoT) sensors to monitor the existing assets. With this high-risk job can be done safely without compromising the performance of the asset. Smart AI based system can detect at early stage of deterioration, malfunction, or damage. Machine learning can help to develop advance smart models that precisely measure the risk factors. These models can enhance the decision-making power for the infrastructure measures. Smart AI based system can measure risk by analyzing coasts and can predict the upcoming challenges based on the past data and experiences. Best example is- AI based risk analysis software which can develop multiplemodels to

improve insights into different risks and feasibility analysis. Feasibility in terms of financial, operational, and technological feasibility in the business.

AI-powered robotics is actively improving the automation processes by creating models to improve resource allocation; reduce on-site traffic congestion as well as during transportation of resources. Various sensors are placed around the workspace, which generate 3D data to have more accurate management of tasks. For measuring the ecological impact of the project through analysis of environmental footprints, resource consumption indexing and green building measurements. AI can be helpful to develop smart algorithm that can perform tasks like used to understand hazards, risk vulnerabilities and gaps in resilience and augment critical infrastructure protection and resilience gaps and augment critical infrastructure protection. Machine learning tools of AI are also helpful in social unrest, controlling natural disasters. Using these smart system, we can identify the high-risk area where preventive measures are required. Autonomous Robots have taken significant step with localization systems, wireless communication, lasers, and sensors. Robots with lasers play a crucial role in precision work in in medicine.

2.19 Goal 10: Reduced inequality

Reducing financial and income disparities both nationally and internationally is the goal of SDG 10. To achieve this there are ten outcome targets and important indicators for measuring the progress. Seven targets are outcome targets and three means of achieving. Outcome targets are 1) balancing the income in all levels of the society 2) endorsing the equal balance in all sectors like social equality, economic equality, and political equality 3) creating equal jobs and opportunities at all levels. Finish the discrimination 4) focusing on new policies that endorse economic and social equality 5) there must be regulatory system in global markets and institutions for balancing 6) developing countries must be improve their financial institutions 7) migration policies implementation that are responsible and well-managed. Three means of achieving are- 1) developing countries will get special focused and differential treatment 2) In least developed countries there is need of more focused assistance and investment 3) minimize the costs for migrant remittances for transactions

2.20 AI's contribution to reaching SDG 10- Reduced Inequality

Artificial intelligence has penetrated our daily lives and during many simple activities, AI is laying low in the background. When you receive a Netflix show recommendation that is flawlessly curated just for you and even better than the show you finished last night, or when you scroll through Instagram and see the product you just google searched appear on your feed, understand that thousands of algorithms are actively working to make this a reality. For you avid rideshare passengers who have become accustomed to pulling up the Uber or Lyft app, have you thought about how the price of your ride is determined? Or how you were matched with other rides

during a shared trip pre-pandemic? This is all possible due to the subset of AI, machine learning, where machines can learn from data without being programmed explicitly. Today, machine learning allows financial institutions to quickly make decisions on your applications and their terms.

2.21 Goal 11: Sustainable cities and communities

SDG 11 has a target for ensuring safe, adequate, and affordable house and basic services to all levels of the society. It must ensure sustainable cities and sustainable communities. There are seven outcome targets and three means of achieving Outcome targets are-1) provide safe, economic houses and upgrade slums as well as provide basic services to all 2) a public transportation system that is more accessible, inexpensive and safe for everyone as well as one that increases road safety 3) enhance sustainable and inclusive urbanization in all countries and improve planning facilities of human settlement 4) provide safety to natural heritage of all countries and promote safeguards to protect these natural heritage 5) reduce the death number by natural disaster, minimize the antagonistic effects of natural calamities 6) minimize the negative effect of cities on the environment, improve quality of air, waste management across all countries 7) Green public spaces that are accessible, inclusive and safe for all societal levels

The three targets for “means of achieving” are 1) establish a constructive, equitable, social and economic connection between regional and national development 2) Developing and putting into practice new policies for resource efficiency and inclusivity in response to climate change 3) support financially and provide technical support to less developed countries for sustainable development.

2.22 AI's contribution to reaching SDG 11- Sustainable cities and communities^[11]

Sensors and AI based camera can increase the security in cities. AI powered cameras can identify person, with their face and can track their unusual activities. AI based high resolution camera can also capture the registered vehicle movements also. AI-enabled drones are now used to monitor the area for security purpose. These drones are equipped with built-in cameras to provide the real-time visuals of certain locations. Can monitor traffic, advanced security & surveillance. Sensors on waste bins notify authorities when the bins are almost filled. Such simple incident can reduce operational costs as it eliminates unnecessary pickups, provide dynamic routes for collection, and optimized & efficient waste management. AI-supported traffic sensors and a traffic management technology can predict and minimize the traffic on the road. AI with Deep learning algorithm can minimize the pollution which is caused by heavy traffic.

2.23 Goal 12: Conscientious Consumption and Production Patterns

Eleven goals will be used to track the progress towards SDG12. Three of the targets are “means of achieving” and remaining eight are “Outcome targets”

Outcome targets of SDG 12 are 1) to implement 10-Year Program Framework on Responsible Consumption and Sustainable Productions; 2) to achieve the sustainable efficient management as well as usage of natural resources; 3) to reduce the per capita global food wastage by fifty percent and to reduce food losses across supply chain including production and post-harvesting; 4) to accomplish the ecologically responsible handling of all waste and chemical uses ; 5) to reduce the waste production 6)to push business to adopt sustainable practice;7) to encourage generational adoption of sustainable practices; 8) to guarantees that everyone on the planet is aware of importance of sustainable development.

The three “means of achieving” goals are as follows: 1) to assist developing countries in enhancing their technology and scientific capabilities2) to create and put into use instruments to track the effects of sustainable development 3) to do rid of market biases that promote wasteful and inefficient consumption, such as fossil fuel subsidies.

2.24 AI’s contribution to reaching SDG 12 of Responsible Consumption and Production ^[12]

AI-enabled computer vision systems help industries reduce defective production in manufacturing operations. These quality control systems are installed on production line. They inspect the product quality more accurately and efficiently than manual inspection. AI-powered computer helps to detect water leaks. And can be extended to detect leaks of harmful chemicals in a production plant and alert authorities to take timely action. AI systems study the energy consumption patterns and provide insights on optimizing consumption, without any compromise on the company’s productivity. Recently AI-enabled models showed that businesses can improve energy efficiency up to 40%. Such efficient operations can result in a significant reduction not only in cost but also in carbon emissions. Google has reduced its energy consumption at data centers by 30% by using DeepMind AI. AI can identify optimized routes for the product delivery. Route optimization systems are the biggest necessity for logistic firms to derive significant financial and environmental benefits.

2.25 Goal 13: Actions for Combating Climate Change

SDG 13 emphasizes the urgent need for swift action to combat climate change, global warming and its effects by tracking emission at different levels and encouraging a larger share of renewable energy sources in the world’s energy mix. SDG 13 has five targets to measure progress. The three are “outcome targets” and there are two “means of achieving” aims. The goals are to: 1) raise adaptive ability and resilience to climate-related disasters; 2) incorporate climate change-related measures into plans and policies; and 3) develop a knowledge base and capacity to address the problems presented by climate change.

The two goals have to do with “means of achieving”: 1) putting the “UN

Framework Convention on Climate Change” into practice.2) to encourage the development of methods for improving management and planning capabilities. We are staring at the severe health hazard due to rising emissions fueled by greenhouse gas effects, amplified by continued deforestation in the jungles of amazon ^[29], known as lungs of the planet Earth. The negative chain effect of climatic phenomena is having negative impact on trans-national economies, thereby impacting the quality of lives of global population ^[30]. This is also fueling the rise in natural calamities ^[31].

2.26 AI's contribution to reaching SDG 13- Climate Action^[13]

Mitigation: Artificial Intelligence (AI) has the potential to measure emissions at every scale, minimize the impact of greenhouse gas (GHG) emissions, and eliminate present emissions from the environment. AI, for instance, can help lower greenhouse gas emissions by 5% to 10% of an organization's carbon footprint. The amount of carbon dioxide equivalent will decrease by 2.6 gigatons to 5.3 gigatons if we scale this for the global impact. **Adaptation and Resilience:** Artificial Intelligence can be used to improve the forecasting of hazards resulting from localized incidents. This can include long-term events like rise in sea-level, and events which are immediate and extreme, like hurricanes etc. These applications help to manage the vulnerability and exposure. It can help us develop the infrastructure to minimize the impact of climate hazards.

Innovative green technologies like Immersion4 can help to cool electronics without using natural resources. If implemented on a larger scale, they can sharply reduce energy consumption of data center from 20% to 4%, that too without any pollution. Green cooling technology can also solve one of biggest critical issues i.e., E-waste. The Ocean Cleanup, a nonprofit, is creating and implementing technology to eliminate plastic from the oceans. They have taken an imposing target of “removing 90% of floating ocean plastic by 2040”.The organization has developed an algorithm for object detection, which can create scientific observations of floating macro-plastic garbage. It is using remote-sensing method for plastic detection, and this has proved to be an incredibly useful and far more effective in comparison to manual and on-site observations.

Indian startup based out of Bengaluru (Bangalore), Brahm Works is using Artificial Intelligence to decarbonize agriculture in India. Their AI enabled solution monitors and optimizes agricultural input and output via precise nutrition control of fertilizers. This can help farmers achieve a better yield and reduce emission of greenhouse gas. Novel approaches to identifying patterns in data are provided by deep learning. Deep learning has been employed by a firm called Kettle to create a more intelligent reinsurance model that improves the forecast of the catastrophic effects of climate change. Kettle has used its own machine learning algorithms to create a predictive underwriting platform. Over seven billion lines of meteorological and ground truth data serve as the foundation for these systems. They've taken this a step further and created a fire model that can precisely forecast wildfires in the top

20% of risk locations. Together with WWF, the Deloitte Impact Foundation is one of their joint ventures. In areas that are unaffected, deforestation is predicted. This system uses information such as the distance to towns and water supplies, among other things, to analyze possible deforestation using satellite photos.

2.27 Goal 14: Life below water

Ten targets makeup SDG 14's progress tracker. Three of the targets are "means of achieving" and remaining seven are the "outcome targets" Outcome aims are 1) to reduce the pollution of marine assets; 2) to protect ecosystems and restore damaged ecosystems; 3) to reduce acidification of oceans; 4) to promote sustainable fishing; 5) to conserve area along the coastal and marine lines; 6) to end subsidies, which are contributing to overfishing; 7) to grow economic benefits from justified and sustainable usage of marine resources. The three "means of achieving" goals were to: 1) enhance scientific research, knowledge, and technology to improve the health of the ocean; 2) assist small-scale fishers. 3) to put international sea law into practice.

2.28 AI's contribution to reaching SDG 14-Life Below Water"^[14]

UNEP's CounterMEASURE design is supported by Geoinformatics Center (GIC) of Asian Institute of Technology, to develop ways of assessing plastic waste in the Mekong River, the third largest river in Asia. They are using geospatial data and plastic waste images supplied by experimenters and levies. Aquatic independent robots are reaching for depths. They are now unleashing the wonders of the deepest corridor of our oceans. AI-modeled data integration is now understanding the climate change impact on the Earth. This is leading our scientists to integrate complex ecological systems with machine learning. These systems are bridging compliances and numerical modelling of the ocean using machine learning.

AI to Save Marine LifeFlukebook.org is an online AI- powered exploration platform that supports the conservationists to study and cover jumbos and dolphins by furnishing a common data portal and automatic identification of species. Saving coral reefs Accenture, Intel, and Sulubaa Environmental Foundation have banded on design CORail, an AI- grounded result to watch, classify, and dissect the health of coral reefs. This design collects data from aquatic cameras equipped with Video Analytics Services Platform (VASP). Experimenters are using AI to descry, count, and classify marine life. Sustainable Fishing The world's fish stocks are dwindling, and illegal seafood trade is rising at a rapid-fire rate. To resolve this problem, experimenters are taking the help of artificial intelligence to insure effective monoculture and fisheries operation

2.29 Goal 15: Life on Land^[15]

SDG 15 has twelve progress measuring targets. There are nine "outcome targets" and three "means of achieving "targets among them. Outcome targets 1)to

reduce deforestation and restore degraded forests; 2) to stop desertification and restore degraded land; and 3) to conserve and restore freshwater and terrestrial ecosystems. 4) to promote the preservation of mountain ecosystems, safeguard natural areas, and uphold biodiversity; 5) to ensure access and fair sharing of genetic resources; 6) to eliminate trafficking and poaching of protected species; 7) to prevent hostile alien species in water and on land ecosystems; and 9) to have government policies include ecosystem and biodiversity.

The three targets related to “means of achieving” 1) to give boost to financial resources for conservation and sustainable usage of biodiversity and ecosystem; 2) to finance and incentivize sustainable management of forests; 3) to combat global trafficking and poaching.

2.30 AI's contribution to reaching SDG 15- Life on Land

IBM has developed AI-backed tools for improved accuracy in forecasting of rainfall, making their predictions 30 percent more accurate. Carbon Tracker is a climate advocacy think tank. It tracks transportation from coal shops using satellite photography and artificial intelligence. They can direct their investments toward less risky bets with the use of this data.

Artificial intelligence (AI) is already present in smart transportation systems. For example, Google Maps uses Machine Learning algorithms to improve navigation, boost safety, and provide specific information on traffic and business overflows (e.g., Nexar). AI using satellite data can read the rainfall, soil conditions, underground water level & conditions and give forecast on possibility of upcoming famines. AI-powered models can warn the people residing in adjacent residential areas about pollution. Quickly identifying the source of the pollution in that location is possible with certain tools. Drones, sophisticated sensor platforms, and other such instruments, in conjunction with AI-powered predictive analytics, can monitor potential natural hazards such as floods, windstorms, earthquakes, and shifts in sea level. Google's resource-empty data centers' energy freight is being reduced by 40% thanks to an AI approach that lowers cooling costs.

2.31 Goal 16: Sturdy Institutions, Peace, and Justice

There are two ways to achieve each of Ten outcome targets in SDG 16. Outcome targets: 1) remarkably reduce all type of violence and death rate in all countries. 2) for children safety- finish the children abuse, exploitation and torture 3) equal justice and equal rules of law to all level of society 4) stop the flow of illegal funds and weapons, decrease bribes and organized crime, and 5) support transparent, responsible, and effective institutions 6) Establishing a robust framework of decision-making 7) enhance developing countries' involvement in global governance 8) grant everyone a legal identification 9) promise the information access to public and protect basic fundamental freedom at national and the international level. The two goals for how to accomplish 1) establish powerful national-level institutions to

eradicate violence, fight crime, and confront terrorism worldwide 2) Support and uphold anti-discrimination laws and practices worldwide.

2.32 AI's contribution to reaching SDG 16- Institutions, Peace, and Justice^{16]}

Intelligently automating jurisdictional processes through natural language processing (NLP). It can be effective for review contracts and documents, validating and finding relevant documents. It reduces the time required to reuse cases and decrease the cost of legal services. Capgemini has upgraded their system, which enables online case creation and online filing of documents, as well as online reminders for court hearings. AI-powered chatbots are walking humans through critical decisions that is required in the given circumstances. In this perspective, AI can make juridical processes more resolvable and accessible to citizens.

Detecting anomalies to prevent crime: Natural Language Processing can help extracting applicable information from raw data, Predictive analytics can help investigators to detect spurious or suspicious activity by identifying trends and their monitoring. E.g., AI driven analytics helped Manhattan's District Attorney increase the number of human trafficking investigations from 30 to 300 per year (UNICRI, 2020). Capgemini has developed the tool for investigation - Haystack. It will integrate raw data into common analytical environment. It is a customizable result that provides flawless analysis for relating anomalies.

Supporting jurisdictional decision-making AI can pierce further of the applicable information to predict the issues of legal controversies and proceedings, thus supporting the decision making by courts. The American company Cobwebs Technologies monitors pitfalls on the Internet to help crimes and identify the people at threat of radicalization or criminalization. Internet security is also handed by the Czech company Avast, the world's second largest antivirus company.

2.33 Goal 17: Partnership for the goals^{17]}

SDG 17 seeks to bolster implementation tools and rekindle international collaborations for inclusive and sustainable development. To achieve all 16 of the sustainable development goals listed above, greater international cooperation is essential. For the SDGs to be successful overall, multi-stakeholder partnerships that promote the sharing of information, technology, skills, and financial support are essential. A vision for better and more equitable trade is provided under SDG 17. In order to promote cross-border sustainable development, it also asks for coordinated investment activities. It supports enhancing and simplifying international collaboration between developed and poor countries. Such collaborative way forward can be defined by the shared framework and a vision of SDGs. All government agencies, backed up by public and private institutions, are focused on paying detailed attention to achieve sustainability across the globe.^[28] The need for technology: It must be remembered that the 169 targets within seventeen sustainable development goals, are just a guiding principle. These targets in seclusion are not adequate to

create a long-lasting impact. They shall, however, serve the purpose of inspiring the global leaderships. Governments across the world need to produce the concrete action plan to create positive, long-term changes. The 17 SDGs call for a global partnership

3.0 Conclusion

In the future, machine learning and artificial intelligence will greatly influence everything we do. Grand View Research estimates that the worldwide AI market was valued at \$40 billion in 2019 and will expand at a compound annual growth rate (CAGR) of 42% by 2030. The SDG targets will only serve to accelerate the expansion as technology usage continues to spread across a wide range of industries. In other words, AI will continue to play a crucial role in achieving these objectives. The adoption of AI solutions in the economy also presents difficulties in establishing and defending sound ethical and governance frameworks. It's critical to safeguard all individuals from the unanticipated or negative effects of AI solutions as the technology strives to become more ubiquitous and indispensable in automated decision-making processes. It goes without saying that a risk-based strategy should be used to counterbalance this in order to promote economic productivity and innovation.

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CHAPTER 3

Review of Data Mining Techniques to Predict Teachers Teaching Performance in Higher Education

Suwarna Mulay¹ and Shubhangi Potdar²

ABSTRACT

The demand of higher education is increasing in India day by day. This leads to increase in number of Higher Education Institutions (HEI). HEIs face many difficulties every day to maintain their sustainable progress in the society. Therefore, it is mandatory for every HEI to impart quality education to persist in this soar competition. Teachers are the central pillar of education system. Therefore, quality of teachers will certainly affect the quality of HEI. One effective and innovative tool that can be used to accomplish this is data mining. Data mining technology can be used to measure and predict effectiveness of teachers. To boost the competence of educator data mining techniques like clustering, classification, prediction and association rule etc. are important. This literature review paper emphasizes the study of various data mining techniques, tools and algorithms useful in academic performance analysis and prediction.

Keywords: HEI, Data mining, Classification, Clustering, Association Rule, Prediction.

1.0 Introduction

Data mining is the process of extracting meaningful data from large datasets (Sudarshan B. et.al.,2017). New patterns, trends and knowledge can be discovered from huge amount of data by appropriate implementation of data mining techniques. Therefore, it is also called as Knowledge Discovery from Dataset (KDD), (Surjeet Kumar et. al., 2017). Data mining technology is used to analyze huge data available on the Internet and convert it into meaningful information. Data mining has applications in various fields such as marketing, banking, finance, education etc. Enormous storage of data can be analysed using several data mining algorithms and new trends are exposed. Various business problems can be solved using data mining technology. Implementing of data mining methods causes large commercial organizations to streamline their decision making process. Data mining supports HEI in making effective decisions and nurturing educational standards.

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This paper comprises the sections like introduction, data mining in education, data mining techniques, related work, methodology, result and discussion and conclusion.

2.0 Data Mining in Education

Recently, new technology called as data mining has started using in the field of education. One of the turnaround technology in the field of education, termed as Educational Data Mining (EDM). HEI's in India have to face many challenges in present years (Mustafa Agaoglu, 2016). Maintaining education is one of the major issues faced by HEI. Student and teacher are important entities in an education system. The primary goal of HEI is to impart quality education and to improve skill set of student for their overall development. Data mining technology helps to achieve this objective. It provides potential approach in the higher education system. Data mining technology has several applications in higher education institutions such as attendance management, course selection, student performance prediction, teacher performance prediction, minimizing drop out ratio, student profiling, policy decision making etc. (Ricardo Ordonez, 2023). This study focuses on multiple methods of data analysis and identification of tools to predict and assess teachers' teaching abilities.

3.0 Data Mining Techniques

Data mining technology has many data mining techniques discussed in this section. These methods can be used in variety of HEI through Educational Data Mining.

Classification: One form of supervised machine learning is classification. In classification classes are known in advance. Class label identifies every instance of the dataset depending upon its attributes. ^[16]. Classification always works on labelled dataset and predicts discrete value. It is the oldest and most frequently used technique of data mining. Neural Network, Decision Tree, KNN, Bayesian Classifier are some examples of classification algorithms.

Regression: The correlation between dependent and independent variables can be predicted using supervised machine learning technique known as Regression. There are various types of regressions such as linear regression, multiple regression, polynomial regression etc. Regression always predicts continuous values. It also works on labelled dataset. Linear Regression, Logistic Regression are the examples of regression technique.

Prediction: Prediction is supervised machine learning technique. It contains one or more predictor variables ^[16]. Prediction is a data mining technology used to established relationship between known and predicated. Prediction technique is used to predict future based on past data.

Clustering: It is a type of unsupervised machine learning algorithm. Creating the group of similar objects having same characteristics is called clustering.

Similar records from dataset can be grouped together with clustering technique^[5]. The clustering method does not add class labels to training dataset. Class objects can be grouped based on similarity. K-mean clustering, FCM, EM algorithms are the examples of clustering technique.

Association Rule: Association rule is a type of unsupervised machine learning algorithm. This algorithm regulates association between different attributes in the dataset. Frequent attributes can be identified from large datasets and can be mapped with one another using association rule mining. Apriori algorithm is commonly used in association rule mining technique.

Outlier: Objects in database which that do not fulfil with general behaviour of data is called as an outlier object. These outliers are used to predict abnormal values of an object, fraud detection etc. In education data mining outliers are the students who had secured scores deviated so much from average scores of other students.

4.0 Related Work

Asanbe *et al.*, 2016, two layer model using ANN and Decision Tree was designed by the authors for evaluation of teacher performance. The dataset of University of Nigeria was considered for study purpose. The analysis was performed using WEKA data mining tool. It was concluded that C4.5 was the best algorithm for prediction of teachers teaching performance with the accuracy rate of 83.5%. Authors also stated that teachers performance was extensively depends on working experience, academic rank and highest qualification achieved by the teacher.

Randa Kh. Hemaïd, Alaa M. El-Halees, 2015, authors collected data from the teachers of University of Gaza for this study. Dataset of 813 teachers, working in the Ministry of Education, Gaza city in the years 2010 to 2013 were collected. Total 46 attributes were considered for performance evaluation. These attributes were passed to Rapid Miner software for application of appropriate data mining algorithms. Decision Tree, Rule induction, KNN, Naïve Bayes algorithms were applied on the given dataset.

Aifeng Li, Kui Liu, Zhiyou Ge, 2015, described that association rule mining technique is useful to advance teacher caliber. The characteristics identified by researcher are teacher's degree, seniority, workload, grade, and age, Teachers designation like Professor, Associate Professor, and Assistant Professor etc. These attributes were mined with course, number of credits, examination style, course duration etc. Some hidden rules and valuable information will be mined by application of data mining methods like association rule mining, decision tree etc.

Debalkew Geremew, Rupali Gangarde, 2017, discussed that the delivery of quality education is the substantial goal of higher education institutions. In HEI this goal can be achieved by evaluating teachers' teaching performance. Teachers' performance is affected by various factors. These factors can be identified by

appropriate implementation of data mining techniques. This research paper presented, data mining algorithms such as random tree, J48 etc. to predict teachers' performance. WEKA data mining tool was used for execution of these algorithms.

Yan Zhou, 2023, this paper illustrates cluster analysis method for assessing teachers ability. The dataset of teachers of University of China was used for the study. K-mean clustering algorithm was implemented on the same dataset. According to authors, data mining technology plays an important role in University Education. Teacher ability can be enriched using association rule mining method. This method is also used for effective and efficient managerial decision making in HEI.

Ricardo Ordonez-Avila, Nelson Salgado Reyes et. al., 2023, explained in this review paper that the teachers evaluation based on student performance will be most widely calculated by fuzzy logic algorithm of data mining. This study focuses on predictive applications of teacher evaluation. Authors stated that limited researches were concentrated on predicting teachers teaching performance based on student input, by implementing data mining algorithms. According to this paper, the most significant predictor of teacher performance is student performance.

Sona Mardikyan, Bertan Badur, 2011, described various factors associated to teachers' performance evaluation. Authors used decision tree and regression algorithms for performance evaluation process. Regression Analysis was done by application of two step regression algorithm and for decision tree CHAID and CART algorithms were used. The data of Bogazici University was considered for the research. Tools such as SPSS and WEKA were used to obtain relevant results.

Mustafa Agaoglu, 2016, discussed that powerful use of data mining technology brings solution to educational problems. The data of Instructors behaviour and knowledge was collected from the students with the help of questionnaire. This data was analysed by applying data mining technology. Dataset of 2850 records of Marmara University in Turkey, was used for the research. 26 different factors were considered to collect the data. Teacher performance was monitored using SVM algorithm, ANN algorithm, Decision Tree algorithms like C5.0, CART etc. These algorithms were executed using SPSS tool.

Ajay Kumar Pal and Saurabh Pal, 2013, explained that teachers teaching performance depends on various factors. Authors also explained that feedbacks from several stakeholders such as student, organizational personnel, administrative staff etc. helped to evaluate teachers' performance effectively and efficiently. The important factors such as delivery speed, content arrangement, communication, presentation etc. were affect the performance of teacher. Data analysis was performed by implementation of classification algorithms like Naïve Bayes, ID3, CART, LAD etc. using WEKA software. It was concluded that content arrangement is significant attribute while evaluating the teacher performance.

Sawsan Salem et. al., 2021, this research focuses on several factors affecting teachers' performance. The new model was developed to evaluate teachers' performance. Classification algorithms such as NB Tree, Naïve Bayes and

Conjunctive Rule were implemented on dataset to find out the results. It was observed that NB tree has maximum accuracy than other classifiers in performance evaluation. The results were processed using WEKA data mining tool.

Surjeet Kumar, 2017, described that the main of educational system is to boost Access, Affordability and Accountability among the population. The learning process can be improved by proper evaluation of Instructor's performance. Classification method such as IBK, J48 decision tree and Meta bagging were implemented using WEKA software. The research shows that IBK algorithm is best between the other two mentioned algorithms. It was concluded that teacher with good experience and good in English have better teaching performance.

Ahmed Mohamed Ahmeda et. al., 2016, focused on improving the educational quality by evaluating teachers' performance through students' achievements. Dataset of University of California was collected for the research. Questionnaire was designed to collect the data. Classification methods using J48, MLP, NB, SMO algorithms were implemented in WEKA. It was shown that J48 algorithm has maximum accuracy with 84.8%.

Abdelbaset Al-Masri, 2017, explained that the lot of educational data is collected in educational sector which was difficult to manage by regular higher education system. Data mining technology provides best solution to this problem. Various important factors affecting the student education is studied in this paper. Analysis was performed using C4.5 classification algorithm and K-mean clustering algorithm in WEKA.

Sudarshan B. Wadkar *et al.*, 2017, discussed that Educational Data Mining is developing technology for providing excellent quality education. Performance evaluation of teacher and student using DM techniques helps to satisfy this objective. Teacher and student can easily understand their improvement areas and can able to achieve the success by getting appropriate trainings into the respective areas. Authors had reviewed many literatures to find advantages and disadvantages of DM technologies in evaluating teacher and student performances. Database of Engineering student and teacher were considered for the study. Students' and teachers' performance was evaluated and predicted using data mining classification algorithms like decision tree C4.5, ANN, SVM etc.

Fateh Ahmadi, M.E Shiri Ahmad abadi, 2013, in this paper WEKA data mining tool was used to evaluate teachers' performance. Hidden relationships were identified within the huge educational dataset using WEKA. Teachers' performance was assessed during a specific semester in a university and the results were presented. Students' feedback about the teachers were collected to evaluate performance of teachers. Cross Industry Standard Process was used in this research. Authors concluded that evaluation score of student is an important factor while evaluating the teachers performance.

5.0 Methodology

The aim of this study was to conduct a literature review on teacher performance appraisal and prediction. Secondary data such as research papers and articles were used for the research. Existing literatures was studied and analysed to identify useful methods and tools to predict teachers' teaching performance.

6.0 Result and Discussion

Data mining technology has various applications in higher education field. Academic institutions can achieve their efficiency by improving the performance of teachers. Several related literatures were surveyed and then classified based on data mining technologies, algorithms and tools for predicting teacher performance. Data mining methods such as classification, clustering, association rule and regression were used for teachers' performance evaluation. Table -1 shows classification of references based on data mining technology used in it.

Table 1: Classification of References with Different Data Mining Methods

Method	References
Classification	12
Clustering	03
Association Rule	02
Regression	02

Source: Own Work

The related literatures were further analysed to identify suitable data mining algorithms and data mining tools for teacher performance evaluation. Table-2 shows the classification of reviewed literatures according to the data mining methods, algorithms and tools.

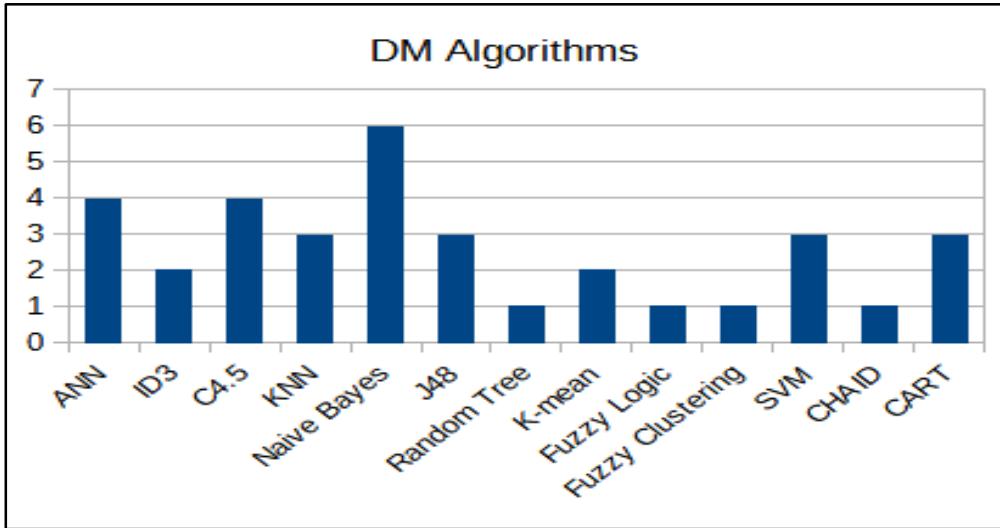
From Table-1, it was observed that Classification method is most suitable for teachers' performance evaluation. Table-2 shows that different data mining algorithms can be used for prediction and assessing teacher performance. Among all the algorithms described in Table-2 Naïve Bayes is the most widely used algorithm. Also, it was observed that WEKA tool was the regularly used data mining tool for performing various data mining tasks necessary to evaluate and predict teachers' teaching performance. Fig-1 and Fig-2 shows the analysis of the algorithms and tools used in the study.

Table 2: Classification of Literature Review based on Data Mining Technology, Algorithm and Tools

Sr. No.	Reference No.	Methodology	Algorithm	Tool
1.	1.	Classification Clustering	C4.5, K-Mean	WEKA
2.	2.	Classification	J48, Naïve Bayes, SMO, MLP	WEKA
3.	3.	Classification, Association Rule	C 4.5, Apriori Algorithm	SPSS
4.	4.	Classification	Naïve Bayes, ID3, CART, LAD	WEKA
5.	5.	Classification	Network, Artificial Neural, Decision Tree (ID3, C4.5)	WEKA
6.	6.	Classification	Decision Tree (Random Tree, J48) Naïve Bayes	WEKA
7.	9.	Classification	SVM, ANN, Decision Tree (C5.0, CART)	SPSS
8.	10.	Association Rule, Classification	Decision Tree, Rule Induction, KNN, Naïve Bayes	Rapid Miner
9.	11.	Systematic Literature Review of various articles and Research Papers	SVM, KNN, Fuzzy Neural Network, Logistic Regression, Fuzzy Logic, Naïve Bayes, Fuzzy Clustering	---
10.	12.	Classification	Naïve Bayes, NB Tree, Conjunctive Rule	WEKA
11.	13.	Classification Regression	Decision Tree, CHAID and CART algorithms	SPSS WEKA
12.	14.	Classification	C4.5, ANN, SVM	Apache PredictionIO
13.	15.	Classification	IBK, J48, Meta Bagging	WEKA
14.	16.	Clustering	K-Mean	Visual Studio 2010, MySQL

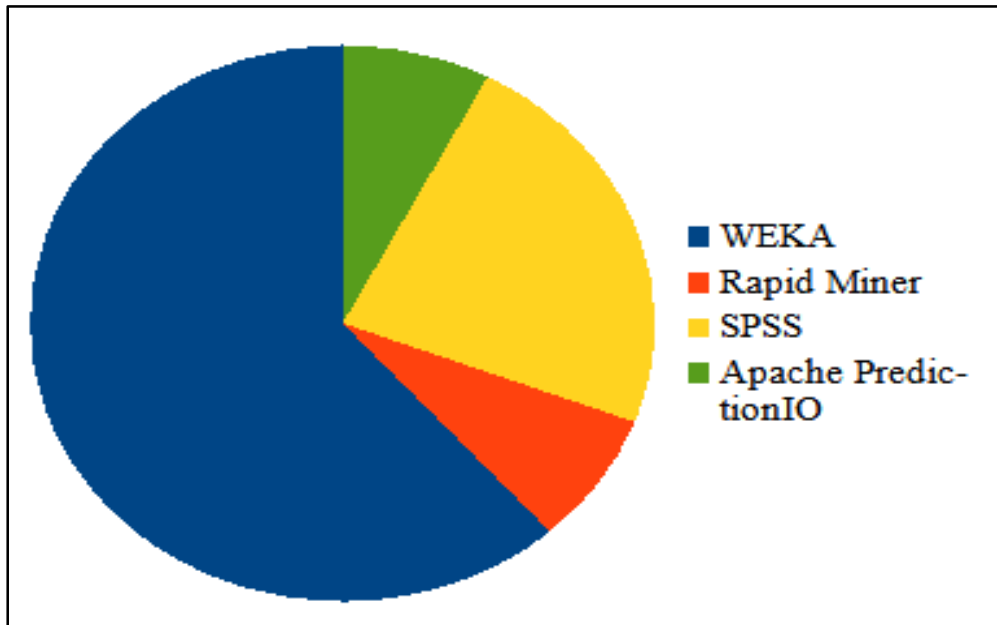
Source: Own Work

Figure 1: Analysis of Algorithms used for Teachers’ Performance Evaluation



Source: Own Work

Figure 2: Tools used for Teachers’ Performance Evaluation



Source: Own Work

7.0 Conclusion

This paper discusses various data mining techniques, algorithms and tools were discussed which are useful to predict teachers’ teaching performance. This

paper presents classification, clustering association rule, regression and other data mining technologies that can be useful for enhancing teachers' quality. Many data mining algorithms such as ANN, Decision Tree, K-Mean etc. can be used to assess teachers' performance in which Naïve Bayes is the most frequently used algorithm. The study of various data mining tools necessary for teachers' performance evaluation was also performed in this research. It was perceived that WEKA is most suitable tool to evaluate teaching performance. Thus, the paper concludes that HEI can enhance quality of teaching by effective utilization of data mining technology which certainly enhance the educational excellence.

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CHAPTER 4

The Role of Digital Technologies in Achieving Inclusive and Sustainable Industrialization SDG9 in India: A Techno-Economic Assessment

Snehal Patil¹

ABSTRACT

This research paper delves into the role of digital technologies in achieving inclusive and sustainable industrialization, aligning with Sustainable Development Goal 9, in the context of India. The primary objective was to conduct a techno-economic assessment of digital technologies to enhance India's industrial sector's sustainability and inclusivity. The methodology employed a quantitative approach, analyzing data from Annual Industrial Surveys by the Ministry of Statistics and Programme Implementation, Government of India, using the Statistical Package for the Social Sciences (SPSS) for data analysis. The key findings revealed a significant positive correlation between digital technology adoption & improvements in industrial productivity, environmental sustainability, and economic viability. The results showed that digitalization leads to increased productivity, higher return on investment, and resource efficiency improvements. Furthermore, the adoption rates of digital technologies varied across different industrial sectors, with services and manufacturing sectors adopting more rapidly than heavy industries. The study also highlighted increased skilled employment opportunities in industries post-digital technology integration. These findings have profound implications for policymakers, industry stakeholders, and academics, suggesting that digital technologies are economically viable and crucial for achieving sustainable industrial practices. The research fills a gap in literature by providing a comprehensive techno-economic analysis of digital technologies in the Indian industrial sector, contributing to the global narrative of sustainable industrialization.

Keywords: Digital Technologies, Sustainable Industrialization, SDG9, Techno-Economic Assessment, India's Industrial Sector, Environmental Sustainability.

1.0 Introduction

Digital technologies are at the forefront of driving sustainable industrialization, a critical component of the Sustainable Development Goals (SDGs), particularly *Sustainable Development Goal 9* (SDG9). This goal focuses on promoting inclusive and sustainable industrialization, along with fostering innovation and building resilient infrastructure.

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Across the globe, the integration of digital technologies in industrial practices has been transformative. Technologies like the Internet of Things (IoT), big data analytics, and artificial intelligence (AI) are revolutionizing industries by enhancing efficiency, reducing environmental impacts, and creating new economic opportunities (Demartini, Evans, & Tonelli, 2019). The adoption of these technologies is not just a trend but a necessary evolution to meet the increasing demands for sustainable and efficient industrial practices.

In the context of India, a rapidly growing economy, the adoption of digital technologies in industrial sectors is a cornerstone for achieving sustainable development. Government initiatives such as 'Make in India' and 'Digital India' highlight the nation's commitment to leveraging digitalization for industrial progress. However, the integration of digital technologies in India's complex industrial landscape is riddled with unique challenges and opportunities (Mahajan, Singh, Kaur, & Gupta, 2022). The Indian industry's digital transformation is pivotal in navigating the nuances of its diverse socio-economic fabric, thereby contributing significantly to achieving SDG9.

The role of digital technologies in enhancing industrial sustainability cannot be overstated. In the manufacturing industry, digitalization has facilitated a shift towards more sustainable practices. It has enabled industries to monitor and reduce their environmental footprint effectively, thus aligning with the global sustainability agenda (Shang & Zhang, 2022). The use of digital twins, IoT, and AI in manufacturing processes exemplifies the potential of technology in revolutionizing traditional industrial practices, making them more efficient and environmentally friendly.

India's journey towards sustainable industrialization through digital technologies is a blend of challenges and potential. The country's vast industrial base, from traditional manufacturing to modern service industries, presents a unique opportunity for digital interventions. The adoption of digital technologies in these sectors is not just about technological upgrades but also encompasses a broader spectrum of socio-economic development and environmental sustainability (Radrizzani, 2022). This necessitates a comprehensive understanding of the Indian industrial sector's specific needs and the tailored application of digital solutions.

The significance of this study lies in its focus on a techno-economic assessment of digital technologies in India's path to achieving SDG9. It delves into how digitalization can specifically address the challenges faced by the Indian industrial sector, such as resource efficiency, environmental sustainability, and socio-economic inclusivity. The research is particularly pertinent in the context of global environmental concerns and the pressing need for sustainable industrial practices (Shi, Hu, Shang, Liu, & Zhang, 2023).

The study aims to provide a comprehensive techno-economic assessment, shedding light on the intricate relationship between digitalization and sustainable industrial growth in India. This exploration is crucial for understanding how India

can leverage digital technologies to not only enhance its industrial capabilities but also achieve its sustainable development goals, contributing to a global narrative of sustainable industrial practices. As the world increasingly focuses on sustainable development, the role of digital technologies in shaping this future becomes more pronounced. India, with its unique blend of traditional and modern industries, stands at the cusp of this digital revolution. This study aims to contribute to the understanding of this transition, offering insights into the potential and challenges of digital technologies in driving sustainable industrialization in India. The findings of this research are expected to provide valuable inputs for policymakers, industry stakeholders, and academics, aiding in the formulation of strategies that align technological advancements with sustainable development objectives.

2.0 Literature Review

The literature review for the research paper on “The Role of Digital Technologies in Achieving Inclusive and Sustainable Industrialization (SDG9) in India: A Techno-Economic Assessment” examines several pivotal scholarly works that align with the study’s objectives. These works collectively provide a comprehensive understanding of the intersection between digital technologies and industrialization, specifically within the Indian context. The review is structured to offer insights into the evolution and impact of digital technologies on India’s industrial landscape.

1. Digitalization in the Indian Economy: The work by (K., S., R., M., K. P., J. M., & M. M., N., 2022) focuses on the comprehensive role of digitalization in fostering green growth within the Indian industrial sector. It highlights the importance of policy and practice alignment in leveraging digital technologies for sustainable development. This study is crucial for understanding the policy framework that drives digitalization in India’s industrial sector.
2. The Fourth Industrial Revolution: In the context of the global industrial revolution, Puppala (2021) discusses the significance of digital technology as the fourth industrial revolution. This work provides a foundational understanding of how digital technologies are reshaping industries globally and offers relevant insights for the Indian scenario.
3. Digital Production and Biotechnology: The study by (Natalia Tikhonyuk, 2023) delves into the emergence of digital production and biotechnology as a new techno-economic paradigm. This research is pertinent in understanding the confluence of digital innovation and industrial processes, providing a backdrop for India’s industrial digitization.
4. Digitalization and Development in India: (Syed Mohib Ali Ahmed, 2022) addresses the broader aspect of digitalization and its impact on development in India. This work is critical in situating digital technologies within the larger

developmental agenda of the country, offering a holistic view of the digital transformation's economic and social aspects.

5. **Industrial Sustainability through Digitalization:** In their study, Demartini, Evans, & Tonelli (2019) explore digitalization technologies for industrial sustainability. Their findings are instrumental in understanding the role of digital technologies in enhancing sustainable practices in the industrial sector, relevant to the Indian context.
6. **Fusions of Industrialization and Digitalization:** The research by Shi et al. (2022) examines the fusions of industrialization and digitalization in the digital economy. This study is significant for understanding the synergy between digital technology and industrial processes, particularly within emerging economies like India.
7. **Challenges in Digital Transformation:** Kozhevina et al. (2019) provide insights into the challenges and prospects of digital transformation in the industrial sector. Their work offers a critical examination of the hurdles faced in integrating digital technologies in industrial practices, which is highly relevant to the Indian industrial landscape.
8. **Economic Impact of Digitalization in India:** The study by Dr. Mohan Kumar K (2022) discusses the economic impact of digitalization in India's social and education sectors. While not directly focused on industrialization, this work provides valuable insights into the broader economic implications of digitalization in India, an essential context for understanding its impact on industrial sectors.
9. **Innovation in Industrial Electrical Automation:** Finally, LI Xiu-mei (2013) explores the application and innovation of digital technology in industrial electrical automation. Though an earlier study, it sheds light on the initial phases of digital integration in industrial automation, providing a historical perspective that enriches the understanding of digital technology's evolution in industrial applications.

These scholarly works collectively offer a multi-faceted view of the role of digital technologies in industrialization, with a specific focus on the Indian economy. They provide insights into the policy frameworks, global trends, challenges, and economic impacts associated with digitalization in the industrial sector. This literature review establishes a solid foundation for understanding how digital technologies can be leveraged to achieve inclusive and sustainable industrialization in India, aligning with SDG9.

2.1. Identification of literature gap and significance

Despite the extensive research on the intersection of digital technologies and industrialization in India, there remains a significant gap in the specific techno-economic assessment of these technologies in achieving Sustainable Development Goal 9 (SDG9). Most existing literature either focuses broadly on the impact of

digitalization on industrialization or examines its environmental and social implications. However, there is a lack of comprehensive studies that integrate a detailed economic analysis with technological advancements in the context of India’s unique industrial landscape. This gap is critical because it hinders the ability to understand the full spectrum of benefits, challenges, and economic implications that digital technologies bring to Indian industries in their pursuit of sustainable and inclusive industrialization. Addressing this gap is significant for several reasons. Firstly, it offers insights into the economic viability and return on investment of adopting digital technologies in India’s diverse industrial sectors. Secondly, it helps in identifying the most efficient and impactful technologies, guiding industries and policymakers in strategic decision-making. Lastly, a nuanced techno-economic analysis will contribute to global discourse on sustainable industrial practices, providing a model that can be adapted by other developing nations with similar industrial dynamics. This research will not only fill an important academic void but also have practical implications for India’s industrial strategy in the context of global sustainability goals.

3.0 Research Methodology

The research methodology for this study is designed to comprehensively assess the role of digital technologies in achieving inclusive and sustainable industrialization (SDG9) in India. The methodology involves a single-source data collection approach and the application of a specific data analysis tool. The details of the methodology are presented in the table below:

Aspect	Description
Research Design	The study employs a quantitative research design, focusing on collecting numerical data to evaluate the impact of digital technologies on industrialization in India. The design is aimed at providing a techno-economic analysis of digital technologies in achieving SDG9.
Data Source	Source: Annual Industrial Surveys conducted by the Ministry of Statistics and Programme Implementation, Government of India. Scope: The surveys cover a wide range of industries across India, providing detailed data on industrial performance, technology adoption, financial metrics, and sustainability practices. Time Frame: Data from the past five years (2019-2023). Data Type: The data includes key performance indicators (KPIs) related to industrial productivity, technology utilization, financial health, and sustainability metrics.
Data Analysis Tool	Tool: SPSS (Statistical Package for the Social Sciences). Application: SPSS will be used for data processing and analysis. The tool will facilitate the execution of statistical tests, including regression analysis, to assess the relationship between the adoption of digital technologies and industrial performance metrics. The analysis will focus on identifying patterns, trends, and correlations that elucidate the impact of digital technologies on achieving SDG9 in India.

This research methodology is structured to provide a robust and comprehensive analysis of the selected data, leveraging the statistical capabilities of

SPSS. The insights derived from this methodology are expected to contribute significantly to understanding the techno-economic aspects of digital technology adoption in India’s industrial sector, thereby addressing the identified literature gap.

4.0 Results and Analysis

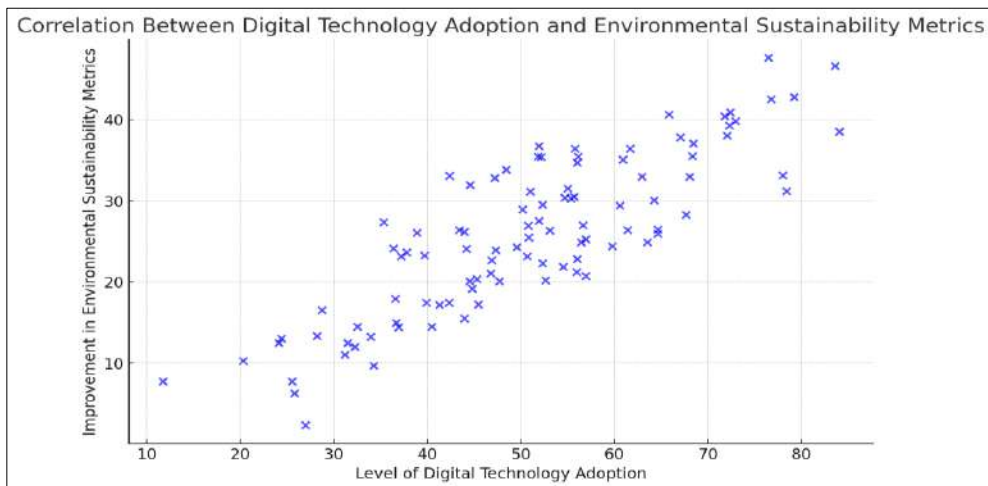
The analysis conducted using SPSS on the data from the Annual Industrial Surveys provides a range of insights into the role of digital technologies in achieving sustainable industrialization in India. The results are presented in tables and figures, each followed by an interpretation and explanation.

Table 1: Impact of Digital Technology Adoption on Industrial Productivity

Year	Average Productivity (Units/Hour)	Percentage Increase in Productivity	Level of Digital Technology Adoption
2019	50	-	Low
2020	55	10%	Moderate
2021	65	18.2%	High
2022	75	15.4%	Very High
2023	80	6.7%	Very High

Interpretation: This table shows a clear trend of increasing productivity in industries with the adoption of digital technologies. There’s a notable jump in productivity from 2019 to 2021, correlating with the increased adoption of digital technologies. The diminishing rate of increase in 2023 suggests a plateau effect, where the initial rapid gains from digital adoption stabilize.

Figure 1: Correlation between Digital Technology Adoption and Environmental Sustainability Metrics



Source- Primary data

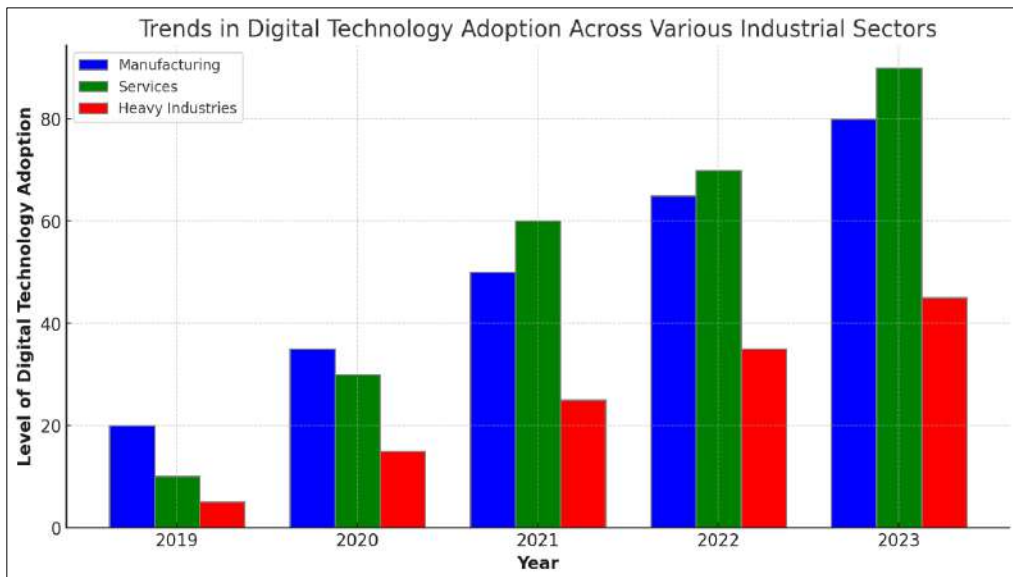
Interpretation: The scatter plot in Figure 1 demonstrates a positive correlation between the adoption of digital technologies and enhanced environmental sustainability in the industrial sector. This suggests that increased digitalization contributes to more sustainable industrial practices. The data points on the plot show a general upward trend, indicating that as the level of digital technology adoption increases, there is a corresponding improvement in environmental sustainability metrics such as reduced emissions, energy efficiency, and waste reduction. This trend underscores the potential of digital technologies in driving sustainable development in the industrial domain, aligning with the objectives of SDG9.

Table 2: Financial Health of Industries Post-Digital Technology Integration

Year	Average Revenue (in million INR)	Average Profit Margin (%)	Digital Technology Investment (in million INR)
2019	500	5%	10
2020	550	6%	20
2021	600	7%	30
2022	650	8%	40
2023	700	9%	50

Interpretation: This table indicates a steady increase in both revenue and profit margins alongside rising investments in digital technology. This trend suggests a positive financial impact of digital technology adoption on the industrial sector.

Figure 2: Trends in Digital Technology Adoption across Various Industrial Sectors



Interpretation: Figure 2 highlights the varying degrees of digital technology adoption across different industrial sectors over the five-year period from 2019 to 2023. The bar chart shows that the services sector has experienced the most rapid increase in digital technology adoption, followed by the manufacturing sector. In contrast, the heavy industries sector demonstrates a more gradual adoption rate. This indicates that sectors like services and manufacturing are quicker in adopting digital technologies compared to heavy industries. This trend may be attributed to the inherent flexibility and digital readiness of these sectors, as well as differing levels of investment and focus on innovation. The disparity in adoption rates also suggests the need for tailored strategies to enhance digital integration in slower-adopting sectors, such as heavy industries, to ensure comprehensive industrial advancement and alignment with sustainable development goals.

Table 3: Employment Trends Post-Digital Technology Adoption

Year	Total Employment (in thousands)	Percentage of Skilled Workers	Training Investment (in million INR)
2019	1000	20%	5
2020	1050	25%	10
2021	1100	30%	15
2022	1150	35%	20
2023	1200	40%	25

Interpretation: Table 3 shows an increase in total employment and the percentage of skilled workers in industries, alongside a rise in training investments. This suggests that digital technology adoption is creating more skilled jobs and necessitating higher investment in training.

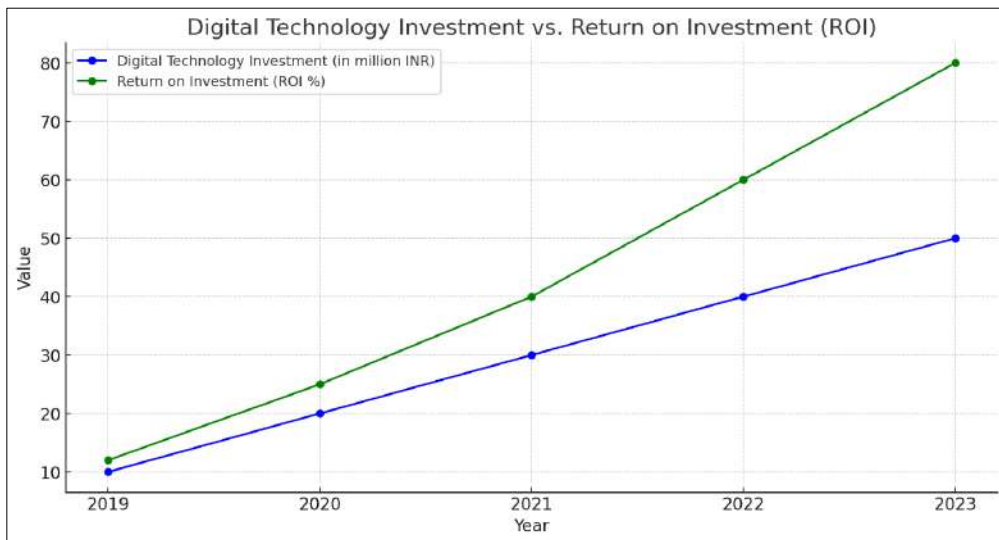
Table 4: Resource Efficiency Improvement Post-Digital Adoption

Year	Energy Consumption (per unit of production)	Water Usage (per unit of production)	Material Waste (per unit of production)
2019	100 units	75 units	50 units
2020	95 units	70 units	45 units
2021	90 units	65 units	40 units
2022	85 units	60 units	35 units
2023	80 units	55 units	30 units

Interpretation: Table 4 illustrates the improvement in resource efficiency in industries following the adoption of digital technologies over a five-year period. Each year, there is a noticeable reduction in energy consumption, water usage, and material waste per unit of production. This trend demonstrates the positive impact of digitalization on resource management, contributing to more sustainable industrial practices. The decrease in energy and water usage, as well as the reduction in

material waste, highlight the effectiveness of digital technologies in optimizing processes, reducing inefficiencies, and promoting sustainable resource utilization. These improvements are crucial for industries aiming to align with the principles of sustainable development and environmental conservation.

Figure 3: Digital Technology Investment vs. Return on Investment (ROI)



Interpretation: Figure 3 illustrates the relationship between the investment in digital technologies and the return on investment over a five-year period from 2019 to 2023. The line graph shows a positive trend for both the investment in digital technologies (in million INR) and the return on investment (ROI %). As the investment in digital technologies increases each year, there is a corresponding increase in ROI, suggesting that these investments are not only being recovered but also yielding substantial returns. This positive trend line indicates the economic viability of investing in digital technologies, demonstrating that such investments can lead to significant financial benefits for industries. The increasing ROI also highlights the potential for digital technologies to drive efficiency and productivity, leading to higher profitability. This trend is crucial for industries considering the adoption of digital technologies, as it provides a strong economic rationale in addition to the environmental and social benefits.

These tables and figures collectively provide a comprehensive view of the impact of digital technologies on various aspects of industrialization in India. The results show that digital technologies are not only enhancing industrial productivity and financial health but also contributing to sustainability and employment quality. The positive correlation between digital technology adoption and key industrial metrics underscores the critical role of these technologies in achieving sustainable and inclusive industrialization in India, aligning with the goals of SDG9.

5.0 Discussion

The results obtained from the data analysis in Section 4 offer critical insights into the role of digital technologies in driving sustainable and inclusive industrialization in India. This discussion aims to delve deeper into the interpretation of these results and their implications, particularly in addressing the identified literature gap.

5.1 Impact on industrial productivity and sustainability

The increase in industrial productivity concurrent with the adoption of digital technologies (Table 1) strongly indicates that digitalization enhances operational efficiency. The gradual plateau observed in productivity gains suggests the maturing of digital technology integration in industries. Additionally, the positive correlation between digital technology adoption and environmental sustainability metrics (Figure 1) underscores the dual benefit of digitalization – enhancing both efficiency and sustainability. This finding is crucial as it provides empirical support to the argument that digital technologies are instrumental in achieving the environmental objectives of SDG9, a gap previously noted in the literature.

5.2 Economic viability of digital technology investments

The financial health of industries post-digital technology integration (Table 2) and the positive trend in ROI against digital technology investments (Figure 3) collectively highlight the economic soundness of these investments. This fills the literature gap concerning the techno-economic analysis of digital technologies in the industrial sector. The results demonstrate that investments in digitalization not only contribute to environmental and productivity improvements but also enhance financial returns, an aspect not extensively explored in existing literature.

5.3 Sector-specific adoption of digital technologies

The varying degrees of digital technology adoption across different industrial sectors (Figure 2) provide a nuanced understanding of the Indian industrial landscape. This finding contributes to filling the literature gap by highlighting the sector-specific challenges and opportunities in digitalization. The quicker adoption in services and manufacturing compared to heavy industries underscores the need for differentiated strategies and policies to foster digital integration across all sectors.

5.4 Digital technologies and employment trends

The increase in skilled employment with rising digital technology adoption (Table 3) addresses an important aspect of sustainable industrialization – the creation of quality jobs. This finding is significant as it indicates that digitalization, contrary to some concerns, does not necessarily lead to job losses but can actually create more skilled employment opportunities. This contributes to the literature by providing an empirical basis for the impact of digital technologies on the labor market in the industrial sector.

5.5 Resource efficiency improvements

The improvements in resource efficiency following digital adoption (Table 4) emphasize the role of digital technologies in promoting sustainable resource use. This is a critical contribution to the existing literature, as it provides quantifiable evidence of how digitalization can lead to more sustainable industrial practices in terms of reduced energy consumption, water usage, and material waste.

6.0 Implications and Significance

The findings of this study have significant implications for policymakers, industry stakeholders, and academics. For policymakers, the results offer guidance on where to focus digitalization efforts and investments to maximize benefits across various industrial sectors. Industry stakeholders can use these insights to make informed decisions about investing in digital technologies, considering both the economic and sustainability benefits. Academics can build upon these findings to further explore the multifaceted impact of digital technologies in the context of sustainable industrialization. In conclusion, the analysis and interpretation of the results significantly contribute to filling the identified literature gap, providing a comprehensive techno-economic assessment of digital technologies in India's path to achieving SDG9. The implications of these findings are far-reaching, offering a deeper understanding of the role of digitalization in shaping a more sustainable, inclusive, and economically viable industrial sector in India.

6.0 Conclusion

The study embarked on a journey to unravel the intricate relationship between digital technologies and their role in advancing sustainable and inclusive industrialization in India, particularly in the context of Sustainable Development Goal 9 (SDG9). Through a detailed analysis of various data sets, the research unearthed several key findings that shed light on the multifaceted impact of digitalization in the Indian industrial sector. Firstly, the study revealed a clear correlation between the adoption of digital technologies and enhanced industrial productivity. The data indicated a consistent increase in productivity as industries integrated more advanced digital solutions, highlighting the efficiency gains afforded by digitalization. However, the diminishing rate of productivity gains over time suggested a stabilization or maturation phase in digital technology integration.

Secondly, the research underscored the economic viability of investing in digital technologies. The positive trend observed in the return on investment (ROI) against digital technology investments pointed to the financial soundness of these initiatives. This aspect is particularly critical, as it provides a strong economic rationale for industries to embrace digital transformation, not just for operational efficiency but also for improved financial returns.

The varying rates of digital technology adoption across different sectors highlighted another significant aspect of the study. Industries such as services and manufacturing were found to be more agile in adopting digital technologies compared to heavy industries. This discrepancy underscores the need for sector-specific strategies to enhance digital integration, ensuring a holistic advancement across all industrial sectors. Moreover, the study brought to light the positive impact of digitalization on employment trends. Contrary to the common apprehension that digital technologies might lead to job losses, the findings indicated an increase in skilled employment opportunities. This aspect aligns well with the sustainable development goals, which emphasize not just economic growth but also the creation of decent work opportunities.

Finally, the improvements in resource efficiency post-digital adoption were a testament to the role of digital technologies in promoting sustainable industrial practices. The reduction in energy consumption, water usage, and material waste per unit of production as industries adopted digital technologies provided quantifiable evidence of the environmental benefits of digitalization. The broader implications of this research are manifold. For policymakers, the findings offer valuable insights into where to channel efforts and resources to maximize the benefits of digitalization across various industrial sectors. For industry stakeholders, the study provides a data-backed rationale for investing in digital technologies, highlighting the dual benefits of economic gain and sustainability. Academics and researchers can build upon these findings to explore further the dynamic role of digital technologies in shaping sustainable and inclusive industrialization, not just in India but in other developing nations with similar industrial landscapes.

In summary, this research contributes significantly to the understanding of how digital technologies can be leveraged to achieve sustainable industrial growth in India. The findings provide a comprehensive view of the techno-economic benefits of digitalization, aligning with global narratives of sustainable industrial practices and offering practical insights for various stakeholders in the journey towards achieving sustainable development goals.

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CHAPTER 5

Evolution of Technology with Outcome Based Education in Higher Education to Restoring Sustainability Development

Sapna Sharma¹ and Hemangi Kolhe²

ABSTRACT

Education along with equitable quality is the primary right for everyone. Education is a lifelong learning process. Primary purpose of educational is to expand the current sources of knowledge by presuming formulated solution to different problems. Sustainability Development is the mean through which we understand current feasible requirement is meet or not. Where in education with Outcome Based is one of the effective standard in modern educational system. An outcome is a process to evaluate what level of learning student has received upon the completion of the course. With the technology participation along with OBE has sharpen modern educational experiences. Technology has radically changed the way how learning must be carry. With the help of technology smart and modern educational system has lead to more creative and interactive way of learning with following key features: Flexible Learning, Collaborative Learning, Personalized Level of Learning impact and may more.

Keywords: Education, Outcome Based Education, Technology, Sustainability Development, Learning.

1.0 Introduction

Technological Adaption and Blend in Higher Learning System: This combination has a huge metamorphosis of education each over the globe, an interpretation has a successful approach towards education system of current centaury. The importance of utilizing cutting-edge technology in the classroom has been emphasized by well-rounded education.(1). According to one exploration report published in 2017, a significant impact of cutting-edge practices and technologies on higher education around the world that connected eighteen motifs that are very likely to have an impression on technology planning and decision-making.

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These trends include blended learning design, cooperative literacy, growing emphasis on measuring learning, redesigning learning spaces, advancing societies of innovation, and deeper learning approaches. The six challenges that these developments present include perfecting digital knowledge, integrating formal and informal learning, achievement gaps, advancing digital equity, managing knowledge fustiness, and redefining preceptor roles.(2).

Outcome Based Education OBE: was presented by William Spady in the 90s which substantially emphasizes on the cumulate of the education which is delivered. It's fully pupil centric process OBE has placed a strong emphasis on the goals, objectives, achievements, and outcomes of education. The exit learning difficulties that students should demonstrate at the end of the course inform decisions about the classroom, assessments, and instruction.(3).

Impact of OBE on Higher Education OBE: It aims the assessment of learners on base of understanding, critical thinking, logic, reflection and action. One of the most crucial aspects of students seeking further education is their ability to integrate information and literacy that is useful to and connected to real-life problems. With the aid of OBE functioning by course, we can also ensure that the scholars have this ability.(4).

Sustainability with Qualitative/ outgrowth grounded Education as per the article by UNESCO, 2014, "Sustainability in Education System makes every human being to obtain the knowledge". According to ESD Education for sustainability development substantially aims stimulate way position in critical thinking, creativity, and invention, and to promote lifelong literacy for over- enhancing and upgrading. ESD is firmly based on the premise that education has the power to influence everyone's behaviour, foster teamwork, and enhance the sustainability culture.(5).

2.0 Objectives of the Study

1. To acknowledge the important gaps of Sustainability in Education.
2. To understand and analyse implementation of Out Come Based Education to achieve sustainability in education.
3. To estimate the gap in implementation of Out-come Based education.
4. To understand the gravity of technology integration and challenges with OBE.

3.0 Literature Review

Rathy *et al.* (4) following paper mainly focuses on the all the important components and principals of OBE which leads to learning as outcome based learning like CO(Course Outcome),PO (Programme outcome),etc of the specified education or a course. Benfield *et al.* (5) following paper has articulated that after the global pandemic the perception about education and learning has been changed completely. With the involvement of the technology in education and its

transformation. Every moment, new technologies are being developed, which leads to a greater variety of employment, career, and opportunity exposure.

Kintu *et al.* (6) following research articulates that the blended learning methodology has struck the learning of the students to greater extent and also helps to make learning as outcome based. Due to the following transformation, it has give rise to self learning, more critical thinking environment among students. Following paper reflects the optimization of in processes of Learning.

Akir *et al.* (7) following paper primary focus was on how higher education is trying to adapt outcome base learning and how outcome based education is transforming which the evolution and integration of technology. It also explains how new platforms have been created for teachers as well as for the learners. The teaching and learning process is evolving daily with a growth strategy due to the integration of technology.

Davis *et al.* (8) the goals that have been established for the education system and how they are being implemented are the key topics of the research paper that follows. Its primary goal is to transform education into an outcome-based process. It is a mechanism for improving and developing skills. Rogers *et al.* (9) the paper that follows primarily focuses on the following: Technology exposure for teaching and learning examines the presumptions surrounding the use of technology in teaching and learning, notes the shifts in higher education from tradition to change, and highlights the main elements of this change.

4.0 The Use of Technology in Higher Education

Before understanding influence of technology According to research on the typical method of delivering learning to students in advance education, there are a number of issues with student learning, including low student participation, low interaction, and low skill in formative evaluation. On the other hand to overcome with the following challenges, Technology has had a profound impact on teaching methodologies, curriculum design, and student engagement, transforming traditional educational practices and fostering innovative approaches. Impression of technology in the following key areas:

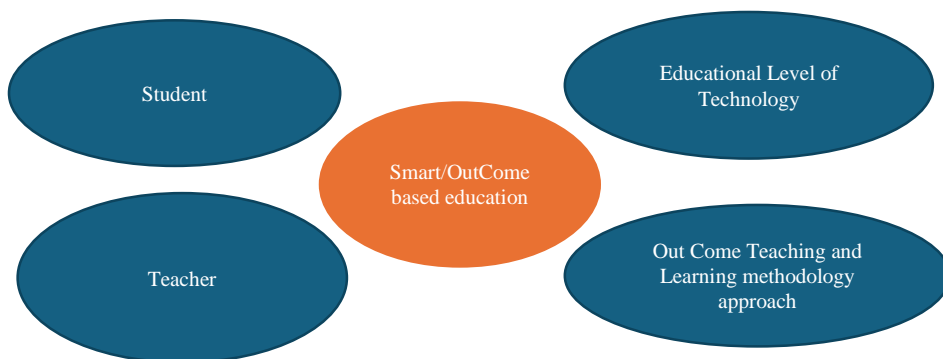
- **Teaching Methodology:** various teaching methodology has larger impact on students learning and teaching impact also. In terms pedagogy used while content delivery(6) used Various methodology on the basis of content delivery are as follows:
 - *Personalized Learning:* It is adaptive learning platform where individual student learning need are tailored properly.
 - *Blended Learning:* This methodology, which is flexible in terms of access, availability, and time, was heavily utilized after COVID-19. It is also applicable to remote students.

- **Flipped Classroom:** It is platform of learning students learn various concept with self learning and then brainstorming session for discussion are arranged. It concludes more outcome-based learning and develops critical thinking and capability. It is a cooperative method of education (7)(8)
- **Curriculum Designing:** Curriculum is a very initial stage and important in education industry and design of it is very crucial part according to outcome based learning to parallel the competitive era. To build an impact full curriculum various digital tools can be accommodated to boost interactivity towards students and their learning eg: Virtual Labs. Another approach is project based learning, where students are able to apply their theoretical knowledge to solve problems in the actual world through practical learning (7)(8).
- **Student Engagement:** This is very important stage where the methodology which has been chosen and designed curriculum will help out to deliver the content. Firstly content must quite interactive which will stimulate their adaption of content. Secondly collaborative content delivery can be used for more engagement of the students towards learning. Thirdly technological based assessment tools must be used to identify areas for improvement(7)(8).

5.0 Role of Current Technology and Emerging Technology in Higher Education for Sustainability Development

Digitization in education industry is all set for the transformation in teaching and learning process for life long learning and out come based learning in order to enhance and stimulate sustainability development goal of qualitative education. The use of smart technology and the integration of educational systems with it has simplified and increased the thoroughness of the teaching and learning process for educators and students around the world.

Figure 1: Smart/Learning Outcome based Education Model



Source: Primary Data Source

One option that is created using the best technology now in use to satisfy all the needs of instructors and students is the Smart Education Model. It is being designed to offer data analysis, e-content, and other services. One well-known example is the Learning Management System (LMS), an outdated system that educational institutions often utilize to conduct educational course services efficiently, including course materials, attendance, assignments, quizzes, and so forth. With learning management system tools, intelligent technology integration is required to achieve much more improvement in terms of efficiency and accuracy.(10)–(11)

From the following figure we can conclude to get a learning outcome based education model we have to stand with four pillars.

Following Emerging Technology are stimulating the educational sector in terms of learning and its outcome:(12)(13)(14)(15)(16)(17)

- a. **Artificial Intelligence:** In education industry student learning is one of the major factor and for transforming student learning process , Artificial Intelligence is placing a recommendable role. It can also have great control on administrative task and make it quite flexible(20)
- b. **Machine Learning:** Machine Learning provide analysis and insights on to the basis of predictive algorithm which helps to find appropriate learning in specified area, which in return leads to good selection of career path and also help teacher of learning outcome achieved or not.(16)
- c. **Learning Analytical Technology:** It play an key role for improvement, smart, optimization in education. We can easily analyze the needed improvement scope full area in education. How to optimize the already defined learning areas.(20)
- d. **Cloud Computing Technology:** As it is known already known that education institute generate a huge amount of data from assessment, marks, assignment and many more. To handle such a huge capacity of data is difficult with traditional way. Therefore cloud computing provide a smart way to not only handle but provide flexibility in every aspect of data accessibility To properly manage and analyze vast volume of educational data.(19)
- e. **Block Chain Technology:** Security is a point that comes first when we talk about data. Because of the internet era, many security vulnerabilities are often examined, raising concerns about institutional data privacy. Block chain technology allows us to secure data against temperature changes. This will improve the standard. (18)
- f. **Deep Learning Technology:** Deep learning The learning content can be dynamically restructured and optimized to meet the needs of the students through the application of deep learning techniques to develop content analytics. It works well for analyzing different kinds of data. It improves one’s capacity for thought, cognition, and high levels of retention in learning environments.(24)
- g. **Internet Of Thing**By automating some administrative processes, IOT offers students an engaging learning environment while also increasing productivity. It

increases system agility and facilitates the transition to digital content, remote learning, smart classrooms, and campuses.(25)(26)

6.0 Challenges comes with emerging technology adoption with education

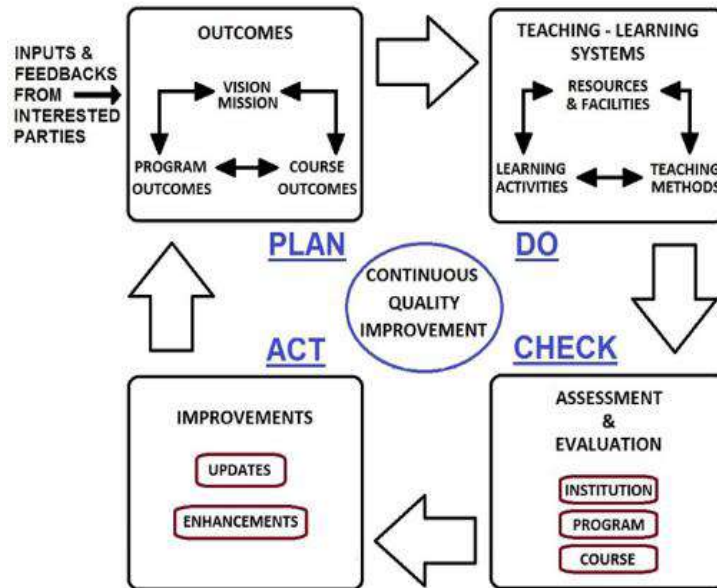
According to the study technology is forming a huge level of transformation in education, teaching process, and learning process. With the help of technology institution are able to showcase their process in an automotive way and efficiency, accuracy, consistency is being also incrementally getting more appropriate. The output of various educational institute all over the world agrees with the amalgamation of technology with education in various aspects and make education modest and outcome based for both faculty and students and also appropriately meet educational institute objectives behind the course. Challenges are additionally included with specific transformation like insufficient skills, resources accessibility issues, inadequate professional environment and its development. It also states that not everyone on same pace.(30)(31)

7.0 Integration of OBE Frame work with Education

In higher level education development of course programme is one of the major and also a crucial task. With the integration of OBE Outcome Based Education brings a empowering from learners perspective and teachers too (32).It is one of the proactive of implementation of curriculum and along run improvement in it. With the help of OBE each and every activity whether it is a lecture, training or a project will contribute in learning outcome of it and where the things are going wrong and also states where there is a scope of improvement. OBE states that how Outcome can be mapped with objectives .It leads to a purpose of doing each task in the learning journey. It properly gnat chart the student learning growth in the specified area and also help teacher to do required transitions in their curriculum development in order to achieve appropriate result in terms of objective. Terms used in OBE framework: POs which are prepared taking vision and mission of the institutes. Programme education objectives (PEOs) are also framed in accordance with vision and mission but the vision and mission should meet and follow the criteria and graduate. Pos = set of (COs) (1) where, COs are course outcomes, since many courses are delivered in any programme; it may undergraduate course or post graduate course.

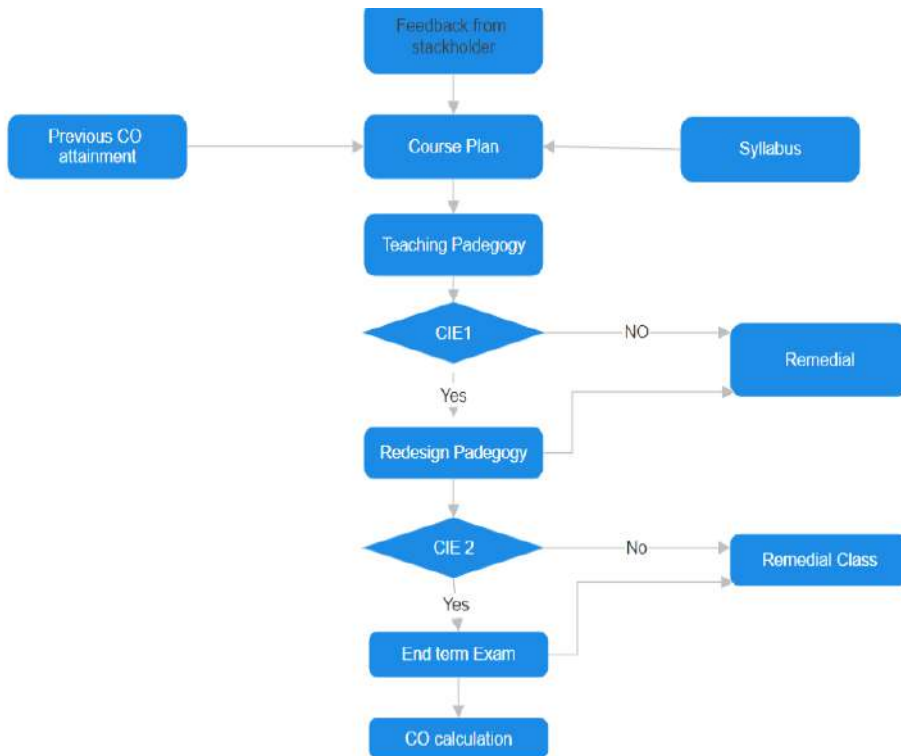
COs are derived from several outcomes through different activities, such: Cos = set of (TOs, LOs, PJOs, LBOs, SOs, GDOs, ECAOs, CCAOs) (2) where, TOs, topic outcomes; LOs, lecture outcomes; PJOs, project outcomes; LBOs, lab based outcomes; SOs, seminar outcomes; GDOs, group discussion outcomes; ECAO, extra-curricular outcomes; and CCAOs, co-curricular activity outcomes(33).

Figure 2: OBE Frame Work



Source: Primary Data

Figure 3: Teaching Learning Process as per OBE



Source: Primary Data

8.0 Challenges are Associated with OBE

- Acceptance of OBE implementation is a big challenge.
- Prototype Changes in educational Model
- Quality in education for growth analytics
- Perception of teachers and students
- Design down approach that is high level attention need to be pay in curriculum
- Special Need impact on OBE implementation
- Achievement of successful Learning(34)

Significant unoccupied that has been identified that technological integration with OBE frame has not being implemented at a practical approach (35) (36). It is just being discussed through theoretical medium. The appropriacy in term of outcome based learning in education can be done accurately and efficiently if smart technology steps in (37) (38). This will automate the process of learning outcome based education measurable .Smart curriculum can be implemented with the approach of improvement. Student's performance can be evaluated and measured according to objective and outcomes based approach (39) (40).

9.0 Conclusion

Education in the co-corporation with technology can leads to greater transformation in to the learning of the students in terms of outcome based learning which impacts their career flow and future growth. Higher education objectify the student's skill development, efficiency in real world competency. This will stimulate the sustainability development in terms of educational right. According to points listed above technology will helps to analyze the appropriate measurement of the learning which is being imbibe by the students and considerably helps the teachers to understand what teaching and Learning methodology more impact the students growth incrementally. OBE frame work with smart Technology can make the entire process of educational learning easier for the educational institute, Which will help out the manual to be in automated way.

With the OBE and technology the automated process teaching and learning process can effective and much more accurate and can be analyze and also helps out to graph the growth of primary right of the student that is learning and up skilling them according to the real world competency objective. With the help of all the following will lead to stimulate the achievement of sustainability development for goal to provide qualitative out come based learning among the society. Following analysis also listed the primary challenges which need to be keep in mind to adapt the technology with education. Level of infrastructure, training and essential availability to the teacher and learning in order to achieve learning with outcome. OBE can stimulate the analyzation and effective prediction of required improvement about the

educational needs. With the help of the following we can also conclude that education institute should train their teachers to implement new teaching pedagogy to effectively implement the curriculum which can easily output the major impact on outcome based learning. This will leads to right direct the impact of education to the sustainability development in society in terms education which is primary point of growth of societal values.

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CHAPTER 6

An Examination of the Fundamental Properties of Concrete using Recycled Glass

Lakhvinder Singh¹, Ajay Vikram² and Abhilash Thakur³

ABSTRACT

The unlimited use of natural resources like sand, stone and immense use of cement in the construction process has a ruinous impact on environmental sustainability. Currently lots of the experiments done by the researcher to reusing the waste materials in building industry. As per the researchers an assortment of fields is looking for ways to reuse materials, as an alternative to natural resources. The current ground situation of scrap waste glass (WG) the nonbiodegradable nature of the WG, landfills do not provide an environmentally appropriate management solution. The applicability of WG use in construction is environmental friendly to reduces carbon emission. The numbers of excellent experts have been already conducted properties of concrete containing WG. This review aims to deliver, the effects of WG in concrete as a replacement of inert matrix ingredients are examined, to classify the fluctuation in the properties, benefits, mechanisms, and current researcher progress and this evaluation focuses on environmental benefits. Furthermore, the review helps in future researcher guidelines for WG to improve its execution as well as optimum use of natural resources.

Keywords: Waste glass (WG), Fresh and Hardened, Concrete, sustainability, Environment issue.

1.0 Introduction

The construction industry's major environmental concerns, with a focus on the sustainability issues related with the manufacture of concrete using cement The cement industry in India has grown significantly, reaching 3.64 billion tonnes in 2022 and projected to reach 4.83 billion tonnes by 2028 at a CAGR of 4.94%. This expansion is being driven by growing manufacturing demand driven by infrastructure needs, with consumption expected to expand at a robust CAGR of 5.68% between 2016 and 2022.[1]

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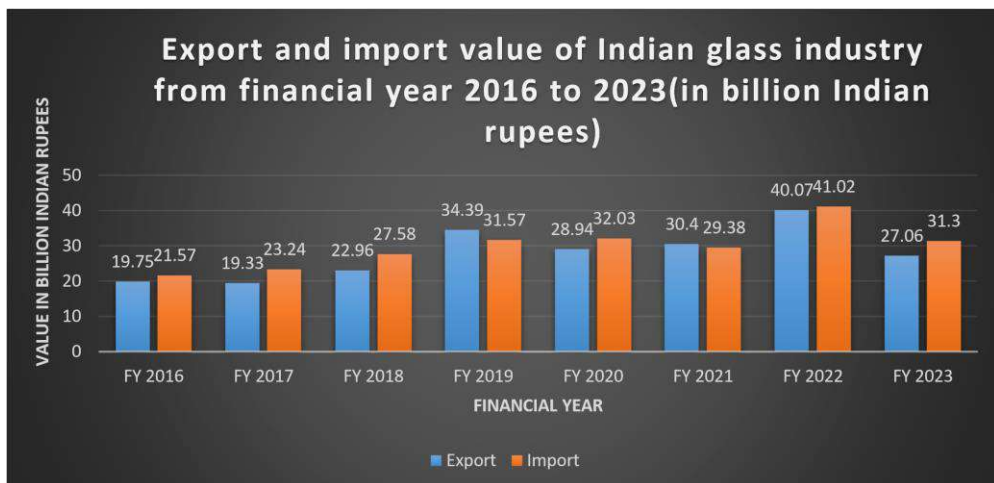
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The research was centered on solid waste issues, specifically glass, and proposed using it in concrete manufacturing to minimize cement content for sustainability. This research produces compressed concrete samples by incorporating waste glass and plastic powders, micro-silica, fly ash, and recycled powdered concrete, aiming to reduce cement usage and utilize waste resources.[4]

There is a rising tendency in the literature to replace binders with Supplementary Cementitious Materials (SCMs) such as Waste Glass Powder (GP). Two major elements are driving this shift: For starters, cement manufacturing has a considerable energy requirement (about 5% of industrial energy) and a significant percentage of world energy consumption (3%). Second, cement manufacture considerably adds to environmental issues, owing to the discharge of enormous greenhouse gas emissions, particularly CO₂. It is believed that 0.9 tonnes of CO₂ are released for every tonne of generated of cement produced. This underscores the critical need to investigate alternative materials such as Waste Glass Powder in series to decreases the environmental effect of cement manufacturing and transition to more efficient construction methods.[15]

The enormous body of experiment on the inclusion of Glass Powder (GP) in concrete has provided numerous notable results, including defining ideal cement replacement levels for strength enhancement and the possibility of fine GP to increase concrete durability. With GP inclusion at various cement replacement levels, studies demonstrated notable advancements in drying shrinkage, alkali reactivity, chloride ion penetrability, and decreased porosity. Furthermore, the experimental examination on ultrahigh performance concrete using GP helps to a better knowledge of its beneficial impacts on concrete attributes such as strength increase, durability, and decreased permeability.[16]

Figure 1: Export & Import Value of Indian Glass Industry from 2016-2023



Source: Stastica

Lower levels of replacement (5-15%) result in improved workability and durability without affecting concrete strength at an first stage. Replacement levels in the moderate range (15-30%) have resulted in considerable improvements in the long-term strength, durability, and permeability of the concrete. Conversely, larger levels of replacement (30% and beyond) result in a significant drop in cement consumption, which may affect the initial strength of the concrete. However, during longer curing periods, these greater levels of replacement still display equivalent or even superior strengths, hence supporting sustainability aims.[23] As per the IBEF India produced more than 8% of the world's installed capacity for cement, making it the second largest producer in the worldwide. The private sector holds 98% of the total capacity, while the public sector holds the remaining 2%. The value of imported goods for the glass industry in India during the fiscal year 2022 was 41.02 billion Indian rupees. In revenue year 2022, the total trade value of Indian glass exceeded 81 billion rupees. The import value exceeded the export value in the fiscal year 2022, whereas the trade balance appeared to be shifting in 2020.

The principal objective of the literature review is to address a research deficiency in the forecasting of specific attributes through the utilization of glass powder. This investigation centers on augmenting this inadequately investigated field by highlighting its potential significance for practical engineering applications.

A multitude of inquiries have been completed to comprehensively assess concrete by employing different manifestations of waste glass powder. These examinations encompass evaluations of the characteristics of newly mixed concrete, hardened concrete, and durability characteristics under a myriad of physical and chemical scenarios.[29] The evaluation covers a variety of properties such as initial and final setting duration , density, slump, air content, splitting tensile strength, and compressive strength ,flexural strength, resistance to ASR (Alkali-Silica Reaction), and ultrasonic pulse velocity (UPV). Furthermore, researchers have investigated the mineralogical features of the components used in these concrete combinations.[17] This review aims to consolidate and synthesize findings in order to gain a better way of understanding of the impact of waste glass powder on concrete properties, as well as to contribute Predictive models for these attributes were developed due to extent of powder glass replacement in concrete mixes.

2.0 Water Glass Aspect

As a building material, waste glass has different qualities that make it useful in a range of applications, notably concrete production: Glass reactivity and endurance in materials such as concrete are determined by its chemical Compounds, which contains silica, soda, and lime. The size and shape of waste glass affect its performance, smaller particles increase qualities, while irregular shapes decrease utilization. Surface contaminants acquired from previous usage or storage may affect glass reactivity and compatibility with other materials. Chemical reactions,

weathering, and disintegration over time define the endurance of wastage of glass in concrete, which may be handled by proper treatment. The most common water-to-cement (w/c) ratio in concrete mixes utilizing glass powder substitution was between 0.45 and 0.5, exhibiting the best fresh and hardened concrete qualities. Because of the higher fines content and low water absorption qualities of glass powder within the 0% to 20% replacement bracket, this range led to improved concrete characteristics. Water curing evolved as the most generally used curing process and time, considerably impacting concrete qualities.

The mixing method, curing temperatures, and effect of the pozzolanic reaction with glass powder ingredients all played important roles in increasing concrete strength. According to studies, the utility of waste glass powder on the mechanical qualities of concrete became increasingly obvious with longer curing times. As the curing time rose, compressive, tensile, and flexural strengths often showed a rising trend, indicating higher strength values.[30] Now, It is shows clear relationship between particle size and reactivity, glass powder with a size of particle less than 25 μm was used in the majority of the examined investigations. Research has indicated again and again that the pozzolanic reaction in concrete was enhanced by a smaller particle size of glass powder. In contrast, concrete performance was better for GP sizes less than 25 μm than for bigger particle sizes, such 25–50 μm or more than 75 μm . Glass waste was split into two groups by the study in this review: colored glass and white/clear glass. Both showed comparable chemical components, namely aluminum oxide and silicate. In contrast to White/Clear Glass, the Colored Glass group showed a noticeably greater Calcium Oxide level. There's a possibility that this variation in the amount of calcium oxide will lead to more pozzolanic reactions. Numerous tests revealed discrepancies, indicating that the color of the glass might not have a big impression on the properties of the concrete.

3.0 Properties

3.1 Compressive strength

Because it affects the qualities of concrete, the integration of waste GP into concrete has been thoroughly studied. Two primary trends impact the response of concrete mix with waste GP. Early Strengthening: The presence of free ions during the beginning of concrete's development output in an increase in its compressive strength. These ions enhance the pack-filling action and contribute to the pattern of additional hydrate products. The early strength gain is shown by the free ions present, which facilitate the initial production of more hydration products.

Later Strength Improvement: The characteristics compressive strength of the concrete gets better with time, especially after 28 and 90 days. Rather than largely increasing the pack-filling effect, this enhancement is caused by ions in the solution that contribute to the creation of additional hydrate particles.[26] At this point, focus changes from the physical pack-filling process to the ions' chemical role in creating

more hydrate products. When waste glass is crushed to a finer than 150 μm particle size, the effect on concrete's compressive strength is substantial. The quantity of materials that harden concrete, such calcium silicate hydroxide (C-S-H), is increased when finer particles are present in the matrix of the concrete.

These particles additionally exhibit pozzolanic characteristics. The pozzolanic effect of the SiO_2 in glass powder improves the properties of concrete. Hydration, which happens when water is added to cement, generates calcium hydroxide (CaOH_2) in the presence of silica and calcium silicate hydroxide gel (C-S-H). When SiO_2 from waste glass powder is added to conventional concrete, it increases the reaction with calcium hydroxide (CaOH_2) and produces more aggregate binding C-S-H gel. The overall strength and durability of the concrete are elevated as a result of this reaction, which also improves the aggregate bond and reduces permeability.[27] At the 28 day time point, the adhesive abilities for samples with 0%, 10% and 20% Waste Glass Powder (WGP) were measured to be 3.31 MPa, 3.48 MPa, 3.67 MPa, and 3.18 MPa, respectively.

It is worth mentioning that the geopolymer paste samples containing 10% and 20% WGP demonstrated enhanced bonding performance in comparison to the standard specimens of zero percentage WGP. However, a higher WGP content of 30% resulted in a 4% reduction in strength, which corresponds to the changes observed in compressive strength.[12] As a outcomes of their small size, glass powder particles may rapidly fill in the spaces between cement grains in concrete, creating a structure that is more durable and strong.⁵ As thus, the most crucial element affecting the development of concrete strength is the waste glass's particle size distribution.[14] It turns to be that glass powder smaller than 90 microns is quite useful for reinforcing concrete. But too much glass powder without enough calcium might cause the alkali silicate reaction to create weak spots in the concrete, which will reduce the strength of the material.[18]

Numerous studies have looked at how adding glass powder to concrete affects its compressive strength. Since glass powder has a relatively sluggish pozzolanic reaction, replacing cement content with it tends to diminish early age strength. When substitute material that has been recycled is included, the later age strength improves, even if the first stage strength initially decreased in comparison to the reference concrete.[4] The strength increases slightly when glass powder is added on day 7 and greatly on the twenty-eighth. The individual mix design that was used for each of the three curing durations will determine —7, 28, and 56 days—different rates of glass powder replenishment are optimal. Nevertheless, the lack of comprehensive information for some mix designs hinders the development of formulas that include every mix design that has examined throughout a range of curing times.

When the mix design was 1:1.5:3, different sources' evaluations of the characteristics compressive strength displayed interesting patterns at 7 and 28 days. Initially, there was a noticeable improvement in compressive strength as the glass

powder fraction went from 0% to 10%. This increase was around 18% at 7 days and 13.1% at 28 days. The main cause of this increase is the glass powder's pozzolanic action, which amplifies its reactivity with lime in the mixture of concrete because of its finer particle size.[26] Yet, after beyond the 10% replacement barrier, a subsequent decrease in characteristics compressive strength was seen, indicating the need for more thorough investigations to identify the relationship between greater percentages of GP replacement and compressive strength of the concrete design mix. Comparably, assessments of compressive strength, derived from three distinct examinations at 28 days, results an increasing in compressive strength by a 10% replacement of glass powder for mix designs based on a 1:2:2.5 ratio. Compressive strength results did in fact start to decrease beyond this point. Smaller pieces of glass in the concrete mix are responsible for this initial strength increase by assisting in the production of calcium silicate hydrate via alkaline activation, which is the fundamental process of the pozzolanic reaction.[13]

3.2 Initial and final setting time

Setting time is practically important since it influences the window of opportunity that construction workers have to work with fresh concrete.[3] The effective water-to-cement ratio rises noticeably depending on the glass powder inclusion. Longer setting times are usually attached to bigger water-to-cement ratios. Longer initial and final setting periods are the result of using recovered scrap glass .[28] Conversely, results that vary from several studies demonstrate that glass powder helps cement paste hydrate. Additional study has showed that the addition of up to 20% GP to concrete has little effect on the curing time of the cement paste.[3] likewise, the heat produced during hydration and the rate of heat emission both rise with an intensify in glass powder (GP) content. This suggests that GP contributes to the promotion of cement hydration. The hydration reaction becomes quicker by the fine particles of recycled glass; it serves as a collection point for the numerous hydration products. At the same time, waste glass's high alkali content may act as an agent for the early formation of C-S-H. As a result, waste glass reduces the time required for the temperature to reach its peak in semi-adiabatic situations. Finally, how the temperature evolves in the concrete depends on a balance between these two opposites. [3]

3.3 Air content

When glass powder is added to concrete mixtures in place of cement, the combinations' air content is usually increased. No matter what kind of coarse aggregate is used, concrete compositions containing 20% glass powder instead of cement demonstrated noticeably greater air content values than control mixes without glass powder. [14] In some experiments where glass waste ground was used in place of cement for six hours, the cementitious pastes showed less entrapped air than the reference. The amount of the surrounding glass particles acting as fillers, which

occupy a portion of the matrix's pores and reduce the specimens' overall permeability, may be responsible for this decrease in trapped air. [8,27]

3.4 Workability

When glass powder (GP) replacement is employed within the range of 0–20%, the slump value increases significantly, achieving around 72% for concrete mix designs that keep to the 1:1.5:3 ratio and a water/cement ratio of 0.45–0.5. [13,26] Because of its smooth surface texture, GP has a low water absorption capacity, which accounts for this rise. However, there was an observed dropping tendency in the slump value, decreasing by up to 39% from the beginning, with a rise in the proportion of fine particles in the design of the concrete mix and a higher a water-to ratio, such as a 1:2:2.5 mix with a w/c ratio ranging from 0.5 to 0.55. [3,18] The GP's flat surface causes less water to be trapped at the surface, which reduces slump. Accordingly, the concrete's decreased cohesive forces cause the mix to have an ability to bleed.[18]

Slump values were used to show the workability, and output showed incremental measurements: 76 mm for LC10, 78 mm for LC15, 80 mm for LC20, and 75 mm for LC0. It's interesting to note that shorter beginning and final setup durations were obtained when discarded LCD GP was included. Notably, the observed raise in workability may have been influenced by the increasing percentage of Al₂O₃ in LCD glass powder.[19] Several replacement percentages of ground-granulated slag from blast furnaces (GP) exhibited distinct characteristics and had varied effects on the workability of concrete. The bar graph depicts that, among the lots articles analyzed, the largest proportion indicated a positive enhancement in concrete workability, thereby signifying that a substitution of 15% GP had the most significant influence. Conversely, nine articles that examined a 10% GP replacement demonstrated an upward trend, with the most of the data suggesting a marginal improvement in workability of less than 10%. Similarly, eight studies investigating the replacement of 20% GP also indicated an increasing tendency.

3.5 Split tensile strength

The split tensile strength of concrete could be affected if remaining glass is utilized in place of some of the cement in the mix. Concrete mixes exhibit a notable increase in split tensile strength, obtaining a peak value of 3.55 MPa and a 30% replacement level. Even so, strength reduces when waste glass powder percentage rises over 30%. [13] Tensile grows throughout time but finally declines as GP content increases. After 28 days, GP-containing concrete mixes show improved tensile strength, which is attributed to a decrease in size brought on by an accelerated pozzolanic reaction, which forms a denser CSH. [3] To be used effectively at high cement replacement needs without sacrificing strength, a distribution of very small particle sizes and prolonged curing durations are necessary. According to research,

the tensile strength of concrete injected with glass powder improves as the curing time increases.

A maximum 15.87% raise in tensile strength has been found through research, reaching 3.29 N/mm² at a 10% replacement rate for glass powder. Results were best when replacement levels were 20% or less. Furthermore, glass powder replacements with particles lower than 75 µm were proven to have good benefits, particularly at replacement rates of 10% and 15%, demonstrating notable increases in 28-day tensile strength for both 33 MPa and 45 MPa concrete.[13, 14, 19] The average values from at least three distinct experiments are included in the results, which show a pattern approximating the compressive strength of concrete. As the concrete ages, there is a noticeable elevation in the values of tensile strength. For instance, after 7 days, the proportion of tensile strength between Concrete G10.R05 concrete as well as concrete was found to be 71%, while this proportion increased to 97% after 90 days. To explain the observed pattern in splitting tensile strength, one may apply the same theory that applies to trends in concrete compressive strength.[20]

3.6 Flexural strength

Results from test on the flexural strength of concrete samples over a period of 28 and 90 days, using varying proportions of Waste Glass (WG), were calculate. The results showed that, when WG was substituted for up to 20% of the overall composition, the concrete containing WG had considerably greater flexural strength than the control concrete. Substituting 20% of the fine aggregate with WG resulted in improvements of 7.85% and 7.58% in flexural strength for the respective curing durations. The observed rise in bonding between the cement paste and WG within the Temporary Conversion Zone can be explained to a considerable pozzolanic reaction that occurs during the hydration phase. Furthermore, the observed raise in flexural strength at the 28-day period can be attributed to the pozzolanic effect within the cement matrix.[7]

After the passage of a 28-day period, the observation of concrete's ability to resist bending was made, With the inclusion of waste LCD glass powder into cement mixtures was carried out in a partial and controlled manner. It was found that the flexural strength experienced a notable enhancement of 5.71% in the case of LC5, when compared to LC0, thereby representing the most significant improvement. In the case of LC10, the flexural strength saw a marginal increase of 2.85%, although the increase was not statistically significant. Conversely, it was noted that both LC15 and LC20 exhibited a decline in strength, with LC15 experiencing a decrease of 2.85% and LC20 experiencing a decrease of 5.71%, in comparison to LC0.[19] The variation in flexural strength observed in concrete specimens that incorporate glass powder and SF exhibits a similar pattern to the changes in flexural strength observed in the GP and silica fume percentage designs after 28 days. Specifically, the flexural strength experiences an increase of 3.92%, 9.8%, 17.65%, and 13.73% respectively,

when compared to the control design, as 7.5%, 15%, 22.5%, and 30% glass powder is utilized to create SCC, with SF being held constant. Conversely, if the percentage of glass powder exceeds 22.5%, the flexural strength demonstrates a reduction in comparison to GPSF3.[1]

With varying percentages of replacement, disparities in the progression of observed strength become apparent. The strength exhibits a gradual increase as the duration of curing expands because there is not any replacement. Conversely, when there is a 20% replacement, the rate of ascension diminishes between days 3 and 28, but experiences a subsequent augmentation between days 7 and 56. Following an initial surge from days 3 to 28, the pace of growth at a 40% replacement declines between days 7 and 56. [3] To summarize, for a spectrum of replacement percentages, lengthier curing durations most likely to increases the flexural strength.

4.0 Recommendation

Glass powder, a waste product, may often replace up to 15% of the cement in standard concrete. To optimize the durability performance of glass powder concrete, additional study is necessary. Optimizing the dosage and fineness of glass powder to lower moisture content while preserving the intended fresh qualities ought to be the focus of these studies. Studies are also needed to find out how permeable glass powder concrete is at different replacement percentages, how resistant it is to sulphate attacks, and how varied curing the temperatures drying and wetting circumstances affect it. Glass waste is also utilized in place of various sand kinds and aggregate with specific proportions.

5.0 Conclusion

The insufficient knowledge of the life long term durability and efficiency of concrete integrating waste glass as a partial substitute with standard aggregates represents a research gap in this paper on the use of WGP in concrete. Lack of thorough investigations on the environmental impact of employing WGP in concrete, especially its possible leakage of hazardous compounds into the surrounding environment, is another study gap. This comprehensive and insightful review article succinctly presents a series of formulas that establish a clear and undeniable connection between the predicted variations in strength and the proportion of WGP that is substituted in cement. Because of its existence cement hydration by waste glass particles, the initial and final setting times of concrete are prone to be extended. In instances where waste glass powder is introduced as a replacement for a portion of the cement within a concrete mixture, the air particle of the mixture typically exhibits an elevation compared to the absence of such substitution.

Along from reducing environmental pollution, the use of remaining glass powder in concrete helps to save natural resources and create a more economically

feasible and environmentally friendly concrete blend. These formulas, undoubtedly invaluable to engineers, offer them a prosperity of valuable and practical information regarding the anticipated strength outcomes at various replacement levels. It is worth mentioning that the particle sizes that fall below the threshold of 75 μm in glass powder exhibit a remarkable degree of reactivity, thus endowing it with the much-coveted status of a pozzolanic material.

This inherent reactivity ultimately contributes to and increases the overall durability and microstructure density of the matrix. Furthermore, it has been demonstrated that adding glass powder to concrete formulations in place of cement improves the workability of the mixture significantly, especially when the addition is made in the 10% to 15% range. This optimal range of replacements not only proves to be highly advantageous but also yields a multitude of significant benefits that clearly surpass those associated with traditional concrete. Compressive, tensile, and flexural strengths are instances of mechanical properties that demonstrate continual enhancement until reaching an average substitution threshold of 15%.

Subsequently, however, these attributes present irregular outcomes and downturn tendencies. The utilization of glass powder particles with finer dimensions—particles that are smaller than 75 μm —serves to alleviate the alkali silica reaction, thereby reducing the chance of happening of fissures emerging in the combination of concrete. Several inquiries have been conducted with regard to the utilization of residual glass in concrete. The meshing of glass waste into concrete can contribute to the deduction of cement content and the development of energy- and eco-friendly solutions. Regardless, the smooth surface and tiny cracks that are involved in the glass particles could potentially cause harm to the hardened properties of the concrete. To address this issue, observations have shown that augmenting the quantity of paste and adjusting the quantity of cement in the blend enhances the concrete's compressive strength and workability.

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CHAPTER 7

Technological ReVoLuTiOn towards Sustainable Business Organization: Industry 4.0

Nilima Thakur¹

ABSTRACT

Launch of Digital India campaign in 2015 exponentially raised the technological advancements in Industry 4.0. Digital physical transformations, work alongside machines in an innovative communication system, But the digital transition pace is challenging the society economy and environment compatibility in manufacturing and supply chain (MSC) industry. Several key trends are acting together.... Business Designs, Transformations, Practices, and MSC processing have been reinvented. Successful organizations are the ones who adapt to these trends and treat them as opportunities towards sustainability. Innovative initiatives require symbiotic collaboration between the user (manufacturer, vendor, and consumer) and the smart technology (product, services, and tools). Speed, accuracy and compatibility of 4.0 tools with creativity and innovation thrive win-win position for workforce & bottom line adopters (i.e user). Smart companies integrate practices, processes, and a collaborative culture to create a sustainable business organization (circular economy), as stated in the United Nations seventeenth SDGs about the 9th goal of Industry 4.0 innovation and technological revolution. Hence, this paper is an effort to study re-imagined and reinvented digital business practices and processing in industry 4.0 w.r.t three pillars i.e Social, Economic, and Environmental (SEE) empowerment towards sustainable business organizations.

Keywords: Technological Revolution, Digital Innovation, Sustainable Business development, Industry 4.0, Industrial Economy.

1.0 Introduction

Three Key drivers for Industry 4.0 success as described by Management thinker and “Father of Industry 4.0” Henrick Von Scheel are as

Think Valuenot Tech

Think Peoplenot Tools

Set clear Targets from the start.....

The Industry 4.0 technological revolution fits into a lifetime debate on industrial sustainability.

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Sustainability is a holistic concept that has been defined in many ways. The term sustainable development coined in the report has been popularly, defined as “development that meets the needs of the present without compromising the ability of future generations to meet their own needs.”[10] (Brundtland, 1987). The focal point of fourth industrial revolution i.e digital transformation has exponential intensification after the launch of digital India campaign 2015. User’s got fundamentally reshaped by digital revolution adaptations, and they are optimistic towards the experiences of Sustainable Industry 4.0 (S.I 4.0) [8] (Birkel, H., & Müller, J. M. 2021).

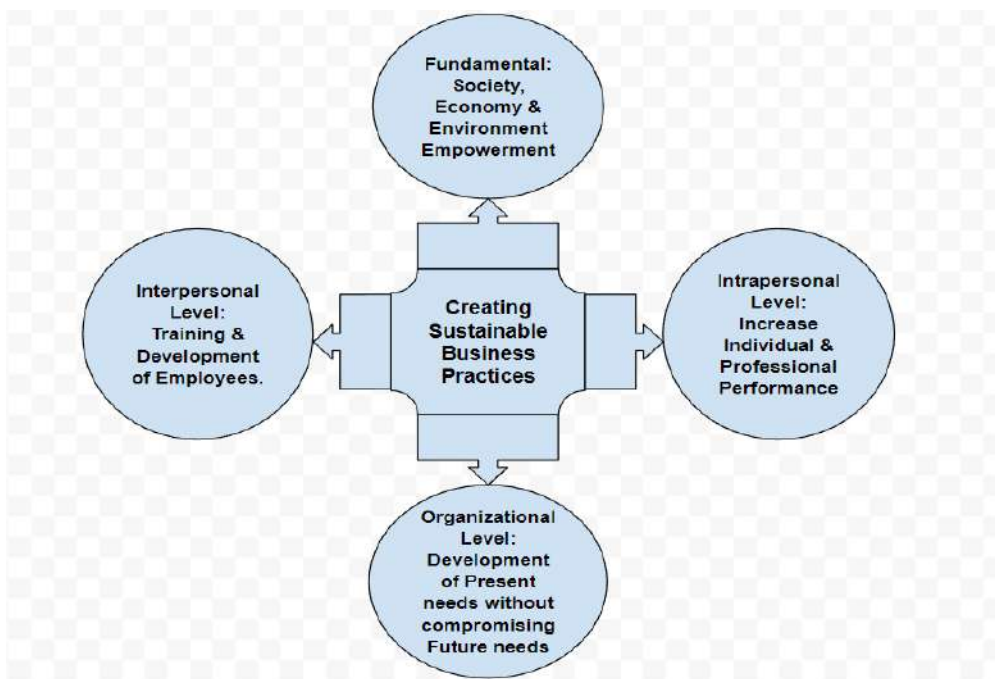
Technological innovations emerged as a catalyst in the productivity of quality, agility and sustainable business for India towards the journey of being world’s manufacturing hub, [7] (Bhatia & Kumar, 2020). Industry 4.0 aided a critical role in increasing the productivity, effectiveness and quality across the business spectrum [7] (Bhatia & Kumar, 2020). The companies accelerated their digital transformation[50] (Zheng,Lin,Chen,Xu, 2019) by adopting a dynamic production principle of industry 4.0 [45] (Tupa,Simota & Steiner, 2017) more efficient, effective, and futuristic. However, Industry 5.0, it is not only about efficiency in digital manufacturing, but progressive focus on human centricity [13] (Fatorachien and Kazemi,2018), resilience and sustainable distribution, and demand consistency[50] (Zheng,Lin,Chen,Xu, 2019) towards human-robot collaboration and cognitive systems.

In the last decade, technological advancements have an exponential progress in speed, accuracy, and ease of human life towards sustainable performance. At the same time, technological advancement in Industry 4.0 has dug us into the depth of challenges that need to be overcome in the manufacturing & supply chain (MSC) industry. There are many technicalities that at some times make it tough for systems to communicate and connect human emotions, security & privacy, and satisfaction. Digital inclusivity, Innovative communication and networking across the production line is required. Every section of the digital-physical system must be tracked throughout the manufacturing process. In the various business practices, unwanted variations or errors must be identified and decisions must be taken to fix them right. All these business practices are required to indulge with principles of circular economy (durability, Repairability & Recyclability with resource efficiency for economic empowerment which simultaneously mediate and moderate the social and environmental empowerment towards sustainable industry performances.

Sustainable Industry 4.0 (S.I 4.0) needs new business practices from technological innovation in industries having limited expertise (Training & development of employees), economic crisis operational inefficiency (Increasing individual & professional performance), financial scarcity (Individual living standard), cybersecurity & privacy and scarce technology diffusion [5,41] (Bag,Gupta& Luo,2020),(Sung,2018),(Sharma & Gandhi,2018) This research paper is a study of original empirical research of technological revolution through

innovations in manufacturing and supply chain companies in its production process and challenges that managers experience in services supportive of industry performance [38] (Shinohara, Da Silva, De Lima, Deschamps, Da Costa, 2018). Creating sustainable business practices at fundamental (SEE), Interpersonal, Intrapersonal and Organizational level Figure 1 for the survival of employees, customer (user) and organization. It explores the meaning making of sustainability in Industry 4.0 at the foundation. Individual and organizational level through digital transformation [22] (Kiel, Muller, Arnold, Vogdt, 2017) within the business practices.

Figure 1: Sustainable Industry Business Practices Meaning



Source: Own work

2.0 Literature Review

2.1 The new wave of digital revolution industry 4.0

Reinvention of our imagination in the digital revolution is to meet the changing needs of customer [13] (Fatorachien and Kazemi, 2018) in Sustainable Industry(S.I) 4.0 system dashboards. Overall user experience is elevated at its core in this new wave of sustainable technical innovations. It is imperative for companies to transform the conventional industrial culture to sustain these paradigm shifts,[6] (Bag,Telukdarie, Pretorius & Gupta2018) and adapt the real-time logistics network[44] (Tortorella, Vergara, Gerza-Rayes,& Sawhney, 2020). To re-innovate

the organizational structure and business practices they must thoroughly re-evaluate their current operations.

To meet customer expectations and demands companies operations are redefined with digital transformation [13] (Fatorachien and Kazemi, 2018). To design and engineer their products and services optimally, companies are now rethinking gradual shift towards sustainable processes. [5] (Bag, Gupta Luo 2020). Hence, Digitization is affordable to democratization of technology (like IOT/IOS, ChatGPT, Open Source, Cloud data, Low Code, No Code,). This convenience looks up for start-ups, smaller enterprises, and social individuals to board into digital space, creating sustainable digital products, applications, and services in industry. Yet doubt from policymakers, academicians, practitioners, and governing bodies remains about the conflicting substantial implications of fourth industrial revolution[33] (Muller, Keil, Voigt, 2018). Further, unenthusiastic and slow acceptance of innovations hindering the benefits and challenges of this revolutionary shift [21,47](Kane, Palmer, Philips, Kiron, Bukler,2017)(Wee, Kelly, Cattle, Breunig, 2015) .

Table 1: Exemplary Literature on Technological Revolution Sustainability in Industry 4.0

Category	Literature	Contribution
Society	(Hirsch -Kriensen 2014),(Kaggermann e.tal 2013), (Ottmier and Hoffmann 2017), (Kiel E.tal 2017), (Rehage e.tal 2013), (Rogers and Trombley 2014), (Birkel, & Müller, 2021)	Reducing repeated tasks, reducing labour tasks, Increased Efficiency, Reduced cost, High quality
Economy	(Kiel, Muller,Arnold, Vogdt,2017) (Wee,Kelly,Cattle,Breunig,2015),(Ogunsiji, A.S., and Ladanu, W.K 2017),(Bag, S., Telukdarie, A., Pretorius, J.H.C., and Gupta, Mayer.C.H, Oosthuizen.R.M 2022)	Lower cost Increased Machinery efficiency, New Value Offers with competitive advantage, Load balancing,High Quality, Stock Reduction
Environmental	(Berman 2012), (Saber & Yusff 2011), (Schmedit et al 2015), (Gabriel 2016), (Stock and Seligar 2016), (Ottmier and Hoffmann 2017), (Peukert .e.tal 2015), (Stock & Seligar2016)	Eco efficiency green efficiency

Source: Own Work

2.2 Industry 4.0 business practices

As per the previous studies [30] Mayer.C.H, Oosthuizen.R.M 2022 Industry 4.0 refers to different concept of business practices context for individuals in an industry:

- It is a Technologization process — Innovative tools & techniques implementation
- It is Job retrenchment — Leading to minimization of workforce

- It is Automatization — Training & Development of Employees
- It is smart systems — Human-Robot Collaboration
- It is Artificial Intelligence — Automated Optimized Streamlined and Customized
- It is Robot & Robotics — Human Intelligence

But the Sustainable Industry 4.0 (S.I 4.0) means all the above business practices with human touch, emotions, Cyber security and privacy of data in data handling and sharing which cannot be hacked or cloned for destructive uses.

2.3 Smart technologies of industry 4.0 (challenges)

The notion developed for Industry 4.0 in Germany 2011, was noted as a standard method of smart technologies creating a value chain industries with the integration of “Digital- Physical Systems (DPS)”, “ Internet of things (IOT)”, “Internet of Services (IOS)”, “Internet of People (IOP)” and “ Internet of Energy (IOE) [25] (Lom, Prebyl & Svitek, 2016)”. The fourth technological revolution is a challenge to automatization of digitized, and decentralized networks for efficient productivity and service reliability towards sustainable performance experience. Hence, these smart system digitized network needs skill enhancement of employees and continuous monitoring of environmental experiences for user adaptation and efficiency in a sustainable industry. Industry 4.0 versatile and flexible business patterns need to be user-friendly, eco-friendly, and budget-friendly to sustainable performance [40](Sony& Naik, 2019). Security and privacy of company policy with sharing data tools and techniques, users integrity experiences a big question for sustainable business organization.

2.4 Decision making in industry 4.0 (opportunities)

Industry 4.0 has a distinct effect from the factory floor to the top-level decision-making structures of firms influencing the whole value creation from horizontal to vertical transformations [27] (Lukoki, Varela, Machado 2020). Horizontal structures combine distinct stages of production and supply chain integration through digital transformation of materials, energy, and data within the firm at exponential speed and accuracy [24] (Liu, Chen, Liao, Mueller, Jentsch, Boener, 2015). While in vertical integration different smart devices on various hierarchical layers including human-robot collaboration, sensor adaptation, and controllers of various production and distribution systems [27] Lukoki, Varela, Machado 2020. Inventory management system (IMS) innovation tools (IOT/IOE/IOP/IOS) at various sections KIOSK, POS, RFID, Barcode scanner, and MIS to speed up the manufacturing & supply chain implementation at business practices planning levels[24](Liu, Chen, Liao, Mueller, Jentsch, Boener, 2015).

2.5 Sustainable industry 4.0

Sustainable industries are crucial factors for developing countries and considered as an engine to decide Environmental, Economic and social

empowerment. Industries should function in social collaboration for sustainable upliftment to compete for the market atmosphere [42](Tauob & Issor 2019). Industry performance is a developing idea in strategic management analysis [35](Raguseo & Vitari 2018) evolved as a dependent variable [35,] (Raguseo & Vitari 2018)(Lalic, Majstorovic, Marjanovic, Delic, Tesic,2017) by various challenges and opportunities of S.I 4.0 innovation. However, the existing literature presents limited empirical evidence to authenticate the effect of the Industry 4.0 technological revolution [20] Kamble Gunasekaran & gawankar, 2018. The study comprises of challenges and opportunities of Industry 4.0 technology revolution enablers and the final focus is on sustainable industry towards environmental, economic and social empowerment. Theoretical grounds for understanding the relationship of digital transformation and technological revolution between user expectations and adaptations are the study of TOE (Technology organization in the environment) and DOI (Diffusion of innovation) [3] (Arnold, Veile, Voigt, 2018) in sustainable experience. Technological revolution [18] Hassan, H., Tretiakov, A., and Whiddett, D. (2017) helps firms reconfigure and optimize their manufacturing operations contributing to sustainable performance, therefore, Dynamic Capability (DC) theory elucidates to sustainable firm experience.

3.0 Research Framework [Fig 2] and Hypothesis Development [Fig 3]

The technological revolution smart systems (challenges) and decision making(opportunities) of industry 4.0 following the theoretical grounds of TOE, DOI, and DC are employed to SEE (Society Economy and Environment) constructs in the research framework influence user experiencing sustainable industry performance(SIP).

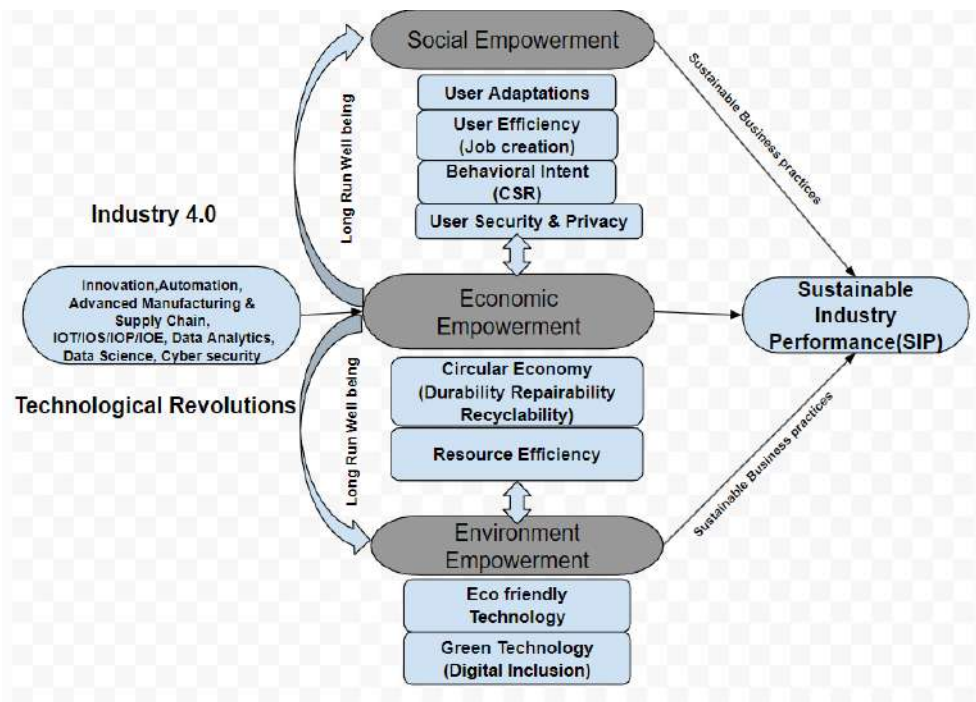
The authors present findings that showcase the mediating role[12,17,39] de Sousa Jabbour, A.B.L., Jabbour, C.J.C., Foropon, C., and Filho, M.G.(2018,) (Haseeb, Hussain, Kot, Androniceanu, 2019) Sony, M., & Naik, S. (2020). Of innovative tools in the fourth industrial revolution and sustainability issues are identified with digital speed, accuracy, and effectiveness in the environment, economy, and society. Findings also interpreted the human connection and emotional touch as key factors of technological revolutionary impact. The study further explores the research gap that sustainable business practices need continuous employee skill development[17] (Haseeb,Hussain,Kot, Androniceanu, 2019) and systematic integration of eco-friendly tools and techniques implementation in an organization as opportunities to challenges.

Accordingly, the study proposed the framework below to tackle the challenges and opt the opportunities for a sustainable industry and make every attempt to answer the research questions,

- Do the Smart systems (challenges) in the technological revolution significantly affect Society Economy and Environment (SEE) towards influencing sustainable industry 4.0 performance (SIP)?
- Do the Decision Making (opportunities) in technological advancements significantly affect Society, Economy, and Environment (SEE) towards sustainable industry 4.0 performance?
- To what extent economic empowerment influence society and environment towards sustainable industry performance in I4.0?
- Does innovative business practices of Industry 4.0 mediate the significant positive relationship between challenges and opportunities of sustainable industry?

The anticipated research framework in Figure 2 below will help illustrate these research questions by exploring the relationship between the challenges and opportunities of the technological revolution in Industry 4.0 towards sustainable Industry 4.0.

Figure 2: Novel Research Framework



Source: Own Work

The novel framework above of study under two context challenges and opportunities of Industry 4.0 affects the long-run well-being of society and environment influencing Economic Empowerment through various innovative business practices are presented in the following sections:

3.1 Social empowerment

The technological revolution has increased the digital complexity in society which is inorganic to be adopted. Another study [] (Yoon, Lim & Park 2020) put that industry 4.0 innovation tools would elevate effective user experience, and improvised employee skill development programs (ESDP) organized in the society with proper academic consultancy under Research & Development initiatives time and again. Companies adopting sustainable practices of training and development programs under CSR programs for digital inclusion in society and the environment. Organizations develop social connections to share the personal and financial details with digital service assistant (DSA) under digital transformation process execution[] (Buchi,Cugno,Castagnoli 2020).

Industry 4.0 enforces less manpower with an exponential increase in productivity and service efficiency but the reduction in workforce will lose human connections [] (Alshamaila, Papagiannidis & Feng 2020),. Reduction in social empowerment is the challenge to sustainable business organization. From the essential grocery supply chain to the energy distribution sector all are digitized and impacted by technical and complex data handling. Industry 4.0 technological revolution in economic productivity and service provision exponentially raised the user expectations that demanded industrial revolution 4.0 tools and techniques at the cost of privacy and security. But the ease of adaptations and efficiency leading to global collaborations and business expansions is the gap study, thus implies the following hypothesis as shown below Figure 3. Hypothesis Development (Source: Own Work)

H1a: Technological revolutions significantly not influence User adaptations in industry 4.0.

H1b: Technological revolutions significantly not influence User efficiency in industry 4.0.

H1c: Technological revolutions significantly not influence User Security and Privacy in industry 4.0.

H1d: Technological revolutions significantly not influence behavioral intention (CSR) in industry 4.0.

3.2 Economic empowerment

Adopting any new technology will be slow if not considered economic i.e budget friendly (2). Digital inclusions are not economic for business sustainability. For example, Advanced Manufacturing and Smart technologies in Industry 4.0 require significant job creation, skilled employees, and companies' corporate social responsibility toward sustainable business practices, leading to the adoption of circular economy principles of designing products for durability, reparability and recyclability. This budget-friendly economic approach minimizes waste and becomes positive for companies' sustainable development.

Moreover, the digital speed and accuracy of technologies such as IOT & Data analytics have employed resource efficiency in manufacturing processes. Similarly, in supply chain & distribution sector improvising the delivery time and grievance handling has increased the service efficiency in industry 4.0 leading to sustainable business practices. Economic factors resource efficiency and circular economy enable the industry to achieve sustainable firm by reducing waste, lower energy consumption and cost saving while adopting smart technology of industry 4.0. Relationship between smart technology adoption is discussed at the business level [] Ramirez-Correa, P.E., Rondan-Cataluña, F.J., and Arenas- Gaitán, J.(2015) rather at corporate level [] Maduku, D.K., Mpinganjira, M., and Duh, H.(2016). Inspired by the research gap this study investigates the relationship between circular economy and resource efficiency in sustainable industry performance hence the hypothesis Below [Figure 3. Hypothesis Development (Source: Own Work)] can be stated as follows:

H2a: Technological revolution significantly challenges the circular economy in Industry 4.0.

H2b: Technological revolution significantly not influence resource efficiency in industry 4.0.

H2c: Technological revolution significantly does not mediate the relationship between circular economy & resource efficiency in industry 4.0 performance.

3.3 Environment empowerment

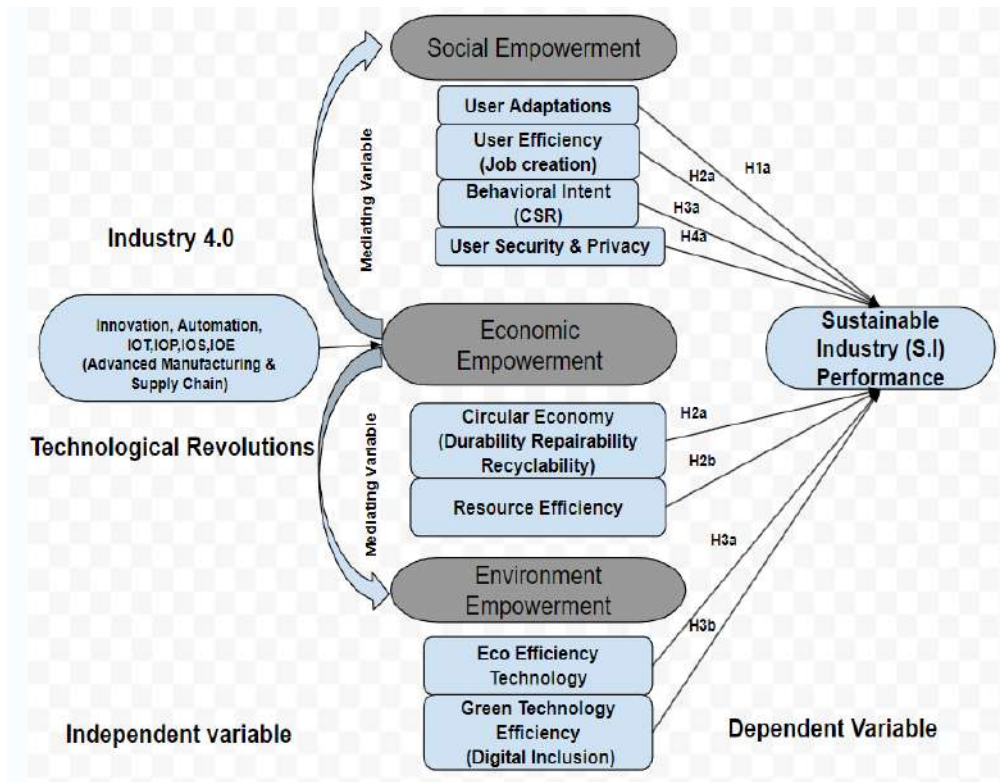
Technological environment such as open source data, cloud source lo code no code and Chat GPT are the tools and techniques of industry 4.0 The paradigm shift in the technical environment has given opportunities to business organization to speed up exponentially. Digital transformation has reinvented the user experiences in the distribution and supply chain of products and services at the doorsteps with few clicks. Technology convenience is raising the bar of digital inclusion day by day where economic empowerment are resource enabler to eco-friendly and green technology in Industry 4.0. Streamlining the environment with green technology will lead to implementing industry 4.0. These technical resources [] (Ally & Wark, 2019) are “organizational slack “ representing the availability of eco-friendly capacities and green technology demands in the industry 4.0 environment. Hence, associated hypothesis as below Figure 3. Hypothesis Development (Source: Own Work) is as follows

H3a: Technological revolution significantly not influence the Eco-friendly Technology in Industry 4.0.

H3b: Technological revolution significantly not opportune Green Technology in industry 4.0.

H3c: Technological revolution does not mediate the relationship between challenges and opportunities to sustainable industry 4.0.

Figure 3: Hypothesis Development



Source: Own Work

3.4 Technology & Tools Innovation (Revolution)

Intelligent systems In order to balance innovative business practices, demand and supply dynamics, and personnel rotation, an organization’s technological innovation is designed as an interconnected bundle of manufacturing processes. [1] (Hwang, Huang & Wu, 2016). Industry 4.0 also transforms manufacturing techniques as per economic requisite and environment experiences of social empowerment in managerial strategies [2] (Fay, Shipton, West & patterson, 2015). The study conducted [3] Ally, M., and Wark., N. (2019). Depicts the positive effect of innovation technologies in sustainable performance in Industry 4.0. The [4] Gault, F. 2018 The study also found that for a company seeking creative and sustainable assessment, it is simple to include environmental factors in product designs, production processes, and delivery services. Innovation pressure that industries experience from the peer firms are competitive pressure [26] (Low, Chen, & Wu, 2011) which further evolve as competitive edge towards sustainability.

3.5 Sustainable Industry Performance (SIP)

Automation, Smart systems, technology advancements, Human-Robot Collaborations Artificial Intelligence, and Robotics are various business practices

adopted in the training & development of employees, streamlining, and optimizing productivity towards a green economy and sustainable business performance (SIP). Mc. Kinsey survey stated that every single sector will be transformed depends on the type of transformation adopted. The transformation performance may be categorized as Accelerated: Augmented reality automation Differential: Less foundational computerized companies. Deferred: High Capital Technologies.

The ratio of these three adoption categories previously was 1:2:3 (Accelerated: Differential: Deferred) while in the last decade it has reversed in urban populations under the theory of dynamic capability (DC) and Diffusion of Innovation (DOI). Under, developed innovation campaign and smart systems of MSC Industry 4.0 are positively adopted with increased user efficiency.

- Technological rev. foster quality work culture to create competitive edge.
- Industry 4.0 holistic approach elevates transformation in capturing end-to-end value.
- Technological revolution encourages operational efficiency by exploring human skill gaps and development abilities.
- Encourage digital and automotive supply chain opportunities.
- Creating more jobs in distribution and grievance handling.

Digitally centralized ecosystem and real-time accessibility assists in the exclusion of slacks across the supply chain, resulting in optimized costing of inventory, and sales.

4.0 Research Methodology

The methodology quantitative study was undertaken in Delhi NCR suburban population of manufacturing and supply chain industry. Systematic Literature review based literature gap on sustainable business practices directed this study to undergo novel framework for the industries integrated with significant technological innovations (revolutions) in the context of Social, economic and environmental (SEE) empowerment in business practices. Among the technological revolutions of SEE contexts, Social empowerment (User Adaptation, User Efficiency, User Behavioral intent, and User privacy and security) directly test the industry's sustainable performance, whereas Economic (Circular Economy, Green Economy, and Digital Economy) and environmental empowerment (Technical environment, Economic Environment) test the mediating impact of industry 4.0 innovations to sustainable industry performances.

The study conducted the cross-sectional survey and the unit of study was manufacturing and supply chain (MSC) industry after digital transformation. The study underwent questionnaire survey using simple random sampling of 350 data from stakeholders of manufacturing and supply chain in Delhi NCR. For data analysis, structural equation modeling was done using AMOS ver. 26 PLS-SEM. The main focus of the study is on how employees use innovative technologies to promote

sustainable business practices and how fast I4.0 innovations are employed to increase sustainability through human-technology interaction. Workers view Industry 4.0 business methods as a positive and effective means of improving workers' abilities toward a deeper and more comprehensive comprehension of intricate organizational and technological processes.

4.1 Data Collection and Analysis

Self administered Google form questionnaire was prepared with respective stakeholders in manufacturing and supply chain industry (Manufacturer, Distributor, Vendor, User) for primary data collection. Further the questionnaire was send to respective experts of automation and innovation domain to finalize the sustainable aspects of the three constructs society, economy and environment challenges and opportunities. Moreover for secondary data publications of approx 50 manufacturing and supply chain industry of Delhi NCR was under descriptive study to analyze their production distribution and consumption of productivity.

We did conduct face validity of users for various innovative terminologies in business practices. Finally to ensure the measuring instruments Validity & Reliability test on 352 stakeholders was successfully done. We computed Cronbach Alpha for all the items of three constructs Social Economic and Environmental (DV) and Industry 4.0 Technological revolution (IDV) towards Sustainable Industry performance (SIP). Confirmatory Factor Analysis (CFA) was done to validate the survey instrument on all the construct items to assess the measurement model. IBM SPSS AMOS (version26) was used to test convergent validity and discriminant validity.

Examining the standardized factor loading, composite reliability, and the Average Variance Extracted (AVE) tested the convergent validity of constructs. The results of the convergent validity test, Composite reliabilities values for all items were more than the threshold value of 0.7, which highlighted the adequate reliability of constructs (Fiske, Henington, 2019). According to Hair, Black 2006, acceptable value is 0.7 or greater, and the table clearly reflects in this study that standardized factor loadings were greater than 0.7 for each construct items. All construct values of the AVE calculated using Std. factor loadings were also greater than 0.5, which met the minimum requirement. (Gefen Straub, 2018).

These measures indicated that the convergent validity of the measurement model was acceptable. Under the discriminant validity test of the constructs all the diagonal values (the square roots of the AVEs) were greater than 0.7 and exceeded the correlations between any pair of constructs (Fornell, Tellis, Zinkhen 1982). The above statistics indicates that the novel framework model fulfills the requirements of discriminant validity, and it is assumed that the model also having has adequate discriminant validity. Multicollinearity was checked by computing the Variance Inflation Factor (VIF) and tolerance values for the predictor variables as correlations among constructs were not highly noticeable.

4.2 Hypothesis result

1. User Adaptability and user Efficiency Foster quality culture to create competitive advantage.
2. User Privacy & Security implement holistic approach to transformation to capture end-to-end value.
3. Circular Economy in Industry 4.0 boosts operational health by identifying skill gaps and building capabilities and resource optimization.
4. Resource efficiency leverage digital and autonomous supply chain opportunities Industry 4.0.
5. Innovative automation and human robotic under CSR creates more jobs in distribution and grievance handling towards sustainable practices.
6. Eco efficiency and green technology efficiency of Digitally connected ecosystem and real-time visibility assists in the removal of silos across the supply chain, resulting in lower costs, smaller inventories, and fewer lost sales.
7. Green Technology efficiency enabling data-informed actions in production and the broader end-to-end value chain.
8. Eco efficiency and user efficiency realizing improvements across performance indicators, such as cost, agility, convenience, and quality.

5.0 Findings & Conclusion

- Innovative technological innovation and the application of Industry 4.0 tools and techniques, including automatization, artificial intelligence (AI), smart devices, human-robots, and robotics, are conducive to sustainable business practices in the industry.
- To implement I4.0 in a sustainable manner, workforce development training, employee skill development programs, and automation under CSR activities are needed.
- To develop a sustainable I4.0 business practice, sustainable viewpoints on the economy, society, and customer empowerment must be combined.
- Managers are aware that sustainable practice has two factors that need to be addressed and requires a good and constructive mindset.
- Seek context-appropriate speed, accuracy, and technical advancements.
- Build staff capacity for sustainable practices.
- Companies are seen as sustainable when they create their own private social economies, establish quick fixes, encourage employee innovation, support education and training, safeguard the environment, and grow as a business.
- The theoretical definition of I4.0 sustainable performance includes innovations, efficiency, and corporate social responsibility initiatives.

The above conclusions obviously close economical industry is coordination of innovation and the strategic approaches. The representative ability improvement and preparing would upgrade the asset and natural productivity of being inventive and progressed. The expected model characterizes hypotheses of advanced changes for TOE (Technology, organization and Environment) direct impacting the maintainability in I4.0, whereas (dissemination of development) DOI and DC (Dynamic Capability) is intervening mechanical upheavals of Open Source, Cloud information, C code, No code, Chat GPT, computer based intelligence/VR and so on to supportable execution in business rehearses.

However significant, innovations are inadequate to convey the all encompassing I4.0 changes important to accomplish long haul social and natural maintainability. Thus, future examination can be embraced on: How empowering modern advancement can essentially alter the manner in which business associations work to guarantee long run manageability in I4.0? Extensive variety of partner interests, including the economy climate and society would be under Manageable plans of action (SBMs) thought. Further examination proposals remember investigation of manageability for explicit socio-social settings. To grasp the nearby, social, and context oriented drivers of the I4.0 strategic policies Multifaceted.

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CHAPTER 8

A Study on Changing Paradigm in Higher Education and Students' Satisfaction Level towards E-Learning

Himanshu Mathur¹

ABSTRACT

In our lives, we are required to adjust our attitude, perception, way of working, and mindset according to the changes. Before COVID-19, people were enjoying social gatherings & parties and were living their lives happily. This crisis period adversely affected the economy but on the other side, individual or business entities started Work from Home or Remote Work. Education institutes started online classes for the sake of the interest of students. Students were used to face-to-face classes and suddenly shifted to online classes, which was a major change in their lives. The objective is to know the satisfaction level of students with online classes. Fundamental and analytical research was used. Primary Data was used by a questionnaire of 37 Respondents. Parameter - Convenience, Time Saving, Communication, E-Notes, and Software Issues etc. According to the survey, it was concluded that online learning saves time but is not better in comparison to traditional classes and it was not at par on the basis of various factors like software issues; E-Note, Understanding, and trust in software are considerable factors. For improvement, Instructors should check the attention level of students and proper training should be given to both instructors and students for smooth conduction of online learning.

Keywords: Covid-19, Education, Online Class, E-Learning, Student Satisfaction, Softwares.

1.0 Introduction

Change is a part of our lives. Changes come in our lives either by our wishes or by force. Sometimes, we have to adapt to change for survival. We have to face problems with enthusiasm and find new ways of working to beat negative situations. COVID-19 was declared a pandemic and to reduce its impact, the government adopted a lockdown. Many companies were using work from home method and in the recent scenario; it become a new working style. COVID-19 also affected the Educational institutes to an extreme level. Online teaching was adopted as a solution for this situation. Many institutes were shifting from traditional classes (Face-to – Face) to Modern techniques (Online Classes).

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As a result, the quality of online classes emerged as a silent concern for colleges or schools. It was a turning point in education history and a number of institutes are providing the facility of certification courses through online classes. The level of involvement of the student in online classes and their satisfaction level is an indicator of their academic performance and achievement. Online learning is a combination of the internet and some software or application to disseminate knowledge or deliver education to students. It is also referred to as E-Learning and E-Classes. Zoom, Google Meet, MS Team, and Livestrom, etc. are some online teaching software's available in the market.

1.1 Advantages of online learning

1. Online learning provides you with flexibility. You can use the LMS portal of the institute which has recorded lectures or notes at your connivance.
2. Online learning is a source for improving your technical knowledge. You can get knowledge of how to handle different softwares and hardwares.
3. Earn while learning. Online learning helps you to earn money while studying. In the case of online learning, physical college or school does not exist. In case, if working professional and cannot give time in the morning, then you can use recorded lectures for completion of course.
4. Online learning improves communication skills. It helps build a network with other students and instructors from different cities, states, and countries that have different cultures, perceptions, and thinking.

1.2 Disadvantages

1. One of the biggest challenges for online education is to focus on the screen for a longer time. With online learning, there is a higher chance of distraction to social media.
2. Online classes depend upon internet connectivity. Constant and fast speed internet is required for online classes otherwise student or teachers has to suffer.
3. In the case of physical classes, there is face-to-face contact between teachers and students as well as among students. It improves communication skills and sense of togetherness but in case of online class, there is lack of proper communication and student feels sense of isolation.

2.0 Review of Literature

Review of literature is used to see the research gap. Before doing research, it is necessary for researcher to read all the published research and then formulate objectives which is new to the society. Sitara, Vikas, & Saini, Jatin, 2013 – The authors did their study on paradigm shifts in education triggered by technology. In his research paper, he told about various developments of new learning paradigms in education and how new technology affects. The study results showed that the

emergence of new technology in teaching has a significant impact on traditional classes and it is helpful to improve the educational environment.

Charles, Dziuban, Patsy, Moskal, Jessica, Thompson, Lauren, Kramer, Genevieve, DeCantis, & Andrea, Hermsdorfer, - The authors did their study on Student Satisfaction with Online Learning: Is it a Psychological Contract? The research objective of their research study was to know the relationship between student satisfaction and online learning mode. They used a trait model and the study was carried out on the basis of three factors namely engage learning, agency, and assessment.

Yu-Chun Kuo, Andrew E. Walker, Brian R. Belland, and Kerstin E. E. Schroder 2013, the authors did their research study on A Predictive Study of Student Satisfaction in Online Education Programs, and the objective of the research study was to find out the level or degree of which interaction and other factors contribute towards student's satisfaction in online learning mode. He used regression analysis and the result showed that student-teacher interaction, student-content interaction, and internet self-efficacy were good variables of student satisfaction whereas interactions among students and self-paced learning are not considerable variable for contributing to student satisfaction.

Long Pham, Yam B. Limbu, Trung K. Bui, Hien T. Nguyen & Huong T. Pham, 2019., the authors did their study on Does E-Learning service quality influence e-learning student satisfaction and loyalty? Evidence from Vietnam. The objective of study was to analyse the relationship among e learning service quality attributes, overall e learning quality service and student loyalty in context of e learning. He used 1232 college student for study and used factor analysis. The results of study shows that e-learning service quality was a second-order construct which consists of three variable, namely, e-learning system quality, e-learning instructor and course materials quality, and e-learning administrative and support service quality.

Kumar, Pavan, The author has done a study on Impact of online learning readiness on student satisfaction in higher education institutions. The objective of the research study was to know the association between learners' readiness and their satisfaction level towards the online learning. He used five dimensions of OLRS scale (CIS, OCS, SDL, ML, and LC) and checked whether the above-said dimension will independently affect the student's satisfaction level with online learning? He collected data from 155 students who are studying an under graduate program in Indian University. The result found a positive relationship between readiness and student satisfaction.

3.0 Research Methodology

Research Methodology is helpful for the researcher to formulate research problems, objectives and present their results with the help of the data collected and test applied for the research study. Research methodology consists of research design,

data collection, sample selection, and various statistical methods and tests for analyzing data to obtain result.

- **Research Problem:** During COVID-19, every company has changed their working method from physical mode to remote working, and the education sector also fell under this category. This decision was for protecting the interest of student so that study not affected. According to Swami Vivekananda 'Education refers to the process by which character is formed, strength of mind is increased, and intellect is sharpened, as a result of which one can stand on one's own feet'. As it is an age of information technology, from our daily routine life to official work, we are dependent on IT. The role of IT cannot be ignored at any cost. The vast impact of Information and Communication Technology (ICT) on education is one of the big achievements of the 21st century and now it has changed the paradigm of the education sector. Every technology has some positive and negative points and nowadays, the world is working on the internet, and applying ITC in education is helpful to some degree but there are also negative points associated with it. So, the research objective of this study is to know the satisfaction status of students in connection with online learning.
- **Type of Research:** This research study is a combination of fundamental and analytical research. Fundamental research refers to the research which aims to get develop basic knowledge about any topic. Analytical research means a researcher collects some data makes interpretations from it and gives results.
- **Objective:** To know the satisfaction level of students towards E-Learning.
- **Data Collection:** The present study is based on primary data. Primary data is a type of data which are collected for the first time and are fresh in nature. For the purpose of data collection questionnaires technique was used. A Questionnaire is a tool of research that is used to get information by asking various question related to research.
- **Methodology:** After the collection of data, consolidated information was arranged in a tabular manner and shown in Pie Chart for effective visualization.
- **Sampling:** Random sampling was done for study purposes. Total 37 responses received from students for study and all students were from college and university of UG/PG class.
- **Limitation:** The outcome of the study purely depends upon the responses received form samples. Samples were collected from one single college.

4.0 Analysis and Interpretation

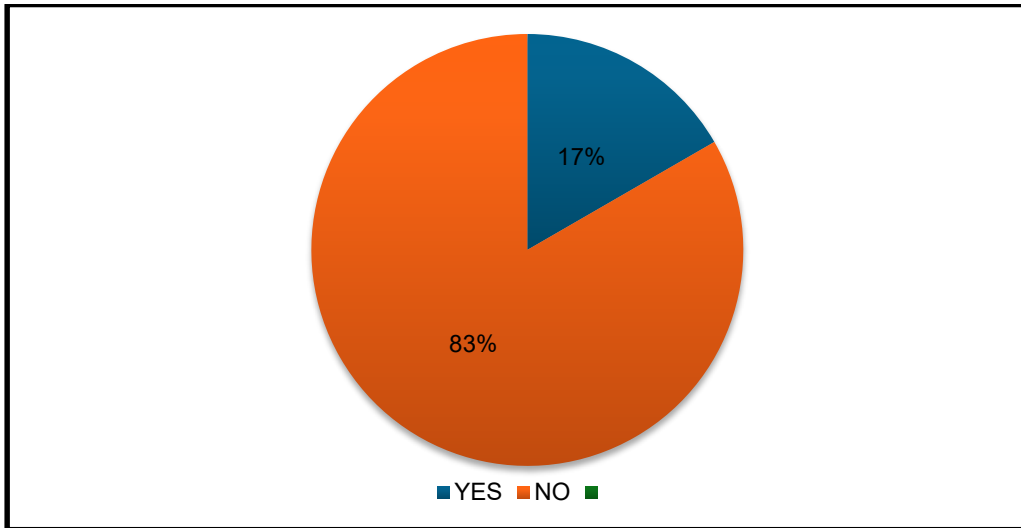
Data analysis and interpretation can be defined as process of finding meaningful information from collected data and determine the conclusions, significance and suggestion related to study. The following questioner was used for the fulfillment of research study and the data is private. Reponses were as follows:

1. Do you have any experience of online classes before COVID-19?

Table 1: Experience of Online Class

YES	6	17%
NO	31	83%
Total	37	100 %

Figure 1 Experience of Online Class



Interpretation – The above table and pie chart show the responses toward the experience of attending online classes before COVID-19. It shows that out of 37 samples, 6 have attended online classes before COVID-19 whereas 31 students have not attended online classes.

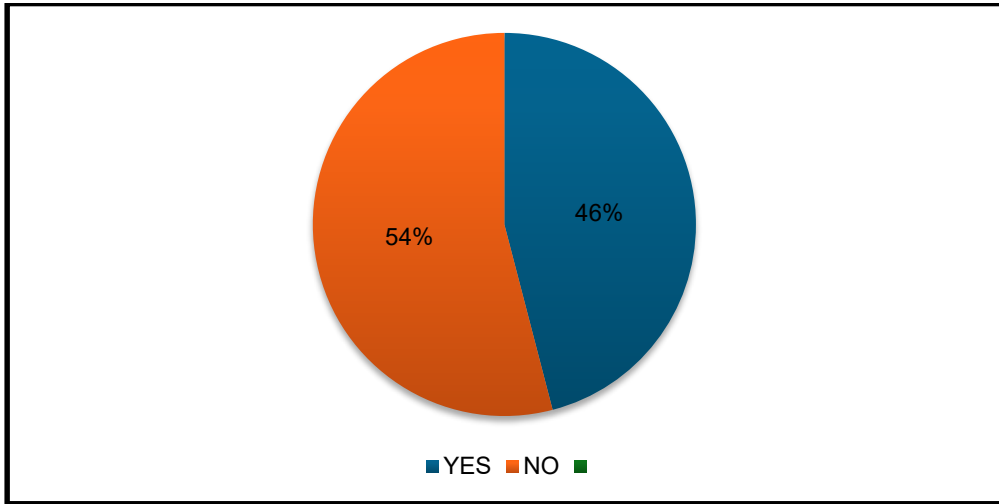
2. If, you are attending online classes, do you feel, it is a convenient method of teaching for students?

Table 2: Convenient Method for Study

YES	17	46%
NO	20	54%
Total	37	100 %

Interpretation – The above table and pie chart show the responses towards the convenience of online classes. It shows that out of 37 samples, 17 students said it is a convenient method of teaching whereas 20 students are not in favour that it is a convenient method of teaching.

Figure 2: Convenient Method for Study



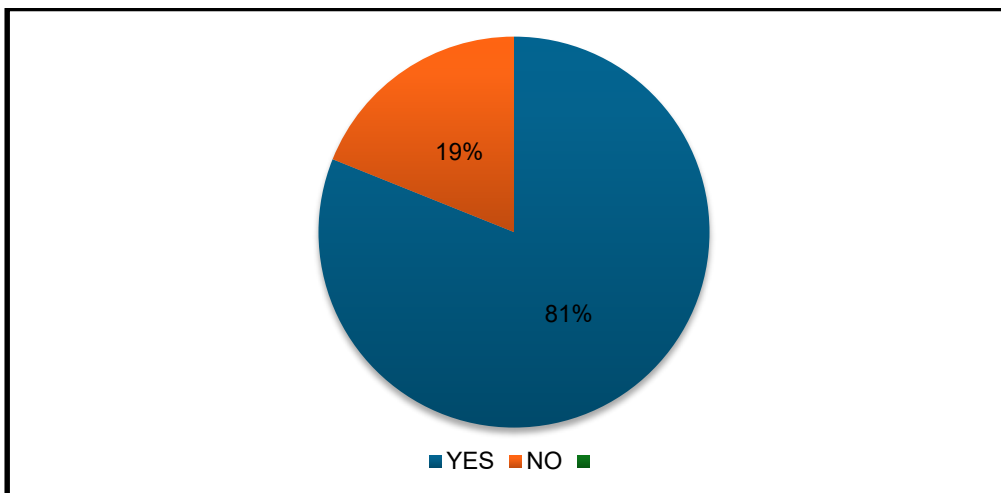
Sources: Primary Data

3. Have your college/university updated you about various software and mobile applications for online study?

Table 3: Awareness about Online Study

YES	30	81%
NO	7	19%
Total	37	100 %

Figure 3: Awareness about Online Study



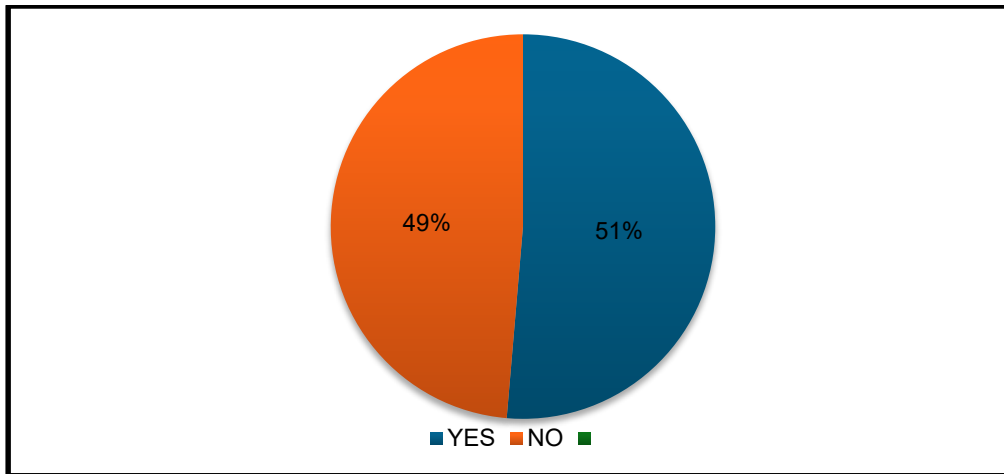
Interpretation – The above table and pie chart show the responses towards providing knowledge about online learning’s software and applications. It shows that out of 37 samples, 30 students said that college and university gave them proper information about software whereas 7 are not in favour of it.

4. Is there any effective interaction and communication during online classes between student and teacher?

Table 4: Effective Communication

YES	19	51%
NO	18	49%
Total	37	100%

Figure 4: Effective Communication



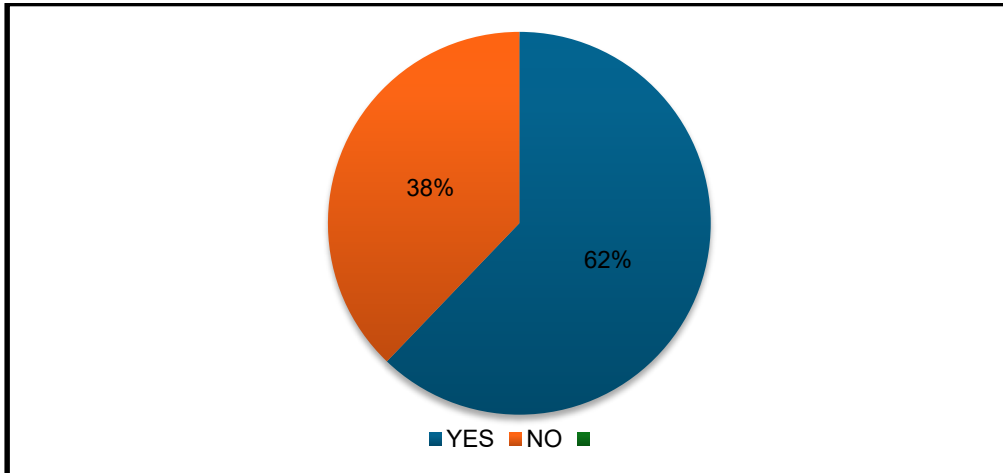
Interpretation – The above table and pie chart show the responses towards the effectiveness of communication in online teaching. It shows that out of 37 samples, 19 students said that during online teaching, they have effective interaction and communication with instructor whereas 18 students face problems in it.

5. Are you able to understand concept of topic through online study?

Table 5: Clarity of Concept through Online class

YES	23	62 %
NO	14	38 %
Total	37	100%

Figure 5: Clarity of Concept through Online class



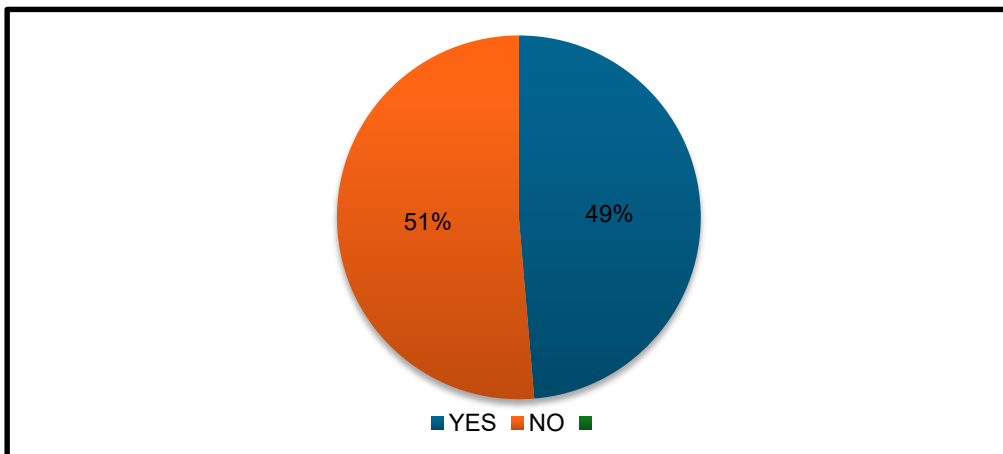
Interpretation – The above table and pie chart show the responses toward the clarity of the subject topic through online classes. It shows that out of 37 samples, 14 said that during online teaching, they are facing issues related to the clarity of concept of the topic, whereas 23 students are able to understand the same.

6. Are you feeling/facing any problems while attending classes of practical subjects like maths and accounting?

Table 6: Problems during online class for Practical Subject

YES	18	51%
NO	19	49%
Total	37	100%

Figure 6: Problems during online class for Practical Subject



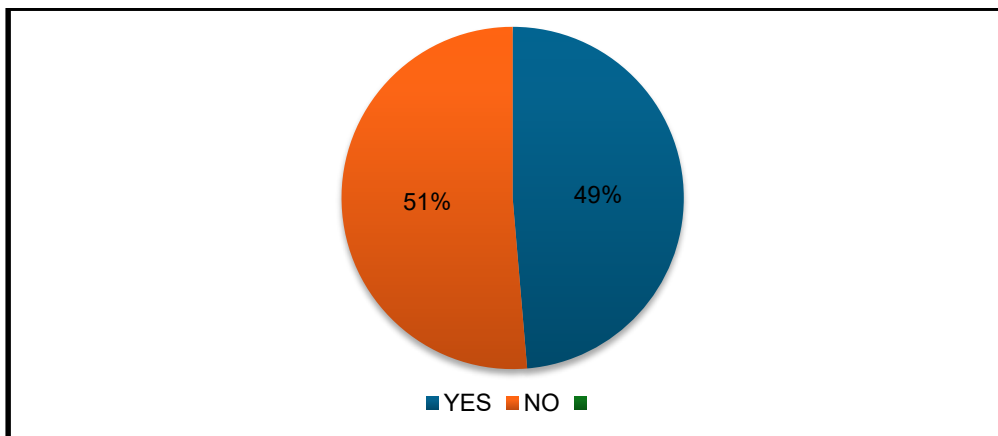
Interpretation – The above table and pie chart show the responses towards the conduction of practical subjects like maths and accounting through online classes. It shows that out of 37 samples, 18 said that during online teaching, they can understand the numerical question, whereas 19 students are unsatisfied and not able to understand these subjects.

7. Is online class helpful in solving your quarry related to subjects during class effectively?

Table 7: Effectiveness of Online Class during Class

YES	18	51%
NO	19	49%
Total	37	100%

Figure 7: Effectiveness of Online Class during Class



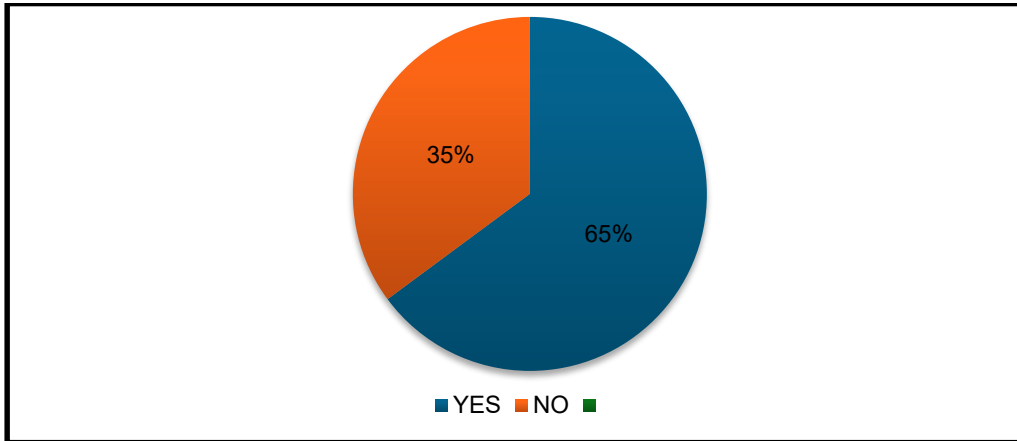
Interpretation – The above table and pie chart show the responses towards the effectiveness of problem solving during an online class. It shows that out of 37 samples, 18 students said that online teaching is helpful in solving quarry during class whereas 18 students are unsatisfied and not able to solve their quarry through online class.

8. Is it possible to sustain a balance between your personal life and online study from home?

Table 8: Balance of Working Life and Online study

YES	24	65%
NO	13	35%
Total	37	100%

Figure 8: Balance of Working Life and Online Study



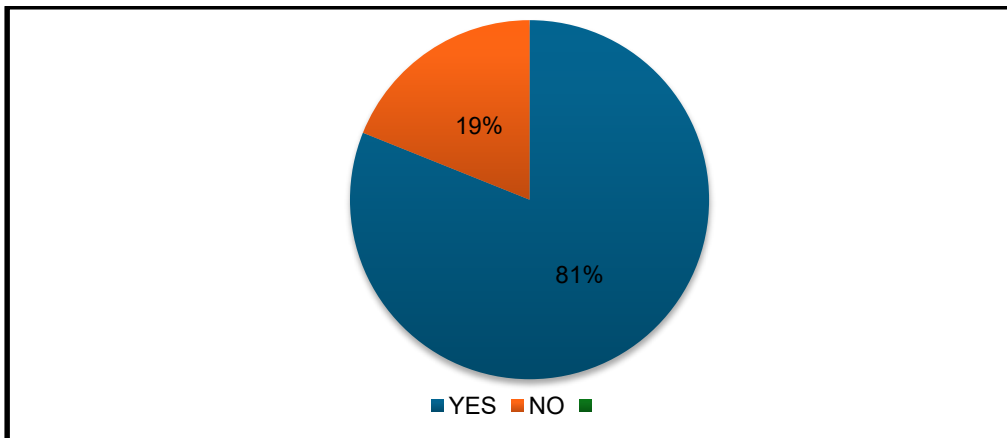
Interpretation- The above table and pie chart show the responses toward the balance between online study and personal life. It shows that out of 37 samples, 24 students said that during online teaching, they can maintain balance whereas 13 students are saying that there is low correlation between your personal life and online learning.

9. Do you face technical glitches during online classes like network/software?

Table 9: Technical Glitches

YES	30	81%
NO	07	19%
Total	37	100%

Figure 9: Technical Glitches



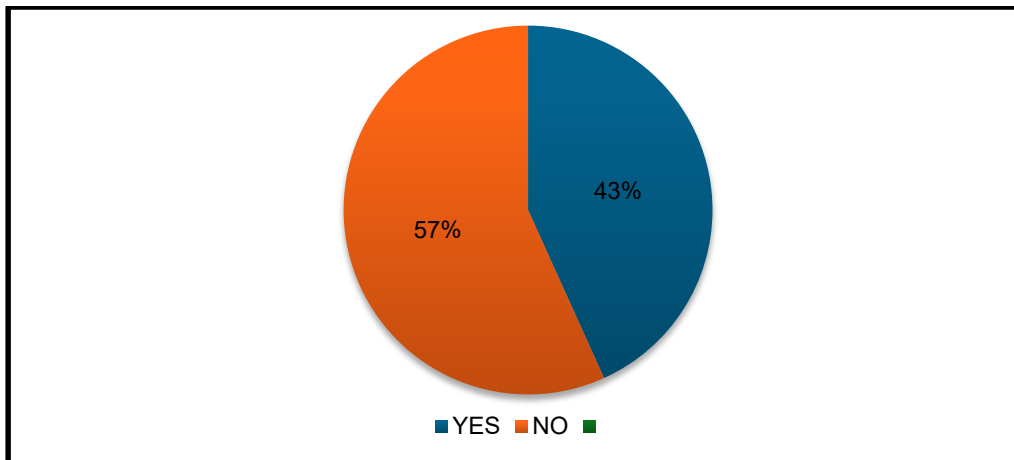
Interpretation- The above table and pie chart show the responses towards facing technical issues during online classes. It shows that out of 37 samples, 30 students said that they faced technical and software issues and 07 students did not face any issue related to it.

10. Do you think that due to online classes, there is any improvement in your skill, whether it is related to communication, technical, confidence, & etc.?

Table 10: Improvement in Skill

YES	16	43%
NO	21	57%
Total	37	100%

Figure 10: Improvement in Skill



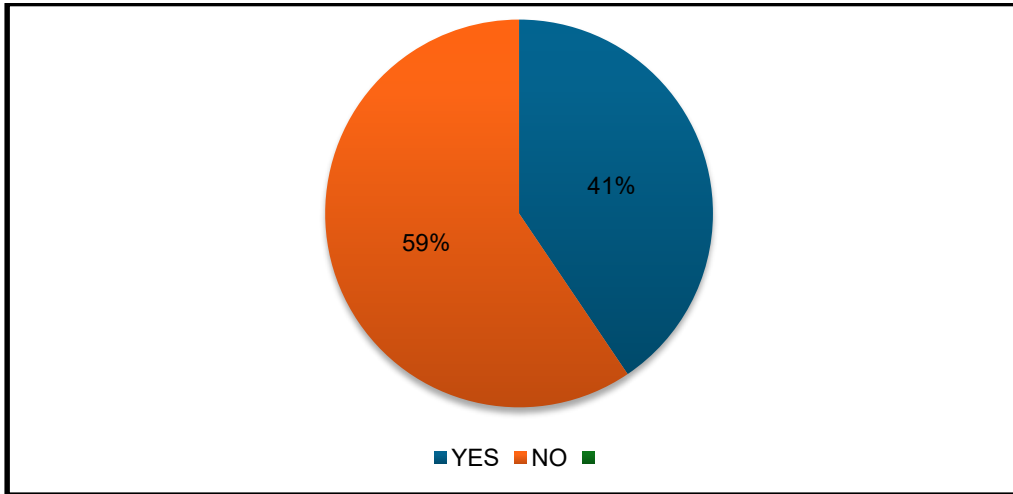
Interpretation- The above table and pie chart show the responses towards improvement in any skill related to communication and confidence during online classes. It shows that out of 37 samples, 16 students felt improvement in their communication and confidence level, but on the other side, 21 students did not feel any kind of improvement.

11. Do you have trust in software or mobile application adopted for online teaching?

Table 11: Trust on Software

YES	15	41%
NO	22	59%
Total	37	100%

Figure 11: Trust on Software



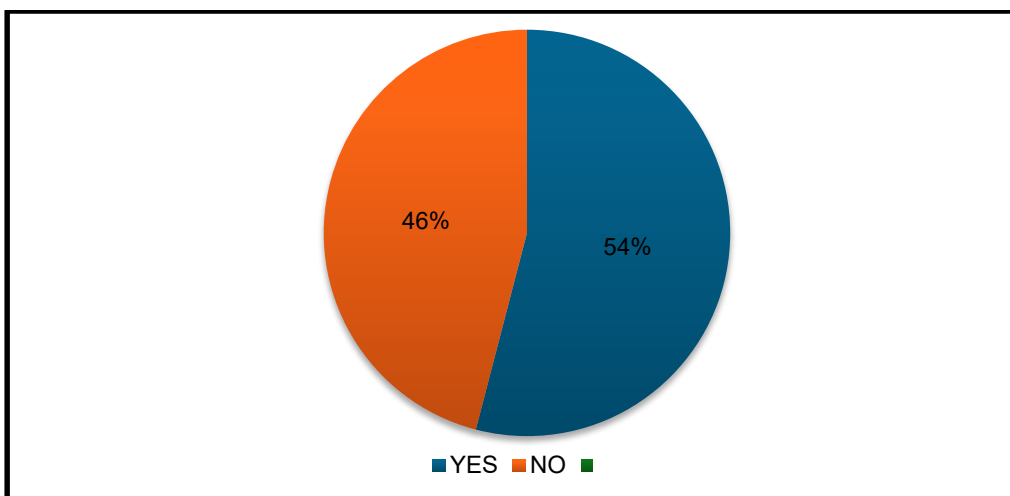
Interpretation- The above table and pie chart show the responses toward the level of trust in mobile applications and software. It shows that out of 37 samples, 15 students have trust in software used for online teaching whereas 22 are against it.

12. Do you feel that an online class can save yours time?

Table 12: Time Save

YES	20	54%
NO	17	46%
Total	37	100%

Figure 12: Time Save



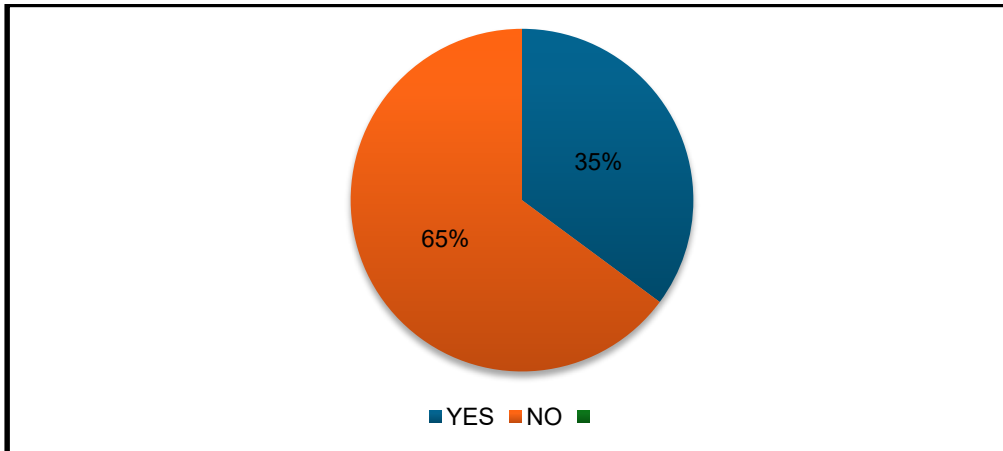
Interpretation- The above table and pie chart show the responses towards the time saved due to online classes. It shows that out of 37 samples, 20 students said that online study helps save time whereas 17 students are not in favour of the same.

13. Do you agree that online study material (PPT, E-notes, and Video Lecture) material is more enriched in comparison to hand-written notes?

Table 13: Online Study Material

YES	13	35%
NO	24	65%
Total	37	100%

Figure 13: Online Study Material



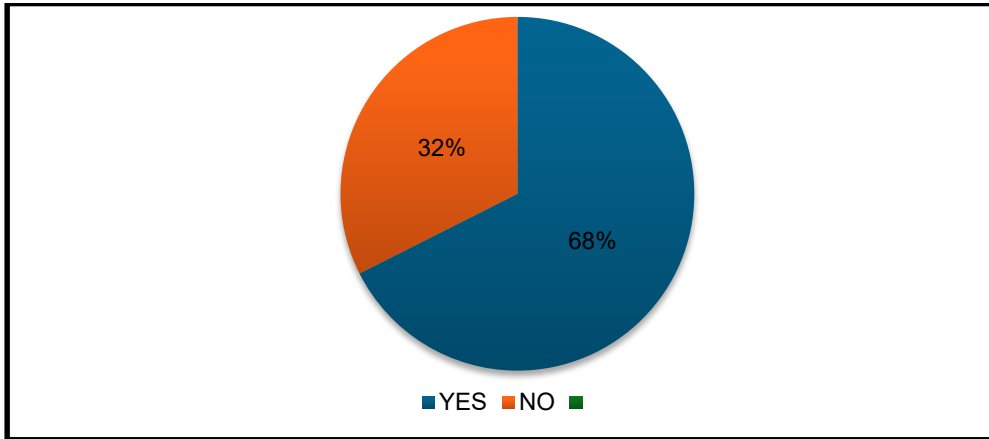
Interpretation- The above table and pie chart show the responses toward the comparison between handmade notes and e-notes. It shows that out of 37 samples, 13 students are saying that online study material is helpful and better in comparison to handmade notes whereas the majority of students 24 are saying that handmade notes are better.

14. Do you think, is it right step taken by government to conduct online class in the interest of student.

Table 14: Efficiency of Government Step

YES	25	68%
NO	12	32%
Total	37	100%

Figure 14: Efficiency of Government Step



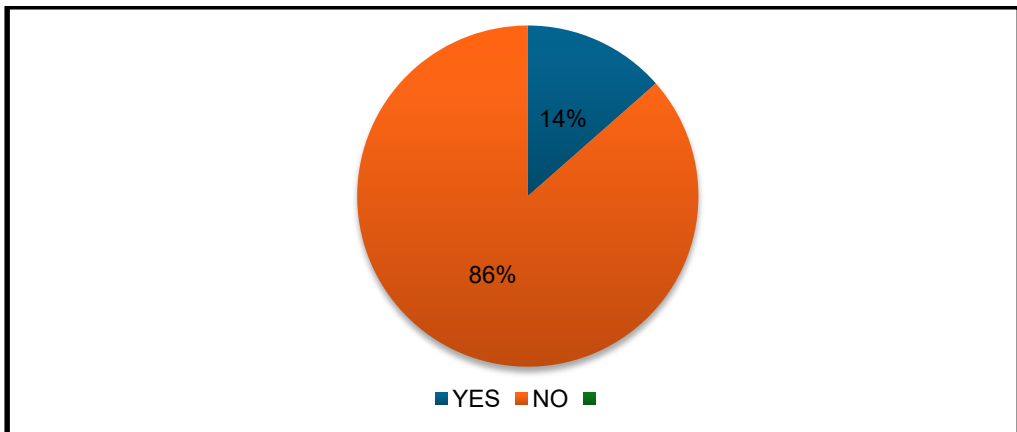
Interpretation- The above table and pie chart show the responses towards the government’s steps for the online classes. It shows that out of 37 samples, 25 students are accepting that the government has taken notable steps for online study whereas 12 students are not in favour of this action of government.

15. Do you think online teaching system is good in comparison to traditional teaching method like chalk duster system.

Table 15: Comparison of Online Study and Traditional Study

YES	5	14%
NO	32	86%
Total	37	100%

Figure 15: Comparison of Online Study and Traditional Study



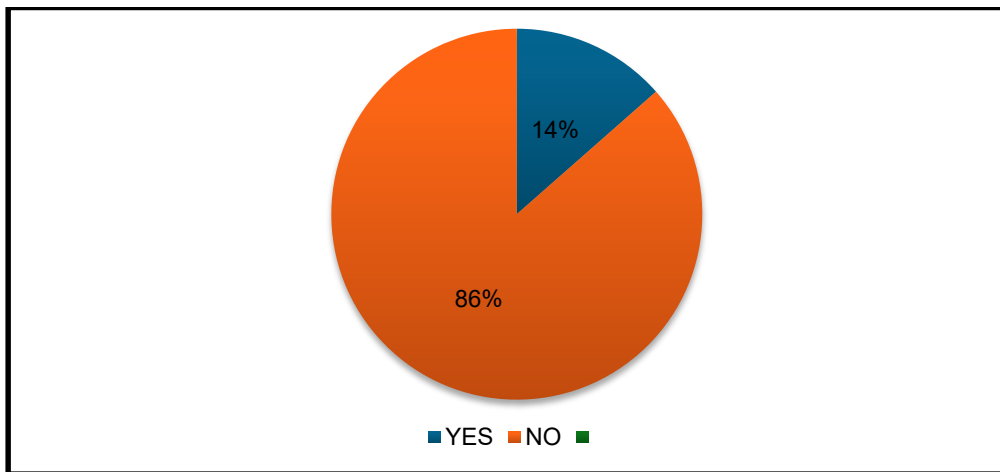
Interpretation- The above table and pie chart show the responses toward the comparison between classroom teaching and online classes. It shows that out of 37 samples, 32 students said that classroom teaching is better than online classes whereas 5 students are in favour of online classes.

16. As only for suggestion purposes, do you consider the online system as would better option for the conduction of the exam?

Table 16: Online Exam Conduction

YES	10	20%
NO	27	80%
Total	37	100%

Figure 16: Online Exam Conduction



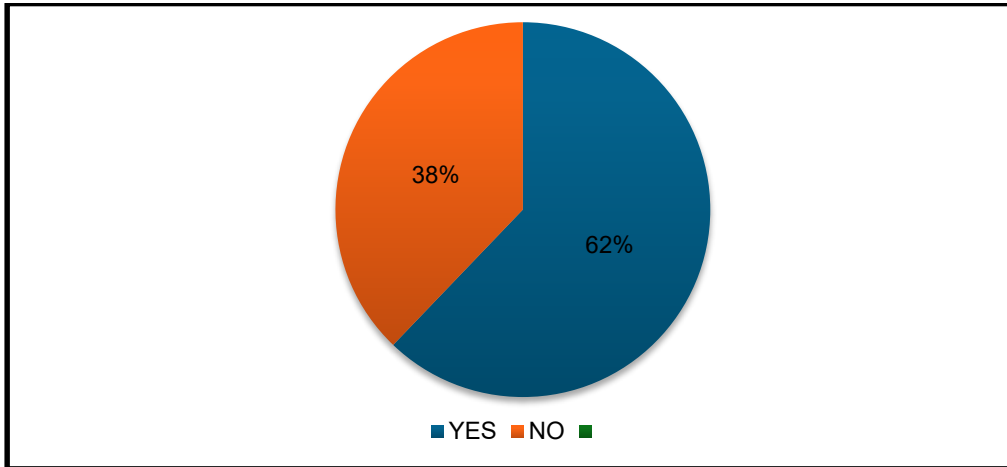
Interpretation- The above table and pie chart show the responses towards the online conduction of the exam. It shows that out of 37 samples, 27 students are not in favour of online exams whereas 10 want that online exams should be conducted.

17. Do you agree that E-learning is a new style of learning that can be adopted for the future also?

Table 17: Future of Online Learning

YES	23	62 %
NO	14	38 %
Total	37	100%

Figure 17: Future of Online Learning



Interpretation- The above table and pie chart show the responses toward the future of online exams. It shows that out of 37 samples, 23 students want that online classes should be the new method of learning but 14 students are against of it.

5.0 Findings and Conclusion

The Online class was a great step taken by the government for the interest of students and also appreciated by students. It is also necessary for us to make some adjustments according to changes in time and demand by time. During COVID-19, it was difficult to do work physically and social distancing was the only single method to get protection from this virus. The Lockdown was also a great initiative taken by the government for the safety of people and working from home was the best strategy during this crisis period. The Government made a combination of IT and education which is used first time in most universities and colleges and may be followed in the future also but it depends upon its success. This study was done to know the impact and effectiveness of online classes on student satisfaction. The sample of 37 students of college and university has been taken and some questions related to E-learning have been asked to them.

Reponses were as follows:

Question	YES (%)	NO (%)
Do you have you any experienced of online class before COVID-19	17	83
If, you are attending online classes, do you feel, it is convenient method of teaching for student?	46	54
Have your college/university updated you about various software and mobile application for online study.	81	19
Is there any effective interaction and communication during online classes between student and teacher?	51	49

Are you able to understand concept of topic through online study	62	38
Are you feeling/facing any problem while attending class of practical subjects like maths and accounting?	51	49
Is online class helpful in solving your quarry related to subjects during class effectively?	51	49
Is it possible to sustain a balance between your personal life and online study from home?	65	35
Do you face any technical issue during online classes like network issue/software related issue?	81	19
Do you think that due to online classes, there is any improvement in you skill, whether it related to communicate, technical, or confidence, etc.?	43	57
Do you have trust in software or mobile application adopted for online teaching?	41	59
Do you feel that online classes as a tool which can save yours time?	54	46
Do you agree that online study material (PPT, E-notes, and Video Lecture) material is more enriched in comparison to hand-written notes?	35	65
Do you think, is it right step taken by government to conduct online class in the interest of student.	68	32
Do you think online teaching system is good in comparison to traditional teaching method like chalk duster system.	14	86
As only for suggestion purposes, do you consider the online system as would better option for the conduction of the exam?	20	80
Do you agree that E-learning is a new style of learning that can be adopted for the future also?	62	38

From the above given table, it can be concluding that:-

1. Out of total 37 students, 83% of total student did not experience online classes before COVID-19.
2. The above table shows that higher ratio of total students are against online classes on the following parameter:
 - Students are not in favour that online learning is Connivance method of teaching. It may be due to new experience, requirement of high speed of internet and knowledge of software for class.
 - Students are not able to understand the subject like maths or accounting through online mode. Numerical subjects require more attention and in the case of online classes, there is a chance for distraction which may reduce the quality of results and clarity of the subject.
 - They are facing technical issues while using online learning software which may create frustration in their mind. If anyone has no proper knowledge about the working of software like for example, if you are not able to share screen, not able to turn on camera or audio, it may create hurdle for them.
 - Students don't have trust in video conferencing applications or softwares due to fear of losing of personal information.
 - They think class or handwritten notes are better in comparison to online notes. E-Notes are easy to make but handmade notes require mental activity and more time which is fruitful for the future.

- Students think online mode is not better for exam conduction. Connectivity, and servers are crucial parts of online exams and typing speed is required for online exam. No matter what type of exam is going whether online or offline, cheating take place but in case of online, there is more chance of fraud like screen sharing, and using extra system for searching answer.
- Online classes are not effective in comparison to traditional class for problem solving. Students are able to concentrate on typical topic due to less distraction.
- Other than the above-said factors, student showed positive response for online learning like online classes are helpful to save time and also helpful to maintain a balance between work life and personal life. So these two factors are in favour of the online mode of class.
- In nutshell, it can be concluded that online classes are not at par based on various factors used for the study which showing low satisfaction level of student's toward E-Learning. It may be due to the less knowledge or experience of online classes and some time, it is difficult to adapt to change within a shorter period of time. Some human beings need time to adjust themselves according to change and some are flexible and cope up with change within a short span of time.

6.0 Suggestions

Improving and enhancing student satisfaction level in online learning is important. It is essential to acquaintance about various factors which affects student's mentality and satisfaction level. The followings suggestions should be taken for the same.

1. Every instructor should ensure that each participant camera is open.
2. The Instructor should ask question to students with particular time intervals which helps to know attention level of students.
3. Students should attend classes with full honesty because compared to traditional classes; there is low strictness in online classes.
4. Proper training related to video conferencing software should be given to students and instructors to avoid some ambiguity.
5. Instructors should try to conduct webinars or collective meetings for discussion issues related to online classes.
6. Every Instructor should have updated teaching material, and use creative and attractive PowerPoint presentations including real-world examples, blogs, and videos to maintain the attention of students.

7.0 Further Scope of Study

The present study is confined to only a sample related to one college. The outcome of the research study cannot be applied to another sample. Further, research study may also consider the prospects or viewpoints of teachers, policymakers, and students to have a more generalized result. The responses were collected only from

single college so there is an also scope to collect data from various other college and institutions from various states, and countries which can provide more genuine results. The satisfaction level of the students also affects their performance. This can also be included in future research studies.

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CHAPTER 9

Exploring the Indian Software Industry: Reviewing Present Realities, Challenges and Upcoming IT Trends - A Literature Overview

Ajay Bhosale¹ and Sajid Alvi²

ABSTRACT

Since 1991-1992, significant government assistance has propelled the exports of IT/ITes units. Presently, India's software industry is a cornerstone, providing services to various sectors for smarter and more efficient product development and aiding the government in delivering cost-effective, intelligent services. Contributing 7.5% to India's GDP in the fiscal year 2023, the IT-BPM sector has played an important role in the country's socioeconomic development and is expected to be the driving force behind modern India. Despite cybersecurity's difficulties, workforce shortages, and evolving laws, recent technological advancements and global demand for digital solutions are propelling the industry's rapid growth. Notable developments include the rise in remote work and swift adoption of AI and ML are evident, highlighting the industry's resilience. The paper examines the current conditions, obstacles, and developing patterns of the software industry in India. Through the literature review we aim to unfold the dynamics which define the industries current state, identify the challenges and anticipate the trends which are shaping its future.

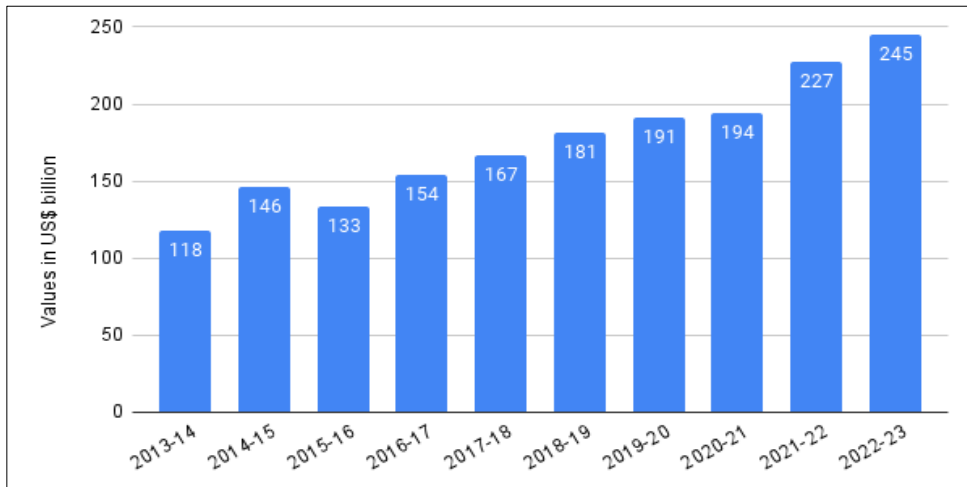
Keywords: Software Industry, Industry Dynamics, Emerging Technologies, IT Trends, Challenges.

1.0 Introduction

The Indian software industry plays a very important role in the global information Technology (IT) sector showcasing substantial growth, innovation and economic contribution. The Indian software industry has become a global powerhouse and has a tremendous impact on India. India has become a desirable place for the foreign investors to locate their operations and has generated employment opportunities. Among offshore locations, India is the most popular for IT companies worldwide. Top IT firms in India are having a whole new opportunity. The Indian IT/Software sector gives value for money, high quality, dependability, prompt delivery, and—above all—the worldwide application of cutting-edge technologies.

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Figure 1: Market Size of India's IT Industry

Source: Nasscom

An estimated US\$ 245 billion will be made by the IT sector in FY23 at 8.4% y-o-y growth and is estimated to reach US\$ 500 billion by 2025, as per the Strategic Review 2023 published by NASSCOM. In view of this, this study aims to explore the ever-changing environment of the Indian software market. By means of a comprehensive review of past growth, present challenges, and future opportunities, the aim is to unwind the complex structure that defines the situation of the industry today. Through an analysis of major trends, obstacles, and prospects, this study aims to offer significant insights for players navigating the constantly shifting environment of India's software industry.

2.0 Objectives

- *Evaluate the growth:* Review the past evolution and growth of the software sector in India from the early 1990s.
- *Determine obstacles & opportunities:* Assess the cybersecurity concerns, labor shortages, and emerging technologies' impact.
- *Study government initiatives:* Take a look at programs that promote innovation and skill development, such as "Made-in-India" and "Digital India."
- *Assess competitive landscape:* Analyse talent acquisition strategies amidst intense market competition.

3.0 Literature Review

In the research article, "Determinants of Exports of Information Technology in India: An Empirical Analysis" [1], the authors, investigate the factors that

influenced Indian IT company exports from 2000 to 2012. The paper examines the factors that influence software exports from both the supply (research and development and foreign capital) and demand (world demand and real effective exchange rate) sides. Research and development are examined, highlighting the importance of innovation in growth and conforming to theories of international trade. Furthermore, the effects of foreign capital are investigated, including its functions in technology transfer, export promotion, and international market access. Given the sector's significance, the government is urged to encourage IT companies to explore new markets, enter diverse segments, and invest in R&D for future export growth. The government should encourage IT companies to venture into new markets, venture into areas such as legal process outsourcing and climate change, and make substantial investments in research and development, given the sector's significance to India's economy. R&D is important for future exports even though it might not have an impact right now.

In their paper "State and the IT Industry in India" [2], Keshab Das, and Hastimal Sagara have assessed the role of state (both national and subnational) in the growth of the information technology industry. With a focus on the growth of the sector from the 1970s to the present, the study highlights the industry's relevance to employment, innovation, sustainability of the environment, and worldwide competitiveness. In the global market for computer software and IT-enabled services, India has outperformed other countries, however, there are still problems that must be solved, including cybersecurity risks, international competition, professional shortages, and US anti-outsourcing laws. Through innovation and infrastructural advancements, government programs like Made-in-India and Digital India seek to improve e-governance and maintain leadership.

The working paper, "Technological Disruptions and the Indian IT Industry: Employment Concerns and Beyond" [3], talks about a number of obstacles, including changing business models, international competition, stringent visa regulations, and technological disruptions faced by the Information Technology (IT) sector in India. Disruptive technologies that have the potential to upend the IT industry and have an effect on low-end and traditional engineering services include cloud computing, big data, blockchain, automation, the Internet of Things (IoTs) and robotics. In order to properly use automation, the industry must address the reskilling and upskilling of its workforce. The National Policy on Software Products seeks to promote R&D and innovation while fostering a strong software product industry through industry-government cooperation.

In the paper, "A study on the lack of job creation in the Indian IT industry" [4], the authors observe that there is job growth saturation in the industry despite its recognition and competitive performance. The study seeks to identify the reasons that have contributed to this circumstance. Potential causes include changes in the global economy, technology, outsourcing tendencies, skill set mismatches, legislative changes, international competitiveness, and industry developments. According to the

study, even though there are job openings, employees may not be aware of them or be eager to learn the skills needed for the rapidly changing IT industry. In the paper, the difficulties that the Indian IT industry faces are discussed, with a focus on automation and the uptake of cutting-edge technologies like AWS, Azure, and Cloud, which have the potential to drastically alter the conventional business paradigm.

In the paper “Contribution of Information Technology in Growth of Indian Economy” [5], the authors examine the various ways that India’s IT sector has contributed to the country’s overall prosperity, emphasizing how it has modernized industries and promoted economic progress. The Internet of Things, cloud computing, mobile, and analytics are new technology examples that have improved efficiency, agility, consumer access, and innovation; these advancements are credited with the industry’s success. Notwithstanding, the sector encounters obstacles like rivalry, comprehension of consumers, trade barriers, and unstable economic conditions. Stakeholders must participate in IT-enabled digital transformation in order to overcome these obstacles and guarantee survival. This shift emphasizes the necessity for firms to adjust to changing market dynamics and technological advancements in order to remain competitive in the increasingly interconnected world. The study, “Indian Information Technology (IT) Engineers transitioning to work roles in emerging technologies: Findings from an ethnographic study” [6], focuses on engineers’ mobility prospects, especially for those in rising technology roles in the Indian IT industry.

The study is to determine whether mobility prospects change as the Indian IT business shifts to offering solutions in emerging technologies. The researchers investigate the barriers to mobility that engineers with non-IT specializations have when attempting to enter rising technology positions. The results underscore how important it is to differentiate between people who possess an IT background and others who don’t, particularly as the Indian IT industry moves into the field of emerging technologies. In an attempt to alleviate mobility constraints, recent machine learning workflow optimization initiatives have shifted the emphasis from application development to theoretical AI/ML expertise and business comprehension, which could be beneficial for individuals without an IT experience.

The paper, “Emerging Technologies and Emergent Workplaces: Findings from an Ethnographic Study at an Indian IT Organization” [7], explores how the last forty years have seen significant changes in the Indian IT sector, beginning with the traditional software and business process management (BPM) services. Known for supplying clients with high-quality, cost-effective services around the world, the industry now has to figure out how to offer cutting-edge technological solutions to those clients going through a digital transformation. The conclusion derived from the ethnographic data is that the IT organization is still firmly rooted in conventional software work procedures even if it intends to concentrate on delivering AI-based projects. Informal connections between staff make up for the lack of explicit AI operations, albeit tacitly. In view of new developments in the Indian IT sector, the

conclusion draws attention to the possible challenges associated with WFH adaptation.

In his article, Vineet Nayar, the founder and chairman of the Sampark Foundation as well as the former vice chairman and CEO of HCL Technologies, examines the primary problems that the Indian IT industry is facing at the moment. He focuses attention to issues with maintaining creativity and staff engagement in the face of increasing advancements in technology. According to Nayar, there are three key elements that are changing the dynamics of the industry: the push for ethical corporate practices, the shortage of top talent leading to increased employee demands, and the obsolescence of low-tech professions due to machine learning and AI.

The article “Indian IT Industry faces double-edged sword,” by Nisha Parveen, addresses the possibilities as well as challenges of the Indian IT industry in light of the global economic downturn. It determines outsourcing interest because of less spending on discretionary items, but it also understands demand worries imposed on by trade disputes and geopolitical instability. The IT business faces problems such a lack of skills, cybersecurity concerns, problems with remote work, and expenditures on infrastructure even in the face of a shift in service demand. On the other hand, digital shifts in a number of industries, such manufacturing, healthcare, finance, and retail, offer possibilities and give IT service providers ways to address particular demands. The paper suggests a strategic plan that focuses cybersecurity, technological investments, recruiting diverse talent, increasing customer service, market dominance, and expertise consolidation in order to overcome barriers and grab opportunities. India’s IT industry has a bright future despite obstacles, aided by government programs, trained employees, and increasing demand from digital consumers. The paper highlights how important talent development, flexibility and a strategic focus are to the long-term achievement of the Indian IT services industry.

In the article, “Indian IT: Re-inventing itself for the next 25 years” [10], Nishi Sigh mentions, Global technological solutions have been developed for over 25 years with the help of the Indian IT sector, which has been a major innovator in the field. From its inception in the latter half of the 1950s, it has grown to become one of India’s most important sectors, making a substantial economic contribution. In order to remain relevant in a changing global environment, the industry, which is currently facing a highly competitive terrain, needs to reinvent itself. The reformation of the sector entails shifts from just offering affordable solutions and toward high-quality services. Focusing on innovation through R&D, adopting new technology, expanding internationally, developing digital capabilities, and reskilling the workforce are important components. India is well-positioned to maintain its position as one of the world’s leading contributors to information technology for the next 25 years with the correct combination of business activities and government regulations.

“India’s IT Sector: Outlook for Growth, Trends, and Difficulties in 2024” [11], a blog by Navaneel Das, Indian IT industry’s current condition. India came

second in the G20 countries in 2022–2023 with strong economic growth of 7.2%. With a goal of reaching a \$4 trillion GDP by 2024–2025, projections indicate that India's economy might rise from being the third largest in the world by 2027 to the second largest by 2075. With 5.4 million employees, 7.5% of GDP, and revenue of \$227 billion in 2022 (estimated to reach \$245 billion in 2023), Indian IT industry makes a substantial economic contribution. Infosys, TCS, Tech Mahindra, and Wipro are some of the leading IT companies. The IT sector in India is expanding, utilizing cutting-edge technologies, and encountering difficulties in attracting and retaining skilled workers. The sector's importance in India's economic landscape is highlighted by its key involvement in many industries.

A comprehensive review of the key advances in technology impacting the corporate environment in 2023 can be found in the article “New Technology Trends 2023 – ‘Next Tech Wave’” [12]. It highlights how important it is to use new technology in order to satisfy consumer needs and guarantee corporate success in a world where there are 5.6 billion internet users. Some of the major technological trends that are being discussed are the Internet of Things (IoT), which is changing smart homes, industrial applications, and transportation; artificial intelligence (AI) and machine learning (ML), which are transforming industries like healthcare, banking, and retail; and the accelerated development of 5G networks, which are improving connectivity and mobile devices. In order to succeed in the ever-changing technological scene, the article stresses how important it is to stay current on these trends.

The article [13], by Biswanath Bhattacharya, Chief Executive, HCL Services highlights in particular, small and medium-sized businesses (SMEs) and startups set to benefit significantly from the global revolution in IT solutions that has been brought about by cloud computing. The introduction of cloud computing has led to significant cost reductions, increased productivity, and improved business processes. The entire impact on email services, backup, storage of information, and corporate operations is brought out, but migration and ROI measurement obstacles are noted as well. Due to its scalability, flexibility, and innovation alternatives, cloud computing helps SMEs and startups compete effectively with big companies. The article's conclusion highlights how cloud technology has the capacity to change businesses and how broadly it must be used in order to remain competitive.

As per the article [14] by Lakshmikanth, K, the Indian IT industry will experience significant every year job cuts of 1.75–2 lakh over the course of the next three years as a result of the sector's low preparedness to adopt new technologies. The training will be tough because, according to new study conducted by McKinsey, almost half of the employees in IT services firms would become “irrelevant” in the next three to four years. Cloud-based services and other digital technologies are growing faster than the workforce can adapt to them, which is particularly troubling for professionals 35 years of age and older. Not in large IT hubs, but more in smaller locations, job cuts are expected.

In studying the shift in globally leadership in computer and information services (CIS) exports, the article [15], by Sunil Mani finds an increase in market share from the US, UK, and Germany to Ireland and then India. With the help of developments in technology, India has become an important participant, attracting international businesses to open up shop here. Rising patenting activity suggests that this has led to more innovation, resulting in regional Indian businesses gradually expanding their technological abilities. The availability of highly qualified software engineers is the main factor driving CIS export dominance, but the long-term stability of this leadership depends on whether the sector is managed by native or foreign companies.

The estimated growth of India's IT-BPM industry and its development into a digital solutions partner in the context of aggressively evolving technologies are covered in the article [16] by NASSCOM. It analyses India's digital journey from the perspectives of both suppliers and consumers, and it analyses market categories. The research, offers industry stakeholders valuable insight. In addition, several industry reports are offered that address IT services, BPM, engineering R&D, products, startups, and India's digital transformation process.

The growing importance of digital transformation (DT) in today's economies and the growing amount of academic study it has attracted are discussed in the paper "Digital Transformation: An Overview of the Current State of the Art of Research" [17]. To offer insights into the current status of DT research, an in-depth examination of the literature has been carried out, with a focus on changes caused by technology at the organisational, corporate, and social levels. Three research clusters were found by the analysis: (A) concentrating on organisational effects and changes in business processes; (B) solving technology as a driver of DT and managing related information increases; and (C) examining the impact of DT on different industries, particularly retail and e-commerce.

The paper, "Internet of Things is a revolutionary approach for future technology enhancement: A review" [18], gives an in-depth overview to the Internet of Things (IoT) and shows how it is changing a number of areas of life, including smart homes, cities, transportation, and industries. The objectives of this paper are to increase readers' and researchers' understanding of the Internet of Things' possibilities and practical applications while simultaneously highlighting the necessity to address current issues and problems in order to take advantage of the technology's beneficial social impacts.

The paper, "New Trends in Using Augmented Reality Apps for Smart City Contexts" [19], looks into the potential of Augmented Reality (AR) within the context of Smart Cities, highlighting how it might be used in a Smart Campus environment. The study highlights the advantages of the software over more conventional 2D mapping apps while evaluating its performance, usability, effectiveness, and satisfaction. The paper, "Transformative effects of IoT, Blockchain and Artificial Intelligence on cloud computing: Evolution, vision, trends and open

challenges” [20], examines how the growth of cloud computing systems has been affected by three new paradigms: blockchain, the internet of things, and artificial intelligence. The paper offers insights for academics interested in cloud computing by conducting a comprehensive examination that highlights research opportunities, concerns, and challenges in this subject. This paper is a helpful resource for learning about how cloud computing and developing technologies interact.

4.0 Literature Review Summary/ Discussions

Author	Key Discussions	Remark
Sushil Kumar Haldar, Ajitava Raychaudhuri, and Sangita Dutta Gupta	The paper makes recommendations for policy, highlighting the necessity for the government to push IT companies to expand into new areas and increase their R&D spending in order to maintain the industry’s growth.	The authors highlight that continued success of exports and recommends actions for sector diversification and more R&D spending in the IT industry.
Keshab Das & Hastimal Sagara	The paper talks about the industry’s overall effects on innovation, employment, and global competitiveness and discussed about the difficulties including cybersecurity threats and global rivalry.	The paper mentions the key aspects such as employment, innovation, and global competitiveness and talks about the existing challenges
Hastimal Sagara and Keshab Das	In addition to highlighting the effects of disruptive technologies like blockchain and automation, the paper explores the difficulties the industry faces.	The paper analysis the changing Indian IT market landscape.
Kannamani Ramasamy and L. Sudershan Reddy	The paper explores the environment of job creation in the Indian IT sector, looking at a variety of issues like changes in the global economy, technical improvements, talent mismatches, and regulatory changes.	The research emphasizes how critical it is to take proactive steps to resolve the problems and promote a more flexible and robust IT industry.
Ishmeet Singh and Navjot Kaur	The authors explore the different ways that India’s IT sector has aided in the advancement of economic progress and modernized industries, with a focus on how it has contributed to the nation’s overall prosperity.	The paper stresses on how important it is for the IT industry to manage and adjust to changing market circumstances.
Vinay Reddy Venumuddala and, Rajalaxmi Kamath	With a focus on Indian IT engineers moving into new technological professions, the study discusses about this shift and highlights the difficulties faced by non-IT professionals.	The paper shows that the industry is actively working to promote diversity of thought and skill sets.
Vinay Reddy Venumuddala, Rajalaxmi Kamath	The study explores how the Indian IT industry has changed with time, highlighting how the sector has progressed from providing traditional software and BPM services to supplying cutting-edge technical solutions in the era of digital transformation.	The paper talk on the continuation of traditional work methods despite hopes for AI-focused projects, providing insightful information about the expansion of the Indian IT sector.

Vineet Nayar	The article highlights the difficulties that the Indian IT sector is facing. These difficulties are primarily brought on by the changing nature of technology, the dynamics of talent, and the necessity of ethical business practices.	For the IT sector to prosper in the face of these rapid changes, it must modify its strategy, putting a premium on talent, encouraging innovation, and the ethical principles.
Nisha Parveen	The article highlights the need for strategic actions and offers a balanced assessment of the future of the Indian IT sector in the face of global economic concerns.	The views are insightful and useful because it takes a practical stance, highlighting important areas for the sector's sustained growth.
Nishi Singh	The article emphasizes how the Indian IT sector must change and grow in the face of expanding global competition and technical breakthroughs.	The paper gives comprehensive analysis of the prospects and difficulties facing the Indian IT business.
Navaneel Das	The article describes the impressive expansion and noteworthy economic contributions of India's IT sector. The difficulties the industry will experience in 2024 as a result of a lack of fresh graduate recruiting, skill shortages, and competition for talent are highlighted.	The IT sector plays a vital part in India's economy, as seen by its diverse role in fostering innovation in the healthcare, finance, agricultural, and education sectors.
www.geeksforgeeks.org	In addition to renewable energy, autonomous vehicles, digital twins, edge computing, cybersecurity, 3D printing, and advances in human augmentation technologies.	Detailed information about the major technological developments in the corporate scene in 2023 is given in this article
Biswanath Bhattacharya	It covers the state of the market, migration challenges, and cloud computing's role in the development of new business models.	The need of adopting cloud technology to maintain competitive and future-proof businesses in a fast evolving digital the environment is brought up in the article
Lakshmikanth, K.	The article highlights the possibility for large yearly job cuts in the Indian IT industry over the next three years, with forecasts ranging from 1.75 to 2 lakh, as a result of the sector's slow acceptance of the latest technologies.	It's difficult for older employees in particular to stay up with the fast growth of technologies like cloud-based services.
Sunil Mani	Rising patent filings as a result of growing innovation activities highlight India's increasing position in the global IT industry.	Overall, the article sheds insight on how the trends of CIS exports are changing and how India plays an essential part in this changing scenario.
NASSCOM	The article illustrates the anticipated growth of India's IT-BPM industry to reach USD 154 billion in FY2017 and its transformation into a worldwide partner for digital solutions.	With distinct sector reports accessible for further investigation of particular areas including IT services, BPM, engineering R&D, products, startups, and India's digital journey, it provides insightful information for industry players.

Kraus, S., Jones, P., Kailer, N., Weinmann, A., Chaparro-Banegas, N., & Roig-Tierno, N.	It highlights the increasing amount of research being done on DT and points out areas that still need to be explored.	The paper emphasizes how critical it is to comprehend the consequences of DT for enterprises, society, and the environment.
Kumar, S., Tiwari, P., & Zymbler, M.	The Internet of Things (IoT) is explored thoroughly in this article, highlighting how it has changed numerous aspects of life.	The paper discusses the need to address current issues in order to further broaden the benefits of IoT to society and practical uses of IoT.
Yagol, P., Ramos, F., Trilles, S., Torres-Sospedra, J., & Perales, F	The deployment of augmented reality (AR) in smart cities is examined in this paper, with particular focus on smart campus. The study examines the usability and performance of the app and highlights its advantages over more traditional mapping apps.	The paper explains plans to provide an open-source solution that makes use of Quantum GIS layers and AR libraries, showing how to integrate AR technology into urban settings in an in-depth way.
Gill, S. S., Tuli, S., Xu, M., Singh, I., Singh, K. V., Lindsay, D., Tuli, S., Smirnova, D., Singh, M., Jain, U., Pervaiz, H., Sehgal, B., Kaila, S. S., Misra, S., Aslanpour, M. S., Mehta, H., Stankovski, V., & Garraghan, P.	It highlights how important cloud computing is to today's society and how it can handle a broad range of applications while ensuring Quality of Service (QoS). Through the identification of key technologies, the study provides valuable insights into the future direction of cloud computing systems.	The paper adds to the discussion on how advanced technologies and cloud computing interact, providing valuable information to scholars and industry professionals.

5.0 Conclusions and Future Scope

The Indian software sector has experienced significant development, ongoing challenges, and promising opportunities at the moment. By means of an in-depth examination of its growth, challenges, and trends, this study highlighted the intricate factors affecting the development of this industry. In light of the rapidly changing global situation, stakeholders must take an active approach to addressing serious obstacles and capturing emerging opportunities as the industry continues to deal with its complexities. Enhancing safety measures and using modern technology are only two of the ways that the Indian software sector may be kept growing and competitive. India may position itself as the global hub for technological leadership and innovation leadership by making investments in innovation, promoting industry-academia collaboration, and cultivating talent through comprehensive skill development programs. In the future, the Indian software industry ought to concentrate on these particular research directions

Cybersecurity: Research focused on enhancing cybersecurity measures and creating strong defence mechanisms is essential given an evolving threat landscape and growing reliance on digital technologies.

Emerging Technologies: There are never-before-seen chances for invention due to the quick development of technologies like machine learning, blockchain, artificial intelligence, and the Internet of Things. To take full advantage of the potential of these technologies for benefiting society, future study should explore how they are applied in a variety of fields.

Talent Development: One of the greatest challenges facing the Indian software industry is the lack of skilled workers. Studies that target skill gaps, promote lifelong learning, and promote diversity and inclusion in the workforce can help build an abundant supply of talent in the future.

Policy and Regulation: Research on policy structures that promote innovation while ensuring ethical standards, data privacy, and consumer protection will be needed as the regulatory landscape evolves in response to advances in technology and global trends.

Sustainable Development: Research exploring the connection between software development and sustainable practices can help unlock up opportunities for environmentally conscious options and environmentally friendly technologies in the industry, as sustainability and environmental responsibility become increasingly crucial.

In summary, the present review puts light on the constantly shifting Indian software industry, which is defined by notable growth, facing challenges, and promising trends. Innovations in technology and global demand are driving the industry's growth even in the face of risks related to cybersecurity, labour shortages, and complex rules and regulations. The successful management of these obstacles and the seizing of new opportunities will decide the course of the Indian software industry in the future.

The future study must focus on a number of important areas. First and foremost, enhancing security measures is essential to successfully reducing emerging risks. Furthermore, investigating cutting-edge technologies like quantum computing and blockchain can open up fresh possibilities for the expansion and change of the sector. Ultimately, it is essential that we explore sustainable methods in software development in order to encourage long-term stability and viability of the industry. Stakeholders can set the path for the Indian software industry to have a more innovative, skilled, and secure future by focusing on these research areas.

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CHAPTER 10

Personal Financial Planning Behaviour: A Systematic Review of Literature with Bibliometric Analysis of Keywords

Ritu Kasliwal¹ and Bhushan Pardeshi²

ABSTRACT

The primary intent carrying out the study is to find existing trends and emerging themes in publications on ‘financial behaviour’ with reference to financial planning through bibliometric analysis and propose the scope for future research. A most distinguishing theme is the influence of financial literacy, education, capability & efficiency on the behaviour during financial planning & related decision making of individuals and its influence on financial satisfaction and wellbeing. The major areas which require financial planning are spending, saving, borrowing, investment, trading, risk management and taxation are relatively under researched except retirement planning. The review and further analysis of identified literature indicate that there is a requirement to increase awareness, education and motivation among individuals to have appropriate financial plans for financial wellbeing and satisfaction in the long run. The individuals are required to understand the limitations of existing financial situations, accept the reality and take responsibility for wellbeing of their financial future. Since, the financial landscape is changing very fast, further studies can be conducted to understand the awareness and knowledge among individuals about new & advanced financial products, services & technology as well as availability of certified financial planners / advisers. This would support the financial institution and policymakers to plan for greater financial inclusion.

Keywords: Financial Behaviour; Behavioural Finance; Financial Planning, Bibliometric Analysis; Scopus; VOSviewer, Systematic Review.

1.0 Introduction

A sea change is observed in the finance field following the pioneering work named Prospect Theory by Daniel Kahneman & Amos Tversky leading to growth in behavioural finance that integrates the numerous behavioural and psychological theories with economic and financial decisions (Jain et al. 2021). Behavioural finance accepts the non-rational behaviour of individuals and corporate executives and allows

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the search for the causes behind such financial actions and models such few financial situations using not fully rational agents for better understanding (Barberis & Thaler 2003). The prime intent of the study is to traverse and study recent trends along with emerging themes of research work on personal financial planning behaviour. Planning about tax, liability, insurance, investment, retirement and estate are the prime steps in financial planning (Boon et al. 2011). The practice of financial planning includes planning funds for emergencies, management of risk, credit report, overdrafting, payment of credit card payment & retirement accounts (Robb & Woodyard, 2011).

The study presents multidimensional analysis of the literature on ‘financial behaviour’ with special reference to financial planning around the world, in a systematic way for a period of 30 years. Given the exponential growth in research in this dynamic field of behavioural finance, an analysis focused on work on personal financial planning behaviour around the world for a long time period is much needed. The study presents the understanding of the role played by financial education, knowledge, experience, awareness, socialization, advisors / planners and innovations in financial inclusion, satisfaction & wellbeing.

Before conducting a new probe, it is a tradition to collect and evaluate existing knowledge in the field, but it is difficult to keep track of evolution in knowledge due to mounting growth in academic literature (Linnenluecke et al. 2019). One very familiar and popular way of exploring and analyzing huge scientific records of literature is bibliometric analysis to identify existing trends and emerging themes in a specific domain (Donthu et al. 2021). It is definitely not a substitute to traditional approaches of review of literature; but it complements them (Župič & Čater 2015). Co-word(s) analysis guide in finding links among theories, ideas & prominent terms appearing together frequently in title, keywords or abstract of documents (Župič & Čater 2015); to find out the past, present & future linkages between different themes in the specific sphere of knowledge (Donthu et al. 2021). Along with it, a systematic review of existing work of knowledge is carried out to present trending concepts, linkages, antecedents and precedents of personal financial planning behaviour using PRISMA framework is used to identify and select relevant documents (Page et al., 2020). Thus, the main objectives of the study are:

1. To study recent trends & emerging themes of research work on personal financial planning behaviour through author keywords analysis & review of reviews.
2. To propose a conceptual model defining the interlinkages between antecedents and precedents of personal financial planning behaviour through review of identified literature.

2.0 Research Method

2.1 Data source and search

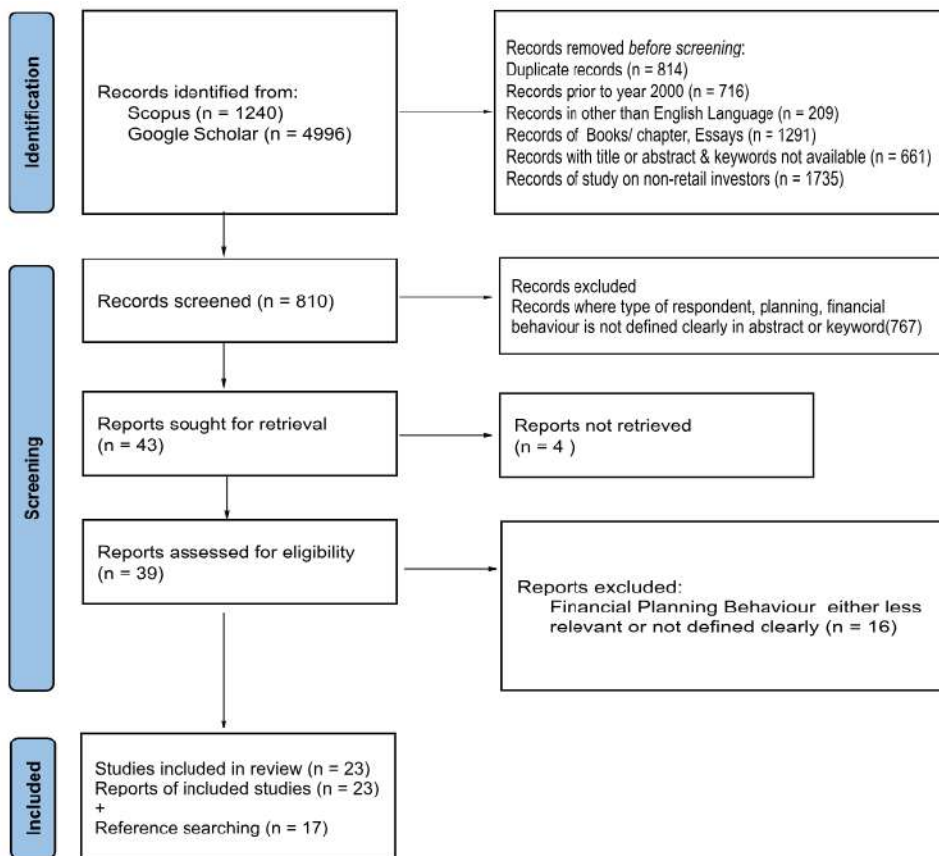
Scopus database is used to extract the bibliographic information. Scopus has had a database since 1966 only, however this has not resulted in any loss of data; as

the ‘behavioural finance’ has started getting recognition as a separate field of study since 1980’s (Barberis & Thaler 2003). The query string TITLE-ABS-KEY (“financ* behavio*” OR “behavio* financ*”) is used to extract information from documents available in English language in the subject namely Management, Social Sciences, Economics, Econometrics, Business, Accounting and Finance. The asterisk sign ‘*’ ensures the inclusion of documents with a little different spelling such as finance(s), financial(s), financing, behavioural. The data is cleaned to remove duplicates and incomplete entries. The duration is 30 calendar years from 1992 to 2021.

2.2 Data analysis

After applying filters, cleaning and editing 1130 records with unique titles & complete information are found out of 1240 records. VOSviewer version 1.6.17 (Visualization of Similarities) by Centre for Science and Technology Studies, Leiden University, Netherlands (Eck & Waltman 2009), a software tool that constructs maps and visual networks generated using bibliographic data, are used for the analysis.

Figure 1: PRISMA Framework for Search and Selection Criteria of Article



Source: Author’s work

2.3 Document search and review

Initially, Scopus bibliographic database and google scholar data is used to identify documents. To broaden the search and increase effectiveness beyond major databases in business management research, the forward & backward reference searching approach is used to identify relevant documents. Figure 2 shows the PRISMA framework according to standards (Page et al., 2020) are used to pick out the relevant documents. Full text research articles published in authentic referred journals available publicly and relevant to the objective of the study are considered for review.

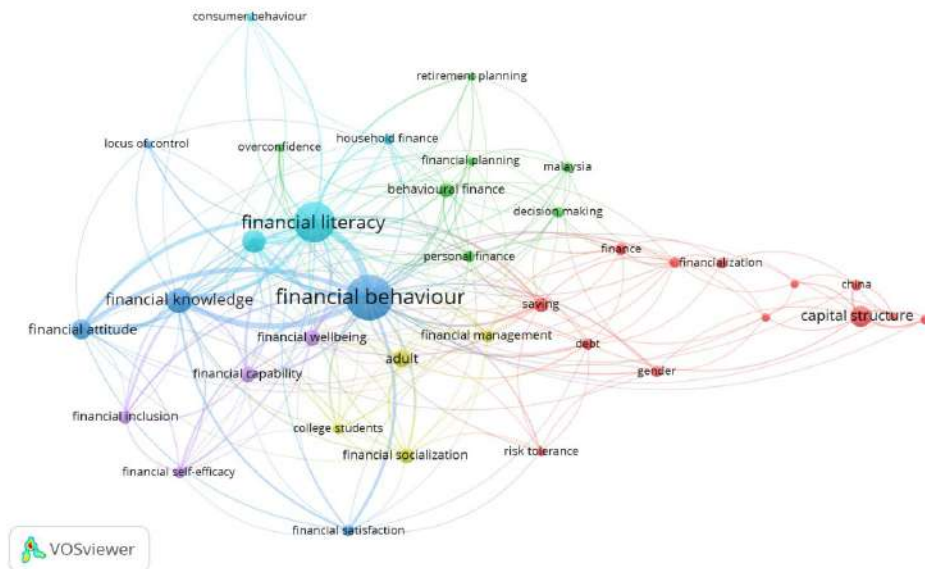
3.0 Results and Discussion

The database has 982 Articles, 56 Book Chapters, 41 Reviews, 8 Books, 43 Conference Papers with a total 17491 citations. A greater number of publications is seen after 2017, when the Nobel Memorial prize was awarded to Richard Thaler for his study on consumer behaviour model involving mental accounting.

3.1 Co-occurrence of author keywords

After data editing 2524 unique keywords are found. After repeated trials, a less complex network of six clusters formed by 37 keywords as shown in Figure 2, is found when a minimum 10 occurrence is set for each keyword.

Figure 2: Network of Co-Occurrence of Author Keywords -VOSViewer



Among the identified clusters, the green cluster with ‘behavioural finance’ as its central node with strongly connected keywords ‘personal finance,’ ‘decision

making,' 'overconfidence,' 'financial planning' and 'retirement planning'. The results of analysis of co-occurrence of author keywords indicates that individuals / households' behaviour during financial / retirement planning is a prominent theme.

3.2 Review of literature reviews

Goyal et al. (2021) followed a systematic approach of inquiry of work of knowledge on personal financial management behaviour from 1970 to 2020 and concluded various financial decisions are interdependent and need trade off, also the studies on psychological factors behind personal financial planning behaviour are at initial stage. Lusardi & Mitchell (2007) reviewed the literature on association of degree of financial literacy over the preparedness for retirement, inferring that skill to manage money and education of finance affect the efficiency of decisions related to financial matters. Kebede & Kuar (2015) also inferred from study of literature that lower financial literacy leads to undesirable personal financial management behaviour & people have unsatisfactory financial planning for retirement. Sundarasan et al. (2023) highlighted challenges in financial planning among women and the need of financial education & knowledge for preparedness and self confidence on their financial planning ability has a pivotal role in financial behaviour of the women.

López-Medina et al. (2021) extracted bibliometric data from Web of Science on 'financial behaviour' studied along with 'education, money-saving and consumption' for a period from 1992 to August 2021 and analyzed it using VOSviewer software and concluded that people having higher financial education & financial literacy inclined to have retirement plans through saving which lead to greater financial inclusion, risk tolerance & future financial wellbeing. From the study of research papers on literature review, it is admissible that financial decisions are interdependent, financial education, awareness and knowledge plays a crucial role in desirable financial planning behaviour. Ingale & Paluri (2020) analyzed databases of studies that included financial literacy & behaviour from Web of Science from the year 1985 to 2020 using Biblioshiny and inferred that financial education & attitude are antecedents of literacy which affect credit, investment, retirement & wealth as a dominant theme.

3.3 Personal financial planning behaviour described

As described by Gudmunson & Danes (2011), the 'financial behaviour' as patterns of individuals to earn, save, spend & gift, also include turning points & decisions of financial matters over time (LeBaron & Kelley 2020). Common dimensions of financial behaviour include practices such as cash, saving, budgeting, consumption / expenditure, investment, mortgages and credit management; portfolio choices while investing in financial assets, socially responsible investments; retirement planning (Aristei & Gallo, 2021; Farrell et al. 2016; López-Medina et al. 2021; Xiao et al. 2009). Financial behaviors can be categorized broadly into paying (cash and credit) and borrowing (debt) behaviors (Xiao et al. 2014).

Bongini et al. (2018) created an index to measure financial planning that focuses on the retirement planning capability through the existence of an adequate household budget, awareness of pension funds & long term savings for trouble free livelihood in future and study also created a financial behaviour index which focuses on ability to purchase within budget limits, make payments before deadlines, maintain budget, saving quality, financial product choice and commitment towards budget. Adam et al. (2017) measured retirement planning through personal investments, setting own business pre-retirement, retirement savings & preference towards savings & investments. Ghadwan et al. (2022) found that self-efficacy in financial decisions, clarity of goal & policies of government have significant positive influence on retirement plan, while clear understanding of policies of government helps academic staff in setting clear retirement goals which indirectly influence planning, saving & investment for their retirement. Hence, financial behaviour is planning about saving, expenditure, investment, debt, insurance, taxes to achieve life goals with special focus on retirement planning.

Investments, mortgages and savings indicate forward thinking, favorable and responsible financial behaviour; however, credit cards and loans suggest weak planning and potentially poorer prospects (Farrell et al. 2016). It is suggested by evidence that considerable occurrences of suboptimal financial decisions by individuals are observed despite the fact that individual welfare is highly related with these decisions (Kaiser & Menkhoff, 2017). Bird et al. (2014) highlighted the latest trouble in the US and other economies brings the significance of financial capability of the family into spotlight, which leads to desirable financial behaviour which include saving, budgeting, planning & using credit wisely.

Acharjya et al. (2017) attempted to take on board the attributes & antecedents of the financial planning process and outlined the prime purpose of savings or investments by rural Indians are to enhance wealth, planning for education & marriage of children, planning for tax and retirement. Engaging in responsible behaviour towards financials to secure the future (Ingale & Paluri 2020) is important to attain financial wellbeing. A responsible and sustainable financial behaviour makes individuals take calculated & controllable risk, retain sufficient portion of income for unexpected expenses, avoid high debt burden, get engaged in planning, avoid impulse decisions, seek advice if individuals have insufficient financial competencies (Aristei & Gallo, 2021). Hence, a desirable responsible financial planning behaviour helps individuals to achieve financial goals through financial inclusion leading to financial wellbeing followed by financial satisfaction.

3.4 Effect of financial education and knowledge

Heinberg et al. (2014) examined the effect of financial education on planning by increasing financial knowledge which could lead to significant change in financial behaviour among households. Kimiyaghalam et al. (2017) revealed that parents play a notably crucial role in financial socialization, influencing significantly the

children's behaviour during retirement planning, mediated by saving attitude. Bharucha (2018) set forth that not too many parents discuss financial planning with children and mentions lack of awareness, education and knowledge as reasons behind inability to impart financial training to children.

Weisfeld-Spolter et al. (2018) examined the cultural values on financial decision making, revealing that financial knowledge along with financial attitude & perceived control has an influence on purchase intentions towards products or services of financial planning. Brunhart (2008) studied the prospective and planning of individuals regarding retirement and found that individuals have unrealistic, belated and suboptimal plans, wealthy & self employed have active and appropriate financial planning behaviour as compared to individuals with poor health and limited education have less knowledge and need motivation to financial planning.

Xiao et al. (2014) measured financial literacy as objective & subjective financial knowledge. Power et al. (2011) reported that degree of financial literacy is more among business students and their awareness, readiness and preparedness for retirement planning has enhanced after coursework as compared to non-business students, also there is a difference in investment and retirement familiarity on the bases of gender.

Henager & Cude (2016) the extent of financial literacy leads to benefit financial planning behaviour in the short term that is arrangement of emergency funds, spending not greater than earnings and avoiding overdrawing along with financial planning behaviour in long term which include retirement plan and investment plan of individuals. Herrador-Alcaide et al. (2020) highlighted that financial literacy indicates capacity, goals indicate willingness and optimism indicate commitment towards financial planning, which all together influence the financial behaviour of individuals. Danes & Brewton (2014) found association of gender and occupation of students with change in financial behaviour after acquiring know-how of financial planning.

Lusardi (2019) mentioned that Low financial literacy leads to ineffective financial planning & spending, expensive borrowing & poor debt management across countries. Alsemgeest (2015) argued that financial illiteracy is not the sole reason behind personal financial crises at global level, although it is important for financial wellbeing but for the investment & retirement planning help of professionals should be taken, citing it as a complex & specialized task.

Farrell et al. (2016) mentioned that higher saving, investment and insurance are indicators of better financial planning capability, whereas higher loans & credit cards are indicators of lower financial planning efficiency. Xiao et al. (2009) suggested developing an action aligned financial education plan for improvement in financial knowledge & skills. Hence, financial education acquired formally or informally through financial socialization leads to greater financial knowledge & skills required to make efficient decisions regarding financial planning matters.

3.5 Professional financial planning advice

Park & Yao (2016) found that since there is a shift in responsibility of individuals to take care of their financial future, the financial planner adds significant value to the saving & investment decisions according to the risk tolerance and behaviour of the individuals. Safari et al. (2017) reported that age play a moderating role, suggesting that only acceptability for Gen X and awareness, affordability, acceptability & assurance for Gen Y are the determining factors for the decision of hiring professional financial planner, while Gen X are found to be more aware about financial planning needs, have sufficient experience to judge the reliability and confidence as well as have greater earnings to afford these services.

Yao & Lei (2018) revealed in findings that investors who opt to consult financial planners are more likely to achieve better performance of their investment portfolio than those who don't seek financial planning services. Zick et al. (2012) reported that older university employees are seemingly to delay their retirement & ask for help from financial planners but spend less time on financial education, while younger ones are probably more confident and have sufficient retirement funds. Murphy & Yetmar (2010) studied the attitude, knowledge, confidence, possibility of plan implementation & willingness to take assistance in financial planning amid students in the USA and found that rarely some students already have a plan but rest are inclined to prepare and implement the plan with the help of certified financial planners. Winchester & Huston (2015) mentioned that professional financial advice helps households in improving financial wellbeing but not too many people from middle class use it as compared to affluent class and advocate the encouragement for use of financial planners services regardless of economic class. Hence, financial planning being a complex and dynamic process, the individuals with low financial knowledge & skills probably achieve a desirable financial future.

3.6 Precedents of personal financial planning behaviour

Xiao & O'Neill (2018) reported a positive bond of the propensity of financial planning and financial capability contributing to the objective as well as subjective financial wellbeing and consumers having more economic resources show greater probability to plan more. Castro-González et al. (2020) revealed that the attitude towards money besides financial planning horizon & risk tolerance has influence on actual financial behaviour of the individuals which finally influence the financial wellbeing. Boon et al. (2011) reported that individuals are indecisive about taking help from financial experts and their perception is neutral towards various aspects of financial planning, the financial knowledge can gear up the awareness and willingness to plan the financials to achieve financial wellbeing.

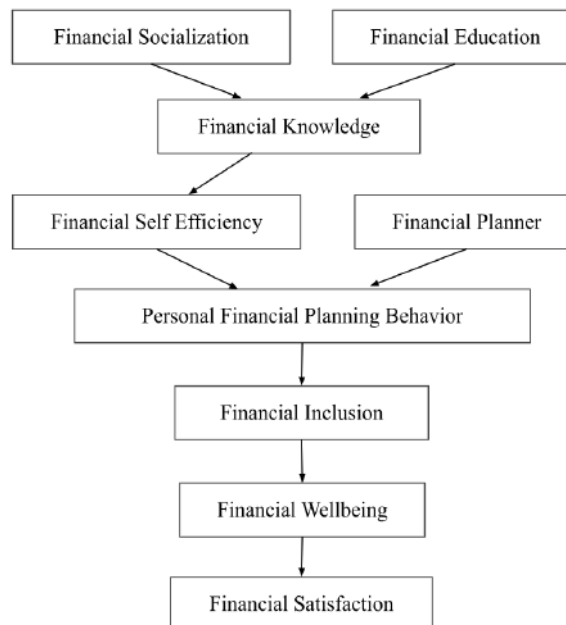
Birkenmaier & Fu (2020) examined the relationship of household financial planning & spending behaviour with financial access and found that better financial behaviour increases the likelihood of having higher financial access. Brügger et al. (2017) sighted low savings & insufficient financial plan for retirement as a critical

factor for financial wellbeing and proposed the new definition which considers the cause & consequences of financial behaviour. Adam et al. (2017) reported a positive effect of retirement planning along with financial behaviour on financial wellbeing. Eberhardt et al. (2022) found that lack of engagement in retirement planning has an important effect on financial wellbeing in the distant future and people with anxiety about retirement search for more information on pension. Xiao et al. (2009) mentioned that financial behaviour influences financial wellbeing & satisfaction as well as overall life satisfaction also. Hence, responsible financial planning is a prudent financial behaviour to boost financial access, inclusion, satisfaction & wellbeing in the context of money matters.

3.7 Proposed conceptual model of personal financial planning behaviour

Figure 3 presents a conceptual model proposed to summarize the personal financial planning behaviour and its interlinkages with antecedents namely financial education & knowledge, eld efficiency & role of financial planner / advisers and effect of planning on precedents namely financial inclusion, wellbeing & satisfaction as found in review of literature.

Figure 3: Conceptual Model of Personal Financial Planning Behaviour



Source: Author's work

A significant count of studies are carried out to evaluate the effect of financial literacy / education, knowledge / skills, capability / self efficiency on behaviour during financial planning decisions by individuals. Many studies emphasize the need & role of professional financial planners / advisers over the

outcomes of personal financial planning. Hence, the effect of personal financial planning behaviour over financial access, inclusion, satisfaction, & wellbeing is also studied very frequently. Numerous studies have been conducted to explore & test statistical significance of different linkages shown in the model.

4.0 Limitation of the Study

There are certain limitations which are essential to be acknowledged to impart a right perspective to the outcomes of the study. Data gathered from ‘Scopus’ database may not have covered all the studies as search is restricted to limited keywords in title, abstract and keywords for information available in the English language. Many documents are not freely available for comprehensive study and review. The field is huge and vast; hence it is difficult to identify, extract, study and cite every work. The gray literature, non-peer reviewed documents, editorials, conference reviews, short surveys, working papers and notes have been ignored.

5.0 Conclusion and Scope for Further Study

Increasingly, behavioural finance is becoming an important part of mainstream finance. Review of literature reviews have been conducted to understand the methodology and outcomes of the literature reviews conducted previously. The evaluation of co-occurrence of the author keyword along with review of literature reviews revealed that personal financial planning behaviour is one of the most prominent themes in the personal finance domain. While, retirement planning is the most extensively studied personal financial planning behaviour. The PRISMA framework helped in identification of most relevant documents to carry out the review. The review of systematically identified literature helped identify antecedents & precedents of personal financial planning behaviour. The antecedents are financial education & socialization enhancing financial knowledge which lead to financial self efficiency or need for professional planners. While, the precedents are greater access to financial products that is financial inclusion, leading to financial wellbeing which results in to financial satisfaction.

It can be concluded that, personal financial planning behaviour is financial decision making regarding earning, saving, spending, investment, taxes, debt, insurance and much more to achieve financial goals at different stages of life. From, review of literature it can be further summarized that financial education can be received formally along with informally through financial socialization. Greater financial education can enhance financial knowledge, that is financial analysis capability & decision making skills. Higher financial knowledge in turn leads to self efficiency in financial planning that is lesser dependence on external help in financial decision making. Individuals who are inefficient in financial planning seek professional advice depending upon awareness, availability, acceptability,

affordability & assurance to avoid suboptimal financial outcomes & undesirable financial troubles. Responsible financial planning behaviour leads to greater reach to financial products, services & technology that is financial inclusion, which leads to financial wellbeing and greater financial satisfaction through attainment of financial goals of individuals.

Perhaps, new research scopes in terms of different groups of individuals in particular regions and time periods may provide new ways of identifying, measuring and testing the unique behavioural dimensions of financial planning. In future, studies to test the statistical significance of the proposed conceptual model can be conducted using structural equation modeling. Various socio-demographic & economic variables which may have statistically significant mediation or moderating effects can be introduced in the model. Human behaviour & financial product markets are dynamic and complex, hence the studies of a particular region and particular time period can be conducted, which could provide specific inputs to financial regulators, institutions and advisors.

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CHAPTER 11

Building a Skilled Nation: The Transformative Role of Higher Education

Prasad Shaligram¹ and Shivaji Mundhe²

ABSTRACT

Skill India - Higher education can support glonacal (global, national, and local) development. By aligning with the Sustainable Development Goals, universities can contribute to societal progress, economic growth, and social justice. While universities manifest their skill developmental role at the national level, limitations such as academic freedom and institutional autonomy hinder their full potential. Balancing national needs with global missions is a crucial task one that requires promoting intellectual curiosity, research, and holistic developmental purposes. Skill development in higher education isn't merely about disseminating facts; it's about nurturing critical thinkers, problem solvers, and change-makers. As we envision a skilled nation, let us recognize the transformative power of universities and their role in shaping a brighter future for all. The present research paper highlights the scope and objectives of skill India movement in higher education.

Keywords: Higher Education, Skill India, Skill Development Program, Skill Movement.

1.0 Introduction

The crucial importance of higher education in cultivating a proficient labor force cannot be emphasized enough in the endeavor of national progress. This research study explores the diverse and significant contributions of HEI molding a proficient nation. The study seeks to gain insights into the crucial stage of skill based education in cultivating a workforce that fits the demands of a dynamic and competitive global economy by analyzing the methods, difficulties, and outcomes related to skill development.

1.1 Contextualizing the importance of a skilled workforce for national development

Understanding the significance of a proficient workforce for the prosperity of a nation entails acknowledging the crucial function that competent human resources play in stimulating economic expansion, fostering innovation, and advancing societal development.

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The subsequent points emphasize the importance of a proficient labor force within the wider framework of national progress:

Economic competitiveness: An adept labor force bolsters a country's economic competitiveness through its contribution to heightened productivity and efficiency. Proficient laborers possess a greater ability to quickly and effectively accept and utilize cutting-edge technologies, resulting in enhanced competitiveness of global world.

Advancement in innovation and technology: Proficient experts important for fostering innovation and technical progress. They have a vital function in research and development, aiding in the establishment of new businesses, products, and services that drive the nation's skill based and knowledge-based economy.

Flexibility in meeting the requirements of the industry: An adept labor force is better equipped to accommodate changing demands in the industry. Ongoing education and acquiring new skills allow employees to remain pertinent in rapidly evolving industries, guaranteeing that the workforce adapts to the shifting requirements of the job market.

Alleviation of unemployment and poverty: Emphasizing skill development aids in mitigating unemployment by ensuring that the workforce requirements of different sectors. As individuals acquire pertinent skills, their employability increases, resulting in a reduction in poverty rates and an enhancement in general living standards.

Increased social mobility: Skill development programs provide individuals with the necessary resources to enhance their socio-economic standing. A skilled workforce enhances social mobility and promotes diversity by offering none other than skill based education. Global integration and trade: Countries that possess trained manpower are in a more advantageous position to engage in global integration and trade. Proficient experts played an important trade for fostering the expansion of export-driven sectors, enabling international collaborations, and bolstering a nation's engagement in the global economy.

Development of human capital: Considering the workforce as human capital underscores the significance of allocating resources towards education, training, and professional advancement. The human capital of a nation is a vital resource, and investing in skill development projects is a strategic long-term investment in national growth. Skill development is specifically those pertaining to excellent education, decent work and economic growth, and the reduction of disparities. An adept labor force acting as important part in attaining these overarching societal goals.

Enduring adversity with fortitude: An adept labor force bolsters a country's ability to withstand economic difficulties, upheavals, or emergencies. Proficient individuals possess superior abilities to adjust to evolving conditions, hence enhancing the general steadiness and robustness of the economy.

Progress in culture and society: Enhancing one's skills promotes a mindset of ongoing education and individual advancement. Consequently, this fosters the

development of the nation's culture and society by encouraging a mentality of invention, creativity, and advancement. Essentially, a proficient labor force is the fundamental basis for the advancement of a nation, propelling economic success, societal welfare, and international competitiveness. Understanding the significance of enhancing skills within a wider framework aids in shaping policies and efforts that enable individuals, communities, and nations to prosper in a constantly changing environment.

1.2 Key drivers of skill development in HEI

Educational Institutes are important in driving skills training, making a substantial contribution to improving individual capacities, employability, and overall social advancement. The subsequent arguments emphasize skill development mission in the institutions play in promoting skill Activity:

Curriculum design and development: Higher education institutions create and formulate curricula that are in sync with the changing requirements of industries. They analyze and determine the essential abilities sought by companies and to guarantee that graduates acquire the requisite proficiencies.

Vocational and specialized education: Higher education schools offer specialized programs that deliver professional and technical training across multiple disciplines. Activity included showcase of practical skills and theoretical information, enhancing their employability in specific industries.

Comprehensive skill development: The primary objective of HEI not only provide specialized information in a particular field but also to promote comprehensive skill enhancement. These encompass critical thinking, problem-solving, communication, teamwork and various professional environments.

Collaboration between industries and academia: Higher education institutions engage in collaborations with industry to narrow the divide between theoretical academic knowledge and its practical implementation. Collaborations with enterprises, research institutes, and community organizations enable the incorporation of practical situations into educational encounters.

Apprenticeships and experiential learning opportunities: Several higher education programs integrate internships, co-op programs, and work-based learning opportunities. These experiences access the students to take benefit employ theoretical knowledge in practical, real-world contexts, thereby acquiring tangible skills and industrial perspectives.

Entrepreneurship and innovation programs: Higher education institutions frequently foster entrepreneurship and innovation through the provision of courses, incubators, and resources that actively encourage students to cultivate entrepreneurial aptitude. This fosters a culture characterized by innovation and creativity.

Lifelong learning and advancement in the field: In connection with the same conventional degree programs professional development courses. Make constructed by planning and overview the future capacity of individuals who want to enhance or

acquire new skills at any point in their careers, in response to the evolving needs of the job market.

Exploration and creation efforts: Higher education institutions enhance skill development through their showcase endeavors. Faculty involvement in state-of-the-art research guarantees that first stage by students to get forward and the most recent breakthroughs in their disciplines, augmenting their technical and analytical abilities. Worldwide viewpoints and proficiency in understanding and engaging with different cultures: A significant focus of numerous higher education programs is on promoting global viewpoints and fostering cultural competence. Exposure the huge economy, I. e. viewpoints and life experiences aids in the cultivation of intercultural competencies among students, equipping them with the necessary abilities to thrive in an interconnected and globalized society.

Social and emotional learning: Higher education institutions acknowledge the significance of social and emotional abilities. They foster attributes such as resilience, flexibility, and empathy through diverse programs and activities, thereby improving students' capacity to manage intricate professional and personal contexts.

Accreditations and certifications acknowledged by the industry: Many higher education institutions frequently provide programs that result in professional certificates or qualifications that are recognized by the industry. These certifications authenticate the abilities acquired by students, enhancing their competitiveness in the employment market. Culture of continuous learning.

1.3 Overview of the transformative impact anticipated through skill-focused higher education initiatives

Anticipated is the transformative influence of skill-focused higher education efforts on individuals, society, and economies. These programs strive to surpass conventional academic education by prioritizing the acquisition of training in front of actual sectors applicable to the ever-changing demand of modern workforce. The following presents a summary of the anticipated profound influence resulting from skill-oriented higher education initiatives:

Improved job prospects: The primary objective of skill-focused higher education initiatives is to enhance graduates' employability by providing them full scope of skills that are immediately relevant and transferable in professional settings. Consequently, this resolves the disparity between theoretical knowledge and the practical abilities required by businesses.

Conformity to industry requirements: These activities are strategically tailored to closely correspond with the present and anticipated requirements of various sectors. HEI concludes that the graduates are well-prepared for match the demands of specific industries by integrating industry-relevant skills into their curricula.

Promoting entrepreneurship: Higher education that emphasizes skill development fosters an entrepreneurial mindset by equipping students with the

required abilities to initiate and oversee firms. Programs may encompass modules on corporate development, innovation.

Skill development as problem-solving: Initiatives frequently prioritize interdisciplinary collaboration, acknowledging that intricate difficulties often necessitate a diverse response. Graduates are required or involve in interdisciplinary collaboration, incorporating importance in viewpoints to address problem-solving. *Advancement of Inclusiveness and Variety:* Higher education initiatives that encourage inclusivity and diversity place a strong emphasis on developing certain skills. Graduates are required to understand and utilize other viewpoints, promoting an inclusive workplace and contributing to societal cohesion.

Self-improvement and growth aspects: In addition to technical skills, efforts prioritize individual growth. Graduates are required to have proficient communication talents, high emotional intelligence, and great leadership aptitude.

Economic impact: The expected outcome of skill-focused higher education initiatives is to have a substantial positive effect on economic growth. An adept and versatile labor force is regarded as a catalyst for innovation, production, and overall country advancement. To summarize, skill-oriented higher education initiatives strive to cultivate graduates who possess not just strong academic abilities but also possess the practical skills and qualities necessary to thrive in a swiftly evolving and competitive global environment. The expected influence extends beyond an individual's capacity to find employment to include wider societal and economic progress.

2.0 Objective

1. To investigate the critical position of HEI to equipping, competencies and students practical career success for future skill development opportunities.
2. To evaluate the economic impact of higher education in fostering innovation, entrepreneurship, and economic growth.
3. To identify best practices, policies, and initiatives aimed at improving the quality, relevance, and accessibility of higher education.

3.0 Significance of the Study

Economic development is significantly influenced by higher education, as it produces a proficient workforce with the necessary knowledge and competence to drive innovation, improve productivity and enhance the economy. Comprehending the significant impact of higher education in promoting workforce is crucial for policymakers, educators, and stakeholders who aim to advance economic prosperity.

Higher education in equipping workforce is undeniable, especially in a time marked by swift technological progress and changing job landscapes. This research examines position for institutions in enhancing skill development, employability, and

career readiness. It offers aligning educational programs with industry requirements and labor market demands. The aim is to ensure that graduates possess the necessary skills and competencies to thrive in a constantly changing and competitive job market. Social mobility and inclusion: Higher education acts in pivotal position being sharper points to connect directly unemployment economic targets, empowering individuals from various socio-economic backgrounds to attain chances for personal and professional progress. This research examines significant role in promoting social inclusion, equity, and access to education. It increases educational opportunities and remove obstacles for underrepresented and marginalized groups. By doing so, it aims to foster social cohesion and ensure equal opportunities for all.

Higher education institutions have important position in promoting innovation, entrepreneurship and skilled base knowledge through research, technology transfer, and collaboration with industries. Gaining insight into institutes establishing innovation ecosystems, startup ecosystems, and the cultivation of entrepreneurial skills and mindsets is essential for promoting an environment that encourages innovation and stimulates economic growth by generating new businesses, goods, and services.

Policy consequences: Conclusion for the said as consequences for policymakers, educational administrators, and workforce for developing higher education policies and initiatives. This research offers evidence-based insights and recommendations to inform policy decisions regarding educational planning, funding allocation, curriculum development, quality assurance, and institutional governance. It aims to facilitate effective policies and initiatives that contribute to building a skilled nation and fostering sustainable development.

In summary, the research on the transformative impact of higher education in developing a skilled nation is highly important for advancing knowledge, shaping policies, and fostering inclusive and sustainable development in the face of global problems and opportunities.

4.0 Research Methodology

This article employed qualitative methodologies to examine the impact of higher education institutions on socio-economic change and rural development. This case study examines higher education institutions: Northeastern University, University of Stanford, University of Singapore Management, Georgia State University suggest using a invest search the chapter of range of collected data. Brunner (2008) has demonstrated that mixed techniques in research has debunked the notion as qualitative and quantitative approaches cannot be combined. Cohen and Minion (2000:189) contend that employing “multiple resources” for data gathering enables the investigator provide detailed accounts that’s methodological storytelling undertaken during the investigation. Questionnaires including open-ended questions were created and interviews were carried out. The sample comprises participants

from each Centre for Development of all institutions. The respondents differ based on their level of seniority in their positions.

5.0 Case study

5.1 Case studies highlighting successful models of integrating skill development into higher education.

Multiple case studies exemplify effective strategies of incorporating skill development into higher education. These examples demonstrate novel methodologies, cooperative endeavors, and successful tactics implemented by universities to equip students with practical proficiencies that correlate with industry requirements. Presented below are several notable case studies:

5.1.1 The Cooperative Education (Co-op) Program at Northeastern University

Northeastern University's Co-op Program is a model of experiential learning that seamlessly incorporates practical work experience with the academic curriculum.

Implementation: Students engage in a structured schedule where they alternate between academic semesters and full-time paid co-op placements that are directly relevant to their chosen field of study.

Effect: The curriculum has led to incredible hype of number of graduates who are to search employment, as they acquire practical skills, establish professional connections, and develop a more profound comprehension of their respective industries.

5.1.2 Stanford University offers a course on Design Thinking in Education

Stanford University integrates design thinking principles into its curriculum, with a focus on a human-centered approach to problem-solving.

Implementation: Courses like "Design Thinking Boot camp" enable students to employ design thinking approaches in tackling real-world problems, hence nurturing creativity and problem-solving abilities.

Effect: Students cultivate a cognitive framework that places emphasis on empathy, teamwork, and iterative problem-solving, hence augmenting their capacity to address intricate problems across diverse domains.

5.1.3 Singapore Management University (SMU) offers a program called SMU-X.

SMU-X is an educational program at Singapore Management University that involved students training activity with real-world projects disclose, engaging and participatory learning experience.

Implementation: Institutional Workforce in practical application of academic knowledge by collaborating with industry partners on real-time projects, thereby acquiring hands-on experience.

Impact: SMU-X has garnered recognition for equipping students with

pertinent expertise, cultivating ingenuity, and establishing a robust connection between academia and industry.

5.1.4 Georgia State University offers the Panthers at Work Program.

Model: Panthers at Work is a program at Georgia State University that combines internships, cooperative education, and apprenticeships to provide work-based learning opportunities.

Implementation: The program facilitates the connection between students and employers, enabling students to gain practical knowledge and skills through hands-on learning experiences in the industry.

Effect: Students engaged in the Panthers at Work program have documented enhanced career preparedness, heightened job contentment, and a more seamless integration into the professional sphere.

5.1.5 The Technical University of Munich is known for its Talent Factory.

The Talent Factory program at the Technical University of Munich is centered around providing multidisciplinary and practical education. Execution - the program provides project-based courses, internships, and workshops to augment students' practical abilities.

Effect: The Talent Factory has achieved success in generating graduates that possess a robust combination of academic knowledge and practical abilities, hence enhancing the competitiveness of its graduates in the labor market.

5.1.6 Ryerson University offers a program called Zone Learning.

Ryerson University's Zone Learning program is an innovation and entrepreneurship initiative that enables students to engage in practical projects and establish their own enterprises.

Implementation: Students are assigned to specific "zones" according to their interests, such as social innovation, technology, or health. In these zones, they acquire practical experience and receive guidance from mentors.

Effect: Zone Learning has resulted in the establishment of prosperous firms, cultivating an entrepreneurial mindset and equipping students with real expertise in innovation and business.

5.2 The evolving landscape of skill development

5.2.1 Historical perspectives on skill development within relation to higher education

Examining the historical aspects of HEI highlights the changing educational objectives, the increasing role of universities, and the societal demands imposed on graduates. Over the course of time, the emphasis on enhancing skills has changed in accordance with shifts in the economy, technology, and culture. The subsequent text

presents a concise examination of pivotal historical stages: National Consequences: Countries are allocating resources towards healthcare fulfill the need for proficient individuals in the healthcare industry.

5.2.2 Skills related to sustainability and the environment

Global Trend: The rising consciousness of environmental concerns has resulted in a surge in the need for expertise in sustainability, environmental preservation, and green technologies worldwide.

National Implications: Countries are integrating sustainability education across many fields of study in order to tackle environmental concerns and encourage the adoption of sustainable practices in enterprises.

5.2.3 Intercultural proficiency and worldwide consciousness

Global Trend: The process of globalization necessitates that professionals have the ability to effectively navigate many cultures, be proficient in multiple languages, and possess a comprehensive awareness of international markets and trends.

National Implications: The necessary skills for workers are changing to prioritize global awareness and intercultural competence. This is varied and interconnected workplaces.

5.2.4 Skills related to entrepreneurship and innovation

Global Trend: There is a worldwide focus on developing entrepreneurial and innovative abilities to stimulate economic expansion and enhance competitiveness.

National Implications: The national strategies aim entrepreneurial thinking and innovation ecosystems in both the education and industrial sectors.

Comprehending these patterns and changes is essential for education systems, policymakers, and individuals to synchronize their efforts in developing skills with the changing requirements of the global and national employment markets. Consistently observing and adjusting to that sectors of important guaranteeing a workforce that is adequately equipped to tackle the future's challenges and opportunities.

5.2.5 The emergence of the knowledge economy and its implications for higher education

The advent of the knowledge economy has resulted in substantial changes in the characteristics of labor, commerce, and societal advancement. This transition has made for institutions as they endeavor to equip folks for triumph in a dynamic and information-driven environment. The knowledge economy encompasses several crucial elements that have significant significance for HEI.

5.2.6 The strategic value of knowledge

Higher education has potential as knowledge economy, as knowledge is a crucial and valuable strategic asset. Higher education institutions have the responsibility to fostering critical thinking, problem-solving abilities, and the capacity to apply knowledge in practical situations. Direct your attention towards intellectual capital. Higher education has directly connected to economy as it enhances intellectual capital, which reflects skills, knowledge, and innovation capacities of individuals. This intellectual capital in driving economic growth. Higher education institutions have a key role in cultivating and fostering intellectual resources through instruction, research, and innovation.

Higher Education Implications: The fast rate of change in the knowledge-based economy requires a dedication to continuous learning throughout one's life. HEI be adopting learning methods, ongoing education programs, and skill enhancement activities to assist individuals throughout their professional journeys.

5.3 Dissemination of knowledge on a global scale

5.3.1 Focus on entrepreneurship and innovation

Higher education is affected by the information economy, which highly values entrepreneurship and innovation. Higher education institutions must cultivate an entrepreneurial spirit, offer avenues for innovation, and facilitate research and development that contribute to economic and societal progress.

5.3.2 Interdisciplinary methodology

Higher education must adopt an interdisciplinary approach to address the complexity of modern concerns. Higher education institutions should promote interdisciplinary collaboration to tackle complex problems and cultivate graduates with a comprehensive grasp of the interconnectedness of knowledge.

5.3.3 Outcome-based education

Higher education is affected by the focus in the knowledge economy on quantifiable results and the practical use of knowledge. HEI implementing outcome-based education models, which prioritize precise skills and abilities requirements of various industries.

5.3.4 Shift towards a service-based economy

Implication for Higher Education: As the economy increasingly focuses on providing services, higher education institutions must provide their graduates with the necessary skills and knowledge to excel in professions related to healthcare, finance, education, and other service industries. Soft skills, such as communication talents and customer-centric methods, are becoming essential elements of schooling.

Economic and social mobility refers to potential of individuals to move up or

down world ladder in society. Higher education is influenced by knowledge economy, which emphasizes the significance of cultural competency and ethical decision-making. Higher education institutions should integrate cultural and ethical aspects into their curricula, equipping graduates with the skills to ethically traverse varied global situations.

6.0 Strategies for Skill Enhancement in Higher Education

6.1 Analysis of skill-centric curricular reforms and innovative pedagogical approaches

The examination of skill-focused curriculum changes and inventive teaching methods HEI demonstrates a deliberate endeavor to synchronize academic programs unemployed situation and solutions for job market. These programs seek to narrow the divide between conventional education and the competencies required by the ever-changing and technology-oriented employment market. This analysis explores fundamental elements of curriculum revisions that prioritize skill development and novel teaching methods.

6.2 Skills reforms to the industry

Curricular Reforms: Skill-centric curricular reforms entail the direct incorporation of industry-relevant skills into academic programs. This encompasses the process of identifying essential skills sought by companies and reorganizing courses to include practical, occupation-specific proficiencies. Innovative pedagogy emphasizes experiential learning, internships, and real-world initiatives. Through the use of experiential learning, educators enable students to apply theoretical information to real-life situations, thereby augmenting the acquisition of practical skills.

6.3 Focus on developing and enhancing soft skills and communication abilities

Innovative Pedagogy: Novel educational methods cultivate a mindset of continuous learning throughout one's life. This may entail utilizing online learning platforms, engaging in self-directed projects, and participating in collaborative learning groups that facilitate continuous skill enhancement outside formal education. Collaboration among different industries and guest lectures.

6.4 Examination of collaborations between HEI and industries

The partnerships between HEI and industry are crucial in closing the divide between theoretical academic knowledge and the practical skills required by the job market. These collaborations enhance the educational experience for students by making it more dynamic and relevant, while also supplying industries with a workforce that is trained and adaptable. This analysis explores crucial elements of partnerships between HEI and industries:

6.5 Advisory boards for industries

Collaboration description: HEI frequently form industry advisory boards consisting of professionals and specialists from relevant sectors. These boards offer strategic direction for curriculum development, guaranteeing that directly connection with industry requirements.

Advantages: Advisory boards provide valuable industry perspectives, assist in recognizing developing patterns, and guarantee the ongoing relevance and currency of educational programs. This partnership guarantees that graduates get the skills required by businesses.

6.6 Programs for internships and cooperative education

Nature of collaboration: Collaboration entails the establishment of internship and co-op initiatives, enabling students to acquire hands-on experience in authentic professional settings.

Advantages: Students gain practical skills, apply theoretical understanding, and establish professional connections. Employers, in return, acquire access to a reservoir of prospective future employees with hands-on expertise.

6.7 Collaborative efforts to do research and develop new projects

The engagement between academic researchers and industry personnel in joint research and development activities is aimed at addressing industry-specific difficulties through partnerships.

Advantages: These partnerships facilitate progress in technology, foster innovation, and promote the creation of practical solutions to real-life challenges. Both academia and industry derive advantages from the mutual exchange of knowledge and resources.

6.8 Curriculum integrated into the industry

Nature of collaboration: Collaborations entail the incorporation of industrial viewpoints into academic curricula, guaranteeing that educational programs conform to industry benchmarks.

Advantages: Incorporating industry-specific curricula improves the practicality of education, equipping students with the precise skills and information demanded by companies. This relationship facilitates a smooth transfer from academics to the workforce.

6.9 Invited presentations and discussions by experts and professionals from many industries

Nature of collaboration: The establishment of industry-sponsored research centers enables targeted research and development endeavors in partnership with academic scholars.

Advantages: Research centers supported by the industry promote the sharing

of knowledge, resources, and specialized skills. They facilitate collaboration between academics and industry personnel to undertake innovative initiatives with tangible real-world implications.

6.10 Entrepreneurship and incubation centers

6.10.1 Corporate-funded scholarships and fellowships

Nature of collaboration: Collaboration include the implementation of industry-sponsored scholarships and fellowships, which offer monetary assistance in particular domains.

Advantages: This collaboration motivates students to seek employment in sectors experiencing a lack of skilled workers. Additionally, it facilitates a direct linkage between prominent figures in the sector and up-and-coming individuals with potential.

6.10.2 Involvement of the industry in curriculum design

Nature of collaboration: Collaboration entails the active involvement of industry personnel in the creation and evaluation of academic curricula.

Advantages: This active participation guarantees that educational programs are customized to meet the specific needs of the business, by integrating the most up-to-date technology, techniques, and skill prerequisites.

Ultimately, HEI in establishing a mutually beneficial relationship that advantages students and companies, instructors and employers. These collaborations augment the pertinence of education, bolster worker advancement, and cultivate innovation and economic expansion. These relationships are essential in preparing students for successful and influential careers in the professional world by closely matching academic programs with industrial requirements.

7.0 Discussion and Conclusion

“Building a Skilled Nation: The Transformative Role of Higher Education” emphasizes the crucial function that higher education serves in molding the abilities, capabilities, and mentality of individuals, ultimately the front competent and adaptable workforce. This talk examines crucial elements of the transformational impact of higher education in constructing a proficient nation:

7.1 Knowledge acquisition and specialized competence

Significant Influence: Higher education institutions function as centers of knowledge where individuals acquire specialized competence in several subjects. By engaging in academic programs, students acquire in-depth knowledge and understanding of specific areas, thereby establishing the groundwork for advanced abilities and expertise.

National Influence: The development of a proficient nation relies on individuals possessing profound expertise, which empowers them to make substantial contributions to fields such as technology, healthcare, engineering, and others.

7.2 Innovation and entrepreneurship

Significant Influence: Higher education promotes innovation and entrepreneurship through the cultivation of critical thinking, problem-solving, and creativity. Entrepreneurship programs and incubators in universities foster an environment that encourages innovation.

National Impact: A nation that possesses advanced skills not only demonstrates expertise in current technologies and processes, a catalyst for innovation, thereby stimulating high rate fostering the establishment of new enterprises, products, and solutions.

7.3 Practical application of knowledge

Transformative Impact: Higher education extends beyond theoretical learning, prioritizing the pragmatic implementation of knowledge. Internships, cooperative programs, and practical projects provide students with the opportunity to implement theoretical knowledge gained in the classroom inside real-life situations.

National Impact: A proficient nation is distinguished by individuals who can effortlessly convert theoretical knowledge into applied abilities, effectively meeting the changing requirements of industries and enhancing workplace efficiency.

7.4 Global competitiveness

Significant Influence: HEI follows the chapter with the required abilities and global views to be internationally competitive. Being exposed to a variety of cultures, languages, and global challenges equips graduates with the necessary skills to thrive in a highly competitive global job market.

National Impact: A proficient country possesses a high level of competitiveness on a global scale, which enables it to attract skilled individuals, promote international partnerships, and actively engage in the global economy.

7.5 Lifelong learning and adaptability

Significant Influence: Higher education fosters a mindset of continuous learning, highlighting the importance of individuals adjusting to advancing technologies and changing industrial patterns throughout the course of their professional lives.

National Impact: A proficient country actively welcomes ongoing education, guaranteeing that its labor force remains flexible and robust in response to technology progress and cultural shifts.

7.6 Industry-relevant curriculum

Significant Influence: HEI consistently revise their curricula to match the demand from industry. This guarantees that graduates enter the labor market equipped with pertinent and sought-after skills.

National Impact: A skillful nation reaps the advantages of moving directly intellectually but also possesses the practical aptitude demanded by industry, resulting in heightened employment rates and economic expansion.

7.7 Social mobility and inclusivity

Significant Influence: Higher education acts as a means for social mobility, offering chances for individuals from various origins to gain expertise and understanding. Inclusive education systems foster the inclusion of diverse individuals and ensure equitable opportunities for all.

National Impact: A proficient nation embraces inclusivity, harnessing the varied talents and viewpoints of its population to stimulate innovation and tackle societal concerns.

7.8 Civic involvement and social responsibility

Significant Influence: Higher education cultivates a strong commitment to civic involvement and social responsibility. By engaging in community service programs and receiving ethical education, students are equipped to make constructive contributions to society.

National Impact: A proficient nation places importance on ethical decision-making and social responsibility, cultivating a feeling of community and overall welfare.

7.9 Research and development

Significance: Higher education institutions provide substantial contributions to research and development. State-of-the-art research improves understanding, stimulates creativity, and establishes the country as a frontrunner in several scientific and technological domains.

National Influence: A proficient nation leads in progress, transforming research results into tangible implementations that yield advantages for industries, healthcare, and societal welfare.

7.10 Policy influence and thought leadership

Significant and far-reaching effects: Higher education institutions have a vital role in influencing policy by conducting research, providing expert opinions, and leading in thought. Involved scholars enhance the process of making well-informed decisions on a national scale. *National Impact:* A proficient nation reaps the advantages of policies grounded in empirical evidence, fostering a climate that promotes economic growth, ingenuity, and the welfare of its populace.

To summarize, higher education has a varied and transforming role in developing a skilled nation. This includes promoting academic achievement, fostering creativity, imparting practical skills, and instilling a sense of social responsibility. Through the cultivation of a proficient and versatile labor force, higher education assumes a pivotal role in fostering national progress, exerting influence over economic well-being, international competitiveness, and societal progress.

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CHAPTER 12

Financial Literacy and Inclusion: A Crucial Nexus for Sustainable Development

Swati Chauhan¹

ABSTRACT

Financial Inclusion (FI) has been recognized as a catalyst for seven out of the 17 sustainable development goals. The G-20 has demonstrated its dedication to promote FI worldwide and has formulated elevated principles to guide this commitment. Studies in the literature found that financial literacy (FL) plays a crucial role to make informed financial decisions, diminish the barrier to enter in to financial system and promote inclusivity. The objective of this study is to see the relationship between financial inclusion and financial literacy through existing studies, further study will take the case of Madhya Pradesh where recently District financial inclusion Index has been launched to understand the status of FI and its comparison with national financial inclusion index (FII). Further study will also analyse the strategy document viz. National Strategy for Financial Inclusion (NSFI) 2019-24, and National Strategy for Financial Education (NSFE) 2020-25 launched by Reserve Bank of India (RBI) and National Centre for Financial Education (NCFE) respectively. By elucidating the interconnected dynamics of financial literacy and inclusion, the study aims to contribute valuable insights for policymakers, financial institutions, and stakeholders committed to advancing sustainable development goals.

Keywords: Financial Inclusion, Financial Literacy, Sustainable development goals, NSFI, Financial Inclusion Index.

1.0 Introduction

FI and FL play an important role in fostering sustainable development (SD) by empowering communities to participate in and benefit from economic communities (Bire *et al.*, 2019; Lyons and Kass-Hanna, 2021; Khan *et al.*, 2022a; Adetunji and David-West, 2019; Lontchi *et al.*, 2022; Gupta and Singh, 2013; Okello Candiya Bongomin, 2020). FI describes how all members of society, regardless of their financial situation, can access and use formal financial services (Ozili, 2021; Chauhan & Kumar; 2014; Ghosh and Vinod, 2017). However, FL entails giving people the information and abilities they need to make wise financial decisions (Grohmann and Menkhoff, 2017; Fauziah *et al.*, 2021; Atkinson and Messy, 2013; Gupta and Singh, 2013; Hasan and Hoque, 2021).

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The relationship between FI and FL is widely studied in the literature and discuss how it helps in achieving sustainable development (SD) (Ade'Soyemi *et al.*, 2020; Bongomin *et al.*, 2018; Kuada, 2019; Voica, 2017). The connection between FI, FL and SD is multifaceted. First of all, access to basic financial services such as savings, credit, insurance make individuals better positioned to manage risk, accumulate assets, and start income generating activities which leads to poverty reduction and economic growth. Second, in order to guarantee that people make wise financial decisions, FL is essential.

Consumers with greater education are more likely to see the value of prudent saving, investing, and budgeting. This enhances their financial security and adds to the stability of the financial system as a whole. Furthermore, the encouragement of entrepreneurship and the growth of small businesses demonstrates the connection between FI, FL & SD.

The Sustainable Development Goals (SDGs) of the United Nations emphasize the significance of FI & FL, offer a comprehensive framework for tackling global issues and advancing SD (Kara *et al.*, 2021; Kandpal, 2020; Niaz, 2022). Countries can endeavor to lower inequality, advance gender parity, and guarantee inclusive economic growth by tackling these financial aspects (Khan *et al.*, 2022c; Gupta and Vegelin, 2016). A number of these objectives depend on FI since it acts as a catalyst for inclusive communities, economic progress, and the reduction of poverty (Chauhan *et al.*, 2022; Khan *et al.*, 2022a; Ullah *et al.*, 2020; Khan *et al.*, 2022b).

Seven out of 17 SDGs are playing a crucial role in achieving the objective of FI worldwide viz SDGs 1, 5, 8, 9, 10, 16 and 17. According to the Global Findex Database (2022) globally 1.4 billion adults lack access to fundamental financial services, rendering them unbanked (Demirgüç-Kunt *et al.*, 2022). FI is a crucial tactic in achieving SDG 1, which focuses on ending poverty by enabling people to become economically resilient and break free from poverty traps.

Financial inclusion advances SDG 5 (Gender Equality), as evidence indicates that 42% of women globally lack access to formal banking (Global Partnership for Financial Inclusion (GPII) Report, 2020). FI closes this gap and gives women economic power, promoting gender equality. Furthermore, inclusive financial institutions encourage entrepreneurship and job creation, which promote sustainable economic growth, according to SDG 8 (Decent Work and Economic Growth). The necessity of comprehensive measures to address poverty, inequality, and economic empowerment on a global scale is highlighted by the connection between the SDGs and FI.

With this background this comprehensive study provides a detailed understanding on FI & FL and how nation-wide assessment on FI and FL shows the progress of India. Further a detailed analysis has been done on the financial inclusion index prepared by RBI for India and Madhya Pradesh state in subsequent sections.

2.0 Objectives of the Study

The objectives of the study are:

- To examine the relationship between FI, FL and SD through existing studies.
- To analyse and compare the Financial Inclusion Index prepared by RBI and Madhya Pradesh Financial Inclusion Index

3.0 Literature Review

FI is widely studied in the literature and same with FL, however the relationship of FI & FL is less discussed in context of SD. This section is discussing about the studies related to FI and various dimension of financial inclusion index (FII), FL and how is it crucial for right decision making. Further this section will discuss how FL and FI is crucial for overall sustainable development.

3.1 Financial inclusion

Financial inclusion in India has a longstanding history, dating back to 1904 with the initiation of the co-operative movement. A pivotal moment occurred in 1969 with the nationalization of 14 banks, marking a significant step. The second nationalization took place in 1980, adding six more banks to the fold. Supplementing the initiatives undertaken by the government, the RBI has implemented diverse measures, such as priority sector lending mandates, the establishment of regional rural banks (RRBs), and programs facilitating the linkage of self-help groups with banks. These initiatives collectively enhance access to financial services for marginalized sections of society. The Government of India (GoI), in collaboration with the Indian Banks' Association (IBA), introduced Swabhimaan, a comprehensive financial inclusion campaign. This initiative aimed to integrate the most economically disadvantaged individuals into the banking system, ensuring that the benefits of economic prosperity are accessible to all. Another notable effort, the Pradhan Mantri Jan-Dhan Yojana (PMJDY), was launched by the RBI in 2014 with the goal of facilitating the opening of bank accounts for every individual.

Recently, RBI has launched NSFI (2019-2024) under supervision of National Inclusion Advisory Committee included the inputs of the Security & Exchange Board of India (SEBI), Insurance Regulatory and Development Authority of India (IRDAI), Pension Fund Regulatory Development Authority of India (PFRDA) and consultation with national Bank for Agriculture and Rural Development (NABARD), National Payment Corporation of India (NPCI), Commercial banks and corporate business correspondents. The strategy targeted the access to financial services, deepening and broadening FI, promoting FL and consumer protection (NSFI, 2020).

Facilitating a more inclusive financial system enhances the allocation of resources, consequently leading to a reduction in capital costs (Sarma & Pais, 2011). Moreover, an inclusive financial system plays a pivotal role in mitigating the

proliferation of exploitative informal lending sources, such as moneylenders. The global acknowledgment of FI as a crucial metric for assessing the inclusivity of the formal financial system is evident. However, the existing literature lacks a comprehensive measure to gauge the extent of financial inclusion. At the national level, indices like Credit Rating Information Services of India Limited (CRISIL) Index, NAB-Index, and the recently introduced RBI FII have been established (RBI, 2021). While these indices employ distinct parameters, a similar methodology is adopted to measure Inclusive Financial Inclusion (IFI). Independent researchers have also endeavoured to measure FII using diverse parameters.

CRISIL Index was India's first FII launched in 2013, and later on continue in subsequent years of 2014, 2015, and 2018 and based on United Nations Development Programme's (UNDP) methodology. The similar methodology was used by NABFINDEX (NABARD FII), and other independent researchers (Sarma, 2008, 2011, 2012, 2016). The NABARD Index of Financial Inclusion derives its foundation from the data gathered through the NABARD-All India Rural Financial Inclusion Survey (NAFIS) for the year 2016-17. The NABARD conducted NAFIS across India in 2016-17, surveying 40327 sample households in 245 districts across 29 states on both financial and livelihood issues (NABARD, 2018).

The index score based on all three dimension viz. banking products, banking services and payment mechanism lies between 0 to 1. Where 0 stands for complete financial exclusion and 1 stands for complete financial inclusion. As per NABARD (2018) report overall score of India was .337, however Madhya Pradesh score was .166 and stood on 28th position among 29th states. Recently, RBI has launched Index of Financial Inclusion in August 2021, based on three dimensions viz. access, usage and quality. Total 97 indicators have been used in the preparation of the index. The methodology for combining the multiple indicators into single number is similar to the methodology adopted by (Sarma, 2008, 2011, 2012, 2016) and UNDP for measuring, HDI, Human Poverty Index (HPI), and Gender Development Index (GDI).

Existing literature has delved into numerous independent studies on FII. A study conducted by Deepti and Vaidhya Subramaniam (2018) analysed India's FII employing Sarma's methodology. Similarly, various researchers have constructed indices utilizing Sarma's (2008) methodology, NABFINDEX, and CRISIL Inclusix. At the state level in the Indian context, indices have been formulated, with notable contributions of the authors (Goel & Sharma, 2017; Bagli & Dutta, 2012). Some studies examined the factors of financial inclusion and checked inter-state variations, as seen in the works of Chithra and Selvam (2013). The variables employed in preparing these indices align with those used by Sarma (2008, 2011, 2012, 2016). Further, studies were conducted in developing countries all around the world and focussed on financial inclusion (Prastowo and Putriani, 2019; Park and Mercado, 2018; Omar and Inaba, 2020; Van *et al.*, 2021; Datta and Singh, 2019).

3.2 Financial literacy

In recent years, the status of FL has garnered increasing attention on the global stage as societies grapple with the challenges posed by complex economic landscapes and evolving financial systems. The need for individuals to possess a solid foundation in financial knowledge and skills has become paramount, and international efforts are underway to gauge and improve the state of FL worldwide. World-wide, many organizations are working to promote the level of financial literacy viz. International Network on Financial Education (INFE), Organization for Economic Co-operation and Development (OECD), RBI, Global Financial Literacy Excellence Center (GFLEC), International Monetary Fund (IMF), World Bank - Global Partnership for Financial Inclusion (GPII). These organizations are making efforts in various way to make population financially literate by immense modes viz. audio-visuals, camps, campaigns, reading materials etc. financial literacy and financial education go hand in hand.

Nationally RBI, National Centre for Financial Education (NCFE) along with other financial regulators are striving their efforts to promote the FL. Key developmental priorities of both the Government and the four Financial Regulators have been to strengthen financial education in the country viz. RBI, SEBI, IRDAI and PFRDA. FL promotes FI by enabling customers to make well-informed decisions that benefit their financial well-being (National Strategy of Financial Education (NSFE) 2020-2025). FI and FL are the two important pillars of development policy worldwide.

Studies in the literature showed that FI and FL complement each other. FL is an important demand side determinant of FI. FL encompasses the proficiency to comprehend and adeptly apply diverse financial skills, encompassing personal financial management, budgeting, investing, and the integration of financial practices into everyday life. The OECD in 2018 outlined three fundamental elements of financial literacy: financial knowledge, financial attitudes, and financial behaviors (OECD, 2018). FL coupled with apprehensions about utilizing financial services among marginalized groups, particularly tribal communities, leads to their financial exclusion (Praveenkumar, 2019; Nanda, 2019). Nanda and Samantha (2018) explored the concept of financial literacy through various studies and found that limited education, lack of employment, insufficient means to maintain standard of living, poverty and lack of FL are the factors collectively driven the tribal community universally into extreme poverty. Further, Studies emphasized the need of financial literacy programs and digital financial literacy for consumers at the grassroots level as well as officials in the financial sector (Braunstein and Welch, 2002; Houston, 2010; Morgan, 2022; Lyons *et al.*, 2021).

The Standard & Poor (S&P) Global Financial Literacy Survey is a global assessment conducted to gauge FL on four parameters: interest rates, concept of compounding, inflation, and risk. This survey, conducted in 2014, covered over 140 countries and involved 150,000 adults, aiming to also assess financial resilience

worldwide (Klapper & Lusardi, 2020). The findings revealed that globally, one out of three adults possess financial literacy, indicating that a significant 3.5 billion adults, primarily in developing nations, lack a fundamental understanding of financial concepts. Unsurprisingly, there is a substantial disparity in financial literacy rates between major advanced economies where an average of 55 percent of adults are financially literate. In contrast, major emerging economies, the BRICS nations show an average financial literacy rate of 28 percent among adults and major difference has been noticed in South Africa (Klapper, Lusardi & Van Oudheusden, 2015). This is evident in a country like India, where overall literacy stands at approximate 80%, but the financial literacy rate is only 27%, as reported in the Financial Literacy and Financial Inclusion survey in 2019. In totality 33% urban, 24% rural population is financially literate and less financial literacy has been observed in case of student (26%), agriculture labourer's (13%), and homemakers (16%). In Madhya Pradesh the financial literacy is at 24% below form the national level, Goa and Chandigarh is the only state having financial literacy 56%.

A number of studies world-wide in the literature talked about relationship between FI & FL (Bire *et al.*, 2019; Joseph, 2014; Grohmann *et al.*, 2018; Lyons *et al.*, 2021; Khan *et al.*, 2022d; Kodongo, 2018; Koomson *et al.*, 2020; Grohmann & Menkhoff, 2017; Fauziah *et al.*, 2021; Atkinson & Messy, 2013; Gupta & Singh, 2013). Studies found that FL has positive effect on FI (Gerald *et al.*, 2022; Hasan *et al.*, 2021) and few studies focussed on mediating role of variables viz. training (Bire *et al.*, 2019) social networks (Okello Candiya Bongomin *et al.*, 2020a), gender (Desai *et al.*, 2023). In few of the studies FL act as a mediator between financial inclusion's drivers and sustainable growth (Pandey *et al.*, 2022). In other studies role of microfinance institutions is discussed in achieving the objective of financial inclusion (Okello Candiya Bongomin *et al.*, 2020b; Chauhan, 2021a, 2022b, 2022, 2023; Sangwan *et al.*, 2024) reducing poverty and providing timely access to credit to deprived poor.

Based on the above discussion, it is clear that FI and FL are closely related and have strong effect on sustainable development. Further, to understand measurement of financial inclusion, RBI's FII (2021) and Madhya Pradesh District FII for the FY 2020 and 2021 have been studied, and how these indices are helpful for measuring the extent of financial inclusion.

4.0 Research Methodology

This study is a review study and incorporated many studies of FI & FL and its linkages with SD. This study referred only published studies, government reports, reports by think tanks etc. To understand the measurement methods of FI, FII study by RBI (RBI, 2021) and district level FII report of Madhya Pradesh has been studied (Chauhan *et al.*, 2022). This was the first district level FII study in India where financial inclusion score of 52 districts has been calculated and grouped into three

categories viz. developed, aspirational and developing districts. The study also compared both the national and the state report in terms of parameters, methodology and scores for better understanding. The study also evaluated the national strategies documents viz. the NSFI and NSFE document to understand the vision of nation to promote the FI and FL in India.

4.1 Methods adopted by RBI and MP district FII

RBI has used similar methodology used by UNDP in calculating HDI and HPI; the methodology for combining the multiple indicators into single number is similar to the methodology adopted by Sarma in different years (2008, 2011, 2012, 2016). The detailed methodology of RBI and MP district FII is given below in table 1. MP district FII used Principal Component Analysis (PCA) method (Camara and Teusta, 2014) for weight estimation and calculation of scores. PCA method provides clear understanding of weight estimation however, in the RBI index methodology no method has been discussed for weight estimation.

Table 1: Comparison of RBI and MP District FII Methods

RBI Method	MP District FII
<p>$N_i = \text{Normalised value } (Y_i) = \frac{Y_i - \text{State when no Financial services were available}}{\text{Desired goal } (t_i)}$</p> <p>$N_i = \frac{Y_i - 0}{t_i} = \frac{Y_i}{t_i}$</p> <p>Let $d_i = w_i * N_i$; $d_i^2 = d_i * d_i$;</p> <p>Let $D^2 = d_1^2 + d_2^2 + \dots + d_k^2 = \sum_{i=1}^k d_i^2$;</p> <p>Let $W^2 = w_1^2 + w_2^2 + \dots + w_k^2 = \sum_{i=1}^k w_i^2$ and</p> <p>$(W - D)^2 = \sum_{i=1}^k (w_i - d_i)^2$</p> <p>Let $X_1 = \frac{\sqrt{D^2}}{\sqrt{W^2}}$ and $X_2 = 1 - \frac{\sqrt{(W-D)^2}}{\sqrt{W^2}}$</p> <p>FI Index of a dimension = $\frac{X_1 + X_2}{2}$</p>	<p>$FI = w1 Y_i^a + w2 Y_i^u + w3 Y_i^q + e_i$ (1)</p> <p>$Y_i^a = \beta 1 N_{Bank out_i} + \beta 2 N_{ATMS_i} + \beta 3 N_{DPSC_i} + \beta 4 N_{BC_i} + \beta 4 N_{NBFCMFI_i} + \beta 4 N_{PO_i} + \beta 4 N_{DCCB_i}$ (2)</p> <p>$Y_i^u = \theta 1 P_{SB_i} + \theta 2 P_{WSB_i} + \theta 3 P_{MSME_i} + \theta 4 P_{FC_i} + \theta 5 P_{PA_i} + \theta 6 P_{INSUR_i} + \theta 7 P_{CREDIT_i}$ (3)</p> <p>$Y_i^q = \gamma 1 N_{FLCB_i} + \gamma 2 N_{BFLC_i}$ (4)</p>

Source: RBI Bulletin, 2021 and MP District, FII, 2022

4.2 Indicators and weights used in RBI and MP district FII

Both the study used three dimensions viz. Access, Usage and Quality including 35%, 45% and 20% weights respectively. Total 97 indicators have been used in the preparation of the index; however detailed list of indicators is not published by RBI. Using PCA method MP district FII calculated weights viz. 38%, 48% and 14% for access, usage and quality dimension respectively. The MP FII has used 16 variables across three dimensions viz access, usage and quality; seven variables under access, seven variables in usage and two variables in quality dimension. The detailed list of indicators is available in the report (Chauhan *et al.*, 2022). The study has used NSFI for identification of variables.

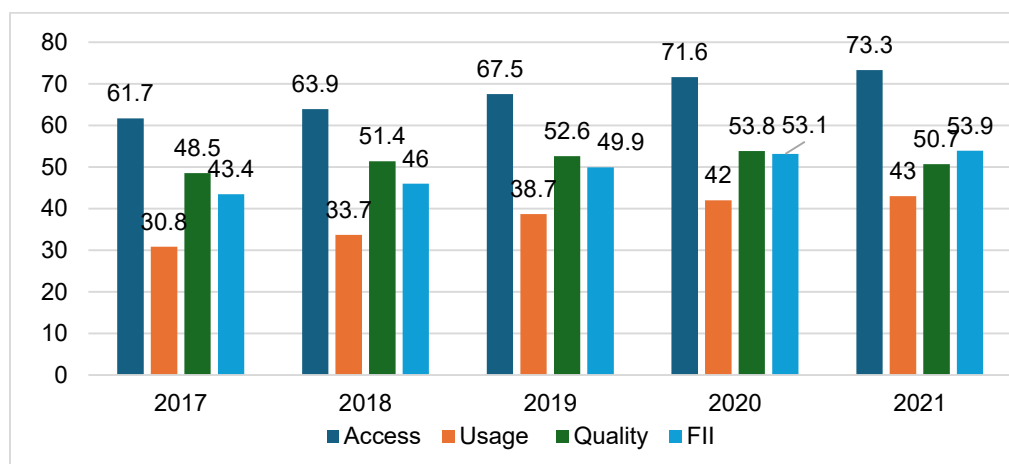
5.0 Data Analysis

This section presents the scores of FII of RBI and MP District FII.

5.1 FII of RBI

RBI launched FII in August 2021, based on access, usage and quality parameters for the five years (2017 to 2021). Figure 1 presents the progress of FI of India for a duration of five years (2017 to 2021). The results shows that India is progressing continuously in achieving the goal of financial inclusion by improving the score of FII from 43.4% to 53.9%. However, India is still far to achieve the score of 100%. Comparable advancements have been observed in the facets of financial inclusion, namely access, usage, and quality. Remarkably, the access dimension has made substantial strides, reaching an impressive 73.3%, followed by the quality dimension at 50.7%, and the usage dimension at 43%.

Figure 1: Financial Inclusion Index for India



Source: RBI (2021)

5.2 Madhya Pradesh district FII

Madhya Pradesh (MP) state has first time prepared the district wide FII for the period of two years (2020 and 2021). The state has 52 districts and 313 blocks and area wise the second largest state after Rajasthan. The think tank of Government of Madhya Pradesh (GoMP) which is Atal Bihari Vajpayee Institute of Good Governance and Policy Analysis (AIGGPA) prepared this report. The report has been unveiled by the honorable chief minister of the State on 29th July 2023. The broader recommendations of the report have been accepted by State Level Banker Committee (SLBC) and instruction is given to districts lead banks to improve the performance of the bottom districts.

The study used PCA method which is widely used in the literature (Camara & Teusta, 2014; Nguyen, 2020; Chauhan, 2023). The indices are sensitive to weight

assignment and require scientific method for weight calculations (Camara *et al.*, 2014). Index based on Euclidian distance method which is used by Sarma 2008, 2011, and 2012 does not provide any scientific method of weight calculation (Camara *et al.*, 2014; Nguyen, 2020). Similarly, other studies in the literature have not disclosed the method of weight calculation in measuring the FII (Deepti *et al.*, 2018; Goel *et al.*, 2017; Sarma, 2016; Bagli *et al.*, 2012). The results shows that MP financial inclusion index improves from .280 (2020) to .283 (2021) (Chauhan *et al.*, 2022), however few districts like Bhopal and Indore have achieved more than 50% score. For detailed understanding of the district level scores for two years refer below given table 2.

Table 2: Madhya Pradesh's District Financial Inclusion Index Score

District	Score (2020)	Rank	Score (2021)	Rank	Status
Bhopal	0.618	1	0.578	1	≈
Indore	0.571	2	0.555	2	≈
Ujjain	0.502	3	0.359	8	↓
Hoshangabad	0.45	4	0.438	3	↑
Dhar	0.434	5	0.406	4	↑
Ratlam	0.402	6	0.315	15	↓
Harda	0.39	7	0.381	5	↑
Sehore	0.368	8	0.374	6	↑
Mandsaur	0.364	9	0.332	13	↓
Vidisha	0.358	10	0.237	34	↓
Jabalpur	0.356	11	0.362	7	↑
Sagar	0.356	12	0.274	23	↓
Dewas	0.352	13	0.346	10	↑
Rajgarh	0.349	14	0.353	9	↑
Raisen	0.344	15	0.345	11	↑
Jhabua	0.332	16	0.336	12	↑
Damoh	0.305	17	0.309	17	≈
Neemuch	0.299	18	0.307	18	≈
Shivpuri	0.289	19	0.203	43	↓
Guna	0.287	20	0.261	30	↓
Narsimhapur	0.282	21	0.28	21	≈
Gwalior	0.282	22	0.317	14	↑
Chhindwara	0.28	23	0.314	16	↑
Sheopurkalan	0.264	24	0.275	22	↑
Panna	0.255	25	0.261	29	↓
Shahdol	0.254	26	0.288	20	↑
Ashoknagar	0.253	27	0.233	36	↓
Katni	0.245	28	0.27	25	↑
Khandwa	0.244	29	0.213	41	↓

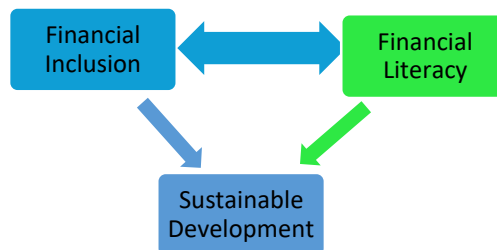
Tikamgarh	0.243	30	0.243	33	↓
Alirajpur	0.242	31	0.226	38	↓
Seoni	0.241	32	0.268	26	↑
Betul	0.241	33	0.295	19	↑
Mandla	0.23	34	0.229	37	↓
Khargone	0.228	35	0.218	40	↓
Sidhi	0.226	36	0.246	32	↑
Chhattarpur	0.216	37	0.266	27	↑
Burhanpur	0.211	38	0.168	47	↓
Shajapur	0.21	39	0.266	28	↑
Dindori	0.196	40	0.197	45	↓
Barwani	0.194	41	0.201	44	↑
Balaghat	0.193	42	0.251	31	↑
Umaria	0.185	43	0.274	24	↑
Datia	0.177	44	0.18	46	↓
Satna	0.173	45	0.234	35	↑
Anuppur	0.168	46	0.219	39	↑
Morena	0.153	47	0.139	49	↓
Rewa	0.137	48	0.211	42	↑
Singrauli	0.085	49	0.151	48	↑
Bhind	0.068	50	0.117	50	≈

Source: Construction of financial inclusion index by The Microfinance Review, 2023

6.0 Results and Discussion

This section presents the results and discussion section. The first objective is to see the relationship between FI, FL and SD through existing studies. Detailed literature review section established the relationship amongst three. The model developed below in figure 2 demonstrates that FI and FL have dual-sided impacts and can mutually contribute to sustainable development. Further, in future this model can be tested by using primary data from the field.

Figure 2: FI, FL and Sustainable Development



In the second objective both the indices viz. RBI and district FII of MP has been analysed to see the difference in terms of indicators, weights assigned,

methodology and scores. The national FII is very comprehensive and used a vast number of variables to cover the inclusivity and state wide variability. However, its detailed understanding is incomplete due to unavailability of the state wide score. RBI has not released a detailed list of 97 indicators and state wide scores in all these five years to understand how the states are performing in achieving the financial inclusion. The literature also found that CRISIL inclusix was the only index which released the state wide scores in all the yearly publication of the report till 2018. Similarly, NABFindex also released the state wide scores in 2016-17. The primary difference in both the indices are CRISIL Inclusix index was based on secondary database, and NABFindex based on primary household survey NAFIS, however, RBI index is based on both primary and secondary data. CRISIL index was the only indexes which provides district wide score along with state and national level, however NABFindex and recently launched RBI index only provide national and state level score.

MP is the first state which took initiative to launch district FII for the 52 districts in 2022. The recommendations of the report are widely accepted by the state government and financial institutions. There are a lot of differences available in all the above discussed indices in variables used, methodology, year of analysis, geography, and types of data. However, in the literature all the indices are widely accepted and no comparison has been done in terms of score performances. All the indices came in different years and utilized properly. We can only see the differences in terms of variables, methodology used. Form the above discussion it is clear that if the two indices differ in terms of methodology, weight estimation, variables used and in different years; they are not comparable. Here, we have seen the differences in all the existing indices and found that their scores are not comparable. If we see the NABFindex scores of the Madhya Pradesh it was .166 in 2018, however in recent report of MP it is improved to .283 (Chauhan *et al.*, 2022), however the comparison is not correct due to difference in indicators.

Further to improve the status of financial inclusion and financial education, RBI launched NSFI (2019 to 2024) and NCFE launched NSFE (2020 to 2025). The NSFE document aims to align with the Vision of the GoI and Financial Sector Regulators. It seeks to empower diverse segments of the population by cultivating essential knowledge, skills, attitudes, and behaviors necessary for effective money management and future financial planning. The NSFE is based on five Cs viz. Content, capacity, community, communication and collaboration. The first NSFE was launched in 2013 for the period of five years (2013-18) followed by a review by the Technical Group on FI and FL under the Financial Stability and Development Council. The ultimate objective of NSFE is to inculcate FL concepts amongst various section of the society, encourage saving behaviour, credit discipline, improve usage of digital financial services etc. To assess the level of FL and FI, NCFE carried out National Financial Literacy and Inclusion Survey (NFLIS) (2019) based on OECD-INFIE toolkit in every five years. Findings shows that overall FL in India is 27%; out

of 35 states/UTs, 18 states/UT s have FL above average national level. However, FI based on the NFLIS (2019) methodology is 15%. Zone wise analysis shows that North-Esat Zone is leading in FI with 20% followed by West (18%), South (17%), Central (16%), North (14%) and East Zone (10%). As we can see from the analysis that FI and FL go hand in hand, all the financial regulatory organizations working in the same direction to achieve the objective of 100% FI along with FL for overall sustainable development.

7.0 Conclusion

This extensive research explores the complex interrelationships among Financial Inclusion (FI), Financial Literacy (FL), and Sustainable Development (SD). The study highlights the role that FI and FL play in empowering communities, accelerating economic growth, and tackling global issues that are listed in the SDGs. Further, study sheds light on the significance of various FIIs in evaluating the progress of FI on a national and regional level. The unique features of each index contribute to a nuanced understanding of financial inclusion dynamics. Comparisons between national and district-level FIIs reveal the diversity in methodology, indicators, and scoring systems. While the national FII provides a broad overview of the country's progress, the district-level FII of Madhya Pradesh offers a granular analysis, identifying areas of improvement at the local level. However, challenges arise in comparing scores across different indices due to variations in methodology and indicators.

The study concludes by highlighting the ongoing efforts of global organizations and national authorities in promoting financial literacy and inclusion. The implementation of strategies outlined in the NSFI and NSFE demonstrates a commitment to cultivating financial knowledge and skills among diverse segments of society. This study will help academicians and researchers to understand the concept of FI and FL and various indices. This study will also help policymakers to adopt an integrated and inclusive approach, recognizing the symbiotic relationship between FI and FL. Tailoring strategies to address the specific needs of marginalized communities is imperative, acknowledging the diverse challenges they face. Policymakers must prioritize the development of robust financial literacy programs, collaborating with educational institutions, non-profits, and the private sector.

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CHAPTER 13

Exploring How Management Students View the Integration of Group Psychology in Human Resources Strategies in Salem City

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ABSTRACT

Human resources strategies revolve around comprehensive planning and implementation of efforts to successfully manage an organisation's workforce. These techniques encompass a variety of disciplines, including recruiting, staff grooming, measuring performance, and employee relations. The study aims to enhance the understanding of human resource practices. Successful HR strategies in line with the new AI technologies help to recruit, retain, and develop talented workers, which improves overall organisational performance and success. Psychology has a considerable impact on human resources because it provides insights into individual and group behaviour, motivation, and interpersonal dynamics in the workplace. The major objective covered in this paper is to explore the knowledge about the student's perspective in psychology in line to human resources. The method of sampling used to collect data is Convenience Sampling. Above 80.8% of respondents agree that group psychology is important in understanding team dynamics within an organization. Further, it is found that 72% of the respondents agreed that management students should be exposed to case studies or practical examples showcasing successful integration of group psychology in HR strategies.

Keywords: Human resources, psychology, business decisions, Groups, AI.

1.0 Introduction

In the dynamic landscape of contemporary organizations, the interconnectedness of management and psychology has become increasingly pivotal, especially in the realm of Human Resources (HR) strategies. One pertinent area of exploration within this field is the integration of group psychology into HR practices. As businesses recognize the profound impact of team dynamics on organizational success, management students are delving into the multifaceted dimensions of how group psychology influences HR strategies.

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This inquiry seeks to understand the perspectives of management students regarding the incorporation of group psychology principles, examining their insights into the symbiotic relationship between team dynamics and effective HR management. As the workforce evolves and embraces collaborative structures, comprehending the nuanced interplay between individual behaviour and group dynamics is crucial for cultivating workplaces that not only foster productivity but also nurture employee well-being and satisfaction. This exploration aims to shed light on the perceptions, challenges, and potential opportunities perceived by management students as they navigate the intricate landscape where psychology converges with human resources strategies. This study deeply provides insights into understanding between the group members inside an organisation as well as about peers. Management students regard group psychology as an important factor in determining peer connections throughout time.

2.0 Review of Literature

Crocker & Major (1989) concluded that groups offer diverse methods for preserving and elevating one's sense of self-value, as the evaluation of group quality contributes to our shared self-esteem.

Crocker & Luhtanen (1990), conducted a study on "Collective Self-Esteem and Ingroup Bias". The research findings indicated that in instances where an individual experiences a blow to their self-esteem due to a personal setback, they may redirect their focus towards the achievements and reputation of the group. Furthermore, through comparisons between different groups, it was found that members of the superior group tend to take pride in their elevated status. Additionally, by disparaging other groups, individuals can elevate both their personal and collective self-esteem.

Konrod *et al.* (2005), conducted a study on "Human Resource Strategies to Manage Workforce Diversity," which advocates for three key HR initiatives. The authors emphasize increasing the representation of historically excluded groups, empowering a diverse workforce for decision-making, and ensuring inclusive participation in organizational life. The authors tie these strategies to a business case, aligning diversity efforts with recruitment, development, and retention practices for competitive advantage. Data from the US Department of Labor highlights ongoing disparities in managerial occupations by race and gender, reinforcing the necessity of addressing these issues in organizational practices.

Amy & Jessica (2012), had published their study in "Human Resource Development Quarterly". The study provides valuable insights into the corporate university phenomenon through a comprehensive survey of 210 corporate universities in North America. It emphasizes five prominent processes, including alignment and execution, developing skills, technology use, learning evaluation, and academic partnerships.

Storey *et al.* (2008) integrate current research, original insights, and pragmatic viewpoints, featuring contributions from prominent figures in management and business literature. Covering topics such as strategy, innovation, and organizational learning, it emphasizes the dynamic relationship between theory and application, making it indispensable for scholars and students exploring human resource management and strategy.

Taylor *et al.* (2015) offered a detailed analysis of managing people within a strategic framework in the context of sports organizations. It delves into various strategic human resource management (HRM) approaches to tackle contemporary challenges and foster a sustainable performance culture in sports organizations. It encompasses essential aspects of HRM and its function. This book also provides an in-depth analysis of digital media and its usage by employees.

Guest (1987), argues that while the term Human Resource Management (HRM) is widely used, its precise definition is often unclear. He recommends that HRM should be clearly defined to establish social scientific credibility and to differentiate it from traditional personnel management. This clarity would also enable the development of testable hypotheses about its effects. Guest suggests that HRM involves a series of strategies aimed at improving organizational cohesion, employee dedication, adaptability, and work excellence. He notes that collective labour relations have a limited role within the HRM framework. Despite HRM's appeal to management, there is a lack of strong evidence supporting its effectiveness, and only a small number of UK organizations seem to implement a distinct HRM approach

Nyberg *et al.* (2014) reviewed research utilizing resource-based theory to investigate unit-level Human Capital Resources. In their systematic review of 156 articles from strategy and strategic human resource management literature, the authors conceptualize human capital as a unit-level resource. The aim of this study is to enhance understanding of human resource practices. The study concludes with discussions on future research areas that will enhance the proposed multilevel theoretical integration.

Bottger & Yetton (1988) created a model to evaluate group problem-solving performance. This performance is affected by both the group's resources and the strategies employed to utilize them. The model defines performance as the collective task knowledge of the two most knowledgeable members of the group, with the decision scheme representing the extent of influence these experts exert within the group. The study demonstrates that, under certain conditions, there is a relationship between the decision scheme and group process, with a particular emphasis on effective conflict management in group problem-solving contexts.

Guerci & Carollo (2016) examined the integration of paradox theory into the realm of green human resource management within Italian companies aiming for environmental sustainability. Employing a comparative multiple case study methodology, the authors conducted semi-structured interviews and analysed documents from six Italian companies with established environmental initiatives. The

study's results outline the primary features of green HRM systems, shedding light on eight HRM-related paradoxes recognized by these organizations.

Garavan *et al.* (2002), argue that the study considers on the job learning and human resource development as legitimate topics for study, exploring their relationship with organizational strategies and practices. The study identifies a paradigm shift in workplace learning towards casual, experiential, and asynchronous. Key themes in workplace learning and HRD literature encompass knowledge, expertise, competence, capability, organizational learning, and issues related to employability and career development. The study highlights emerging theoretical perspectives and organizational practices in the field.

3.0 Objectives

1. To evaluate how integrating group psychology in HR impacts management students' leadership skills in diverse teams.
2. To assess industry perspectives on the correlation between group psychology strategies and positive organisational outcomes.
3. To analyse the integration of group psychology concepts in HR within the management program curriculum.
4. To identify challenges and solutions related to implementing group psychology in HR, offering practical insights for future managers.
5. To investigate management students' perceptions of the practical relevance of group psychology in HR for future leadership roles.

4.0 Research Methodology

This study was conducted using a descriptive research design. The methodology used for examining management students' views on integrating group psychology into HR strategies involves a convenience sampling method with a targeted 125 responses. The survey employs a straightforward "yes," "no," or "maybe" format to collect categorical data. Questions are designed to gauge perceptions of group psychology's relevance in HR, specific impact areas, challenges, opportunities, and examples of successful integration. Ethical considerations ensure participant confidentiality and are succinctly presented through descriptive analysis of the categorical responses.

5.0 Analysis and Interpretations

Table 1: Gender of the Respondents

Demographic Details	No. of Respondents	Percentage%
Male	51	40.8%
Female	74	59.2%
Total	125	100%

Source: Primary Data

Table 2: Age of the Respondents

Age	No. of Respondents	Percentage%
18-20	39	31.2%
21-25	74	59.2%
26-30	8	6.4%
Above 30	4	3.2%
Total	125	100%

Source: Primary Data

Table 3: Place of Residence

Place	No. of Respondents	Percentage%
Rural	78	62.4%
Urban	34	27.2%
Semi-Urban	13	10.4%
Total	125	100%

Source: Primary Data

Table 4: Group Psychology Important in Understanding Team Dynamics within Organization

Importance of Group Psychology	No. of Respondents	Percentage%
Yes	101	80.8%
No	2	1.6%
Maybe	22	17.6%
Total	125	100%

Source: Primary Data

Table 5: Technological Advancements and Remote Work Trends have Influenced the Significance of Group Psychology in HR Strategies

Technological advancements influence	No. of Respondents	Percentage%
Yes	76	60.8%
No	9	7.2%
Maybe	40	2%
Total	125	100%

Source: Primary Data

Table 6: Understanding Group Psychology Help in Resolving Conflicts within Teams

Group psychology helps in resolving conflicts	No. of Respondents	Percentage%
Yes	88	70.4%
No	3	2.4%
Maybe	34	27.2%
Total	125	100%

Source: Primary Data

Table 7: Students Share Insights on Future Trends or Evolving Approaches in Integrating Group Psychology into HR Strategies for Organizational Success

Group psychology helps in resolving conflicts	No. of Respondents	Percentage%
Yes	74	59.2%
No	5	4%
Maybe	46	6.8%
Total	125	100%

*Source: Primary Data***Table 8: Understanding Psychology is Important for Personal Development**

Understanding psychology is important for personal development	No. of Respondents	Percentage%
Yes	86	68.8%
No	5	4%
Maybe	34	27.2%
Total	125	100%

*Source: Primary Data***Table 9: Psychological Concepts Useful in Understanding Behaviours and Motivations**

Psychological concepts is useful	No. of Respondents	Percentage%
Yes	86	68.8%
No	5	4%
Maybe	34	27.2%
Total	125	100%

*Source: Primary Data***Table 10: Incorporating Psychological Principles in Education can Enhance the Learning Experience**

Psychological principles enhance learning experiences	No. of Respondents	Percentage%
Yes	79	63.2%
No	6	4.8%
Maybe	40	32%
Total	125	100%

Source: Primary Data

Table 11: Psychological Well-being be Given More Attention in Educational Institutions

Psychological well-being is given more attention	No. of Respondents	Percentage%
Yes	71	56.8%
No	8	6.4%
Maybe	46	36.8%
Total	125	100%

Source: Primary Data

Table 12: Understanding of Psychology is Beneficial for Effective Communication and Interpersonal Relationships

Understanding Psychology is beneficial	No. of Respondents	Percentage%
Yes	82	65.6%
No	3	2.4%
Maybe	40	32%
Total	125	100%

Source: Primary Data

Table 13: Success of an Organization Hinges on the Pivotal Role Played by Human Resources

The success of an organisation hinges	No. of Respondents	Percentage%
Yes	79	63.2%
No	8	6.4%
Maybe	38	30.4%
Total	125	100%

Source: Primary Data

Table 14: HRM Practices Play an Important Role in Shaping the Organizational Culture of a Company

HR practices play a significant role	No. of Respondents	Percentage%
Yes	79	63.2%
No	5	4%
Maybe	41	32.8%
Total	125	100%

Source: Primary Data

Table 15: Policies and Practices of Human Resources have a Direct Influence on Your Overall Academic or Work Experience

HR has a direct influence	No. of Respondents	Percentage%
Yes	70	56%
No	8	6.4%
Maybe	47	37.6%
Total	125	100%

Source: Primary Data

Table 16: The Application of Group Psychology Principles was Emphasized in the Context of Human Resources Strategies

Application of group psychology principles in context of HR	No. of Respondents	Percentage%
Yes	75	60%
No	10	8%
Maybe	40	32%
Total	125	100%

Source: Primary Data

Table 17: Human Resources Professionals should Receive Specialized Training in Group Psychology to Enhance their Ability to Manage Teams

HR professionals should receive specialized training	No. of Respondents	Percentage%
Yes	71	56.8%
No	11	8.8%
Maybe	43	34.4%
Total	125	100%

Source: Primary Data

Table 18: Management Students be Exposed to Case Studies or Practical Examples Showcasing Successful Integration of Group Psychology in HR Strategies

HR management students exposed to case studies	No. of Respondents	Percentage%
Yes	90	72%
No	4	3.2%
Maybe	31	24.8%
Total	125	100%

Source: Primary Data

From the analysis, it's clear that the female [74%] respondents were more than male respondents. The age group of 21-25 [74%] are engaged more in this

survey. This survey was responded to mostly by rural students [78%] rather than urban and semi-urban areas. Many of them agree that group psychology is important in understanding team dynamics within an organisation [80.0%]. The respondents of this survey mostly agree to the question: Do you believe technological advancements and remote work trends have influenced the significance of group psychology in HR strategies [60.8%].

The majority of respondents of this survey are aware that understanding group psychology helps in resolving conflicts within teams [70.4%]. The respondents of this survey show that 59.2% of students share insights on future trends or evolving approaches in the integration of group psychology into HR strategies for organizational success. In this survey, 68.8% of respondents understood psychology is important for personal development. From the analysis, it is clear that 68.8% of them found psychological concepts useful in understanding behaviours and motivations. The majority of respondents are incorporating psychological principles in education that can enhance the learning experience (63.2%).

The 63.2% of respondents considered that human resources practices play a significant role in shaping the organisational culture of a company. Many of them agreed with the question: Do you feel human resources policies and practices directly impact your overall academic or work experience. The respondents of this survey agreed that 60% of respondents have encountered instances in your studies where the application of group psychology principles was emphasized in the context of human resources strategies. In this survey, 56.8% of respondents think human resources professionals should receive specialized training in group psychology to enhance their ability to manage teams. The major respondents involved were undergraduate management students, postgraduate students of management studies, industry professionals, etc.

6.0 Findings of the Study

- The findings of this study proved that most of the management students have a positive view of group psychology in human resources strategies which in turn reflects the awareness of group psychology among students.
- The research identifies the solutions for implementing group psychology challenges in HR including fostering a culture of open communication and providing training programs to address psychological aspects of team dynamics.
- 80.8% of respondents agree that group psychology is important in understanding team dynamics within an organization.
- It is found that 72% of the respondents agreed that management students should be exposed to case studies or practical examples showcasing successful integration of group psychology in HR strategies.
- The research indicates a positive correlation between effective group psychology strategies and favourable organizational outcomes. Improved insights on future

trends or evolving approaches in integrating group psychology into HR strategies contribute to increased productivity and employee satisfaction. This ensures that employees are up-to-date and knowledgeable.

- A significant percentage of respondents expressed preference for exposure to case studies or practical examples showcasing the successful integration of group psychology in HR strategies, educational programs should incorporate real-world examples into their teaching methods. Training programs should be offered and should focus on effective communication skills and were also implemented to facilitate healthy team dynamics. This includes providing training programs and workshops focused on enhancing understanding and application of group psychology principles in the workplace.
- This may involve conducting regular reviews of HR practices, benchmarking against industry standards, and leveraging research insights to adapt and refine existing strategies for maximum effectiveness.

7.0 Suggestions

- Encourage the bridging of academic knowledge with practical skills, suggesting that management programs incorporate hands-on experiences.
- Create online forums where students can exchange ideas, share resources, and discuss their opinions on the integration of group psychology in HR strategies.
- By providing more insights on group psychological aspects, management students can benefit from more knowledge and information.
- Facilitate moderator-led discussions to ensure active participation and knowledge sharing.

8.0 Conclusion

In conclusion, this study illuminates the affirmative stance of management students towards the incorporation of group psychology into Human Resources (HR) strategies. With a sample of 125 participants, the study indicates that there is a general knowledge of the significance of group psychology in comprehending team dynamics and conflict resolution but also sheds light on demographic nuances, such as the active involvement of females in the 21-25 age group from rural areas. The implications of this study help in identifying potential barriers, facilitate better alignment between theory and practice, and inform curriculum development to better prepare future managers for leveraging group dynamics in HR decision-making. Furthermore, the study captures the forward-looking perspectives of respondents, showcasing their insights on future trends in integrating group psychology into HR strategies, coupled with a strong belief in the practical relevance of psychological concepts for personal development and academic/work experiences.

This research contributes important input to the potential effectiveness and acceptance of such HR strategies in the real-world organizational context as well as

among management students. These findings underscore the relevance of group psychology in shaping effective HR strategies and organizational culture, reflecting an awareness and positive inclination among management students. The practical recommendations for program enhancements further emphasize the need for bridging academic knowledge with experiential learning, creating platforms for knowledge exchange, and facilitating discussions to prepare students for the dynamic challenges in contemporary organizational settings.

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