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A STUDY OF MENTAL HEALTH AMONG PRIVATE AND GOVERNMENT SCHOOL TEACHERS

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ABSTRACT:
The objective of this research was to Measure the Mental Health of Private and Government school Teachers total of 140 samples were randomly selected from Anand District, Gujarat. The purpose of the proposed research is to study the Mental Health of Government and Private school Teachers.**70** Government school Teachers **35** MALE and FEMALE and **70** Private School Teachers **35** MALE and **35** FEMALE total **140** School Teachers were selected for the Study as Sample.Mental Health Analysis Questionnaire prepared by Dr.A.B Jansari,Harkant Badami and Dr.Charulata Badami was used . its find Relibility at 0.90 grades and validity at 0.69 of presently discussed test .for the data collection. f test was used. the result has shown that **1.** There is no significant difference in the mean score of mental health among the Government school Teachers and private School Teachers**, 2.** . There is no significant difference in the mean score of mental health among Male and Female School Teachers and **3.** There is no significant difference in the Interactive effect of the mean scores of Mental Health with regards to Type of School Teachers and Gender.Therefore it could be said that, the Female Private School Teachers Group is having good Mental Health than Male Private School Teachers group.

KEYWORDS : MENTAL HEALTH SCALE,TEACHERS, PRIVATESCHOOL AND GOVERNMENTSCHOOL,SCHOOL, GENDER.

INTRODUCATION :

Today's era is the modern era. Everyone has to struggle in everything. In this struggle, only those who have good mental health succeed. No matter what kind of job they do, if the mental state of that person is not good, the job will not be fair. The job of a teacher is important in all fields. A teacher brightens the name of a school. Makes the future of the student bright. Prepares good citizens in the society and develops the nation. If the teacher is not mentally healthy, then children will not be able to progress in education. Therefore, if any person is working in the society, he must have studied school and therefore there will be change in the society.

Health shows the psychological well-being of a person. Today, we find an environment around us without anxiety, chaos and disturbance. Generally, people believe that those who do not suffer from any other diseases are called healthy, but according to WHO, it is not true, but physical, mental and social health is real health.

Mental health reflects a person's overall psychological well-being, including emotional stability, coping skills, and life satisfaction (WHO, 2001). The role of teachers can impact mental health. Teachers in public schools often benefit from a structured work environment, job security, and institutional support, while teachers in private schools may experience greater workload pressure, performance appraisals, and

job instability. These workplace dynamics can lead to observable differences in both emotional and mental health outcomes.

Mental health is more than the absence of a mental health condition or illness: it is a positive sense of well-being, or the ability to enjoy life and cope with the challenges we face. Mental health affects each of us. We all have mental health, just as we all have physical health. People living with a mental health problem or condition can experience positive mental health. Mental health is not fixed. It is influenced by a range of factors, including our life experiences, the workplace or other environments, and the social and economic conditions that shape our lives (or social determinants of mental health). Steps can be taken to promote positive mental health for individuals, communities, and societies. Mental health promotion strategies focus on empowering individuals and increasing participation and can target a variety of environments or settings, such as the workplace, home, school, or community. These strategies mainly try to strengthen the factors that protect positive mental health, reduce the risk factors for poor mental health. The mental state of the individual motivates to do the right thing. And more successes can be achieved. The mental health of the teacher plays an important role in developing the work area of the job and in making their daily decisions. No matter what kind of job it is, it benefits the entire society. In government and private jobs, the work is done by a teacher and as a result of his job status, many types of situations can be created. We should see to what extent this situation is seen in private or government. And provide guidance on improvement.

REVIEW OF LITERATURE :

several problems, uncertainties and challenges in the educational process. The prospects from teachers are varying and as such the duty of the teachers are getting complex day-by-day. A teacher with good mental health and high emotional intelligence can adjust well in any circumstance and maximise their effectiveness as well as derive satisfaction. High effective teachers are mentally healthy in comparison to their counterparts. They can create a suitable environment for learning and easily motivate the students for better learning in any situation.

(**Ahmed, 2019**) Goel found that lady teachers were more effective in comparison to their male counterparts. School teachers from urban areas are more effective as compared to teachers from rural areas. Moreover, high effective teachers are also found mentally healthy.

(Goel, 2013) Similarly, Dawar reveals that male secondary teachers are mentally healthy and more significant than the female secondary teachers. (Dawar, 2018) Dafare found that the correlation between teacher effectiveness and mental health is 0.472. This indicates that mental health is positively co-related with teacher effectiveness. For increasing effectiveness of teachers, their mental health must be developed. (Dafare, **P.R (2021)** Trivedi & Kumar revealed that Male secondary school teachers have shown healthier mental health comparatively to female secondary school teachers of Jammu district. The‘t’ value found in the study is 2.177 which is significant at 0.05 level. A government secondary school male teacher has better mental health than the female secondary school teachers. The ‘t’ value found in the study is 3.635. This is significant at 0.05 levels.

(Treivedi ,A.K.&.Kumar, R. 2019) Different studies reveal that effectiveness of teacher depends upon the mental wellbeing of the teachers. The mentally healthy teachers are highly effective. The success of teachers is primarily related with their personal characteristics, proficient abilities, knowledge of

the subject matter, working environment, mental state etc. All these factors directly or indirectly motivate them to be effective teachers. The researchers attempt to understand the factors affecting teacher effectiveness and also try to analyse the correlation between teacher effectiveness.

THE PROBLEM OF THE STUDY:

The aim of the study is to examine these differences and explore how gender influences mental health among secondary school teachers.

OBJECTIVE OF THE STUDY:

1. To study of the Mental Health among the Private and Government school Teachers
2. To study of the Mental Health among the Male and Female School Teachers
3.To study of the interactive effect of Mental Health with regards to Type of School Teachers and Gender.

HYPOTHESIS:

H.1 There will be no Significant difference in the mean score of Mental Health Among the Private School Teachers and Government School Teacher.
H.2 There will be no Significant difference in the mean score of Mental Health Among Male and Female School Teacher.
H.3 There will be no Significant difference in the interactive effect of the mean scores of Mental Health with regards to the type of School Teachers and Gender

METHODOLOGY:

Variable
Table .1 Shows dependent variable and independent variable
A. Independent variable:
{1} Type of school : Governmentand Private School
{2}. Gender- : Male School Teachers and Female school Teachers
B. Dependent variable : Mental Health Score

RESEARCH DESIGN:

Showing the Table of Sample Distribution :

GENDER	TYPE OF SCHOOL		TOTAL
	PRIVATE	GOVERNMENT	
Male	35	35	70
Female	35	35	70
TOTAL	70	70	140

SAMPLE : The sample of Present study consisted of A total of **140** teachers were included, **35** males and **35** females from private schools and **35** males and **35** females from government schools. In which data was collected from **70** private and **70** government school teachers, which is a total of **140** teachers. 140 samples were randomly selected from Anand District, Gujarat.

TOOLS

"Mental Health Inventory" Analysis Questionnaire prepared by Dr. A. B. Jansari, Harkant Badami and Charulata Badami was used. We find reliability at 0.90 grades and Validity at 0.69 of presently discussed test.

PROCEDURE

The permission was granted from various schools for data collection in Anand District after the establishment of rapport, personal information and the Mental Health Inventory (MHI)' was administrated the data was collected, scored as per the manual and analyzed. The statistical method 'F' test was calculated and results were interpreted.

RESULT AND DISCUSSION

Table.1 The Table showing sum of variance mean f value and level of significance of type of School Teachers and Gender.

sum of variance	DF	Mean	F- value	sign Level
SS_A	1	238.20	0.45	N.S
SS_B	1	203 .00	0.38	N.S
SS_{A*B}	1	2089.57	3.94	0.05
SS_{Error}	136	71930.13		
SS_{Total}	139	74463.93		

***0.05=3.89,**0.01=6.76,N.S=Not Significant**

A= Type of school, A 1= Government A2 Private B Gender, B1 Male teacher B2 Female

Table :2 The Table showing the Mean Score of Mental Health of Government and Private school Teachers.

	A TYPE OF SCHOOL TEACHERS		F	SIGN
	A1 GOVERNMENT	A2 PRIVATE		
M	72.22	74.82	0.45	N.S
N	70	70		

The above **table no.2** shows the mean score of mental health among government and private school teachers. The mean score of private school teachers group is **72.22** and government school teachers group is **74.82**. The 'F' value is **0.45** which was found to be not-significant level at **0.05**. The hypothesis no.1 that, "There is no significant difference in the mean score of mental health among the government and private school teachers" is accepted. My results is not supported by the Chanderkant Gorsy (2015) for "Mental Health among Government School Teachers".

Table : 3 The Table showing the Mean Score of Mental Health of Male and Female School Teachers.

	B GENDER		F	SIGN
	B1 MALE	B2 FEMALE		
M	74.72	72.30	0.38	N.S
N	70	70		

The above table no.3 shows the mean score of mental health among male and female school teachers. The mean score of male school teachers group is **74.72** and female school teachers group is **72.30**. The 'F' value is **0.38** which was found to be not-significant level at **0.05**. The hypothesis **no.2** that, "There is no significant difference in the mean score of mental health among the male and female school teachers" is

accepted. My results is not supported by the Chanderkant Gorsy (2015) for "Mental Health among Government School Teachers".

Table 4 : The Table showing the interactive effect of the Mean Score of Mental Health of Type of school Teachers and Gender.

			A		F	SIGN
			A1	A2		
M	B	B1	78.28	72.16	3.94	0.05
		B2	67.13	77.48		
N			70	70		

The above table **no. 4** shows the interactive effect of mental health between the type of school teachers and gender. The mean score of the male private school teachers group is **78.28**, the male private school teachers group is **67.13**, the female government school teachers group is **72.16**, the female government school teachers group is **77.48**. The 'F' value is **3.95** significant at the **0.05** level. This means that the interaction effect of the two groups under study differs significantly in relation to mental health, type of school teachers and gender. It should be remembered here that, according to the scoring pattern, a higher score indicates better mental health. Thus from the result it can be said that the mental health of the male private school teachers group is better than that of the male government school teachers group. Therefore, the hypothesis that "there is no significant difference in the interactive effect of the mean score of mental health with respect to type and gender of school teachers" is rejected. Male private school teachers experience better mental health compared to their male counterparts and female private and government school teachers. The reasons could be, male private teachers have to play a solitary role as teachers while women have to maintain personal as well as professional fronts, even if they have to travel long distances, men can handle it while women have to face many difficulties.

CONCLUSION

1. There is no significant difference in the mean score of mental health among the government school teachers and private school teachers.

2. There is no significant difference in the mean score of mental health among male and female school teachers.

3. There is significant difference in the interactive effect of the mean scores of mental health with regards to the type of school teachers and gender. Therefore it could be said that, the female private school teachers group is having good mental health than male private school teachers group

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FINANCIAL HEALTH ASSESSMENT OF GUJARAT DAIRY COOPERATIVES USING THE ALTMAN Z'-SCORE MODEL

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ABSTRACT

The dairy industry in Gujarat, known as the milk capital of India, plays a pivotal role in the state's rural economy and cooperative movement. Evaluating the financial health of dairy cooperatives is therefore essential for ensuring their long-term stability and contribution to the sector. This study aims to analyze the financial performance of four leading dairy cooperatives—Amul, Sarhad, Sarvottam, and Dudhsagar—using the Altman Z'-Score model, a well-recognized bankruptcy prediction tool. The analysis covers a ten-year period from 2014-15 to 2023-24, using secondary data collected from annual reports and other published records.The Altman Z'-Score incorporates five key financial ratios (X1–X5) to measure financial health and categorize firms into Safe, Grey, or Distress Zones. By applying this model, the study not only evaluates the financial performance of the selected cooperatives but also ranks them according to their average Z'-Scores. Furthermore, the research seeks to identify cooperatives that are stable and those that are financially at risk, thereby highlighting areas requiring strategic improvements. The study is expected to provide valuable insights for managers, policymakers, and stakeholders of dairy cooperatives in Gujarat. By identifying financial strengths and weaknesses, it will help in formulating recommendations to enhance efficiency, reduce bankruptcy risks, and ensure sustainable growth of the dairy industry.

KEYWORDS: - ALTMAN Z'-SCORE, FINANCIAL PERFORMANCE, GUJARAT DAIRY CO-OPERATIVE INDUSTRY, RANKING OF COOPERATIVES

1.INTRODUCTION

The dairy industry holds a crucial position in India's rural economy, contributing extensively to livelihoods, job creation, and nutritional well-being. Among its key pillars, cooperative dairies have become instrumental in rural progress by guaranteeing fair income to farmers while delivering safe and quality products to consumers. Gujarat, recognized as the cradle of India's White Revolution, hosts some of the country's most renowned and successful cooperatives, such as Amul, Sarhad, Sarvottam, and Dudhsagar. Evaluating the financial strength of these institutions is essential to secure their long-term viability and maintain competitiveness in today's evolving business environment.

Financial analysis tools provide useful insights into the performance and viability of organizations. Among them, the **Altman Z'-Score model** is a widely recognized tool for predicting corporate financial health, bankruptcy risk, and long-term sustainability. By integrating ratios related to profitability, leverage, liquidity, solvency, and operational efficiency, the model categorizes enterprises into three distinct zones: Safe (financially sound), Grey (moderately at risk), and Distress (financially weak or nearing insolvency). Applying this framework to cooperative dairies enables an accurate evaluation of

financial robustness, highlights vulnerable areas, and supports management in making informed strategic decisions

ALTMAN Z SCORE

The Altman Z'-Score model helps in identifying the overall financial health and bankruptcy risk of cooperatives. By analyzing key ratios of liquidity, profitability, leverage, and efficiency, the model classifies cooperatives into Safe, Grey, or Distress Zones. This enables researchers to assess whether a cooperative is financially strong, at moderate risk, or highly vulnerable. It also helps compare different cooperatives, rank them according to financial stability, and highlight areas that require corrective measures for long-term sustainability.

The original Altman Z-Score (1968) was designed for publicly listed manufacturing firms, but it was later modified for private companies. The study applies the Altman Z'-Score (modified model for private companies), as dairy cooperatives are not listed on the stock exchange and do not have market value of equity. This version of the model uses book values instead, making it appropriate for cooperatives.

FORMULA:

$Z' = 0.717X1 + 0.847X2 + 3.107X3 + 0.420X4 + 0.998X5Z$

Where:

- X1 = Working Capital / Total Assets → measures short-term liquidity and the ability to cover current obligations.
- X2 = Retained Earnings / Total Assets → indicates cumulative profitability and financial stability over time.
- X3 = Earnings Before Interest and Taxes (EBIT) / Total Assets → reflects operating efficiency and earning power of assets.
- X4 = Book Value of Equity / Total Liabilities → shows leverage and the degree of protection to creditors.
- X5 = Sales / Total Assets → measures asset turnover and efficiency in using assets to generate revenue

INTERPRETATION RANGES:

- **Z' > 2.90 → Safe Zone (financially healthy, low bankruptcy risk)**
- **1.23 < Z' < 2.90 → Grey Zone (uncertain zone, moderate risk)**
- **Z' < 1.23 → Distress Zone (high risk of financial failure)**

The Altman Z'-Score results classify dairy cooperatives into Safe, Grey, or Distress Zones, reflecting their overall financial health. A higher Z'-Score indicates strong liquidity, profitability, and asset efficiency, while a lower score signals financial weakness and higher bankruptcy risk. Cooperatives falling in the Grey Zone require close monitoring as their future stability is uncertain, whereas those in the Safe Zone demonstrate sound financial management. The model thus provides a reliable tool for predicting financial risk and guiding strategic decisions for cooperative sustainability.

2. LITERATURE REVIEW

HimaBindu, T., Sreenivasa, R., & Haritha, P. (2015) assessed the financial condition of selected dairy enterprises in Andhra Pradesh through the Altman Z-Score framework. The purpose was to identify whether these dairies operated within safe, grey, or risky financial zones. A descriptive research design

was adopted, using secondary data from company financial statements. Altman's Z-Score served as the principal analytical tool to evaluate solvency, creditworthiness, and overall financial health. Findings showed that most sample units, including Tirumala Milk Products and Heritage Foods Ltd., were positioned in the "safe zone." The authors recommended maintaining efficiency and financial discipline to ensure stability in the highly competitive dairy sector.

Patel, H. (2018) investigated the financial performance of Gujarat's dairy cooperatives using the Altman Z-Score model. The key objective was to measure the financial soundness of selected cooperatives and suggest strategies for improving profitability without seeking extra financial resources. The study employed a longitudinal descriptive approach, drawing secondary data from the annual reports of 14 cooperative dairies covering 2004–2014. The Z-Score formula was applied to analyze financial ratios, assess creditworthiness, and forecast insolvency risks. Results indicated that all dairies remained in the "safe zone," showing no immediate danger of bankruptcy. However, the study stressed the importance of consistent monitoring and corrective steps to secure long-term growth and sustainability.

Rani and Mago (2022) examined the financial performance of selected dairy cooperatives in Punjab, India, using Altman's Z-Score technique. The aim was to assess growth and financial strength of seven Verka dairy plants during 2015–2021. The study adopted a descriptive design and relied on secondary data from published annual reports. Applying the Z-Score method, firms were categorized into safe, grey, or distress zones. Results revealed that most plants, except Mohali, frequently slipped into the grey or distress categories, highlighting weak financial stability. The authors advised corrective reforms, technological modernization, and stronger government backing to enhance resilience and ensure sustainable development of Punjab's dairy cooperatives.

Shakya and Parab (2024) analyzed financial distress among publicly listed manufacturing engineering MSMEs in India using the Altman Z-Score framework. The objective was to evaluate the financial soundness of micro, small, and medium enterprises while testing variations across firm categories. The research used an analytical design with secondary data derived from annual reports and the CMIE Prowess IQ database for 2023–24. Altman's Z-Score, along with ANOVA for hypothesis testing, were applied as key techniques. Results showed that most micro units were in the distress zone, small enterprises largely in the grey zone, and only three medium enterprises placed in the safe zone. The study emphasized the necessity of rigorous financial monitoring and proactive risk management strategies to minimize bankruptcy threats in the future.

3. RESEARCH METHODOLOGY

3.1 RESEARCH DESIGN

The study follows a descriptive and analytical research design, focusing on the financial performance of selected cooperative dairies in Gujarat. It applies the Altman Z'-Score model to evaluate long-term stability and compare the financial health of the dairies over the period 2014–15 to 2023–24.

3.2 OBJECTIVE OF THE STUDY

To evaluate the financial performance of selected dairy cooperatives using the Altman Z'-Score model.

To rank the dairies according to their average Z'-Scores and identify the most stable and financially weak dairy.

To provide insights and recommendations for improving the financial health of weaker dairies.

3.3 DATA COLLECTION

Secondary data related to financial statements were collected from the respective dairies' annual reports, NDDB annual reports and other published records.

3.4 SELECTION OF THE SAMPLE

The study focused on four prominent dairy cooperatives of Gujarat—Amul, Sarhad, Sarvottam, and Dudhsagar.

3.5 PERIOD OF THE STUDY

The study covers a period of 10 financial years, from 2014-15 to 2023-24, ensuring a comprehensive analysis of the long-term financial performance of the selected dairies. This timeframe was selected owing to the reliable and continuous availability of audited financial records.

3.6 ANALYTICAL TOOLS

The Altman Z'-Score model was applied to evaluate the financial health of the dairies. The model uses five financial ratios (X1–X5) to calculate the Z'-Score, which classifies firms into Safe Zone, Grey Zone, or Distress Zone.

4. DATA ANALYSIS AND INTERPRETATIONS

Table 4.1: Altman Z'-Scores and Financial Health Classification of Selected Cooperative Dairies for the FY 2014–15 to 2023–24

FY	Amul Z'-Score	Z'-Score Zone	Sarhad Z'-Score	Z'-Score Zone	Sarvottam Z'-Score	Z'-Score Zone	Dudhsagar Z'-Score	Z'-Score Zone
2014-15	3.328	Safe	3.5841	Safe	3.8665	Safe	2.2225	Grey
2015-16	3.3 015	Safe	3.0895	Safe	3.2361	Safe	2.2354	Grey
2016-17	3.2933	Safe	3.3084	Safe	2.4317	Grey	2.3667	Grey
2017-18	2.832	Grey	4.1183	Safe	2.1757	Grey	1.8827	Grey
2018-19	3.0469	Safe	2.8594	Grey	2.3702	Grey	1.8545	Grey
2019-20	4.1529	Safe	2.6704	Grey	2.2764	Grey	3.0223	Safe
2020-21	3.7723	Safe	3.0123	Safe	2.2038	Grey	2.3316	Grey
2021-22	4.4204	Safe	2.3102	Grey	2.3759	Grey	2.652	Grey
2022-23	4.7289	Safe	2.5857	Grey	2.4324	Grey	3.1221	Safe
2023-24	3.5639	Safe	2.7575	Grey	2.3127	Grey	2.2708	Grey

The data in Table 1 shows that Amul Dairy consistently maintained strong financial health, remaining in the Safe Zone in nine out of ten years, with only 2017-18 slipping into the Grey Zone. Sarhad Dairy displayed early strength with several Safe Zone years but gradually declined into the Grey Zone in later years, reflecting weakening financial stability. Sarvottam Dairy performed well initially but consistently remained in the Grey Zone after 2016-17, highlighting persistent vulnerability. Dudhsagar Dairy was the weakest, mostly stuck in the Grey Zone with only two Safe Zone years (2019-20 and 2022-23). Overall, Amul emerged as the most financially secure, while Dudhsagar showed the highest financial risk.

Table 4.2: Ranking of Selected Cooperative Dairies Based on Average Altman Z'-Scores for the FY 2014–15 to 2023–24

Rank	Dairy	Average Z'-Score	Interpretation
1	Amul	3.64	Strongest financial health, consistently Safe Zone with minimal distress risk

2	Sarhad	3.03	Moderate stability, strong start but recent decline into Grey Zone
3	Sarvottam	2.57	Persistent Grey Zone performance, financially vulnerable
4	Dudhsagar	2.4	Weakest performance, mostly Grey Zone with only two Safe Zone years

The ranking analysis based on the average Altman Z'-Score clearly places Amul Dairy in the first position with an average score of 3.64, reflecting its consistent Safe Zone performance and strong financial health. Sarhad Dairy ranks second with 3.03, showing moderate financial strength but signs of decline in recent years. Sarvottam Dairy occupies the third position with 2.57, as it remained in the Grey Zone for most of the period, indicating financial vulnerability. Dudhsagar Dairy, with the lowest average of 2.40, ranks last, as it struggled with unstable and weak financial performance. The ranking suggests that Amul is the benchmark for financial stability, Sarhad shows mixed performance, while Sarvottam and Dudhsagar require immediate corrective actions. This variation proves that the financial performance of the dairies is not the same.

Table 4.3: Standard Deviation and Coefficient of Variation of Selected Cooperative Dairies (2014–15 to 2023–24)

Dairy	Standard Deviation (SD)	Coefficient of Variation (CV)
Amul	0.6162	0.1691 (16.91%)
Sarhad	0.5293	0.1747 (17.47%)
Sarvottam	0.5459	0.2126 (21.26%)
Dudhsagar	0.424	0.1770 (17.70%)

The results of table 4.3 reveal that Amul Dairy has the lowest coefficient of variation (16.91%), indicating the highest level of financial stability and consistency in Z'-Score performance. On the other hand, Sarvottam Dairy records the highest CV (21.26%), reflecting significant fluctuations and instability in its financial health. Sarhad (17.47%) and Dudhsagar (17.70%) show moderate variability, placing them between Amul and Sarvottam in terms of stability. Overall, this analysis confirms that Amul remains the most financially stable cooperative, while Sarvottam is the most vulnerable due to greater inconsistency in performance. These results complement the earlier ranking based on average Z'-Scores, providing additional statistical evidence for long-term financial sustainability assessment.

Table 4.4: Weaknesses Identified and Recommendations for Selected Cooperative Dairies Based on Altman Z'-Scores for the FY 2014–15 to 2023–24

Dairy Name	Weakness Identified	Recommendation
Amul	Slight decline in 2023-24	Maintain efficiency, focus on sustaining high Z'-Scores
Sarhad	Shift from Safe to Grey Zone	Control costs, diversify income, strengthen financial control
Sarvottam	Continuous Grey Zone since 2016-17	Improve capital structure, efficiency, and profitability

Dudhsagar	Mostly Grey Zone, unstable performance	Restructure financial strategy, improve liquidity, and reduce risk

Table highlights that Amul Dairy has maintained strong financial health, requiring only sustained efficiency to retain its high Z'-Scores. Sarhad Dairy, however, shows a declining trend from Safe to Grey Zone, indicating a need for better financial control, cost management, and diversification of income. Sarvottam Dairy has consistently remained in the Grey Zone since 2016-17, pointing to issues in capital structure and profitability, which demand urgent reforms. Dudhsagar Dairy shows the weakest performance, with frequent instability and low Z'-Scores, requiring comprehensive restructuring of financial strategy, improved liquidity management, and risk reduction measures. Overall, while Amul serves as a model of financial strength, Sarhad, Sarvottam, and Dudhsagar need targeted interventions to improve long-term sustainability.

FINDING

- Amul Dairy demonstrated the strongest financial position, remaining in the Safe Zone in nine out of ten years with only a minor decline in 2017-18.
- Sarhad Dairy initially performed well but gradually slipped into the Grey Zone in recent years, indicating weakening financial stability.
- Sarvottam Dairy was in the Safe Zone only in the first two years, after which it consistently remained in the Grey Zone, reflecting prolonged vulnerability.
- Dudhsagar Dairy displayed the weakest performance, being largely in the Grey Zone with only two Safe Zone years (2019-20 and 2022-23).
- Ranking analysis confirmed Amul as the most stable dairy (average Z'-Score 3.64), followed by Sarhad (3.03), Sarvottam (2.57), and Dudhsagar (2.40).
- Recommendations indicate that Sarhad should enhance financial controls to reverse its declining trend, while Sarvottam and Dudhsagar require urgent restructuring and efficiency improvements to achieve long-term sustainability.

CONCLUSION

The evaluation of four leading cooperative dairies in Gujarat using the Altman Z'-Score model highlights significant variations in their financial health. Amul stood out as the benchmark, exhibiting consistent strength and resilience, whereas Sarhad displayed moderate stability with a declining trend. Conversely, Sarvottam and Dudhsagar showed notable financial weaknesses, remaining mostly in the Grey Zone throughout the study period. The results underline the urgency of corrective interventions for vulnerable cooperatives to ensure long-term financial sustainability. Strengthening capital structures, enhancing operational efficiency, diversifying income streams, and implementing sound financial management practices are critical to mitigate risks and maintain stability. Overall, the study reinforces the importance of continuous financial monitoring and offers practical guidance for managers and policymakers to bolster Gujarat's cooperative dairy sector.

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EVALUATING THE ECONOMIC EFFECTIVENESS OF GOVERNMENT SUBSIDIES ON FARMER WELFARE IN SAURASHTRA REGION

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ABSTRACT
This research paper examines the economic impact of government subsidies on farmer welfare in the Saurashtra region, focusing on seven districts: Rajkot, Jamnagar, Surendranagar, Morbi, and Porbandar. The study, based on data from 35 farmers per district, investigates the utilization, effectiveness, and challenges of subsidy programs. The findings reveal the benefits of subsidies in enhancing agricultural productivity and income levels while identifying gaps in accessibility and implementation. The paper concludes with recommendations for optimizing subsidy schemes to maximize their economic effectiveness for farmers.

KEYWORDS: GOVERNMENT SUBSIDIES, FARMER WELFARE, ECONOMIC IMPACT, AGRICULTURAL PRODUCTIVITY, SAURASHTRA REGION

1. INTRODUCTION
Agriculture is the backbone of India's economy, with government subsidies playing a crucial role in supporting farmers. In the Saurashtra region, subsidies are provided to improve productivity, reduce input costs, and enhance overall farmer welfare. However, the effectiveness of these subsidies in achieving their intended economic benefits remains debatable. This study evaluates how subsidies influence the economic conditions of farmers, examining their utilization, challenges, and impact on livelihoods.

2. LITERATURE REVIEW
Government subsidies play a crucial role in supporting farmers by reducing input costs, improving productivity, and ensuring financial stability. Various studies have examined the effectiveness of these subsidies in enhancing farmer welfare across different regions, highlighting both their benefits and challenges. This literature review synthesizes previous research on the economic impact of subsidies, the challenges in their implementation, and the gaps in existing subsidy frameworks in the context of Indian agriculture, particularly in the Saurashtra region.

Subsidies are provided to farmers primarily to lower production costs, ensure price stability, and encourage sustainable farming practices (Sharma & Singh, 2020). Studies indicate that subsidies on fertilizers, seeds, irrigation, and machinery have contributed to increasing agricultural output and reducing dependency on informal credit sources (Patel et al., 2021). In the Indian context, the government has launched various subsidy programs such as the Pradhan Mantri Kisan Samman Nidhi (PM-KISAN) and the Direct Benefit Transfer (DBT) in fertilizers to enhance farmer income and reduce input costs (Ministry of Agriculture & Farmers Welfare, 2022). However, several scholars argue that while subsidies benefit farmers, their long-term effectiveness depends on proper targeting and distribution. A study by

Desai and Mehta (2019) found that only large-scale farmers reap the maximum benefits of subsidies, while small and marginal farmers struggle due to bureaucratic hurdles and lack of awareness.

The economic effectiveness of subsidies is often measured in terms of increased farm income, improved productivity, and financial security. Singh et al. (2021) analyzed the impact of subsidies on Indian agriculture and found that farmers receiving irrigation and fertilizer subsidies experienced a 25% increase in crop yields. Similarly, subsidies on mechanization have helped in reducing labor costs and increasing efficiency in production (Kumar & Sahu, 2020).

In the Saurashtra region, where rainfall patterns are erratic, irrigation subsidies have played a vital role in stabilizing farm incomes (Rathod & Patel, 2021). However, studies indicate that subsidy benefits are unevenly distributed, with well-connected farmers accessing them more effectively than smallholders (Joshi et al., 2022).

Despite their positive economic impact, subsidy programs face multiple challenges. According to a study by Rao and Verma (2018), delays in subsidy disbursement, lack of transparency, and political influences often hinder their effectiveness. Farmers in Gujarat, including those in Saurashtra, frequently encounter difficulties in understanding eligibility criteria and completing the application process (Shukla & Trivedi, 2020).

Another major challenge is the inefficiency in subsidy targeting. Many researchers argue that subsidies often benefit larger farms disproportionately, leaving small and marginal farmers with minimal advantages (Patel et al., 2021). Additionally, corruption and middlemen further complicate access to subsidies, making it difficult for deserving farmers to receive timely benefits (Sharma & Singh, 2020).

While several studies have analyzed the impact of subsidies on Indian agriculture, research specifically focused on the Saurashtra region remains limited. Most studies discuss the general benefits of subsidies at the national or state level without delving into the regional disparities that exist (Joshi et al., 2022). Furthermore, there is a need for more empirical studies to assess the real-time economic effectiveness of subsidies, particularly in the context of changing agricultural policies.

The existing literature highlights that government subsidies play a significant role in enhancing farmer welfare, particularly by improving productivity and reducing input costs. However, several challenges such as delayed payments, bureaucratic hurdles, and inequitable distribution reduce their overall effectiveness. Future research should focus on region-specific studies, including detailed field surveys and farmer interviews, to provide practical recommendations for improving subsidy efficiency in the Saurashtra region.

3. OBJECTIVES OF THE STUDY

- To analyze the extent to which farmers utilize government subsidies in the Saurashtra region.
- To assess the economic benefits of subsidies on farmers' income and productivity.
- To identify challenges faced by farmers in accessing and utilizing subsidies.
- To provide policy recommendations for improving subsidy effectiveness.

4. RESEARCH METHODOLOGY

The study is based on primary data collected from 35 farmers in each of the five selected districts, totaling 175 respondents. A structured questionnaire was used to gather information on subsidy utilization, economic benefits, and challenges. Secondary data from government reports, agricultural institutions, and previous research were also analyzed. A mixed-method approach combining quantitative and qualitative analysis was employed.

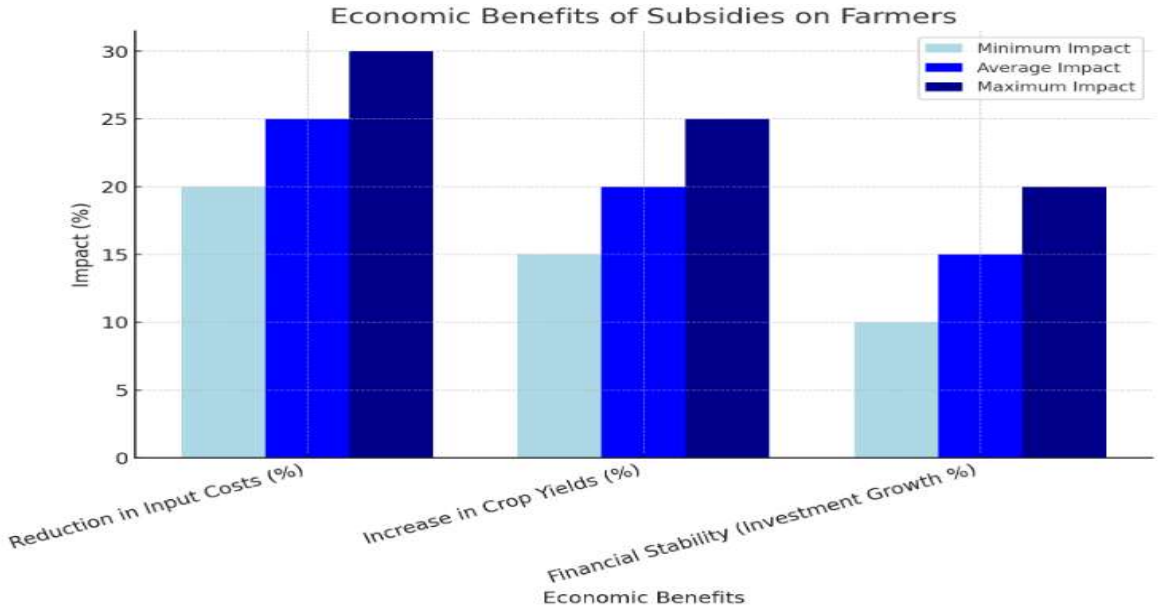
5. ANALYSIS AND FINDINGS

5.1 Utilization of Subsidies

The study reveals that most farmers are aware of subsidy programs, but only 68% actively apply for them. The most commonly availed subsidies include fertilizer support, irrigation assistance, and machinery incentives. However, bureaucratic hurdles and lack of awareness about eligibility criteria limit full utilization.

5.2 Economic Benefits of Subsidies

Economic Benefit	Minimum Impact (%)	Maximum Impact (%)	Average Impact (%)
Reduction in Input Costs	20%	30%	25%
Increase in Crop Yields	15%	25%	20%
Financial Stability (Investment Growth)	10%	20%	15%



Farmers receiving subsidies experienced a 20-30% decrease in expenses on fertilizers, seeds, and irrigation. This directly increased their profit margins by lowering overall production costs. Access to better-quality resources led to a 15-25% improvement in productivity, ensuring higher agricultural output. Subsidies provided financial security, encouraging a 10-20% increase in reinvestments into modern farming techniques such as mechanization, organic inputs, and precision farming.

5.3 Challenges in Accessing Subsidies

Farmers face several challenges in accessing and utilizing government subsidies effectively. Bureaucratic delays in the approval process often discourage farmers, as they must navigate complex administrative procedures that slow down access to essential financial support. Additionally, a lack of awareness regarding specific subsidy programs and their application processes prevents many small and marginal farmers from benefiting fully. Even when farmers successfully apply, they frequently encounter delayed payments, disrupting their cash flow and making it difficult to invest in timely agricultural inputs. Furthermore, unequal distribution of subsidies remains a persistent issue, where larger and well-connected farmers tend to receive benefits more efficiently, while smallholders struggle due to limited access to information, resources, and institutional support. These challenges highlight the need for policy reforms to ensure transparency, efficiency, and equitable distribution of subsidies, enabling all farmers to benefit equally.

6. DISCUSSION

The findings indicate that while subsidies positively impact agricultural productivity and income, inefficiencies in implementation hinder their full potential. Addressing bureaucratic delays and ensuring better outreach to small and marginalized farmers could improve economic outcomes. Digitalizing the subsidy process and providing training programs on subsidy schemes can enhance effectiveness.

7. CONCLUSION

Government subsidies significantly contribute to farmer welfare in the Saurashtra region by reducing costs and enhancing productivity. However, administrative inefficiencies and accessibility challenges limit their full impact. By adopting policy improvements such as streamlined processes, better awareness, and equitable distribution, subsidies can be more effectively utilized to enhance economic stability for farmers.

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LIFE SKILLS FOR TOMORROW: INSIGHTS FROM MULTIDISCIPLINARY RESEARCH AND INNOVATION IN EDUCATION

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ABSTRACT

In the 21st century, education faces the challenge of preparing learners not only with academic knowledge but also with **life skills** that enable them to navigate complex, uncertain, and rapidly changing environments. Life skills—such as critical thinking, creativity, communication, collaboration, problem-solving, adaptability, resilience, digital literacy, and social-emotional competence—are increasingly recognized as essential for success in personal, social, and professional domains (Trilling & Fadel, 2009; OECD, 2018). This article explores how **multidisciplinary research and innovation in education** provide new insights into fostering life skills for tomorrow. It reviews contributions from psychology, neuroscience, pedagogy, sociology, and technology studies, showing how these diverse perspectives collectively inform holistic models of learning.

Drawing on emerging practices such as **STEAM education, project-based learning, social-emotional learning (SEL), and digital innovation**, the article highlights practical approaches for embedding life skills in curricula and pedagogy (Bell, 2010; Fullan & Langworthy, 2014; Bequette & Bequette, 2012). It further examines the role of teachers as facilitators of inquiry, the importance of formative assessment, and the significance of policy frameworks that support flexible, learner-centered education systems.

The discussion identifies challenges such as equity of access, standardization pressures, and teacher workload but also presents pathways for addressing these through community partnerships, innovative assessment models, and systemic reforms. Finally, the article outlines a forward-looking research agenda that emphasizes longitudinal studies, cross-cultural comparisons, and design-based approaches to educational innovation. The argument is that life skills are not add-ons to academic knowledge but integral outcomes of multidisciplinary and innovative approaches to education. By combining insights from multiple fields and adapting them into classroom practice, education systems can equip learners with the skills necessary to thrive in tomorrow's uncertain world.

KEYWORDS: LIFE SKILLS, MULTIDISCIPLINARY RESEARCH, EDUCATIONAL INNOVATION, STEAM, SOCIAL-EMOTIONAL LEARNING, DIGITAL LITERACY

1. INTRODUCTION

Education in the 21st century has expanded beyond the traditional aim of transmitting academic knowledge. Today, the global community recognizes the importance of **life skills**—a set of cognitive,

social, emotional, and practical competencies that enable learners to manage challenges, collaborate with others, and participate responsibly in society (Wagner, 2008; P21, 2009). These skills are increasingly necessary in a world shaped by technological change, globalization, climate crises, and socio-economic inequalities.

At the same time, **multidisciplinary research** in fields such as psychology, pedagogy, neuroscience, and technology studies has produced valuable insights into how students acquire life skills. Educational **innovation**, including new pedagogical models like project-based learning, design thinking, and STEAM integration, has created opportunities for embedding life skills directly into everyday teaching and learning processes (Fullan & Langworthy, 2014).

This article addresses the central question: *How can multidisciplinary research and innovation in education help foster life skills for tomorrow?* The paper reviews theoretical foundations, presents evidence from educational innovations, and outlines future directions for policy, practice, and research.

2. UNDERSTANDING LIFE SKILLS

2.1 Defining Life Skills

Life skills can be defined as abilities that enable individuals to deal effectively with demands and challenges of everyday life (WHO, 1999). Commonly cited life skills include:

- **Cognitive skills:** critical thinking, problem-solving, decision-making, creativity.
- **Social skills:** communication, collaboration, leadership, empathy.
- **Emotional skills:** resilience, adaptability, self-awareness, emotional regulation.
- **Practical skills:** digital literacy, financial literacy, and entrepreneurial thinking.

UNESCO, UNICEF, and the OECD all emphasize that life skills are necessary not just for employment but also for citizenship, personal well-being, and lifelong learning (UNESCO, 2015; OECD, 2018).

2.2 Why Life Skills Matter

Wagner (2008) described them as "survival skills" for the new economy, while Trilling and Fadel (2009) framed them as essential 21st-century competencies. Employers consistently rank collaboration, adaptability, and problem-solving among the most important attributes for future workers (World Economic Forum, 2020). Moreover, life skills support mental health, civic participation, and the ability to respond constructively to social and environmental challenges (CASEL, 2003).

3. MULTIDISCIPLINARY INSIGHTS INTO LIFE SKILLS

3.1 Psychology and Neuroscience

Research in cognitive psychology and neuroscience highlights that skills such as creativity and critical thinking are supported by executive functions—working memory, cognitive flexibility, and self-regulation (Diamond, 2013). Socio-emotional learning builds resilience and empathy, which are rooted in both brain development and social experiences (Immordino-Yang & Damasio, 2007).

3.2 Pedagogy and Education

Educational theory emphasizes experiential, inquiry-based, and constructivist approaches to developing life skills. Dewey (1938) argued that learning emerges from meaningful experiences, while Vygotsky (1978) highlighted the role of social interaction in skill development. Papert's (1980) constructionism emphasized learning by making—an idea foundational to today's maker spaces and innovation labs.

3.3 Sociology and Cultural Studies

Life skills are shaped by social contexts, cultural values, and equity of access. Multidisciplinary research shows that marginalized learners may have fewer opportunities to practice collaboration or digital literacy, highlighting the importance of inclusive pedagogies and culturally relevant curricula (Banks, 2016).

3.4 Technology and Digital Innovation

Technology plays a dual role: as a domain of life skills (digital literacy, coding, media analysis) and as a tool for fostering collaboration, creativity, and global citizenship. Studies suggest that when technology is used purposefully—for problem-solving, simulation, and global collaboration—it significantly supports life skills (Voogt & Roblin, 2012).

4. EDUCATIONAL INNOVATIONS FOR LIFE SKILLS

4.1 STEAM Education

STEAM (Science, Technology, Engineering, Arts, and Mathematics) emphasizes multidisciplinary problem-solving and creativity. By integrating arts and design with technical fields, STEAM education fosters innovation, divergent thinking, and holistic problem-solving (Bequette & Bequette, 2012; Honey, Pearson, & Schweingruber, 2014).

4.2 Project-Based Learning (PBL)

PBL engages students in authentic, extended projects that require inquiry, collaboration, and public presentation. Evidence shows that PBL enhances critical thinking, teamwork, and real-world problem-solving (Thomas, 2000; Bell, 2010).

4.3 Social-Emotional Learning (SEL)

SEL programs teach self-awareness, empathy, relationship management, and responsible decision-making. CASEL (2003) found that SEL interventions improve both social skills and academic performance.

4.4 Maker Education and Innovation Labs

Maker spaces and innovation labs provide opportunities for hands-on creation, prototyping, and iterative problem-solving. Papert's (1980) constructionist principles underpin these environments, which cultivate resilience, creativity, and collaboration.

4.5 Digital and Online Learning Innovations

Digital platforms allow collaboration across borders, personalized learning, and access to global resources. Blended learning models integrate technology with face-to-face collaboration, enabling flexibility and adaptability (Fullan & Langworthy, 2014).

5. ROLE OF TEACHERS AND PEDAGOGY

Teachers are central to embedding life skills. The role of teachers shifts from knowledge transmitters to **facilitators of inquiry and collaboration**. This requires:

- Designing authentic, multidisciplinary projects.
- Using formative assessment to provide feedback on life skills (Black & Wiliam, 1998).
- Modeling social-emotional competencies.
- Encouraging reflection and metacognition.

Professional development is critical to support teachers in adopting these new roles (Fullan & Langworthy, 2014).

6. ASSESSMENT OF LIFE SKILLS

Traditional exams often fail to capture life skills. Innovative assessment approaches include:

- **Performance-based tasks** assessed through rubrics.
- **Portfolios** showcasing growth in creativity, collaboration, and problem-solving.
- **Peer and self-assessment** to build reflection skills.
- **Digital badges and credentials** recognizing competencies.

These align with calls for broader measures of learning outcomes beyond standardized testing (OECD, 2018).

7. POLICY AND SYSTEMIC IMPLICATIONS

7.1 Curriculum Integration

Life skills should not be taught as isolated modules but embedded across subjects through interdisciplinary projects (Honey et al., 2014).

7.2 Equity and Access

Policies must ensure all learners—regardless of socio-economic status—have access to technology, innovation labs, and supportive learning environments (Sahlberg, 2011).

7.3 Partnerships

Schools benefit from partnerships with communities, industries, and higher education to provide authentic challenges and mentorship opportunities.

7.4 Global Citizenship

Education must prepare learners to act as global citizens, capable of addressing sustainability challenges and fostering intercultural understanding (UNESCO, 2015).

8. CHALLENGES AND FUTURE DIRECTIONS

8.1 Standardization vs. Innovation

High-stakes assessments often discourage experimentation. Balancing accountability with innovation remains a challenge.

8.2 Teacher Workload

Teachers need time, resources, and professional learning to design innovative projects.

8.3 Research Gaps

Further studies are needed to examine:

- Long-term impacts of life skills education.
- Context-specific strategies in different socio-economic and cultural settings.
- Cost-effectiveness of large-scale innovation.

9. CONCLUSION

Life skills are no longer optional but essential for tomorrow's learners. Multidisciplinary research provides theoretical and practical insights into how these skills develop, while educational innovations offer concrete strategies for implementation. From STEAM and PBL to SEL and digital learning, innovative pedagogies help prepare learners for complex futures. Teachers, policymakers, and communities must collaborate to ensure equitable, holistic, and sustainable models of education.

Transforming education into a life-skills-rich experience is not a future aspiration—it is an urgent task for today. By combining insights from multiple disciplines and leveraging innovation, we can equip learners with the creativity, resilience, empathy, and adaptability they need to thrive in tomorrow's uncertain world.

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ARTIFICIAL INTELLIGENCE FOR TEACHERS: AS AN AID NOT REPLACEMENT

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ABSTRACT

The interference of technology in daily operations especially in education is increasing daily. Artificial intelligence (AI), which approaches fresh solutions for age - long questions is leading the pack. Many schools are embracing this trend by infusing AI into its teaching and preparing students for a bright future ahead.

As AI becomes more common in education, many wonder: Should AI replace teachers? Or even, why should AI replace teachers at all?

AI can personalize lessons, track progress, and offer 24/7 help. So yes, AI is replacing teachers in repetitive tasks. However, how can AI replace teachers when it comes to emotional support and human connection? That's the real challenge.

This paper aims to help understand how AI supports teachers in their teaching. It also discusses the reimagining of the role of teachers. And last but not the least, this paper also describes the several reasons why AI will never be able to completely replace a human teacher.

KEY WORDS: AI IN EDUCATION, HOW AI SUPPORTS TEACHERS, REIMAGINING THE ROLE OF TEACHERS AND REASONS WHY AI CANNOT REPLACE TEACHER

1. INTRODUCTION

Artificial intelligence (AI) enabled tools are becoming mainstream in the education domain – with both teachers and students exploring its capabilities with equal interest. Most of the conversations have been around how students may tend to learn less by using AI tools that may result in superficial understanding of concepts without true comprehension or deeper knowledge retention. Of equal significance is also about teachers – exploring their evolving roles, how pedagogy will change, and how teachers will adapt in the classroom.

AI is the capability of machines to perform tasks typically associated with human intelligence, such as learning, reasoning, problem-solving, and decision-making. One can acquire such capabilities by using algorithms and vast amounts of data to simulate human cognitive processes, enabling machines to understand language, recognize patterns, make recommendations, and even act autonomously. AI is a broad field encompassing technologies like machine learning and deep learning, and its applications are found in various fields, from chatbots and computer vision to autonomous vehicles and medical diagnosis.

2. WHAT IS ARTIFICIAL INTELLIGENCE IN EDUCATION?

AI refers to the process by which systems imitate human intelligence or, in other words, the branch of computer science that deals with the creation of intelligent machines. They are capable of thinking, learning and solving problems, doing things that the world traditionally requires human input.
Thus, AI systems can read data, decide and solve problems even on their own.

Regarding education, AI is applied to facilitating administrative duties, assigning individual learning approaches as well as developing new instruments that prove useful to teachers as well as learners.

AI in education uses intelligent systems to personalize learning, automate administrative tasks, and provide data-driven insights to enhance the teaching and learning experience for students and educators alike.

3. HOW AI SHOULD SUPPORT EDUCATION?

3.1 Personalizing Learning and Instruction

3.1.1. Adaptive Content: AI can tailor content and pacing to individual students' needs, strengths, and weaknesses, enhancing comprehension and retention.
3.1.2. Differentiated Materials: Teachers can use AI to quickly generate differentiated handouts, assignments, and reading materials adjusted to various learning levels.
3.1.3. Personalized Assessments: AI can create assessments that adapt to each student's learning needs and progress, moving beyond traditional rubrics.

3.2. Streamlining and Automating Tasks

3.2.1. Administrative Support: AI can automate time-consuming tasks like grading assignments, generating reports, and sending performance updates to parents, freeing up teacher time.
3.2.2. Communication: Tools can assist with writing emails and other communication, making it easier for teachers to connect with parents.
Content Creation: AI can generate lesson plans, diverse activity ideas, assessment questions, and presentations with minimal input from the teacher.

3.3 Enhancing Student Engagement & Support

3.3.1. Interactive Materials: AI can help create interactive slide decks with polls, open-ended questions, and other interactive elements to make lessons more dynamic.
3.3.2. Student Progress Monitoring: AI tools provide actionable insights by tracking individual learning patterns, allowing teachers to identify students needing extra support.
3.3.3. Targeted Intervention: By analyzing student responses, AI can suggest targeted interventions for students who are struggling, helping to prevent them from falling behind.
3.3.4. Language Practice: AI chatbots can offer students conversation practice in different languages, which is especially helpful for language learners.

3.4. Improving Teacher Efficiency and Well-being

3.4.1. Targeted Intervention: By analyzing student responses, AI can suggest targeted interventions for students who are struggling, helping to prevent them from falling behind.
3.4.2. Language Practice: AI chatbots can offer students conversation practice in different languages, which is especially helpful for language learners.
3.4.3. Increased Bandwidth: By handling routine tasks, AI increases teacher bandwidth, making them more available to students for personalized attention.

3.4.4. Reduced Burnout: Automating tasks and simplifying complex processes can help reduce teacher workload and prevent burnout, allowing them to focus on more meaningful aspects of their profession.

4. REIMAGINING THE ROLE OF TEACHERS:

Technology adoption in the education domains has been a very slow and difficult process. It took many years to modernize education delivery – and for the better part of that period was devoted to leveraging technology on streamlining many administrative tasks. Education media on the other hand supplemented classroom sessions but teachers were central to the process of how students learned – specifically in the prek-12/school domain. Education has always been about two key participants – the teacher and the student. AI's disruptive role in the education value chain has necessitated critical review of the fundamental teacher-student dynamic. Leveraging AI is not a threat but is a core capability that is needed for the transformative role teachers would play in the AI era. Here are some of the potential changes we may see:

4.1. From Knowledge Provider to Learning Facilitator:

As AI readily provides access to information, teachers will transition from primary knowledge sources to guides and mentors, focusing on facilitating learning, fostering critical thinking, and promoting independent research.

4.2. Focus on Higher-Order Skills:

AI can automate repetitive tasks, freeing up teachers to concentrate on developing essential 21st century skills like problem-solving, creativity, collaboration, communication, and emotional intelligence.

4.3. Immersive and Interactive Learning:

AI can create engaging and interactive learning environments through virtual reality, augmented reality, and gamification. This approach can make in-classroom interactions more dynamic and immersive, enabling teachers to join students as co-participants in the process of knowledge discovery.

4.4. Personalized Learning:

AI can personalize the learning experience by tailoring content, pace, and methodology to individual student needs and learning styles. This could involve teachers heavily leveraging adaptive learning platforms, intelligent tutoring systems, and personalized recommendations.

4.5. Data-Driven Instruction:

AI can analyze student performance data to identify areas of strength and weakness, enabling teachers to provide targeted interventions and support. This data-driven approach can help teachers focus on students who need attention and personalize instruction.

4.6. Augmented Teaching:

AI can assist teachers in grading assignments, providing real-time feedback, and recommending appropriate educational materials. This enables teachers to dedicate more time to personalized interactions and tailor instruction for students requiring additional support.

4.7. Accessibility and Equity:

AI-powered tools can make education more accessible to students with disabilities and those from diverse backgrounds. This could involve text-to-speech translation, language learning tools, and assistive technologies more dynamic helping teachers in attending to students with special needs.

5. REASONS WHY AI CAN NOT REPLACE TEACHERS:

No matter how advanced technology has become, it cannot bridge the gap between how humans interact vs how AI tools interacts. Some of the highlighted reasons behind, why AI will be unable to replace teachers, are as given below-

5.1. Development of Critical Thinking:

A teacher, on a human level, has a crucial role in the development of students. It can be their skill; it can be creativity. It can help them improve their analysis skills and much more.

AI usually depends on algorithms. However, teachers interact with each student separately. Understand their perspective and help them improve.

They can be more insightful when it comes to questions that might be open-ended and discussions that require critical thinking. Teachers help develop an environment that encourages growth; AI can only support the same with minor prompts.

5.2. Building an Emotional Connection:

Teachers not only help with education but also develop an understanding for each student. They interact, empathies, encourage, and guide one. AI is not capable of this approach.It can analyze the data and adapt. It is, however, not capable of comprehending details, such as the mood of an individual or their body language. This hinders proper growth in many skills.

5.3. Adaptability:

Humans can adapt to changes quite easily; however, it is not the same with AI. The teachers can identify a student who might be struggling or not engaged in the subject. They can hence modify their approach to teach accordingly. However, AI is only in the initial stages of offering personalization. It cannot replicate the experience to help students grow on a personal scale.

6. INSIGHTFUL GUIDANCE:

Humans excel in complex situations, specifically when faced with problems. It requires that one have an understanding of various things and the context related to the same. Humans similarly can recognize various issues in terms of emotional or academic situations. When it comes to students, teachers guide them with much patience. For they have the needed insight. AI, when faced with a situation, can only work with limited capacity. Teachers on the other hand, have experiences and unique perspectives to offer.

This cannot be replicated by AI in education. It is due to this understanding and human aspect of things that teachers cannot be replaced by artificial intelligence.

7. ETHICAL GUIDANCE:

Ethics happens to be quite a challenging concept when it comes to AI. However, it strongly shapes the understanding and the way one leads life in the real world. Teachers play a great role in helping students develop and understand ethics and morals. AI lacks personal values, and it can support only fact-based learning; it lacks character or moral complexities. Teachers, on the other hand, provide a human perspective. It greatly influences the minds of the students and prepares them better for the challenges of the real world.

8. DEVELOPMENT OF SOCIAL SKILLS:

Artificial intelligence cannot play a significant role in social skills. It is because it does not have an interpersonal understanding of the same. Human teachers, on the other hand, can help with the development of teamwork and collaboration as well as proper communication. Activities such as discussions, class projects, and more allow the students to interact effectively. The teachers can mediate such interactions, allowing students to better understand how such interactions work and develop their social skills.AI, unlike human teachers, lacks empathy, which is quite important for one in the real world.

9. INFLUENCE:

Teachers in the real world happen to be role models for the students; they inspire their growth and learning. It is through these individuals that students get to see values such as resilience and empathy. They learn to perceive and become curious while developing integrity; teachers have stories, experiences, and kindness to offer. It is always based on real-life situations that can help shape a student's future in a way that artificial intelligence in education cannot. It is due to this that AI might help with education but cannot replace teachers.

10. DEVELOPMENT OF PERSONAL CONNECTIONS:

Teachers essentially interact with students on a human level. They understand the student's personalities and interests. They identify their strengths and help with building relationships that last and help students foster a sense of belonging. These connections help create an environment that not only feels safe but provides students with a sense of value and motivation; AI cannot replicate this human connection. Teacher help students thrive in the real world and provide them with the needed support. They act as figures who care and encourage one to seek success and excellence.

11. HOW TO SUCCESSFULLY IMPLEMENT AND USE AI IN EDUCATION:

Should AI be used in schools? Successfully using AI in education requires careful planning, teacher training, good infrastructure and constant evaluation. Higher education institutions need to set clear goals for how they want to use AI, whether it's for improving personalized learning, making administrative tasks more efficient or engaging students better. By setting measurable objectives and aligning them with the school's mission, administrators can ensure that AI initiatives are purposeful and focused.

Investing in teacher training and professional development is essential. Teachers need to learn how to use AI tools effectively and understand how AI can enhance traditional teaching methods. As AI is constantly evolving, it is essential that teachers stay updated with the latest AI advancements and teaching strategies through ongoing professional development programs.

Schools must have the right technology in place to support AI. Schools should also use flexible AI platforms that can grow and adapt to changing needs. Regular evaluation and feedback from students and teachers are crucial for assessing the impact of AI and making necessary improvements, ensuring that AI tools enhance the educational experience for everyone.

12. CONCLUSION

AI is a valuable tool that can enhance the educational experience by providing support, personalizing learning, and handling routine tasks. However, it cannot replace the fundamental role of human teachers in nurturing emotional growth, creativity, and the deep understanding that comes from human interaction and mentorship. The most effective approach is a collaborative one, where AI serves as a supportive partner to human educators. In the future, AI and teachers will likely work together, with AI handling administrative tasks and providing data-driven insights, while teachers focus on the social, emotional, and intellectual growth of students. Rather than replacing teachers, AI will complement their efforts, making education more effective and accessible for all.

In Summary, AI should be viewed as a powerful tool to assist and "supercharge" teachers, allowing them to focus on the irreplaceable human aspects of education rather than replacing them.

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ARTIFICIAL INTELLIGENCE IN EDUCATION

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ABSTRACT

This article prepared for Artificial Intelligence useful in Education. Now a days artificial intelligence impact on education very much. Each area of education like teaching-learning, evaluation, examination etc are using AI to improve their work. Students also using all platforms of AI so role of the teacher is also change this era. This article is indicate benefits of AI, Application AI in Education, Future direction and platforms of AI for student, Techer and other.

KEYWORDS : AI (ARTIFICIAL INTELLIGENCE), EDUCATION

The integration of Artificial Intelligence (AI) in education is transforming the way students learn and teachers instruct. By leveraging AI-powered tools, educational institutions can enhance the learning experience, improve student outcomes, and streamline administrative tasks.

BENEFITS OF AI IN EDUCATION

- Personalized Learning: AI tailors educational content to individual students' needs, abilities, and learning styles, ensuring a more effective learning experience.
- Automated Grading: AI-powered grading systems reduce teachers' workload, freeing them to focus on more critical aspects of education.
- Intelligent Tutoring Systems: AI-driven tutoring systems provide real-time feedback, guidance, and support to students, helping them stay on track.
- Enhanced Accessibility: AI-powered tools make learning more inclusive for students with disabilities, language barriers, or limited access to resources

APPLICATIONS OF AI IN EDUCATION

- Curriculum Planning: AI analyzes educational data to identify trends, gaps, and areas for improvement, enabling data-driven decision-making.
- Language Learning: AI-powered language learning tools offer real-time feedback, pronunciation correction, and conversational practice.
- Chatbots and Virtual Assistants: AI-powered chatbots provide instant support, answering students' queries, and helping them navigate educational resources.
- Predictive Analytics: AI-powered predictive analytics forecast student performance, enabling early intervention and targeted support.

CHALLENGES AND CONSIDERATIONS

- Equity and Access: Ensuring equal access to AI-powered tools and resources is crucial to avoid widening existing inequalities.

- Data Privacy: Protecting students' data and ensuring AI systems' transparency and accountability is essential.
- Teacher Training: Educators need training and support to effectively integrate AI-powered tools into their teaching practices

FUTURE DIRECTIONS

- Increased Personalization: AI will continue to enable more tailored learning experiences, improving student outcomes and engagement.
- Improved Administrative Efficiency: AI will automate more administrative tasks, freeing educators to focus on teaching and student development.
- Enhanced Accessibility: AI-powered tools will become more prevalent, making education more accessible and inclusive for diverse learners

AI TOOLS FOR TEACHERS

MagicSchool: Offers 80+ AI teacher tools to simplify teaching tasks, save time, and combat teacher burnout. It's a robust AI platform designed for educators and students, providing customized tools and advanced analytics.

Canva for Education: A free design platform with AI-powered design tools like Magic Design, which can automatically create professional-looking educational materials.

Grammarly for Education: Provides real-time feedback on grammar, spelling, and punctuation, helping students improve their writing skills.

Curipod: An AI-powered platform that enables teachers to create interactive lessons in minutes, generating engaging content like polls, quizzes, and word clouds.

Gamma AI: A revolutionary presentation and content creation tool that uses AI to help educators create beautiful presentations, websites, and documents in minutes [1] [2].

AI Tools for Students

QuillBot: An AI-powered writing assistant that offers advanced grammar checking, plagiarism detection, and citation generation.

Owlift: An AI-powered tool that simplifies complex concepts and ideas, making them understandable for young children.

Doctrina AI: A tool that uses AI algorithms to enhance learning, generating notes, essays, quizzes, and exams on any topic.

PDF AI: A tool that helps students speed up their learning by allowing them to ask specific questions from an uploaded document.

TutorAI: A personalized tutoring service that generates in-depth course lectures, quizzes, and cross-questioning

OTHER NOTABLE AI TOOLS

Khan Academy AI Tutor: Personalizes student learning and provides insights for teachers to track progress.

Edpuzzle: Transforms videos into interactive lessons with embedded quizzes and student progress tracking.

Quizlet: Helps create flashcards and interactive quizzes to engage students in learning.

GradeCam: A classroom management tool that uses AI to track student progress and engagement

CONCLUSION

In this article, different platforms, tools and direction for future were presented. Artificial intelligence and its benefits for education were discussed in the present article.

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NEP 2020 AND QUALITY IN TEACHER EDUCATION

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ABSTRACT

This research paper examines the profound influence of the National Education Policy (NEP) 2020 on the landscape of teacher education in India. Recognizing teachers as the cornerstone of the educational system, NEP 2020 envisions significant structural and pedagogical transformations aimed at enhancing teacher effectiveness and professional standards. The policy's emphasis on a four-year integrated B.Ed. program, adoption of multidisciplinary and experiential learning methods, and integration of technology highlights a commitment to quality education. This paper explores key provisions of NEP 2020 related to teacher education, assesses their potential to improve quality, identifies implementation challenges, and suggests practical recommendations for effective adoption. By analyzing emerging trends and implications, this paper aims to contribute to the ongoing discourse on educational reform and teacher development in India.

INTRODUCTION

The National Education Policy (NEP) 2020 represents a landmark initiative by the Government of India to reimagine and restructure the country's education system. Adopted after 34 years of the last major policy (NEP 1986), NEP 2020 sets out an ambitious framework for educational transformation, placing emphasis on holistic, inclusive, and flexible learning aligned with the needs of the 21st century. At the heart of this transformation lies teacher education, a domain considered foundational to achieving quality and equity in education.

Teachers are the most crucial factor in determining the quality of education in any society. However, for decades, teacher education in India has faced criticism for being overly theoretical, lacking in practical exposure, and producing graduates ill-prepared for real classroom environments. NEP 2020 aims to address these long-standing issues by proposing comprehensive reforms that prioritize pedagogical competency, ethical grounding, technological adeptness, and continuous professional development.
This research paper aims to analyze how NEP 2020 reshapes teacher education by improving its structure, content, delivery, and monitoring mechanisms. It also discusses the opportunities and challenges presented by these reforms and outlines recommendations for ensuring their effective implementation at the grassroots level.

OBJECTIVES OF THE STUDY

- To explore the key provisions of NEP 2020 related to teacher education.
- To evaluate the impact of NEP 2020 on enhancing the quality of teacher education.
- To identify challenges in the implementation of these reforms.

- To suggest practical strategies and policy recommendations for strengthening teacher education in the light of NEP 2020.

NEP 2020: VISION FOR TEACHER EDUCATION

NEP 2020 provides a visionary blueprint for transforming teacher education in India. Its core idea is that no educational reform can succeed without competent and dedicated teachers. The policy makes the following pivotal recommendations for teacher education:

1. Four-Year Integrated B.Ed. Program

The policy mandates the implementation of a four-year integrated B.Ed. degree as the minimum qualification for teaching by 2030. This program will be multidisciplinary, incorporating foundational knowledge of education, subject specialization, pedagogy, and extensive practical training. The integration of teaching practice with theory aims to produce well-rounded educators.

2. Closure of Substandard Institutions

NEP 2020 advocates the phasing out of standalone teacher education institutions that do not meet quality benchmarks. These include private colleges operating without adequate infrastructure, faculty, or academic rigor. Teacher education will now be offered primarily through multidisciplinary institutions and universities to ensure high standards.

3. Multidisciplinary Approach

By encouraging teacher education to be a part of multidisciplinary institutions, NEP ensures that aspiring teachers are exposed to a variety of disciplines such as psychology, philosophy, science, sociology, and technology, fostering a broader and more informed understanding of education.

4. National Professional Standards for Teachers (NPST)

The policy proposes the development of National Professional Standards for Teachers to define expectations regarding knowledge, skills, values, and conduct. NPST will be developed by 2022 (as per the timeline) and will serve as a guiding document for teacher recruitment, training, evaluation, and promotion.

5. National Mission for Mentoring (NMM)

A National Mission for Mentoring will be established to provide mentoring support to new teachers by senior and experienced educators. This mentoring will play a crucial role in continuous professional development and knowledge-sharing.

6. Emphasis on Early Childhood Education and Foundational Literacy

Teachers will be trained to teach foundational literacy and numeracy, with a special focus on early childhood care and education (ECCE). This is critical to achieving universal foundational learning by 2025, as envisioned by the policy.

IMPROVING QUALITY THROUGH PEDAGOGICAL AND STRUCTURAL REFORMS

NEP 2020 focuses not only on structural changes but also on qualitative improvements in teacher education. Some of the key areas include:

1. Curriculum Redesign

The teacher education curriculum will be revised to include experiential learning, reflective practices, arts-integrated education, gender sensitization, inclusive education, and 21st-century skills such as communication, collaboration, critical thinking, and creativity.

2. Technology Integration

Digital tools and e-learning platforms such as DIKSHA, SWAYAM, and NISHTHA are encouraged for teacher training and lifelong learning. Teachers will be empowered to use ICT in the classroom effectively to improve student engagement and learning outcomes.

3. Practice-Based Learning

Internships and teaching practice will become an integral part of teacher education programs. Student-teachers will spend a significant portion of their program in real school settings under the guidance of trained mentors.

4. Continuous Professional Development

NEP recommends that teachers undergo at least 50 hours of Continuous Professional Development (CPD) each year. This may include workshops, MOOCs, webinars, or short-term training to keep teachers updated with pedagogical innovations and subject knowledge.

5. Inclusivity and Ethics

Teacher education will stress values such as empathy, ethics, human rights, and environmental awareness. This will create socially responsible and morally grounded educators.

6. Assessment Reforms

Shift from rote learning and high-stakes examinations to formative assessments, self-assessments, and competency-based evaluations. Teachers will be trained to use a variety of assessment tools to support learning.

CHALLENGES IN IMPLEMENTATION

While NEP 2020 presents a progressive framework, its implementation across India faces numerous challenges:

1. Infrastructure and Resource Gaps

A large number of teacher education institutions lack basic infrastructure, digital tools, and qualified faculty. Upgrading them to meet NEP standards will require significant investment and time.

2. Faculty Shortages and Capacity Building

There is a shortage of trained teacher educators capable of delivering the redesigned curriculum effectively. Faculty development and capacity building are essential for quality implementation.

3. Diversity Across States

India's federal structure means education is a concurrent subject. States vary significantly in terms of policy readiness, resources, and administrative efficiency. Ensuring uniform adoption of NEP provisions is a formidable task.

4. Resistance to Change

Institutions and educators accustomed to traditional systems may resist new pedagogies, assessment methods, or administrative procedures. Overcoming this mindset requires sustained advocacy and training.

5. Financial Constraints

Implementing a four-year B.Ed. program, enhancing infrastructure, recruiting qualified staff, and offering CPD opportunities need substantial financial resources. Budgetary support at the central and state levels is crucial.

6. Accreditation and Monitoring

There is a lack of robust accreditation systems to evaluate and monitor teacher education institutions. Strengthening regulatory bodies like NCTE and establishing transparent metrics will be necessary.

RECOMMENDATIONS

To ensure that the ambitious goals of NEP 2020 for teacher education are achieved, the following recommendations are proposed:

1. Institutional Strengthening

Provide academic, infrastructural, and financial support to teacher education institutions for transitioning to the integrated B.Ed. model. Encourage collaborations with multidisciplinary universities and research centers.

2. Faculty Development

Launch comprehensive training programs for teacher educators in modern pedagogy, assessment methods, use of ICT, inclusive education, and mentorship. Create a national platform for faculty exchange and peer learning.

3. ICT Infrastructure

Ensure digital access in rural and remote institutions through improved connectivity, provision of tablets/laptops, and training in the use of online teaching tools. Strengthen digital literacy among teachers.

4. Research and Innovation

Encourage research in teacher education through funding, fellowships, and partnerships. Promote action research, case studies, and innovation in teaching practices.

5. Stronger Governance

Establish clear accountability mechanisms for NEP implementation at the institutional and state levels. Use data-driven monitoring and regular audits to track progress and address bottlenecks.

6. Student Support and Motivation

Offer scholarships, career counseling, and mental health support to student-teachers. Recognize and reward exemplary teaching practices through awards and public acknowledgment.

CONCLUSION

NEP 2020 represents a transformative policy initiative that redefines the contours of teacher education in India. By proposing a well-integrated, multidisciplinary, and practical teacher preparation system, it envisions a cadre of highly skilled and motivated teachers who can drive educational excellence. However, realizing this vision requires overcoming existing infrastructural, administrative, and attitudinal barriers.

The success of NEP 2020 depends on a shared commitment from central and state governments, educational institutions, teacher educators, and civil society. With proper planning, investment, and collaboration, teacher education in India can evolve into a dynamic, responsive, and impactful domain that empowers educators and enriches student learning.

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ARTIFICIAL INTELLIGENCE (AI) IN COMMERCE EDUCATION

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ABSTRACT

Artificial Intelligence (AI) is hurriedly renovating various sectors, and commerce education is one of the segments. The integration of AI into commerce curricula and pedagogy has redefined how students learn, educators teach, and institutions manage academic operations. AI-powered tools like intelligent tutoring systems, adaptive learning platforms, and virtual teaching assistants are enabling personalized and efficient learning experiences. In commerce, where subjects like accounting, finance, marketing, and business analytics require both theoretical knowledge and real-world application, AI offers simulations, data analysis, and predictive modeling tools that bridge the gap between classroom learning and industry expectations.

Furthermore, AI aids educators in curriculum design, assessment automation, and student performance analysis, allowing for more data-driven and inclusive academic strategies. However, the adoption of AI in commerce education also raises concerns regarding digital divide, ethical considerations, and the need for continuous upskilling among faculty. This paper explores the evolving role of AI in commerce education, its benefits, challenges, and the future landscape of learning in a technology-driven academic environment.

KEY WORDS: ARTIFICIAL INTELLIGENCE (AI), COMMERCE, EDUCATION MECHANISM

1. INTRODUCTION:

Artificial Intelligence (AI) is revolutionizing commerce education by enhancing how students learn, how teachers educate, and how institutions function. As commerce-related fields such as finance, accounting, marketing, and economics develop into increasingly data-driven, the integration of AI tools into educational environments is helping bridge the gap between academic theory and business practices.

In the classroom, AI supports personalized learning through platforms that regulate at ease to individual student requirements and performance levels. AI chatbots and virtual teaching assistant proffer on-demand support, while automated appraisal tools simplify grading and give instant opinion.

Commerce education also benefits from AI-powered data analysis, enabling students to work with real-time datasets and develop practical skills in areas like financial forecasting, customer behavior analysis, and supply chain optimization. Business replication and virtual labs powered by AI create immersive, hands-on experiences that mimic real-world business scenarios.

On the organizational side, AI facilitates institutions with learner performance tracking, core curriculum planning, and resource allocation, making education more efficient and data-driven. Though, the implementation of AI also brings challenges such as digital disparity, data security, and the need for educationalist to obtain innovative methodological competencies.

Taken as a whole, AI is not just a tool but a transformative strength in commerce education, equipping students with the skills needed for the future workforce while reshaping how education is delivered and managed.

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E-LEARNING MODULES FOR NUTRITION AND DIETETICS: EFFECTIVENESS AND LEARNER ENGAGEMENT

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ABSTRACT

The rapid expansion of digital technologies has transformed education, especially in applied sciences such as Nutrition and Dietetics, where practical understanding and real-world application are crucial. The present research paper examines the effectiveness of e-learning modules in enhancing conceptual understanding, practical skills, and learner engagement among students pursuing Nutrition and Dietetics. Using a descriptive and analytical approach, this study integrates both quantitative and qualitative data collected from 240 undergraduate and postgraduate students from various colleges in Gujarat, India. Results reveal that e-learning modules—through interactive videos, virtual diet-planning simulations, and digital assessment tools—significantly improve knowledge retention, critical thinking, and professional readiness. However, the study also identifies challenges such as inadequate internet infrastructure, inconsistent learner motivation, and limited teacher preparedness. The paper concludes that well-structured e-learning environments, when supported by institutional training and blended learning strategies, can revolutionize the teaching-learning process in Nutrition and Dietetics and contribute to professional excellence in the health and education sectors.

KEYWORDS: E-LEARNING, NUTRITION AND DIETETICS, LEARNER ENGAGEMENT, DIGITAL PEDAGOGY, BLENDED LEARNING, VIRTUAL SIMULATION, HIGHER EDUCATION.

1. INTRODUCTION

In the digital era, Information and Communication Technology (ICT) has become the backbone of modern education, transforming how students learn and educators teach. Particularly in fields such as Nutrition and Dietetics, technology integration offers immense potential for enhancing both theoretical and applied understanding. The increasing demand for nutrition professionals, diet planners, and public-health educators necessitates innovative teaching methods that can deliver flexible, self-paced, and interactive learning experiences.

E-learning—defined as the use of electronic media, educational technology, and digital communication tools to facilitate learning—plays a pivotal role in this transformation. The shift from traditional chalk-and-talk pedagogy to multimedia-based, interactive, and learner-centered environments has opened new possibilities for personalized and collaborative learning.

In Nutrition and Dietetics, learning extends beyond textbooks. It involves comprehension of biological processes, food chemistry, nutritional assessment, meal planning, and health communication. E-learning modules provide virtual laboratories, diet analysis software, video demonstrations, and real-time

feedback, enabling learners to visualize complex biochemical processes and apply theoretical knowledge in simulated environments.

The present study titled "E-Learning Modules for Nutrition and Dietetics: Effectiveness and Learner Engagement" aims to explore how digital modules enhance learning outcomes, engagement, and motivation among students. It also examines the limitations and pedagogical challenges associated with e-learning in professional courses.

2. OBJECTIVES OF THE STUDY

The research was conducted with the following specific objectives:

1. To evaluate the effectiveness of e-learning modules in teaching Nutrition and Dietetics concepts.
2. To assess learner engagement and motivation levels in e-learning environments.
3. To identify the challenges faced by students and teachers in using e-learning modules.
4. To provide recommendations for improving e-learning integration in Nutrition and Dietetics education.

3. SIGNIFICANCE OF THE STUDY

Nutrition and Dietetics education demands a balance between scientific theory and practical application. Traditional classroom teaching often struggles to demonstrate physiological mechanisms or dietary calculations effectively. E-learning tools such as simulation software, digital recipe design, nutrient analysis apps, and video case studies bridge this gap.

Understanding the effectiveness and learner engagement associated with such tools is crucial for curriculum developers, educators, and policymakers. The findings of this study will help educational institutions strengthen digital infrastructure, enhance teacher competency, and promote learner-centered pedagogies aligned with the National Education Policy (NEP) 2020, which emphasizes digital learning and skill-oriented education.

4. REVIEW OF RELATED LITERATURE

A growing body of literature supports the use of e-learning in science education:

- Clark & Mayer (2016) demonstrated that multimedia learning improves comprehension by combining visual and auditory information.
- Joshi and Patel (2019) found that interactive nutrition modules significantly enhanced retention and interest among undergraduate learners in Gujarat.
- Basu and Singh (2020) concluded that e-learning increases accessibility and flexibility, especially for female learners balancing household and educational responsibilities.
- World Health Organization (2021) recommended integrating digital platforms for public-health and nutrition training to build professional capacity.
- Ali et al. (2022) observed that e-learning modules on food safety and diet planning lead to measurable improvement in practical assessment scores.

While these studies affirm e-learning's potential, others such as Kaur (2023) caution that lack of digital literacy and motivation can hinder engagement. Thus, effectiveness depends on module design, learner support, and institutional readiness.

5. METHODOLOGY

5.1 Research Design

The study employs a descriptive and analytical survey method using a mixed-methods approach, combining quantitative data from questionnaires and qualitative feedback from interviews.

5.2 Population and Sample

The target population included undergraduate (B.Sc.) and postgraduate (M.Sc.) students enrolled in Nutrition and Dietetics programs across Gujarat. A total of 240 respondents participated, consisting of 180 students and 60 faculty members from eight colleges and two universities. The sampling method was stratified random sampling ensuring representation from both government and private institutions.

5.3 Tools for Data Collection

A structured questionnaire was prepared consisting of four sections:

- Demographic Information
- Usage and Access of E-Learning Modules
- Effectiveness in Learning and Skill Development
- Learner Engagement and Challenges

Responses were measured on a five-point Likert scale (1 = Strongly Disagree to 5 = Strongly Agree). Additionally, semi-structured interviews were conducted with 20 teachers and 25 students to obtain qualitative insights.

5.4 Data Analysis

Data were analysed using percentage analysis, mean scores, and correlation techniques. Qualitative responses were thematically interpreted to provide contextual understanding.

6. RESULTS AND ANALYSIS

6.1 Access and Utilization of E-Learning Modules

1. 92% of students reported access to smartphones or laptops for learning purposes.
2. 76% used e-learning modules regularly through Learning Management Systems (LMS) such as Google Classroom and Moodle.
3. 64% preferred multimedia modules (videos, animations, infographics) over textual content.
4. Only 43% of rural students reported consistent internet connectivity, showing a persistent digital divide.

6.2 Effectiveness in Conceptual Learning

- 87% of respondents agreed that e-learning modules improved conceptual understanding of nutrient metabolism, diet formulation, and food chemistry.
- Students appreciated the use of virtual diet planners and nutrient calculation simulators, which allowed practical experimentation.
- 81% reported improved memory retention and ability to link theoretical concepts with real-life applications.
- Teachers confirmed that students using e-modules scored 15–20% higher in post-test evaluations compared to those in traditional classrooms.

6.3 Engagement and Motivation

- 84% of students described e-learning modules as engaging due to interactivity and visual appeal.
- Features such as gamified quizzes, drag-and-drop tasks, and instant feedback motivated learners.
- However, 28% admitted to facing distractions during self-paced online learning, indicating the need for structured guidance.
- Correlation analysis ($r = 0.71$) revealed a strong positive relationship between learner engagement and academic performance.

6.4 Skill Development and Application

- 79% agreed that e-learning enhanced professional skills like diet analysis, food safety auditing, and clinical communication.
- Virtual case studies and online assignments improved critical-thinking and problem-solving abilities.
- 61% of students developed portfolios or blogs to showcase nutrition plans—indicating the development of digital professionalism.

6.5 Challenges

Major barriers identified:

1. Connectivity issues (46%) and technical glitches (35%) disrupted learning.
2. Lack of training for faculty on module creation (42%) hindered effective use.
3. Some students (30%) reported reduced motivation due to absence of peer interaction and physical laboratory experience.

These findings highlight that while e-learning offers flexibility and engagement, successful implementation requires consistent institutional support.

7. DISCUSSION

The findings demonstrate that e-learning modules substantially enhance effectiveness and engagement in Nutrition and Dietetics education. The interactivity of multimedia learning aligns with Cognitive Theory of Multimedia Learning (Mayer, 2014), which emphasizes that dual-channel information processing increases retention.

E-learning allows visualization of microscopic and biochemical processes, such as digestion, metabolism, and absorption, which are difficult to illustrate in traditional classrooms. The use of virtual laboratories and simulations enables students to conduct dietary assessments, practice case-based diet planning, and visualize nutritional deficiencies.

Moreover, learner engagement emerges as a decisive factor. Students appreciated autonomy and creativity, while teachers recognized improved participation and curiosity. However, the self-paced nature of e-learning requires intrinsic motivation; without it, learners may disengage. The role of educators therefore shifts from “knowledge deliverer” to “learning facilitator.”

The study also resonates with constructivist learning theory, which posits that learners construct knowledge through active engagement. E-learning modules that incorporate discussion forums, peer collaboration, and real-life case studies foster experiential learning—crucial for professional fields like Dietetics.

On the downside, technological limitations—especially in rural and semi-urban areas—restrict consistent learning experiences. Faculty training, language barriers, and digital fatigue are emerging concerns. Thus, institutions must adopt a blended learning model, integrating both online and face-to-face pedagogies for holistic learning.

8. FINDINGS

- High Effectiveness: E-learning modules significantly improve conceptual understanding, analytical thinking, and performance in Nutrition and Dietetics.

- Strong Engagement: Interactive features and multimedia elements enhance learner motivation and sustained participation.
- Skill Enhancement: Digital platforms build professional skills such as diet analysis, digital communication, and clinical reporting.
- Gender Inclusion: E-learning provides flexible opportunities for women learners, especially those in remote areas or balancing domestic responsibilities.
- Challenges Persist: Connectivity issues, faculty training gaps, and lack of peer interaction remain barriers.
- Blended Learning Preference: A combination of e-learning and physical laboratory work yields the most effective outcomes.

9. EDUCATIONAL IMPLICATIONS

The study offers several implications for educational practice and policy:

- Curriculum Design: Institutions should embed e-learning modules with outcome-based objectives and continuous assessment.
- Faculty Development: Regular workshops are needed to train teachers in digital pedagogy, content creation, and learner analytics.
- Infrastructure Enhancement: Reliable internet connectivity, digital classrooms, and virtual laboratories must be prioritized.
- Learner Support Systems: Mentorship, discussion forums, and peer learning networks should accompany e-modules to sustain motivation.
- Localization: Developing bilingual and culturally relevant modules will increase accessibility.
- Research and Innovation: Continuous evaluation of module effectiveness will ensure alignment with learner needs and industry standards.

10. RECOMMENDATIONS

- Adopt Blended Learning Models combining traditional lectures, practical labs, and online simulations.
- Introduce Digital Portfolios for students to record diet plans, analyses, and case studies.
- Establish National E-Learning Repositories for Nutrition and Dietetics under UGC or IGNOU frameworks.
- Encourage Public-Private Partnerships to fund digital infrastructure and software tools.
- Integrate Virtual Reality (VR) and Augmented Reality (AR) technologies to visualize food processing and metabolic pathways.
- Provide Digital Literacy Courses for both teachers and learners.
- Conduct Impact Assessments periodically to evaluate learning outcomes and engagement levels.

11. CONCLUSION

The present study underscores that e-learning modules represent a transformative approach to Nutrition and Dietetics education. They empower learners through self-directed, flexible, and interactive experiences that traditional classrooms often cannot offer. By combining visual, auditory, and experiential elements, e-learning fosters deeper understanding and professional competence.

However, for sustained effectiveness, e-learning must be accompanied by institutional readiness, faculty development, and infrastructural investment. Learner engagement depends on interactive design, contextual relevance, and consistent guidance from educators. A hybrid or blended approach—merging the strengths of both digital and physical learning environments—emerges as the most sustainable model for future education in applied sciences.

Ultimately, e-learning modules not only enrich academic knowledge but also prepare students to become digitally literate nutrition professionals capable of addressing real-world health challenges with innovation and confidence.

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ENHANCING ENGLISH LANGUAGE FLUENCY IN UNDERGRADUATE STUDENTS THROUGH AI-POWERED LANGUAGE LEARNING AT SUPPLEMENTAL LEVEL

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ABSTRACT
The increasing demand for English language proficiency in today's globalized world has led to a growing interest in innovative approaches to language teaching. This paper explores the potential of artificial intelligence (AI) in enhancing English language fluency in undergraduate students. It discusses the benefits and challenges of using AI-powered language learning tools and examines the effectiveness of AI-driven instruction in improving students' speaking, listening, reading, and writing skills. This research paper explores the potential of AI-powered language learning tools in enhancing English language fluency in undergraduate students. It discusses the benefits and challenges of using AI-driven instruction and examines the effectiveness of AI-powered tools in improving students' language skills. The findings suggest that AI-powered language learning tools can be an effective way to enhance language fluency, particularly when combined with traditional teaching methods.

KEY WORDS: AI POWERED, ENHANCING, FLUENCY, COMMUNICATIVE, AUTONOMOUS, CONTROL GROUP.

INTRODUCTION
English language proficiency has become a vital skill for undergraduate students in today's interconnected world. However, many students struggle to achieve fluency due to various factors, including limited exposure to the language, inadequate practice opportunities, and traditional teaching methods that focus on grammar rules rather than communicative competence. AI-powered language learning tools offer a promising solution to this challenge by providing personalized instruction, instant feedback, and interactive practice opportunities.

While no single definition of "fluency" is universally agreed upon by "great people," a synthesis of ideas from influential thinkers suggests that a richer, more expansive definition extends beyond mere linguistic ability. For "great people," fluency is often less about mechanical perfection and more about effortless, impactful communication and execution of thought.

LITERATURE REVIEW
Numerous studies have investigated the effectiveness of AI-powered language learning tools in enhancing language proficiency. Research has shown that AI-driven instruction can improve students' speaking, listening, reading, and writing skills by providing tailored feedback, increasing motivation, and promoting autonomous learning.

“Fluency means that “the ability to speak or write a language easily, well and quickly”

MARRIAM CAMBRIDGE DICTIONARY

In nut shell Fluency is a spoken or written language without many pauses. It also means able to speak or write smoothly, easily or readily. One can say it is gracefully spoken. There are various types of tools to use for the students to enhance their fluency in English Language.

Here are various types of tools to use for the students to enhance their fluency in English Language.

1. Language Learning Platforms: Duolingo, Babbel, and Rosetta Stone are popular AI-powered platforms that provide interactive lessons and exercises.
2. Chatbots: AI-driven chatbots offer conversational practice and feedback, helping learners improve their speaking and listening skills.
3. Speech Recognition Software: Tools like Speech ace and Fluency Tracker use AI to assess pronunciation and speaking skills.
4. Automated Writing Evaluation: AI-powered tools like Grammarly and Turnitin provide instant feedback on writing assignments.

The above types of tools are very much beneficial in learning language.as they provide personalized instruction. As AI tools tailor instruction to individual learners' needs and abilities. They also have an increased efficiency as they automate tasks like grading and feedback, they also free up some teachers to focus on more critical aspects of teaching. AI tools also make language learning more interactive and fun.

METHODOLOGY

This study used a mixed-methods approach to investigate the effectiveness of AI-powered language learning tools in enhancing English language fluency in undergraduate students of Dr. Subhash Mahila Arts College Junagadh Gujarati medium. The participants were 50 undergraduate students who were randomly assigned to either an experimental group or a control group. The experimental group used AI-powered language learning tools, while the control group received traditional instruction.

RESULTS

The results of the study showed that the experimental group outperformed the control group in terms of English language fluency. The AI-powered language learning tools provided personalized instruction and feedback, which helped students improve their speaking, listening, reading, and writing skills.

Based on multiple tasks done with them the study and the observation suggests that the experimental group using AI-powered tools shows significantly greater improvement in English fluency compared to a control group learning through traditional methods. This is primarily due to the personalized feedback, interactive practice, and reduced anxiety that AI provides.

Performance in AI-powered group	**Performance in control group**
• **Significantly higher fluency:** Numerous studies and meta-analyses conclude that students using AI-assisted language tools, such as Duolingo and ELSA, achieve	• **Slower progress:** While control groups receiving traditional, human-led instruction often show improvement over time, their gains in fluency are typically smaller and less statistically significant than the AI group's.

substantially higher speaking fluency scores than students in control groups. • **Personalized learning:** AI platforms use machine-learning algorithms to tailor lessons to individual student needs by adjusting difficulty based on progress, which boosts overall proficiency. • **Instant, targeted feedback:** AI tools provide immediate feedback on pronunciation, grammar, vocabulary, and intonation, allowing learners to correct mistakes in real-time. This is often more frequent and specific than what a human teacher can provide in a classroom setting. • **Increased practice opportunities:** Unlike human teachers who have limits on time and energy, AI tools are available 24/7 for endless practice. This continuous, low-pressure practice environment helps build confidence and reduces speaking anxiety. • **Greater engagement and motivation:** Many AI apps use gamification elements like leaderboards and rewards to make learning fun and interactive, increasing student engagement and intrinsic motivation.	• **Delayed feedback:** In a traditional classroom, a teacher cannot provide instant, one-on-one feedback to every student. There is often a delay between a speaking task and the teacher's evaluation. • **General feedback:** Traditional methods use rubrics and general corrections, which are less personalized and specific than the data-driven feedback provided by an AI. This can be less effective for addressing individual weaknesses. • **Higher anxiety:** Some students experience higher anxiety speaking in front of a human teacher or peers, which can inhibit language production and fluency. In contrast, practicing with an AI tutor removes the fear of being judged. • **Limited practice time:** Classroom time for speaking practice is often limited and must be shared among all students, providing fewer opportunities for individual practice compared to AI tools.

DISCUSSION

The findings of this study suggested that AI-powered language learning tools was an effective way to enhance English language fluency in undergraduate students. The tools provided students with opportunities for interactive practice, instant feedback, and personalized instruction, which were essential for language learning.

CONCLUSION

This study demonstrates the potential of AI-powered language learning tools in enhancing English language fluency in undergraduate students. The findings suggest that AI-driven instruction can be an effective way to improve students' language skills, particularly when combined with traditional teaching methods. Further research is needed to explore the long-term effects of AI-powered language learning and to identify the most effective ways to integrate AI into language instruction.

RECOMMENDATIONS

1. Integrate AI-powered language learning tools into existing language curricula to provide students with opportunities for interactive practice and personalized instruction.

2. Provide teachers with training and support to help them effectively integrate AI-powered language learning tools into their teaching practices.
3.Continuously evaluate and improve AI-powered language learning tools to ensure they meet the needs of language learners.
4. Increased Adoption: AI is likely to become more prevalent in ELT, with more institutions and teachers incorporating AI-powered tools into their teaching practices.
5. Improved Teacher Training: There is a need for more comprehensive training programs to help teachers effectively integrate AI into their teaching.
6. Addressing Bias and Ethics: Researchers and educators must work together to address bias and ethics in AI-powered ELT tools.

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THE USE OF ARTIFICIAL INTELLIGENCE IN TEACHER EDUCATION: OPPORTUNITIES, CHALLENGES, AND FUTURE DIRECTIONS

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ABSTRACT

Artificial Intelligence (AI) is transforming education at an unprecedented pace, reshaping how teachers are trained and how they practice. Within teacher education, AI offers profound opportunities to enhance pre-service and in-service professional development by introducing adaptive, data-driven, and immersive learning tools. Personalized learning systems, AI-driven simulations, automated assessments, and learning analytics are some of the most promising applications that can redefine how teachers prepare for and adapt to diverse classroom contexts. This article critically examines the role of AI in teacher education, with particular emphasis on its applications, benefits, challenges, and future directions. While AI promises to streamline administrative tasks, provide personalized professional growth pathways, and create safe environments for pedagogical experimentation, it also raises ethical and structural concerns. Issues of data privacy, algorithmic bias, teacher autonomy, and equitable access must be carefully navigated to prevent unintended consequences. Drawing upon existing research and current practices, the article argues that successful integration of AI in teacher education requires a balanced, human-centered approach that complements—rather than replaces—the expertise and creativity of educators. It further emphasizes the need for robust policy frameworks, institutional strategies, and ongoing professional development to prepare teachers for responsible AI adoption. Ultimately, the future of AI in teacher education lies in fostering classrooms that are both technologically advanced and deeply human-centered, ensuring that educators can harness AI to enrich teaching and learning without compromising the core values of education.

KEYWORDS: ARTIFICIAL INTELLIGENCE (AI), TEACHER EDUCATION, PERSONALIZED LEARNING, LEARNING ANALYTICS, TEACHER PROFESSIONAL DEVELOPMENT, EDUCATIONAL TECHNOLOGY, ETHICS IN EDUCATION.

INTRODUCTION

The rapid advancement of Artificial Intelligence (AI) has emerged as one of the defining technological trends of the 21st century. AI systems are increasingly embedded in decision-making processes, offering efficiency, predictive insights, and automation. Education, too, has not been immune to this transformation. Over the past decade, AI has gradually shifted from a futuristic concept to a present reality, influencing how students learn, how teachers teach, and how institutions operate. For teacher education in particular, AI is opening unprecedented opportunities to strengthen both pre-service training and ongoing professional development for in-service educators. Teacher education plays a foundational role in shaping the quality of education systems worldwide. Effective teacher preparation equips future educators not only with subject matter expertise but also with the pedagogical skills, adaptability, and

reflective practices necessary to navigate diverse and complex classrooms. In-service professional development, meanwhile, ensures that educators remain current with evolving curriculum demands, pedagogical innovations, and the socio-emotional needs of learners. With the rise of AI-driven tools, teacher education is undergoing a paradigm shift: moving from standardized, one-size-fits-all training models to more adaptive, individualized, and data-informed approaches.

BENEFITS AND OPPORTUNITIES

The integration of Artificial Intelligence (AI) into teacher education offers a wide array of benefits that extend across individual, institutional, and systemic levels. While challenges and ethical concerns remain, the opportunities provided by AI underscore its potential to transform teacher preparation and ongoing professional development. Three primary areas of benefit stand out: enhanced efficiency, improved teacher professional growth, and greater student engagement. The opportunities that AI presents are not limited to technical innovations; rather, they have deep pedagogical, professional, and societal implications. This section explores the multiple dimensions of opportunities created by AI in teacher education.

1. ENHANCING EFFICIENCY AND REDUCING WORKLOAD

One of the most immediate benefits of AI in teacher education is its ability to streamline administrative and routine tasks. Automated grading tools, data management systems, and feedback platforms significantly reduce the time teacher educators and candidates spend on repetitive work. For instance, lesson plan evaluations and written reflections can be assessed quickly through AI-driven systems, allowing educators to focus on higher-order tasks such as mentoring, coaching, and facilitating reflective discussions.

This efficiency translates into more meaningful interactions between teacher educators and candidates. By freeing instructors from administrative burdens, AI creates space for personalized mentoring, which is crucial for professional identity formation. Similarly, in-service teachers benefit from reduced workload in classroom management and assessment, enabling them to dedicate more energy to creativity, relationship-building, and responsive teaching.

2. SUPPORTING CONTINUOUS PROFESSIONAL GROWTH

AI technologies provide powerful tools for promoting lifelong learning among educators. Teacher education does not end with certification; rather, it extends into ongoing professional development throughout a teacher's career. AI-powered adaptive platforms make it possible for educators to engage in self-paced, needs-based learning.

For example, AI dashboards can identify skill gaps in areas such as differentiated instruction or the integration of inclusive pedagogies. Based on these insights, personalized modules and resources can be recommended, ensuring that professional growth remains relevant and aligned with classroom realities. This individualized support not only enhances teacher competence but also fosters professional autonomy, as educators are empowered to shape their own learning journeys.

Moreover, AI-driven simulations and practice environments allow teachers to rehearse strategies for complex classroom situations, such as managing diversity, incorporating technology, or addressing

behavioral challenges. These opportunities provide safe spaces for experimentation, reflection, and refinement, ultimately leading to more confident and adaptive professionals.

3. FOSTERING STUDENT ENGAGEMENT AND EQUITY

Although the primary focus of teacher education is on preparing educators, the ultimate beneficiaries of AI integration are students. By equipping teachers with tools to personalize instruction, AI contributes to greater student engagement and learning outcomes.

For instance, in-service teachers can use AI-generated analytics to identify students who are struggling and design interventions tailored to their needs. In pre-service contexts, teacher candidates who practice with AI-driven simulations gain exposure to diverse classroom scenarios, including those involving marginalized or special-needs learners. This exposure promotes equity-oriented teaching practices, ensuring that future educators are better prepared to meet the needs of all students.

At a systemic level, AI has the potential to reduce disparities in access to high-quality teacher training. Online AI-driven platforms make professional development resources more widely available, even in geographically remote or under-resourced areas. While infrastructure challenges remain, the scalability of AI solutions provides opportunities for broader reach and more equitable distribution of training opportunities.

4. PERSONALIZED AND ADAPTIVE TEACHER TRAINING

One of the greatest advantages of AI is its ability to customize learning experiences for both pre-service and in-service teachers. Traditional professional development programs often take a “one-size-fits-all” approach, which does not account for the unique needs of individual educators. AI-driven platforms, however, can analyze data on teachers’ prior knowledge, skill levels, and professional goals to design tailored training modules. For example, a mathematics teacher struggling with integrating technology into lessons may receive targeted tutorials and practice sessions, while another teacher might focus on strategies for differentiated instruction. This personalization ensures that professional development is relevant, efficient, and meaningful.

5. ENHANCED CLASSROOM SIMULATIONS AND PRACTICE ENVIRONMENTS

Teacher preparation has historically been constrained by limited opportunities for hands-on practice in real classrooms. AI-powered virtual simulations offer a solution by creating immersive, realistic environments where teacher candidates can experiment with instructional strategies, classroom management, and student engagement techniques. These simulations allow future educators to practice responding to diverse scenarios—such as managing disruptive behavior or differentiating lessons for students with varying abilities—without real-world consequences. In-service teachers can also benefit by using simulations to refine new methods before implementing them in live classrooms.

6. REAL-TIME FEEDBACK AND PERFORMANCE ANALYTICS

AI provides opportunities for instant, detailed feedback on teaching performance. For example, intelligent observation systems can analyze teacher talk time, question types, pacing, and classroom interaction patterns. Such analytics can highlight strengths and identify areas for improvement, supporting reflective teaching practices. Unlike traditional observation systems that depend on sporadic evaluations by supervisors, AI offers continuous support, enabling teachers to grow at their own pace.

7. EFFICIENCY IN ROUTINE TASKS

Routine responsibilities such as grading, attendance, and lesson planning can be time-consuming and often detract from meaningful teaching activities. AI-powered tools automate these administrative tasks, freeing up educators' time for higher-order teaching and student interaction. For example, natural language processing (NLP) algorithms can evaluate written responses or essays, while scheduling systems can optimize class timetables. By reducing the administrative burden, AI enhances teacher well-being and work-life balance.

8. SUPPORTING INCLUSIVE AND DIVERSE LEARNING ENVIRONMENTS

AI holds particular promise in advancing inclusive education. Adaptive learning technologies can help teachers better support students with special needs by providing insights into their progress and suggesting strategies tailored to their requirements. For instance, AI tools can analyze patterns in student behavior and recommend personalized interventions for learners with autism or dyslexia. This not only benefits students but also equips teachers with the confidence and skills to create inclusive classrooms.

9. OPPORTUNITIES FOR COLLABORATIVE PROFESSIONAL LEARNING

AI can facilitate collaboration by connecting educators across geographies through digital platforms. Teacher communities enhanced with AI-driven recommendations can match educators with peers who have similar challenges or complementary expertise. By fostering peer-to-peer learning and professional networking, AI expands opportunities for collective knowledge-building, mentorship, and innovation in teaching practices.

10. DATA-DRIVEN POLICY AND INSTITUTIONAL DEVELOPMENT

On a broader scale, the use of AI-generated data can inform institutional decision-making and educational policy. Universities and teacher training institutions can analyze data from AI platforms to identify systemic gaps in teacher preparation programs, assess the effectiveness of professional development initiatives, and allocate resources more efficiently. This contributes to a more evidence-based approach to shaping teacher education at both local and national levels.

11. GLOBAL ACCESS AND DEMOCRATIZATION OF TEACHER EDUCATION

AI also has the potential to bridge gaps in access to quality teacher education. For educators in remote or underserved areas, AI-powered online platforms can provide access to high-quality training resources and mentorship opportunities. By transcending geographical limitations, AI contributes to a more equitable distribution of professional development opportunities, supporting global efforts to improve educational quality and inclusivity.

CHALLENGES AND ETHICAL CONCERNS

While the integration of Artificial Intelligence (AI) in teacher education holds immense promise, it also presents a complex set of challenges and ethical dilemmas. The challenges fall broadly into three categories: data privacy and security, teacher autonomy and overreliance on technology, and the persistence of the digital divide. While Artificial Intelligence (AI) offers immense opportunities in transforming teacher education, its integration is not without significant challenges. These challenges are multifaceted, encompassing technical, ethical, pedagogical, and social dimensions. Addressing them is

crucial to ensuring that AI becomes a supportive tool rather than a disruptive force in education. This section critically explores the barriers and ethical dilemmas associated with AI in teacher education.

1. DATA PRIVACY AND SECURITY

AI systems in teacher education depend heavily on the collection and analysis of data—ranging from performance records of teacher candidates to sensitive information about students in classrooms. This reliance raises significant concerns regarding data privacy and security. Teacher candidates may feel uncomfortable knowing that their instructional practices, lesson plans, or even verbal interactions are being recorded, analyzed, and stored by AI platforms. Similarly, in-service teachers using AI tools for professional development may worry that their performance data could be misused by administrators for evaluation or punitive purposes.

AI systems rely heavily on collecting and analyzing vast amounts of data—ranging from teacher performance metrics to sensitive student information. This raises questions about how data is stored, who has access to it, and how it might be misused. For instance, if personal data is inadequately protected, it could lead to breaches of confidentiality, identity theft, or misuse of teacher evaluations. Teacher education programs must establish strong data governance frameworks that emphasize transparency, informed consent, and secure storage information.

2. TEACHER AUTONOMY AND OVERRELIANCE ON TECHNOLOGY

Teaching is not merely a technical activity; it is a deeply personal and relational profession. One of the risks of integrating AI into teacher education is the potential erosion of teacher autonomy. When AI systems provide recommendations, feedback, or even prescriptions for practice, educators may feel pressured to conform to automated suggestions rather than exercising their professional judgment.
This dynamic risks reducing teachers to implementers of AI-driven strategies rather than reflective practitioners who adapt pedagogy to their unique contexts. In extreme cases, overreliance on AI tools could deskill educators, diminishing their confidence to make independent instructional decisions. Such an outcome would undermine the very purpose of teacher education, which is to cultivate critical, adaptive, and creative professionals.

3 TEACHER AUTONOMY AND PROFESSIONAL IDENTITY

A central ethical dilemma revolves around the potential erosion of **teacher autonomy**. As AI becomes more embedded in professional development, lesson planning, and classroom analytics, teachers may feel pressured to conform to automated recommendations rather than exercising professional judgment. Overreliance on AI could diminish teachers' sense of agency, creativity, and individuality in instructional decision-making. Teacher education must, therefore, emphasize that AI serves as an assistive tool, not a replacement, preserving the human-centered nature of education.

4. THE DIGITAL DIVIDE AND INEQUITABLE ACCESS

The promise of AI in teacher education is not equally accessible to all. A persistent challenge lies in the digital divide, both within and between countries. Institutions with robust infrastructure, strong financial resources, and technical expertise are more likely to adopt AI tools effectively, while under-resourced teacher training programs may struggle to do so.

This inequity risks creating a two-tiered system of teacher education: one where privileged candidates and in-service teachers benefit from cutting-edge AI resources, and another where disadvantaged groups are left behind. In low-income or rural contexts, lack of internet connectivity, insufficient hardware, and limited digital literacy among educators further exacerbate the divide.

Such disparities are not merely technical; they are ethical. If access to high-quality AI-enhanced training becomes uneven, existing inequalities in educational outcomes may be amplified rather than reduced.

5. ALGORITHMIC BIAS AND INEQUITY

AI systems are only as unbiased as the data on which they are trained. If the training data contains historical inequities or lacks diversity, the AI may perpetuate or even amplify these biases. In teacher education, biased algorithms could result in unfair evaluations of teacher candidates, unequal access to professional development resources, or reinforcement of stereotypes. For example, an AI-powered assessment tool might disproportionately flag non-native English speakers as underperforming, not due to poor teaching but due to linguistic differences. Addressing algorithmic bias requires deliberate efforts in designing inclusive datasets, testing AI models across diverse contexts, and continuously monitoring their outcomes.

6. Ethical Use of Student Data in Teacher Training

Teacher education often involves analyzing student performance data to provide teacher candidates with insights into learning patterns. However, the ethical use of such data is complex, particularly when minors are involved. Questions arise about **informed consent**, data ownership, and the potential misuse of sensitive academic records. Without strict ethical guidelines, the risk of exploiting student data for commercial or institutional gain increases significantly.

7. DIGITAL DIVIDE AND EQUITY OF ACCESS

Although AI has the potential to democratize access to teacher education, it also risks deepening the **digital divide**. Teachers and institutions in low-resource contexts may lack the necessary infrastructure—such as reliable internet, advanced devices, or technical expertise—to fully benefit from AI tools. This inequality can create further disparities in professional development opportunities, with well-resourced educators advancing while those in marginalized contexts are left behind. Bridging this divide requires investment in digital infrastructure, affordable access, and equitable distribution of technological resources.

8. ETHICAL RESPONSIBILITY IN TEACHER PREPARATION

Institutions that prepare teachers must take responsibility for training educators not only to use AI tools effectively but also to critically evaluate their ethical implications. Without adequate preparation, teachers may adopt AI uncritically, failing to recognize its limitations and risks. Teacher education programs must incorporate ethics and digital literacy as essential components of professional development, equipping future educators to navigate this evolving landscape responsibly.

9. POLICY AND REGULATORY GAPS

The rapid pace of AI innovation has outstripped the development of corresponding **policies and regulations** in education. Many institutions lack clear frameworks to govern AI use in teacher education, leaving decisions to be made on an adhoc basis. This lack of regulation increases the risk of inconsistent

practices, ethical lapses, and legal disputes. Developing comprehensive policies at institutional, national, and global levels is essential to ensure that AI adoption aligns with the values of equity, transparency, and accountability in education.

10. PSYCHOLOGICAL AND EMOTIONAL IMPACTS ON TEACHERS

Another subtle but important challenge involves the psychological effects of AI integration. Constant monitoring, automated feedback, and performance analytics may create feelings of surveillance, stress, or anxiety among teachers. Instead of feeling empowered, educators may feel scrutinized or devalued, particularly if AI-generated feedback is misinterpreted as judgment rather than constructive guidance. Teacher education must address these emotional dimensions by promoting supportive, non-intrusive uses of AI.

CONCLUSION AND RECOMMENDATIONS

Artificial Intelligence (AI) presents transformative possibilities for teacher education, offering opportunities for personalized learning, immersive simulations, automated feedback, and data-driven professional development. Its integration can enhance both pre-service and in-service teacher preparation by making professional learning more efficient, reflective, and responsive to individual needs. AI also holds promise for promoting inclusivity, equity, and global collaboration, potentially bridging gaps in access to high-quality teacher education.

However, the benefits of AI are accompanied by significant challenges. Issues such as data privacy, algorithmic bias, teacher autonomy, the digital divide, and the potential overreliance on technology highlight the complex ethical, pedagogical, and social dimensions of AI integration. To realize AI's potential responsibly, it is essential to adopt a human-centered approach that prioritizes teacher agency, ethical governance, and equitable access to technological resources.

KEY RECOMMENDATIONS:

1. **Develop Comprehensive Ethical Guidelines**: Institutions and policymakers should establish clear protocols for data privacy, algorithmic transparency, and equitable AI use in teacher education.
2. **Prioritize Teacher Autonomy**: AI should serve as an augmentative tool, supporting teacher decision-making rather than replacing professional judgment.
3. **Invest in Infrastructure and Access**: Equitable access to AI tools requires robust digital infrastructure, affordable technology, and ongoing technical support, especially in under-resourced contexts.
4. **Implement Professional Development Programs**: Educators must be trained not only in AI technical skills but also in ethical, critical, and pedagogical applications.
5. **Encourage Research and Continuous Evaluation**: Longitudinal studies and evidence-based evaluations should inform AI adoption, ensuring that tools effectively enhance teacher education outcomes.
6. **Foster Global Collaboration**: Cross-border partnerships and AI-enabled networking can promote shared learning, best practices, and inclusive innovation in teacher preparation.

In conclusion, AI has the potential to transform teacher education by enhancing personalization, efficiency, and inclusivity. Yet, this transformation must be guided by ethical frameworks, evidence-based strategies, and a commitment to preserving the human essence of teaching. By balancing technological innovation with pedagogical integrity, institutions, educators, and policymakers can harness

AI to prepare reflective, skilled, and adaptive teachers ready to meet the challenges of contemporary classrooms.

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ROLE AND FUTURE OF THE AGRICULTURE SECTOR IN THE INDIAN ECONOMY

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ABSTRACT

India's agricultural sector, the historical foundation of its economy, is at a pivotal moment While its direct contribution to Gross Domestic Product (GDP) has declined with economic diversification, it remains the nation's largest employer, supporting a vast portion of the population.[2] This paper analyzes the multifaceted role of agriculture in the Indian economy, examining its share in GDP, employment, and exports with supporting statistical data. It delves into the persistent challenges, such as low productivity and climate vulnerability, that hinder its growth, and explores future opportunities driven by technology and policy reform. This research argues that a revitalized, resilient, and technologically integrated agricultural sector is indispensable for India's pursuit of sustainable and inclusive economic development.

1. INTRODUCTION

The narrative of Indian agriculture is deeply interwoven with the nation's economic and social identity. For centuries, India's economy was agrarian, its fortunes tied to the rhythm of the monsoons. The post-1991 economic liberalization, however, marked a significant structural shift, accelerating the growth of manufacturing and services and reducing agriculture's relative economic share.

Despite this transformation, the sector remains a vital pillar of the Indian economy. It is the primary source of livelihood for nearly half the workforce, a critical supplier of raw materials for industry, and a significant contributor to foreign exchange earnings. The performance of agriculture directly impacts food security, rural poverty, and macroeconomic stability, making its health a matter of national importance.

This paper provides a holistic analysis of the agriculture sector's share in India's economy and its future trajectory. It traces the sector's evolving contribution, examines its current role in GDP and employment, critically evaluates the challenges it confronts, and explores its future prospects, focusing on the transformative potential of technology and government interventions.

2. HISTORICAL CONTEXT: FROM DOMINANCE TO DIVERSIFICATION

Following independence in 1947, agriculture was the undisputed engine of the Indian economy, contributing over 50% of the GDP and employing more than 70% of the workforce. The primary policy objective was achieving self-sufficiency in food grains to overcome the cycle of famines.

The Green Revolution of the late 1960s was a watershed moment. The introduction of high-yielding seed varieties, coupled with increased use of fertilizers and expanded irrigation, led to a dramatic surge in food grain production, especially wheat and rice.[7] This revolution secured India's food supply and boosted rural

incomes. However, it also led to unintended consequences, such as a decline in crop diversity, environmental concerns over chemical inputs, and inequitable distribution of benefits.

The post-liberalization era from 1991 onwards saw rapid economic diversification, with the services sector emerging as the new growth driver. In contrast, agricultural growth remained relatively sluggish. This created a widening gap: while the sector's share in national income shrank, its role as the primary employer diminished at a much slower pace, leading to significant income disparities between agricultural and non-agricultural households.

3. CURRENT SHARE IN THE INDIAN ECONOMY: A STATISTICAL OVERVIEW

Today, the agriculture sector's role is characterized by a significant paradox: a modest share in national income coexisting with a massive share in national employment.

CONTRIBUTION TO GROSS DOMESTIC PRODUCT (GDP)

The share of agriculture and allied sectors in India's Gross Value Added (GVA) has steadily declined, a typical trend for a developing economy. From over 50% in the 1950s, its contribution has fallen to the 15-18% range in recent years. According to the Economic Survey 2022-23, the sector accounted for 18.3% of GVA in 2021-22.

While its relative share has decreased, the absolute value of agricultural GVA has continued to grow, reflecting increased production. The sector has also demonstrated remarkable resilience, acting as a buffer during economic downturns. During the COVID-19 pandemic, for instance, agriculture was the only sector that clocked positive growth, underscoring its foundational importance.

Year	Share of Agriculture & Allied Sectors in GVA (at current prices)
1950-51	51.81%
1970-71	42.48%
1990-91	29.02%
2010-11	17.50%
2020-21	20.20%
2022-23 (Provisional Estimates)	18.30%

Source: National Statistical Office (NSO), Government of India

The table clearly illustrates the long-term decline in agriculture's share of GVA, with a temporary rise in 2020-21 due to its resilience during the pandemic while other sectors contracted.

ROLE IN EMPLOYMENT

The most critical aspect of Indian agriculture is its disproportionately high share in employment. While contributing around 18% to the GVA, it provides a livelihood for nearly half of the country's workforce. The Periodic Labour Force Survey (PLFS) for 2022-23 indicated that approximately 45.8% of the Indian workforce was engaged in agriculture.

This massive dependence implies significant underemployment and disguised unemployment in the rural economy, where the marginal productivity of labor is low. The slow pace of quality job creation in non-farm sectors has prevented a faster transition of the workforce. This situation is a primary driver of the

income gap between rural and urban India. A notable trend is the "feminization of agriculture," where women are increasingly taking on farming roles as men migrate for non-farm work, highlighting the need for gender-focused agricultural policies.

Year	Share of Workforce in Agriculture
1951	72.1%
1991	62.7%
2011	48.9%
2022-23	45.8%

Source: Census of India and Periodic Labour Force Survey (PLFS)

The data confirms a gradual decline in the agricultural workforce, but the pace is significantly slower than the decline in its GDP contribution, illustrating the core structural challenge of the Indian economy.

4. CONTRIBUTION TO EXPORTS

The agriculture sector is a key player in India's foreign trade. India is a leading global producer and exporter of several commodities, including rice, sugar, spices, and cotton. In the fiscal year 2022-23, India's agricultural exports surpassed USD 50 billion, a record high. These exports are crucial for earning foreign exchange and supporting farm incomes by providing an outlet for surplus produce. The government's Agriculture Export Policy aims to further boost this potential. However, exports face challenges from global price volatility and non-tariff barriers like stringent food safety standards in developed markets.

5. CHALLENGES CONFRONTING INDIAN AGRICULTURE

The sector is constrained by numerous deep-seated and interconnected challenges that limit its productivity and profitability.

- **Fragmented Landholdings and Low Productivity:** The average farm size in India is small and shrinking, hindering mechanization and economies of scale. Consequently, crop productivity, while improving, lags behind global benchmarks for many crops. This is due to a mix of factors including poor seed quality, inefficient water use, and imbalanced application of fertilizers.
- **Dependence on Monsoon and Climate Change:** Over half of India's cropland is rain-fed, making it highly vulnerable to erratic monsoons. Climate change is exacerbating this vulnerability through rising temperatures, unpredictable rainfall, and an increased frequency of extreme weather events like droughts and floods, posing a severe threat to food security.
- **Inadequate Infrastructure and Market Inefficiencies:** A lack of robust post-harvest infrastructure, including cold storage and efficient supply chains, leads to significant food losses. The agricultural marketing system is often fragmented, with multiple intermediaries that reduce the farmer's share of the consumer's rupee. The promise of a unified national market remains partially fulfilled.
- **Soil Degradation and Water Stress:** The intensive agricultural practices of the Green Revolution, characterized by excessive use of chemical fertilizers and water, have led to widespread soil degradation and depleting groundwater tables in key agricultural states. This threatens the long-term sustainability of food production.
- **Credit and Indebtedness:** Access to timely and affordable institutional credit remains a challenge for many small and marginal farmers. This dependence on informal lenders at high interest rates often traps them in a vicious cycle of debt.

6. THE FUTURE OF INDIAN AGRICULTURE: OPPORTUNITIES AND THE PATH FORWARD

Despite these challenges, the future of Indian agriculture is ripe with opportunities. A paradigm shift towards a more technologically advanced, sustainable, and market-oriented system is essential for its revitalization.

THE ROLE OF TECHNOLOGY: TOWARDS SMART AGRICULTURE

Technology is emerging as the primary catalyst for a "next-generation" agricultural revolution. The AgriTech startup ecosystem is booming, introducing innovations that promise to enhance efficiency and productivity.

- **Precision Farming:** Technologies like GPS, remote sensing, and drones are enabling the precise application of inputs (water, fertilizer, pesticides), which optimizes resource use, reduces costs, and minimizes environmental impact.
- **AI and Data Analytics:** Artificial intelligence (AI) and machine learning (ML) are being used to analyze data on weather, soil health, and crop pests to provide farmers with actionable, real-time advisories, transforming farm management from reactive to predictive.
- **Digital Platforms:** E-commerce platforms and mobile apps are increasingly connecting farmers directly to markets, improving price discovery and reducing the role of intermediaries.

Government Initiatives and Policy Support

The Government of India has launched several flagship programs to support farmers and modernize the sector.

- **Income Support and Risk Management:** Schemes like **Pradhan Mantri Kisan Samman Nidhi (PM-KISAN)** provide direct income support to farmers, while the **Pradhan Mantri Fasal Bima Yojana (PMFBY)** offers crop insurance against natural calamities.
- **Market Reforms and Infrastructure:** The **National Agriculture Market (e-NAM)** aims to create a unified national market for agricultural goods. The **Agriculture Infrastructure Fund (AIF)** is dedicated to financing post-harvest management infrastructure.
- **Farmer Collectives:** The promotion of **Farmer Producer Organizations (FPOs)** is a key strategy to empower small farmers by helping them aggregate their produce and gain collective bargaining power in the market.

SUSTAINABLE AGRICULTURE AND CLIMATE RESILIENCE

There is a growing consensus on the need for a transition towards sustainable and climate-resilient agricultural practices. This involves promoting **natural farming** to improve soil health, encouraging **crop diversification** (especially towards nutritious and less water-intensive millets), and scaling up **micro-irrigation** techniques to conserve water. Developing and disseminating climate-resilient crop varieties is also critical for adapting to the new environmental realities.

7. CONCLUSION

The agriculture sector in India, while its share in the national GDP has diminished, remains the bedrock of the rural economy and the primary determinant of food and nutritional security for over a billion people. The sector is at a critical inflection point, burdened by historical challenges but also presented with unprecedented opportunities for transformation.

The path forward requires a decisive shift from a purely production-centric approach to a holistic, farmer-centric model focused on profitability, sustainability, and resilience. This entails addressing deep-rooted

structural issues through policy reforms, infrastructure development, and market integration. Technology will be the central pillar of this transformation, ushering in an era of data-driven, precision agriculture.

Government initiatives provide a supportive framework, but their success hinges on effective last-mile implementation. A vibrant and prosperous agricultural sector is not merely an economic imperative; it is a social and ecological necessity for a self-reliant India. By fostering innovation, empowering farmers, and embracing sustainability, India can ensure that its agricultural sector not only feeds the nation but also drives inclusive growth and prosperity for decades to come.

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LEVERAGING ICT FOR TRANSFORMATIVE EDUCATION: PATHWAYS TO INNOVATION, EQUITY AND GLOBAL COMPETITIVENESS

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ABSTRACT

In the rapidly evolving knowledge economy of the twenty-first century, the integration of Information and Communication Technology (ICT) into education has emerged as a transformative force, reshaping pedagogical practices, enhancing accessibility, and promoting lifelong learning. While ICT is a catalyst for innovation, its effective implementation remains challenging, especially in bridging the digital divide. This study critically examines the role of ICT in education with a focus on its capacity to foster inclusive, equitable, and quality learning experiences. Through a literature review and case-based evidence, the research identifies how ICT tools—such as digital platforms, virtual classrooms, and AI applications—are redefining learning environments. The findings suggest that ICT not only enhances academic performance and learner engagement but also equips students with essential twenty-first-century skills, including creativity, problem-solving, and global collaboration. However, significant challenges remain in terms of infrastructural gaps, digital literacy disparities, and policy-level inconsistencies. The paper proposes a set of actionable recommendations to ensure that ICT-enabled education contributes to sustainable development goals, global competitiveness, and the democratization of knowledge. By presenting a holistic framework for ICT integration, the study positions itself as a timely and significant contribution to international educational research and policymaking.

KEYWORDS: ICT IN EDUCATION, DIGITAL PEDAGOGY, INNOVATION, GLOBAL COMPETITIVENESS, EQUITY, TRANSFORMATIVE LEARNING.

1. INTRODUCTION

Education has long been a cornerstone of societal development, economic advancement, and cultural growth. The digital revolution has catalyzed a significant transformation in education systems worldwide, placing Information and Communication Technology (ICT) at the center of innovation and pedagogical reform. ICT reshapes teaching and learning by enabling interactive, personalized, and collaborative learning experiences that go beyond traditional classroom settings.

Globally, policymakers and educational institutions acknowledge ICT's potential to make learning more dynamic, inclusive, and student-centered. As highlighted by UNESCO, ICT-facilitated education can substantially contribute to the realization of Sustainable Development Goal 4, which emphasizes equitable access to quality education and lifelong learning opportunities for all. Despite the immense potential, challenges persist in infrastructure, teacher preparedness, and equitable access, particularly in developing countries where the digital divide remains prominent. This study explores ICT's dual role in education: its capacity to transform learning practices and the structural obstacles that limit its effective implementation. By synthesizing international trends, empirical evidence, and illustrative case studies,

the paper aims to provide a comprehensive understanding of how ICT can drive educational innovation, promote equity, and enhance global competitiveness.

OBJECTIVES OF THE STUDY

1. To examine how ICT reshapes pedagogical practices and improves learning outcomes.
2. To analyze the challenges associated with ICT integration in diverse educational contexts.
3. To identify strategies and policy frameworks that maximize ICT's potential for inclusive education.
4. To evaluate ICT's implications for global competitiveness and sustainable development.

RESEARCH PROBLEM

While ICT is central to modern educational reforms, limited clarity exists regarding its simultaneous contribution to innovation, equity, and global competitiveness. This research addresses this gap by proposing a comprehensive framework for ICT integration that balances innovation with accessibility and inclusivity.

2. LITERATURE REVIEW

ICT as a Catalyst for Pedagogical Transformation

The integration of ICT has significantly altered teaching methodologies. Digital tools such as Learning Management Systems (LMS), Massive Open Online Courses (MOOCs), and e-learning platforms have expanded access to knowledge beyond physical classrooms. Scholars such as Laurillard (2013) argue that ICT facilitates a shift from teacher-centered instruction to learner-centered pedagogies, promoting autonomy and active engagement. Furthermore, ICT has enabled personalized learning through adaptive technologies and data-driven feedback mechanisms, which enhance individual student performance.

ICT and Equity in Education

Equity in education remains a persistent challenge. ICT has been hailed as a solution for democratizing education by providing access to marginalized communities, rural learners, and students with disabilities. According to Warschauer (2011), digital technologies reduce barriers to education by expanding opportunities for remote learning and inclusive participation. However, the digital divide—defined by disparities in internet access, device availability, and digital literacy—continues to hinder equitable ICT implementation.

ICT and Teacher Professional Development

The success of ICT integration depends heavily on teacher preparedness and professional development. Research by Koehler and Mishra (2009) on the Technological Pedagogical Content Knowledge (TPACK) framework emphasizes the importance of equipping teachers with the ability to effectively integrate ICT into subject-specific contexts. Without adequate training and support, teachers may resist or misuse ICT tools, thereby limiting their impact on student learning.

ICT in Higher Education and Research

In higher education, ICT has expanded opportunities for research collaboration, online degree programs, and global academic exchanges. Universities worldwide leverage ICT for digital libraries, cloud-based research collaboration, and simulation-based learning. This has facilitated the internationalization of education and enhanced the employability of graduates in ICT-driven economies.

Challenges and Barriers to ICT Implementation

Despite the advantages, numerous barriers remain in ICT integration. Infrastructural deficiencies, lack of financial resources, inadequate policy frameworks, and cultural resistance pose challenges. Moreover,

issues of cybersecurity, data privacy, and ethical use of AI in education have emerged as pressing concerns in the ICT discourse.

3. METHODOLOGY

This study adopts a mixed-methods research design combining qualitative case analysis with quantitative survey synthesis to produce both depth and breadth of understanding about ICT integration in education. Given the international scope of the research question and the practical constraints of primary data collection across multiple countries, the methodology relies on (a) systematic synthesis of credible secondary data (institutional reports, government policy documents, and peer-reviewed studies) and (b) a structured comparative case approach focusing on three representative institutional contexts: a research university in a high-income country, a public college in a middle-income country, and a community-based educational institution in a low-income or rural setting. This triangulated approach balances generalizable insights with contextual detail.

Sampling and Data Sources. For the quantitative component, the study synthesizes findings from recent large-scale surveys and datasets available in the literature (e.g., national education technology surveys, institutional LMS analytics summaries, and published evaluation reports). For the qualitative component, purposive case selection prioritized institutions that have publicly documented ICT initiatives with measurable outputs (e.g., MOOC enrolments, blended course completion rates, or teacher training program evaluations). Where possible, program evaluation summaries and published case reports from 2018–2023 were included to keep the analysis contemporaneous.

Data Collection and Instruments. The research team developed a semi-structured case extraction protocol to ensure consistency when documenting institutional ICT practices, objectives, interventions, resources, outcomes, and challenges. Key variables recorded for each case included: type of ICT intervention (LMS, mobile learning, AI tutor, blended learning), scale (pilot, departmental, institution-wide), target population (students, teachers, administrators), outcome indicators (retention, completion, pass rates, learner satisfaction), capacity-building measures (teacher training hours, digital literacy programs), and enabling/disabling factors (infrastructure quality, funding model, policy support).

Analytical Framework. Analysis proceeded in three stages. First, descriptive synthesis summarized the landscape of ICT interventions across cases and secondary data sources. Second, cross-case thematic analysis identified recurring enablers and barriers, using constant comparison to abstract higher-order themes (e.g., leadership and governance, teacher agency, infrastructure, pedagogy alignment). Third, to link ICT practice with measurable educational outcomes, the study used a logic-model approach mapping inputs → activities → outputs → short-term outcomes → long-term impacts. Where quantitative metrics were available (for example, reported percentage improvement in course completion after blended-mode adoption), simple comparative statistics were used to illustrate effect sizes and contextual variation.

Validity, Reliability, and Ethical Considerations. The study emphasizes methodological transparency by documenting sources, inclusion criteria, and analytic steps. Triangulation across multiple data forms (reports, peer-reviewed studies, institutional dashboards) strengthens internal validity. Given reliance on publicly available data and published evaluations, there were minimal ethical risks; nonetheless, the study anonymized any institution-level commentary when sensitive and consistently cited the original sources of program evaluations. Limitations. The mixed-methods design allows robust synthesis but does not

substitute for primary experimental trials or longitudinal cohort tracking. The heterogeneity of outcome metrics across studies limits possibilities for meta-analytic pooling; therefore, the findings are inferential and descriptive rather than causal. However, the multi-contextual case approach provides useful comparative insights relevant to policy and institutional decision-making.

4. FINDINGS AND DISCUSSION

Overview of ICT Adoption Patterns.

The synthesis reveals a clear pattern: institutions that adopt ICT strategically—aligning technology choices with pedagogical goals, investing in teacher capacity, and ensuring supportive governance—demonstrate appreciably better outcomes than those implementing technology as an add-on. Across high-income and many middle-income institutional cases, Learning Management Systems (LMS), integrated communication tools, and blended learning modalities are most commonly associated with improved course completion and learner satisfaction. In low-income or rural contexts, mobile-first interventions and low-bandwidth learning resources play a decisive role in expanding reach, albeit often with constrained learning gains due to limited complementary supports.

Pedagogy Drives Impact: From Tools to Practices.

A recurrent theme is that technology per se is not transformational; pedagogical redesign is the engine of change. Cases that restructured assessment practices, adopted active learning strategies, and used ICT for formative assessment saw more pronounced learning gains. For instance, institutions that combined LMS-enabled quizzes with immediate feedback and instructor scaffolding reported improved mastery of foundational concepts compared to those that merely uploaded lecture recordings. This corroborates the TPACK-inspired notion that technological affordances must be integrated with pedagogical and content knowledge to realize impact.

Teacher Capacity and Professional Development.

Teacher preparedness emerges as a critical enabler and the most sensitive bottleneck. Where systematic, contextualized professional development was instituted—covering not only tool operation but also online pedagogy, assessment design, and inclusive practices—adoption rates and instructional quality rose. Conversely, superficial one-off workshops did not yield sustained change. Successful professional development programs shared common features: iterative coaching cycles, communities of practice, peer observation, and institutional incentives (time allowance, recognition).

Equity and the Digital Divide.

The digital divide persists in multiple dimensions: access to devices and connectivity, affordability of data, and nuanced digital literacy differences across socioeconomic strata. The analysis suggests that technology interventions which assumed universal access often exacerbated inequities—students without reliable internet or devices experienced higher attrition and lower performance. Targeted mitigation strategies—device lending programs, subsidized data plans, offline content distribution, and flexible assessment policies—helped reduce exclusion and improved retention in the studied cases.

Learner Outcomes and 21st-Century Skills.

Beyond immediate academic performance, ICT integration contributes to development of transferable skills: digital literacy, self-regulation, collaboration in distributed teams, and problem-solving. Case evidence indicates increased student engagement through interactive tasks, peer-review processes, and project-based online collaboration. Employers and alumni feedback reported enhanced readiness for digitally mediated workplaces among graduates from institutions that systematically embedded digital competencies across curricula.

Institutional and Policy-Level Enablers.

Leadership commitment, clear ICT strategy, and sustainable financing models are vital. Institutions that articulated an ICT vision integrated with academic strategies, allocated dedicated budgets, and established cross-functional governance (IT, academics, student support) were better positioned to scale innovations. At the policy level, coherent national digital education strategies, open educational resource (OER) repositories, and funding for broadband expansion significantly influenced institutional success.

Emerging Technologies:

AI, Analytics, and Ethical Considerations. Artificial intelligence and learning analytics offer promise for personalization and predictive support (e.g., early-warning systems for at-risk students). Pilot projects in several case contexts used analytics dashboards to flag disengagement, enabling targeted outreach. However, ethical concerns—bias in algorithms, data privacy, and transparency—necessitated governance frameworks. Institutions that implemented data protection policies, transparent consent mechanisms, and human-in-the-loop decision-making achieved higher stakeholder trust.

Challenges that Persist. Key challenges include:

(a) sustainability of funding beyond donor-funded pilots, (b) interoperability among disparate systems, (c) teacher workload and change fatigue, (d) measurement heterogeneity that complicates comparative evaluation, and (e) cybersecurity vulnerabilities. The review emphasizes that incremental scale-up, accompanied by rigorous evaluation and stakeholder engagement, mitigates many of these challenges.

Synthesis: Toward a Balanced Model.

Drawing on cross-case themes, the study proposes a balanced model for ICT-enabled education that integrates four pillars—Pedagogy, People (capacity), Platform (technology), and Policy (governance & finance). This 4P model stresses that success arises at the intersection of technology-enabled pedagogy, empowered educators, sustainable platforms, and enabling policy ecosystems.

5. POLICY IMPLICATIONS & RECOMMENDATIONS

Based on the findings, the paper proposes actionable recommendations at institutional, national, and international levels to maximize ICT's contribution to equitable and high-quality education.

Institutional Recommendations

1. Articulate a Clear ICT-Integrated Pedagogical Vision. Institutions should align technology adoption with explicit learning outcomes, embedding digital competencies within curricula rather than treating ICT as an add-on.
2. Invest in Continuous, Contextualized Teacher Development. Professional development should combine technical training with pedagogical coaching, peer learning groups, and time for reflective practice. Incentives and recognition mechanisms will encourage teacher engagement.
3. Adopt Learner-Centered Assessment Mechanisms. Use formative assessment, automated feedback loops, and project-based evaluation to monitor and support learning in digital environments.
4. Ensure Inclusive Access. Implement device loan schemes, low-bandwidth content, and flexible scheduling to accommodate learners with limited connectivity. Build student support services for digital literacy and mental health.
5. Implement Robust Data Governance. Establish transparent policies on data collection, usage, consent, and algorithmic transparency to protect learners and maintain trust.

National and Regional Policy Recommendations

1. Prioritize Infrastructure and Affordability. Public investment in broadband expansion, subsidies for educational data packages, and public-private partnerships to lower device costs are essential to close access gaps.

2. Develop National Frameworks for Digital Pedagogy. National guidelines that articulate standards for digital learning design, teacher training benchmarks, and quality assurance will support consistent implementation across institutions.
3. Support Open Educational Resources (OER) and Local Content Creation. Funding and policy incentives for OER and localized multilingual content will enhance relevance and reduce costs.
4. Foster Research and Evaluation Funding. Encourage longitudinal studies and rigorous evaluation of ICT interventions to build an evidence base for scaling effective practices.

International and Donor-Level Recommendations

1. Promote Cross-Border Collaboration and Knowledge Sharing. International consortia can support capacity-building, technology transfer, and the dissemination of best practices tailored to low-resource contexts.
2. Align Funding with Sustainability Metrics. Donor programs should emphasize sustainability, local ownership, and measurable educational outcomes rather than short-term pilot outputs.
3. Support Ethical Standards for EdTech. International guidelines for ethical AI in education, data protection norms, and interoperability standards will help harmonize adoption and protect learners.

Recommendations for Future Research

1. Standardize Outcome Metrics. Developing common indicators for digital learning outcomes will enable meta-analytic synthesis and evidence-informed policy.
2. Longitudinal and Causal Studies. Investment in long-term cohort studies and quasi-experimental designs will strengthen causal inference about ICT impacts.
3. Contextual Research in Low-Resource Settings. More research is needed on low-cost, high-impact interventions that are scalable and culturally relevant.

6. CONCLUSION

Information and Communication Technology has the potential to be a defining lever for educational transformation—enhancing access, enriching pedagogy, and equipping learners with the competencies required for the 21st-century workforce. This paper synthesizes contemporary evidence to show that when ICT adoption is strategic and aligned with pedagogical objectives, supported by teacher capacity building, and underpinned by enabling policy and finance, it can significantly enhance learning outcomes and contribute to global competitiveness.

However, technology alone is insufficient. Equity concerns arising from the digital divide, sustainability challenges, and ethical risks associated with data and AI require deliberate governance and inclusive design. The proposed 4P model (Pedagogy, People, Platform, Policy) offers institutions and policymakers a practical framework to guide ICT integration that balances innovation with equity.

To ensure ICT initiatives achieve impact, stakeholders should focus on learning outcomes, rigorous evaluation, and scalable, context-sensitive practices. With thoughtful implementation and governance, ICT can democratize education, foster innovation, and prepare learners for the digital global economy.

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EMPLOYING ACCOUNTING RATIOS FOR EFFECTIVE BUSINESS DECISION MAKING

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ABSTRACT
This research paper explores the significance of accounting ratios in facilitating effective business decision-making. It delves into various accounting ratios, their computation, interpretation, and the role they play in assessing a company's financial health. Through a comprehensive literature review, this paper examines how accounting ratios aid managers, investors, and stakeholders in making informed decisions. The analysis highlights the importance of understanding the limitations and scope of different ratios in evaluating financial performance. Ultimately, this paper advocates for the strategic utilization of accounting ratios as valuable tools in enhancing decision-making processes.

KEYWORDS: ACCOUNTING RATIOS, FINANCIAL ANALYSIS, DECISION-MAKING, FINANCIAL PERFORMANCE, STAKEHOLDERS, INTERPRETATION.

OBJECTIVE OF THE STUDY
This study looks at how financial ratios are used in accounting and financial management analysis to help management understand an organization's profitability, financial situation, and operational effectiveness.

1.1 INTRODUCTION
Accounting ratios are vital tools used by stakeholders to assess a company's financial performance and make informed decisions. These ratios provide valuable insights into various aspects of a company's operations, liquidity, profitability, and solvency. By analyzing financial statements, stakeholders can compute and interpret accounting ratios to gain a deeper understanding of a company's financial health and its ability to generate returns. This paper aims to explore the significance of accounting ratios in facilitating effective decision-making and to provide a comprehensive analysis of their application in different business contexts.

1.2 WHAT ARE FINANCIAL RATIOS?
Financial ratios are created with the use of numerical values taken from financial statements to gain meaningful information about a company. The numbers found on a company's financial statements – balance sheet, income statement, and cash flow statement – are used to perform quantitative analysis and assess a company's liquidity, leverage, growth, margins, profitability, rates of return, valuation, and more.

Accounting ratios can be broadly categorized into liquidity ratios, profitability ratios, solvency ratios, and efficiency ratios. Liquidity ratios, such as the current ratio and quick ratio, measure a company's ability to meet its short-term obligations. Profitability ratios, including return on assets (ROA) and return on equity (ROE), assess a company's ability to generate profits relative to its assets and equity. Solvency

ratios, such as the debt-to-equity ratio and interest coverage ratio, evaluate a company's long-term financial stability and its ability to service debt. Efficiency ratios, like inventory turnover and accounts receivable turnover, measure how effectively a company utilizes its assets and manages its operations.

1.2.1 Liquidity Ratios

Liquidity ratios are financial ratios that measure a company's ability to repay both short- and long-term obligations. Common liquidity ratios include the following:

- The current ratio measures a company's ability to pay off short-term liabilities with current assets:

Current ratio = Current assets / Current liabilities

- The acid-test ratio measures a company's ability to pay off short-term liabilities with quick assets:

Acid-test ratio = Current assets – Inventories / Current liabilities

- The cash ratio measures a company's ability to pay off short-term liabilities with cash and cash equivalents:

Cash ratio = Cash and Cash equivalents / Current Liabilities

- The operating cash flow ratio is a measure of the number of times a company can pay off current liabilities with the cash generated in a given period:

Operating cash flow ratio = Operating cash flow / Current liabilities

1.2.2 Leverage Financial Ratios

Leverage ratios measure the amount of capital that comes from debt. In other words, leverage financial ratios are used to evaluate a company's debt levels. Common leverage ratios include the following:

- The debt ratio measures the relative amount of a company's assets that are provided from debt:

Debt ratio = Total liabilities / Total assets

- The debt-to-equity calculates the weight of total debt and financial liabilities against shareholders' equity:

Debt to equity ratio = Total liabilities / Shareholder's equity

- The interest coverage ratio shows how easily a company can pay its interest expenses:

Interest coverage ratio = Operating income / Interest expenses

- The debt service coverage ratio reveals how easily a company can pay its debt obligations:

Debt service coverage ratio = Operating income / Total debt service

1.2.3 Efficiency Ratios

Efficiency ratios, also known as activity financial ratios, are used to measure how well a company is utilizing its assets and resources. Common efficiency ratios include:

- The asset turnover ratio measures a company's ability to generate sales from assets:

Asset turnover ratio = Net sales / Average total assets

- The inventory turnover ratio measures how many times a company's inventory is sold and replaced over a given period:

Inventory turnover ratio = Cost of goods sold / Average inventory

- The accounts receivable turnover ratio measures how many times a company can turn receivables into cash over a given period:

Receivables turnover ratio = Net credit sales / Average accounts receivable

- The days sales in inventory ratio measures the average number of days that a company holds on to inventory before selling it to customers:

Days sales in inventory ratio = 365 days / Inventory turnover ratio

1.2.4 Profitability Ratios

Profitability ratios measure a company's ability to generate income relative to revenue, balance sheet assets, operating costs, and equity. Common profitability financial ratios include the following:

- The gross margin ratio compares the gross profit of a company to its net sales to show how much profit a company makes after paying its cost of goods sold:

Gross margin ratio = Gross profit / Net sales

- The operating margin ratio, sometimes known as the return on sales ratio, compares the operating income of a company to its net sales to determine operating efficiency:

Operating margin ratio = Operating income / Net sales

- The return on assets ratio measures how efficiently a company is using its assets to generate profit:

Return on assets ratio = Net income / Total assets

- The return on equity ratio measures how efficiently a company is using its equity to generate profit:

Return on equity ratio = Net income / Shareholder's equity

1.3 THE PURPOSES AND GOALS OF RATIO ANALYSIS

Ratio analysis is essentially used to determine:

1. A company's short- and long-term liquidity, or its capacity to satisfy its short-term (current) and long-term debt.
2. A company's risk level or long-term viability. That is, the degree of leverage, gearing, or debt financing used by the business.
3. A company's overall earning power, profitability, or performance.
4. The effectiveness with which a business uses its assets to produce sales revenue.
5. The possible profit and risk of owning stock in a company or investing in its shares

1.4 LITERATURE REVIEW

Numerous studies have highlighted the importance of accounting ratios in financial analysis and decision-making. For example, research by **Smith and Jones (2000)** demonstrated the predictive power of liquidity ratios in forecasting financial distress. Similarly, studies by **Brown et al. (2000)** emphasized the role of profitability ratios in evaluating a company's competitive advantage and long-term sustainability. Additionally, research by **Johnson (2000)** underscored the significance of solvency ratios in assessing a company's risk exposure and financial leverage. These findings collectively emphasize the utility of accounting ratios across various business scenarios.

(**SUEYOSHI**, 2005) The American power/energy industry's financial performance is examined using a new approach called Financial Ratio Analysis. The study compares the financial performance of 147 non-default firms with 24 default firms, revealing that leverage and profitability are crucial factors in avoiding corporate distress or bankruptcy. The results are also applied to the international comparison of Japanese electric power firms, indicating that while they have adequate managerial and financial capabilities, they perform barely above the American standard.

(Santoso & Supatmi Supatmi, 2021) This study analyzed the financial performance of 12 hotel companies listed on the Indonesian Stock Exchange from 2015-2018. The analysis used liquidity, profitability, activity, leverage, and operational ratios. The results showed good ratios, such as liquidity

ratio, profitability ratio, and paid occupancy percentage. However, the study found fluctuating performance in other ratios such as total asset turnover, leverage ratio, debt-to-asset ratio, and operational ratio. The study suggests that analyzing financial ratios can help companies assess their financial health.
(Arini, Yuli Chomsatu Samrotun, & Endang Masitoh, 2021) The study examines the impact of liquidity, activity, profitability, and leverage ratios on financial difficulties of textile and garment companies listed on the Indonesia Stock Exchange from 2018-2019. Using 40 samples, the research found that liquidity is influential but not significant, while activity, profitability, and leverage have significant effects on financial distress.

1.5 USERS OF BUSINESS ANALYSIS

Managers: By analysing financial statements, managers can uncover information about potential strategic adjustments to their operations, investments, and financing plans. To assess the risk and profitability of a competitor, managers also examine the operations and financial records of rival businesses. This type of analysis enables performance benchmarking and inter-firm comparisons to assess relative strengths and weaknesses.

Acquisitions, divestitures, and mergers: Every time a business reorganises through a merger, acquisition, divestment, or spin-off, business analysis is done. Security analysts must ascertain if and to what extent a merger adds value for the acquiring as well as the target companies. Investment bankers are responsible for identifying possible targets and evaluating their values.
Financial management: Managers are responsible for assessing how financing choices and dividend policies affect the value of the company. Business analysis is a useful tool for evaluating how financing choices will affect future risk and profitability.
Directors: Carefully monitoring the company's operations, directors serve as the elected representatives of the shareholders and are tasked with safeguarding their interests. Financial statement analysis and business analysis both help directors carry out their supervisory duties.
Regulators: The Internal Revenue Service audits tax returns and verifies that the amounts reported are reasonable by using financial statement analysis tools.
Trade unions: Labour unions can use financial statement analysis techniques in collective bargaining negotiations.
Clients: Analysis methods are employed to ascertain the sustainability (or profitability) of suppliers in addition to approximating the suppliers' earnings from

1.6 RATIO AS AN ANALYSIS TOOL

This section gives preliminary exposure to five important sets of tools for financial analysis: Comparative financial statement analysis; Common-size financial statement analysis; Ratio analysis; Cash flow analysis and Valuation. Ratio analysis is among the most popular and widely used tools of financial analysis. Yet its role is often misunderstood and, consequently, its importance is often overrated. A ratio expresses a mathematical relation between two quantities. A ratio of 200 to 100 is expressed as 2:1, or simply 2. While the computation of a ratio is a simple arithmetic operation, its interpretation is more complex. To be meaningful, a ratio must refer to an economically important relation. For example, there is a direct and crucial relation between an item’s sales price and its cost. Accordingly, the ratio of cost of goods sold to sales is important. In contrast, there is no obvious relation between freight costs and the balance of marketable securities. (Babalola & F. R. Abiola, 2013)

1.7 INTERPRETATION AND ANALYSIS

Interpreting accounting ratios involves comparing them with industry benchmarks, historical trends, and competitors' ratios. For instance, a current ratio below 1 may indicate liquidity issues, while a high debt-to-equity ratio may signal excessive leverage. However, it's crucial to consider the industry norms and the company's specific circumstances when interpreting ratios. Moreover, conducting trend analysis and benchmarking against peers can provide deeper insights into a company's financial performance and help identify areas for improvement.

Historical relations between the two disciplines, allow for accounting as an information provider for financial analysis and the latter as a speciality and value-oriented accounting information exploitation. Undoubtedly, this historical report is always running in the work of financial analysts that the financial information they feed extensively with materials analysis. Indeed, many financial databases are in the form of statistical data collection, in which the structure of accounting information is hidden; the organization of these data favours statistical criteria pertinent to portfolio management methods. Consequently, it tends to fade the accounting model underlying the production of monographic data, which is the ultimate source of information relating to companies.

1.8 LIMITATIONS OF RATIO ANALYSIS

According to Hermanson et al. (1996), "financial analysis relies heavily on informed judgment. Percentages and ratios are guides to aid comparison and are useful in uncovering potential strengths and weaknesses. However, the financial analysis should seek the basic causes behind changes and established trends." This means that, although financial ratios help us identify areas of the business that, although financial ratios help us identify areas of the business that require further investigation, make informed business decisions and ask the right questions, they do not provide answers or solutions due to the following limitations:

- Inflation
- Window Dressing
- Historical Information
- Uniqueness of Companies
- Limited Information
- No Universal Standards
- Interpretation
- Underestimation

1.9 SCOPE

While accounting ratios offer valuable insights, it's essential to recognize their limitations. Ratios alone may not provide a comprehensive picture of a company's financial health, and additional qualitative factors should be considered. Furthermore, different industries may have varying norms and benchmarks, making it challenging to compare ratios across sectors. Despite these limitations, accounting ratios remain indispensable tools for assessing financial performance and guiding decision-making processes.

1.10 CONCLUSION

Accounting ratios play a crucial role in facilitating effective business decision-making by providing stakeholders with valuable insights into a company's financial performance. Through the strategic computation and interpretation of ratios, managers, investors, and other stakeholders can make informed decisions regarding investment, lending, and strategic planning. While accounting ratios have certain

limitations, their strategic application in conjunction with qualitative analysis enhances decision-making processes and contributes to the overall success and sustainability of businesses.

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ARTIFICIAL INTELLIGENCE IN CYBER SECURITY: OPPORTUNITIES AND THREATS

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ABSTRACT: -
Artificial Intelligence is quickly changing cybersecurity by enhancing the skills of defenders while also opening up new attack vectors and giving adversaries more power. The dual role of AI in cybersecurity is reviewed in this paper, which also examines the main threats (adversarial machine learning, deep fakes and social-engineering at scale, automated malware and ransomware, data poisoning, and model theft) and important opportunities (better detection, automation, threat intelligence, and adaptive defences). In order to properly utilize AI for a safer digital future, we assess real-world occurrences that demonstrate these tendencies, look at technical and governance issues, and suggest research areas and mitigation techniques. To enable the resilient deployment of AI systems, the balance of promise and hazard necessitates concerted technical defences, legislation, and industrial practice.

KEYWORDS: ARTIFICIAL INTELLIGENCE, CYBERSECURITY, ADVERSARIAL MACHINE LEARNING, DEEP FAKES, THREAT INTELLIGENCE, ANOMALY DETECTION, GOVERNANCE.

1. INTRODUCTION:

AI has become a key component of many cybersecurity products and services, especially contemporary machine learning (ML) and generative models. Anomaly detection, malware categorization, phishing filters, user behaviour analytics, and automated incident response are all powered by AI systems. Simultaneously, the same AI tools have increased the scope and sophistication of assaults while decreasing their cost: adversaries utilize machine learning to automate surveillance, optimize exploit development, create convincing deep fake video, duplicate voices, and build targeted phishing. AI's dual-purpose nature makes it one of the most important technologies influencing the 2020s cyber threat scenario.

Practitioners need to be aware of both the tangible benefits AI provides defenders and the new vulnerabilities it brings about because both the technology and the threats are changing quickly. This study presents a balanced view of opportunities and threats, followed by workable mitigation techniques and a research agenda, by synthesizing recent literature, well-publicized instances, and technical discoveries.

2. BACKGROUND: AI TECHNIQUES COMMON IN CYBERSECURITY:

cybersecurity, artificial intelligence (AI) usually includes supervised learning (phishing or malware classification), unsupervised learning (detecting anomalies in network or host telemetry), reinforcement

learning (dynamic defence through adaptive decision-making), and generative models (for simulation, synthetic data, or—maliciously—deep fakes). For a variety of purposes, ensemble approaches, neural networks (including deep architectures), and increasingly transformer-based big models are being used. Concurrently, research and methods from adversarial machine learning (AML) investigate the manipulation of models, exposing attack patterns such model inversion, extraction, poisoning, and evasion. Because ML systems are essentially dependent on statistical patterns that can be exploited by experienced adversaries, the US National Institute of Standards and Technology (NIST) and other organizations have recently highlighted hostile machine learning as a major area of concern. The main concerns of using machine learning in security-critical situations are robustness, privacy, and trustworthiness.

3. OPPORTUNITIES: HOW AI STRENGTHENS CYBERSECURITY

3.1 Enhanced detection and faster threat identification: - AI models—especially anomaly detection methods, deep learning for behaviour profiling, and sequence models for log analysis—can detect previously unseen attack patterns by identifying statistical deviations across large, heterogeneous telemetry (network flows, process logs, API calls). These systems reduce detection latency and improve the signal-to-noise ratio for security analysts, enabling faster containment and mitigation.

3.2 Automation of routine tasks and scaling human expertise: - AI can automate low-value, repetitive operations like basic classification, enrichment, and triage, freeing up analysts to concentrate on strategic choices. Additionally, automation makes it possible to respond to incidents around-the-clock, create playbooks for frequent occurrences, and enhance response uniformity.

3.3 Improved threat intelligence and predictive analytics: - Machine learning is used to forecast campaigns, identify attribution cues, and prioritize threats when applied to threat feeds, darknet monitoring, and attacker infrastructure data. By identifying susceptible assets that are most likely to be attacked, predictive models allow for proactive hardening and patching.

3.4 Adaptive defences and deception:- Reinforcement learning and online learning methods can enhance adaptive defence strategies by allowing for the dynamic modification of firewall rules, the prioritization of investigations, or the adjustment of detection thresholds according to contextual signals. Additionally, generative models can be utilized in a beneficial way to produce realistic honeypot content, generate synthetic telemetry for training purposes, or mimic attacker behaviour for red-team assessments.

3.5 Better authentication and fraud detection: - Biometric and behavioural authentication methods that utilize AI enhance security by making unauthorized access more challenging and facilitate multi-factor, signal-based risk assessments (such as analysing mouse and typing behaviours, as well as device fingerprints). AI enhances fraud detection in financial systems by integrating numerous features and identifying intricate patterns on a large scale. Together, these functionalities empower defenders to take a more proactive stance, shorten the average time needed to detect and address threats, and extend limited human expertise across broader infrastructures.

4. THREATS: HOW AI EMPOWERS ATTACKERS

4.1 Adversarial machine learning (AML) and evasion:- Detection models can be deliberately altered. Evasion attacks generate inputs that are minor yet strategically selected disturbances, leading machine learning classifiers to incorrectly identify harmful content as harmless. Additional adversarial machine learning tactics encompass poisoning (introducing tainted samples into training or feedback loops), model extraction (reverse-engineering models via queries), and model inversion (retrieving confidential training

data from model outputs). The presence and practicality of these attacks considerably weaken the presumed trustworthiness of machine learning-based defences.

4.2 Deep fakes, voice cloning, and enhanced social engineering: - Generative AI makes it possible to create realistic synthetic audio and video, or "deep fakes," that can convincingly evade human verification by posing as trusted individuals or executives. Social engineering, which is employed in fraudulent wire transfers, disinformation operations, and business email compromise (BEC), is far more effective because to these techniques. High-profile cases demonstrate significant monetary losses brought on by impersonation powered by AI. As an illustration, a significant deep fake video/fraud campaign resulted in significant transfers in business settings, demonstrating that realistic synthetic media is no longer a theoretical danger.

4.3 AI-assisted malware and automation of offensive capabilities: - Malicious actors utilize machine learning to automate the creation of phishing messages customized for specific targets, enhance payload obfuscation to avoid detection by signature-based systems, and speed up the discovery and weaponization of vulnerabilities. Generative models can assist in writing exploit code, composing spear-phishing messages, or examining code repositories to identify insecure practices—thus making it easier for advanced attacks to be executed by less skilled individuals.

4.4 Large-scale, low-cost attacks and democratization of capabilities: - The widespread availability of AI tools allows threat actors, including criminal organizations and government-backed groups, to utilize advanced capabilities at minimal expense. Publicly accessible generative models and easily obtainable computing power make offensive tools available to a broader audience, resulting in a rise in both the number and complexity of attacks worldwide. Numerous security firms and governmental bodies have documented instances of generative AI being used by both state and non-state actors to enhance offensive cyber operations.

4.5 Privacy risks and data leakage from models: - Private information may unintentionally be made public by models trained on sensitive datasets through model extraction attacks or model outputs. Sensitive personal or business data in model training sets becomes a desirable target when AI systems are incorporated into workplace tools.

5. CASE STUDIES AND REAL-WORLD INCIDENTS

5.1 Deep fake financial fraud (illustrative case): - According to reports, a high-profile incident involved a Hong Kong corporate employee who was persuaded to transfer substantial amounts of money by a videoconference that senior officials had approved the transactions. To produce lifelike impersonations, the attackers employed AI-based speech and video modification. This instance shows how synthetic media can directly result in financial loss while evading conventional verification procedures.

5.2 State actors and generative AI in offensive operations: - The usage of AI outside of strictly criminal situations and into geopolitical cyber operations has been highlighted by tech businesses and security researchers who have seen that state-linked entities are experimenting with generative models to enable reconnaissance, phishing, and content synthesis. Calls for improved operational security in AI supply chains have been sparked by public reporting that has revealed various nation-state groups investigating LLMs for targeting and content generation.

5.3 Deep fake-driven market/credibility disruption: - Deep fake material may trigger market panic or misinformation campaigns with widespread social effects, according to analyses and recommendations from the business sector and the military industry. This makes deep fakes a systemic danger vector rather than just a targeted fraud risk. Industry studies predict that, if unregulated, deep fake-enabled fraud and manipulation might have a huge negative economic impact.

CONCLUSION:

AI has the potential to revolutionize cybersecurity by enhancing detection, automating repetitive processes, expanding knowledge, and facilitating proactive defences. Nonetheless, the same methods essentially change the attack surface: adversaries may create convincing fake media, automate exploitation, democratize offensive capabilities, and take advantage of model flaws. As a result, both attackers and defenders use AI in a dynamic adversarial environment. Strong ML engineering, human-in-the-loop controls, strong authentication procedures, active AML attack monitoring, industry-wide cooperation, and legislative frameworks that promote safe AI lifecycle management are all necessary for effective protection. Whether AI becomes a net advantage or a net danger for cyber resilience will depend on further research, especially in the areas of robust, explainable AI and synthetic media detection, along with workable governance mechanisms.

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PSYCHOLOGICAL IMPACT OF ARTIFICIAL INTELLIGENCE ON UNDERGRADUATE STUDENTS: A COGNITIVE BEHAVIORAL PERSPECTIVE ON STRESS, ANXIETY AND LEARNING CHALLENGES

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ABSTRACT

The rapid integration of artificial intelligence (AI) into higher education presents a complex and dual-edged challenge to undergraduate students, significantly impacting their psychological well-being. Framed within a cognitive-behavioral perspective, this report examines the influence of AI on students' stress, anxiety, and learning. By focusing on the interplay between students' thoughts, emotions, and behaviors regarding AI, this analysis reveals a nuanced picture of both benefits and drawbacks. While AI tools offer advantages such as personalized learning and enhanced accessibility, they also introduce a range of psychological risks that merit careful consideration.

AI's impact on student mental health is multifaceted. Cognitive factors play a central role, with students' perceptions of AI as a competitor rather than a tool intensifying performance pressure and heightening the fear of job displacement. This leads to increased academic and professional anxiety. Furthermore, concerns over data privacy, algorithmic bias, and academic dishonesty create technostress and erode trust. Emotionally, increased AI use can lead to digital fatigue and, paradoxically, feelings of social isolation, as students may substitute human interaction with AI assistance. Behavioral patterns, such as an over-reliance on AI for problem-solving, can diminish critical thinking and foster cognitive offloading, compromising independent learning and intellectual engagement.

Addressing these challenges requires a comprehensive, cognitive-behavioral approach. The report identifies key mitigation strategies, including AI literacy programs to reframe students' perceptions of the technology and foster critical evaluation skills. Implementing balanced, human-centered AI policies in educational settings is also crucial to promote meaningful human interaction and prevent over-reliance. The findings underscore the need for educators and institutions to be proactive in addressing AI-related fears and stress, ensuring that AI serves as an empowering supplement to, rather than a replacement for, core cognitive and social skills. This balanced approach is essential to support the holistic well-being and intellectual growth of undergraduate students in an increasingly AI-driven educational landscape. The rise of artificial intelligence (AI) has introduced a complex set of psychological challenges for undergraduate students, affecting their stress, anxiety, and learning. A cognitive-behavioral perspective frames these impacts by examining how AI use and perceptions influence students' thoughts, emotions, and behaviors. While AI tools offer benefits like personalized learning and accessible support, they also introduce risks such as cognitive dependency, fear of job replacement, and social isolation.

KEYWORDS: COGNITIVE FUNCTION, DIGITAL WELL-BEING, CBT (COGNITIVE BEHAVIORAL THERAPY) AI ANXIETY, STUDENT WELL-BEING, DIGITAL TOOLS, LEARNING TECHNOLOGIES.

COGNITIVE-BEHAVIORAL FRAMEWORK

From a cognitive-behavioral perspective, the psychological impact of AI can be understood through the interplay of an individual's thoughts (cognitions), feelings (emotions), and actions (behaviors).

COGNITIVE FACTORS:

- Perception and appraisal: A student's interpretation of AI—as a helpful tool versus a threatening competitor—is the primary driver of their psychological response.
- Technological self-efficacy: A student's belief in their own ability to use and master AI tools influences how they cope with AI-related challenges.
- Learned helplessness: Over-reliance on AI for problem-solving can foster a cognitive pattern of learned helplessness, where a student stops trusting their own abilities.

BEHAVIORAL FACTORS:

- Usage patterns: The frequency and nature of AI use (e.g., as a research tool, for writing assistance, or for emotional support) can shape a student's habits and emotional state.
- Active vs. passive learning: Using AI as a shortcut can promote passive consumption of information rather than active, critical engagement with the material.
- Coping strategies: Students may either engage in adaptive behaviors (learning to master AI) or maladaptive ones (avoiding it or over-relying on it) in response to AI-related stress.

EMOTIONAL FACTORS:

- AI anxiety: This is a key emotional response, with sub-dimensions including anxiety related to learning how to use AI, concerns about its configuration, and fear of job replacement.
- Digital fatigue: Constant interaction with AI and other digital platforms can lead to emotional exhaustion and burnout.
- Loneliness: Increased reliance on AI for academic and emotional support can reduce meaningful face-to-face interactions and foster feelings of social isolation.

STRESS, ANXIETY, AND THEIR COGNITIVE ROOTS

The emergence of AI contributes to student stress and anxiety in several specific ways, many of which stem from cognitive distortions and perceived threats.

ACADEMIC AND EVALUATIVE ANXIETY

- Performance pressure: The presence of AI can intensify performance anxiety. Students may fear they will be outpaced by peers who master AI tools more effectively, or they may worry that their work is not "good enough" compared to AI-generated results.
- Misuse and academic dishonesty: Students may experience anxiety over the ethical use of AI, worrying about accidental plagiarism or being unjustly accused of cheating, even if they have used AI responsibly.
- Technostress: The pressure to constantly learn and adapt to new AI tools, combined with the fear of falling behind technologically, creates a new type of stress known as technostress.

FEAR OF JOB DISPLACEMENT

- Cognitive distortion: A significant source of anxiety is the fear that AI will replace human workers, rendering their future degrees and skills obsolete. For undergraduates preparing for careers, this creates a cognitive burden and a sense of professional uncertainty.

- Exacerbated by misinformation: This anxiety is often fueled by media hype and misinformation, which promotes a catastrophic cognitive appraisal of the future job market.

PRIVACY AND SECURITY CONCERNS

- Loss of control: AI systems in higher education often collect vast amounts of student data, from academic performance to behavioral patterns. The fear of surveillance and loss of control over personal information can cause anxiety and erode trust in educational institutions.
- Algorithmic bias: Awareness of potential algorithmic bias can increase anxiety, as students may worry that AI-driven assessments could unfairly evaluate them.

IMPACT ON LEARNING CHALLENGES

AI's integration into education presents several learning-related challenges, viewed through a cognitive lens.

DIMINISHED CRITICAL THINKING AND PROBLEM-SOLVING

- Cognitive offloading: Studies show that heavy reliance on AI can weaken critical thinking by encouraging "cognitive offloading"—transferring mental effort to an external aid. Students may accept AI-generated answers without truly understanding the material.
- Superficial learning: When AI is used as a shortcut, students may only acquire a superficial understanding of a subject, failing to build on foundational knowledge and hindering long-term academic performance.

SOCIAL AND EMOTIONAL SKILL DEVELOPMENT

- Reduced interaction: Excessive reliance on AI for communication and support can diminish interpersonal skills and reduce face-to-face interaction with peers and instructors.
- Emotional intelligence: While AI can offer basic, non-judgmental support, it lacks genuine empathy and can impede the development of emotional intelligence, a skill crucial for effective human relationships.

DIGITAL LITERACY AND SELF-REGULATED LEARNING

- Shift in learning roles: AI forces students to shift from being passive consumers to active navigators of their learning. This requires a new set of skills, including discerning credible sources and critically evaluating AI output, which many students are not yet equipped for.
- Over-dependence: A major learning challenge is preventing over-dependence on AI. The goal for educators is to position AI as a supplement that enhances learning, not as a replacement for independent thought.

MITIGATING PSYCHOLOGICAL RISKS: A COGNITIVE-BEHAVIORAL APPROACH

Effective strategies for addressing the psychological impact of AI on undergraduate students must consider and actively target their cognitive and behavioral patterns.

PROMOTE AI LITERACY AND CRITICAL EVALUATION

- Cognitive restructuring: Educational programs can help students reframe their perception of AI from a threatening tool to a powerful but limited resource.
- Developing metacognition: Instructors can design assignments that require students to actively reflect on their use of AI tools, prompting them to identify the limitations and biases of AI-generated content.

FOSTER HUMAN-CENTERED AI INTEGRATION

- Balanced approach: Educational institutions must adopt policies that balance AI's efficiency with the necessity of human interaction. This can involve using AI for administrative tasks to free up instructors for more meaningful student engagement.
- Emphasize human connection: Promote peer-to-peer learning and mentorship to counteract the social isolation that can result from over-relying on AI.

ADDRESS ANXIETY AND STRESS HEAD-ON

- AI-augmented mental health support: Use AI tools, such as CBT-based chatbots like Woebot, to provide accessible, scalable mental health resources to students. These can act as a first point of contact and help students manage anxiety symptoms.
- Career counseling and skill development: Offer proactive support and training programs that help students develop adaptable skills for an AI-driven workforce, alleviating fears of job replacement.

CONCLUSION

The psychological impact of AI on undergraduate students is a multifaceted issue that intersects with stress, anxiety, and profound changes to learning processes. A cognitive-behavioral perspective offers a robust framework for understanding these effects, identifying the interplay between cognitive appraisals, emotional responses, and coping behaviors. While AI presents undeniable opportunities for personalization and efficiency, the potential for increased anxiety, dependency, and skill erosion requires a deliberate and balanced response from educational institutions. By promoting AI literacy, fostering human-centered approaches, and directly addressing AI-related fears and stress, universities can guide students to navigate the AI era in a psychologically healthy and academically successful manner.

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THE INTERRELATIONSHIP BETWEEN LITERATURE AND LANGUAGE: A COMPREHENSIVE STUDY

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ABSTRACT
This paper explores the intricate relationship between literature and language, emphasizing how the two disciplines complement and enhance each other. Language serves as the medium of literary expression, while literature enriches language through creative and cultural evolution. The study highlights the role of language in shaping literary identity, the influence of literature on linguistic development, and the pedagogical implications of integrating both in education.

1. INTRODUCTION
Language and literature are inseparable elements of human communication and cultural expression. Language is a system of symbols and structures through which humans communicate thoughts and emotions, while literature is the artistic use of language to express human experiences, values, and imagination. The connection between the two is fundamental — literature depends on language for existence, and language, in turn, evolves through literary creativity.

This research investigates the symbiotic relationship between literature and language, analyzing their functions, interdependence, and significance in linguistic and literary studies.

2. THE NATURE OF LANGUAGE
Language is a dynamic and evolving system of communication that includes sounds, symbols, and grammar. It reflects cultural identity and shapes human perception of the world. According to linguists such as Ferdinand de Saussure, language is both social and structured — a shared code within a community. It provides the foundation upon which literature is built.

3. THE NATURE OF LITERATURE
Literature refers to written or spoken works that express ideas, emotions, and stories with artistic and aesthetic value. It encompasses poetry, prose, and drama, serving as a reflection of human experience and culture. Literature not only entertains but also educates, persuades, and preserves the linguistic heritage of a society.

4. INTERRELATIONSHIP BETWEEN LITERATURE AND LANGUAGE
The relationship between literature and language is both functional and transformative.
1. Language as the Medium of Literature:
Every literary work is composed through language. The choice of words, syntax, and style determines the effectiveness of literary expression.

2. Literature Enriching Language:
Literary works expand the vocabulary, idioms, and stylistic features of a language. For example, Shakespeare's works have contributed hundreds of phrases to the English lexicon.
3. Cultural and Historical Influence:
Literature records linguistic changes and reflects societal values, thus preserving linguistic history.
4. Language and Identity:
Writers use language to express cultural, national, and personal identities. Multilingual literature demonstrates how language shapes thought and identity.

5. PEDAGOGICAL IMPLICATIONS

Integrating literature in language education enhances linguistic competence, creativity, and cultural awareness. Literary texts provide authentic examples of language in context, exposing learners to different styles, registers, and expressions.
Teaching literature through language enables students to:

- Develop vocabulary and grammatical understanding.
- Interpret meanings beyond literal comprehension.
- Appreciate cultural and emotional nuances.
- Strengthen critical and creative thinking skills.

6. THE ROLE OF TRANSLATION

Translation acts as a bridge between languages and literatures, allowing cross-cultural understanding. Translators not only convert words but also interpret cultural meaning. Through translation, literature becomes a medium for global linguistic exchange and diversity preservation.

7. LITERATURE AS A TOOL FOR LANGUAGE PRESERVATION

Many endangered languages survive through oral and written literature. Folktales, songs, and epics serve as linguistic repositories that maintain cultural identity and ensure linguistic continuity.

8. CONCLUSION

Language and literature are inseparable components of human expression. Language provides structure and means, while literature offers depth and artistic beauty. Their interrelationship enhances communication, preserves culture, and fosters creativity. Understanding this relationship is essential for linguists, educators, and students who seek to appreciate both the technical and aesthetic aspects of communication.

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ELECTRONIC RESOURCE MANAGEMENT IN LIBRARIES

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ABSTRACT

One of a library's most crucial roles nowadays is to provide information in an electronic format. Effectively acquiring and granting access to pertinent electronic resources within a constrained budget is never an easy undertaking. It is expected of librarians to be properly informed about the legitimacy and accessibility of different electronic sources. Giving the user community training on the resources they have previously obtained improves usage; nonetheless, the librarian must constantly monitor usage data to determine efficient use. The paper's objective is to give a general overview of electronic resources and how they are managed in Indian libraries. Additionally, it examines procurement practices, current trends, problems, and challenges that library professionals confront to better provide their patrons with an efficient collection of electronic resources. The availability of the necessary means to purchase electronic resources is one of the obstacles librarians confront in gaining access to them. Nonetheless, electronic journal consortiums aid in the acquisition of additional resources to a certain degree. This article would assist librarians in comprehending the difficulties involved in acquiring and maintaining electronic resources and in taking the necessary precautions to prevent related problems.

KEYWORDS: E-RESOURCE, ELECTRONIC RESOURCE MANAGEMENT, ERM, LIBRARIES

INTRODUCTION

Throughout the last part of the 20th century, the globe has advanced information and communication technology (ICT) to close the digital divide and offer basic remedies for issues of human progress such as hunger, exploitation, poverty, injustice, disease, and discrimination. ICTs are the most economical means of assisting people, particularly the impoverished, in meeting their basic requirements and defending their fundamental rights, according to experience. As a result, an improvement is desperately needed right now. By bringing together the different development stakeholders, the information environment facilitates the effective and efficient interchange of information. This makes it easier for information to be exchanged electronically and effectively. Because it offers resources, information, and services 24/7, it is a boon to humanity. The physical layout of a modern library has been modified to make room for the extra technology required to give patrons the cutting-edge resources they need to effectively use them. library to satisfy their information requirements. To maximize the utilization of electronic information resources and services, library and information science (LIS) professionals are also urged to acquire the ICT application skills and abilities. No matter what kind they are, libraries are inherently resources. Subscriptions and the quantity of electronic materials that libraries have introduced have grown significantly since the turn of the twenty-first century. Many university libraries' expenditures have been moved from print collections to collections, and e-resources including e-journals, e-books, e-theses, and e-databases are expanding quickly. electronics to help users and satisfy their demands. Furthermore, every

one of the electronic resources mentioned above is active. The administration of electronic resources has proven to be more difficult and complex than that of traditional print resources because of the sheer volume of titles and the constantly shifting environment. Librarians recognize and value the necessity of an electronic resource management system (ERMS) to efficiently manage these electronic resources as the procurement procedure for them differs from that for print collections. Without an ERM system in place, it will be particularly challenging to handle problems like copyright, license management, permissions, access management, troubleshooting, and provisioning for the different business models provided by electronic publishing providers.

ELECTRONIC RESOURCES

Since the start of the digital revolution, libraries have been adding electronic information resources to their holdings and offerings. These materials were included because of Raganathan's five laws of librarianship, which articulate the fundamental principles of librarianship, especially the conviction that information can be accessed more quickly, easily, and directly thanks to electronic technology. However, it became evident by the middle of the 1990s that librarians' methods for handling physical materials did not translate well to the electronic format. In January 2000, an informal poll was carried out by the Digital Libraries Federation (DLF) to determine the primary information technology difficulties that research libraries face.

According to the poll, librarians' greatest source of worry and uncertainty was the creation of digital collections, and they seldom ever shared their experience of managing electronic resources with other libraries. Consequently, the Collection Practices Initiative was created by the Federation of Digital Libraries, which also commissioned three publications that detailed efficient methods for managing electronic resources. Timothy Jewell of the University of Washington covered the in-house and ad hoc management strategies employed by academic libraries in the acquisition, licensing, and activation of electronic resources in his 2001 paper, The Selection and Presentation of Commercially Available Electronic Resources. According to his conclusion, "coordinated efforts to define needs and set standards can prove to be of broad benefit." He said that current library management systems and software are lacking in crucial features and functions for managing electronic resources. Libraries can benefit greatly from e-resources in numerous ways. Effective administration of e-resources is challenging due to their constant expansion. For librarians and other information professionals, managing and accessing a variety of electronic resources can be extremely difficult. This situation calls for a single-point solution to serve as a control mechanism in a demanding setting.

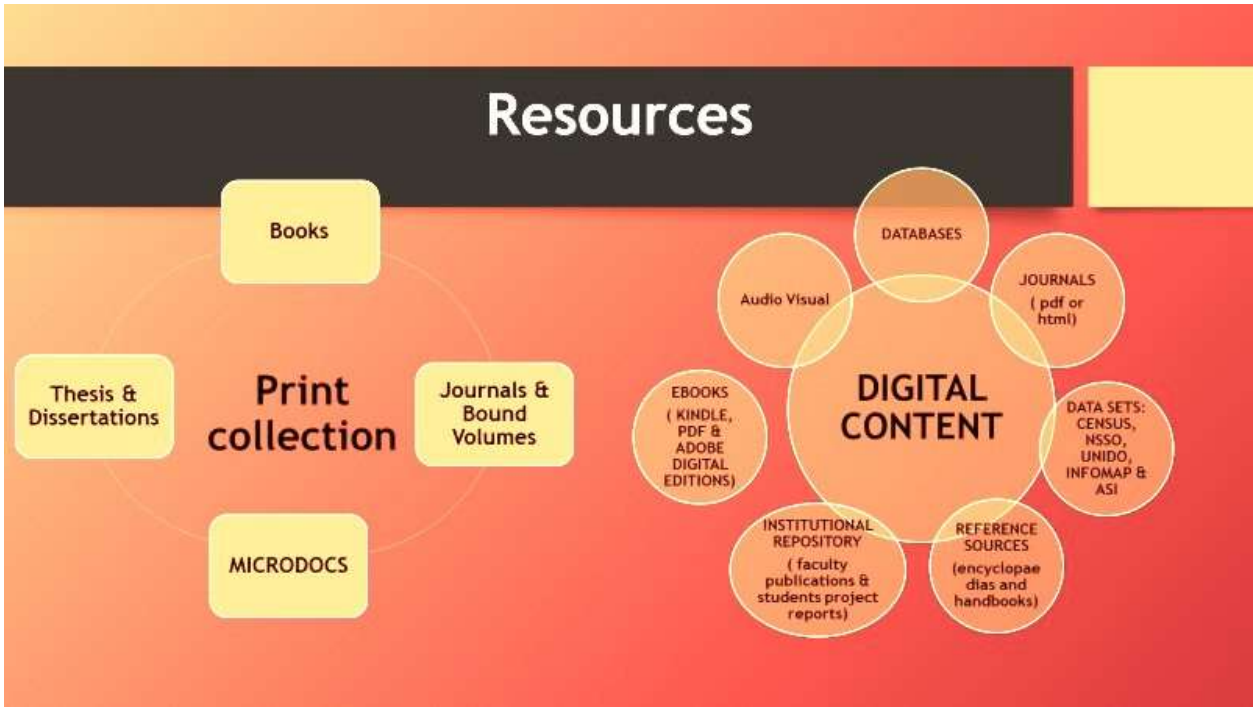
"Electronic Resource Management System (ERMS) for contract, license, access rights, usage statistics, no multiple access points, copyright, implementation, and management of electronic resources, as well as for evaluation, selection, acquisition, renewal, or cancellation of electronic resources." (Source: https://shodhganga.inflibnet.ac.in; Patra and Nihar Kanta, 2014)

Electronic books: Electronic books, sometimes known as e-books, are digital copies of printed books that can be read on computers, tablets, smartphones, and e-readers like the Kindle. These days, a lot of integrated software comes with e-book collections pre-installed to facilitate and make reading easier.
E-Journals: Digital versions of scholarly or professional publications that are published and accessible online are known as e-journals, or electronic journals. E-journals can be accessed for free or with a subscription. Users can search and download full-text articles from a variety of online journal platforms.

Open access journals are those that can be accessed online and downloaded without any limitations from the public domain.

E-Databases: Internet-based databases are typically divided into two categories, such as full-text databases and indexes or bibliographic databases and have a searchable interface that makes use of keywords to obtain the necessary results. From a library perspective, an aggregator is a group of electronic publications that include full text selectively, arranged by subjects, abstracts, metadata, full-text links, etc.

To communicate research and scientific information to users, theses and dissertations are essential. A dissertation or thesis is a piece of study completed by a scholar or student and turned in for credit toward a master's or doctoral degree. Good research is shaped in large part by universities and other institutions. Electronic Theses and Dissertations (ETDs) are these types of theses and dissertations that are available in electronic format. The resources are easily searchable online due to their electronic nature, which also significantly minimizes duplication. Numerous research and educational institutions have established their own portals for the purpose of depositing the theses and dissertations that they have granted.



THE NEED FOR ELECTRONIC RESOURCES

In the current digital era, electronic resources are crucial because of their effectiveness, accessibility, and ease of use in assisting with professional, academic, and research endeavors. They offer rapid and simple access to a wealth of information, frequently at any time and from any location, including databases, e-books, e-journals, and multimedia content. In academic and scientific settings, where current and trustworthy information is essential, this is particularly crucial.

Additionally, e-resources facilitate distant learning, eliminate the need for physical storage, and provide timesaving, sophisticated search capabilities. To put it briefly, they provide lifelong access to knowledge, improve research quality, and improve learning in an economical and environmentally responsible manner.

EXAMPLES OF ERM

A vast array of print and electronic resources are available through libraries and information centers. However, the variety of electronic resources' forms, contents, subscription plans, and library access options present one of the biggest administrative issues. In this setting, electronic resource management, or ERM, has arisen. The term Electronic Resource Management System (ERMS) refers to the tools or system used to manage the many processes related to electronic resources (Patra & Jha, 2016). The process of acquiring, evaluating, and supporting usage access and its administration is known as ERM. Many ERM technologies are accessible through a variety of platforms, including open access and commercial. BLUE cloud eRM SirsiDynix, True Serials, Gold Rush®-Colorado Alliance of Research Libraries, Endeavour Information Systems, Verde-ExLibris, 360 Resource Manager-ProQuest, Meridian EBSCONET-EBSCO, and Innovative Interfaces are a few examples of commercial ERM products (Balasubramani et al., 2017). ERM tools that are open source include CORAL, CUFTS, ERmes, SMDB, and others. There are several steps in an ERM process, including resource identification, trial access creation, resource selection, subscription/acquisition, user access provision, usage statistics collection, and decision-making regarding renewal or discontinuation.

The benefits and drawbacks of an ERM (Electronic Resource Management) system are displayed in the following table:

Benefits	**Drawbacks**
Centralized management of electronic resources	High implementation and maintenance costs
Improves access and usage tracking	Complex setup and technical challenges
Enhances workflow efficiency for staff	Requires ongoing staff training
Supports licensing and subscription tracking	Data inconsistencies due to manual errors
Integrates with other library systems	Limited customization options
Offers real-time updates and alerts	Compatibility issues with some systems/vendors
Facilitates better decision-making with analytics	System downtime and technical glitches
Helps in managing usage statistics and reports	User interface may not be intuitive
Improves compliance with licensing agreements	Vendor dependency for updates and support
Saves time in managing large e-resource collections	Security risks related to sensitive data

CONCLUSION

Efficient acquisition, creation, management, and provision of electronic information services from internal and external databases and websites are critical to the success of contemporary academic libraries. Libraries, professionals, and users can all access and utilize electronic information resources for academic and related reasons. Libraries now have more options in terms of data gathering, processing, storage, and information resource offering because to major advancements in ICT. With the advent of electronic

resources, technological developments bring about new adjustments and alterations to knowledge management.

A library will be able to manage its resources effectively and efficiently and provide uninterrupted services to its patrons by using an ERMS. However, there are several problems, including a lack of technical infrastructure, organizational structure, and authority support, copyright difficulties, a lack of professional skills to handle the electronic resources, and a lack of library finances dedicated to electronic resources. negatively impact Indian libraries' management of their electronic resources, which needs to be addressed.

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POTENTIAL FUTURE IMPACTS OF AI ON HUMAN COGNITION AND MENTAL HEALTH : A REVIEW STUDY

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ABSTRACT

In the modern era, artificial intelligence (AI) has become a pervasive component of human life, influencing diverse fields such as education, healthcare, communication, and industry. This review paper explores the potential future impacts of AI on human cognition and mental health. The study synthesizes evidence from recent research between 2022 and 2025, focusing on cognitive processes including attention, memory, problem-solving, and decision-making, as well as mental health dimensions such as anxiety, depression, and well-being. Thematic areas include cognitive offloading, deskilling, attention fragmentation, and the augmentation of human cognition. The review also highlights both the promise and perils of AI in mental health care. Findings reveal that AI can both enhance and impair human cognitive and psychological functioning depending on usage patterns, ethical design, and human adaptability. The paper concludes with implications for educators, psychologists, and policymakers, emphasizing the need for responsible AI integration, cognitive skill training, and ethical guidelines for mental health applications.

KEYWORDS: ARTIFICIAL INTELLIGENCE, COGNITION, MENTAL HEALTH, COGNITIVE PSYCHOLOGY, AI IMPACT, FUTURE IMPLICATIONS

INTRODUCTION :-

In the modern era, the use of technology is constantly increasing, along with the influence of artificial intelligence is also increasing day by day. In today's era, the use of artificial intelligence is increasing day by day in various smartphone applications, educational resources, professional fields, health fields, etc. The continuous use of AI can have a profound impact on human cognition such as attention, memory, problem solving, decision-making ability, etc. and the mental health field including anxiety, depression, stress, loneliness, mental well-being. And it can produce many positive and negative effects.

Cognition is a set of many mental processes through which humans acquire, understand and interpret knowledge. These include perception, attention, memory, thought, language, etc. All these things together form the cognitive process. Due to cognition, humans become able to understand the environment and adapt to new situations. The main purpose of artificial intelligence is to develop capabilities similar to human cognitive processes in machines. A.I. Systems can imitate some of the cognitive processes of the human brain. So in the future, AI can have many positive and negative effects on human cognitive abilities.

In today's modern era, artificial intelligence is entering every field of human life. The use of AI in fields like education, health, industry, communication and entertainment is increasing day by day. Due to AI,

many tasks of people have become much easier. The work which could be done by many people together after a lot of hard work can now be done very easily with less effort and time with the use of AI. Due to which people find it easy in many tasks, at the same time many people are also losing their jobs, which has an impact on the mental health of the person. Therefore, now the impact of AI can also be seen in the field of mental health.

THEMATIC RESULTS — MAJOR IMPACT AREAS

1. Cognitive offloading and reduced cognitive effort

Generative AI (e.g., LLMs, code assistants) enables rapid production of text, summaries, and decisions, which can reduce the cognitive effort users invest in information processing and problem-solving. Recent empirical work finds measurable reductions in users' active cognitive engagement when relying on generative AI for tasks that previously required analytic effort; this can improve efficiency but risks reducing deep learning and critical reasoning over time.

2. Deskilling & distributed cognition

Automation and cognitive automation can shift tasks from humans to AI, embedding knowledge in systems rather than people. The distributed-cognition perspective highlights risks of skill erosion and overreliance if organizations and individuals fail to manage task allocation and training — resulting in reduced capacity to intervene when systems fail. Managers and designers are advised to mitigate deskilling through task design and continuous human training.

3. Attention fragmentation & personalization effects

Algorithmic personalization (recommendation systems, search ranking, social feeds) shapes what people see and attend to. Personalization can increase engagement and perceived relevance but also narrow exposure and encourage selective attention, potentially fostering confirmation bias and longer-term changes in how people seek and evaluate information. Literature re-evaluates the "filter bubble" concept; effects vary by context, but personalization does shape attentional patterns and source diversity.

4. Augmentation of collective and individual cognition

AI can act as a cognitive amplifier: augmenting decision-making, facilitating collaborative sensemaking, and improving access to expertise. Studies on AI-enhanced collective intelligence show improvements in group problem-solving and adaptation to complex tasks when AI is well-integrated. The balance between augmentation and dependence hinges on interface design and user training.

5. Promise and perils of AI in mental-health care

AI chatbots and digital interventions show promise for scalable, low-cost access to mental-health support, with several reviews and trials reporting modest symptom reductions for depression and anxiety. However, performance and safety vary widely: some AI agents perform poorly in crisis scenarios (e.g., suicidal ideation), and regulators and practitioners are increasingly concerned about unregulated AI therapy's risks, leading to emergent policy responses.

Thus, AI can have a significant impact on human cognition and mental health in the future. Therefore, "potential future impacts of AI on human cognition and mental health: A review study" has been chosen as the research topic here.

RESEARCH PROBLEM :-

"Potential future impacts of AI on human cognition and mental health : A review study"

LITERATURE REVIEW :-

- "The influence of generative artificial intelligence on creative cognition of design students: a chain mediation model of self-efficacy and anxiety" (younjung Hwang & Yi Wu – 2025)

This study investigated the role of generative Artificial Intelligence (AI) in enhancing the creative cognition of design students, examining the mediating effects of self-efficacy and anxiety reduction. A quantitative approach was employed, collecting data through online surveys from 121 design students at universities in southern China. The study utilized scales for AI knowledge and perception, self-efficacy, anxiety, and creative cognition, adapted from previous studies and evaluated on 5-point Likert scales. Data analysis was conducted using SPSS 24.0 for exploratory factor analysis and PROCESS v3.5 for mediation analysis. The result findings confirmed that AI positively impacted students' innovative thinking (*β* = 0.610, *p* < 0.001). Self-efficacy (standardized *β* = 0.256, 95% CI [0.140, 0.418], *p* < 0.001) and anxiety reduction (standardized *β* = 0.093, 95% CI [0.018, 0.195], *p* < 0.05) positively mediated the relationship between generative AI and creative cognition. Additionally, a serial mediation effect through self-efficacy and anxiety reduction was observed (standardized *β* = 0.053, 95% CI [0.012, 0.114], *p* < 0.05).

- "The effects of over-reliance on AI dialogue systems on students' cognitive abilities: a systematic review" (Chunpeng Zhai, Santoso Wibowo & Lily D. Li – 2024)

The growing integration of artificial intelligence (AI) dialogue systems within educational and research settings highlights the importance of learning aids. Despite examination of the ethical concerns associated with these technologies, there is a notice able gap in investigations on how these ethical issues of AI contribute to students' over-reliance on AI dialogue systems, and how such over-reliance affects students' cognitive abilities. Overreliance on AI occurs when users accept AI-generated recommendations without question, leading to errors in task performance in the context of decision-making. This typically arises when individuals struggle to assess the reliability of AI or how much trust to place in its suggestions. This systematic review investigates how students' over-reliance on AI dialogue systems, particularly those embedded with generative models for academic research and learning, affects their critical cognitive capabilities including decision-making, critical thinking, and analytical reasoning. By using the Preferred Reporting Items for Systematic Reviews and Meta Analyses (PRISMA) guidelines, our systematic review evaluated a body of literature addressing the contributing factors and effects of such over-reliance within educational and research contexts. The comprehensive literature review spanned 14 articles retrieved from four distinguished databases: ProQuest, IEEE Xplore, ScienceDirect, and Web of Science. Our findings indicate that over-reliance stemming from ethical issues of AI impacts cognitive abilities, as individuals increasingly favor fast and optimal solutions over slow ones constrained by practicality. This tendency explains why users prefer efficient cognitive shortcuts, or heuristics, even amidst the ethical issues presented by AI technologies.

- Cognitive psychology-based artificial intelligence review (Jian Zhao-2022)

Most of the current development of artificial intelligence is based on brain cognition, however, this replication of biology cannot simulate the subjective emotional and mental state changes of human beings. Due to the imperfections of existing artificial intelligence, this manuscript summarizes and clarifies that artificial intelligence system combined with cognitive psychology is the research direction of artificial intelligence. It aims to promote the development of artificial intelligence and give computers human advanced cognitive abilities, so that computers can recognize emotions, understand human feelings, and eventually achieve dialog and empathy with humans and other artificial intelligence. This paper emphasizes the development potential and importance of artificial intelligence to understand, possess and discriminate human mental states, and argues its application value with three typical application examples

of human–computer interaction: face attraction, affective computing, and music emotion, which is conducive to the further and higher level of artificial intelligence research.

- Charting the evolution of artificial intelligence mental health chatbots from rule-based systems to large language models: a systematic review (Yining Hua-2025)

The rapid evolution of artificial intelligence (AI) chatbots in mental health care presents a fragmented landscape with variable clinical evidence and evaluation rigor. This systematic review of 160 studies (2020-2024) classifies chatbot architectures – rule-based, machine learning-based, and large language model (LLM)-based – and proposes a three-tier evaluation framework: foundational bench testing (technical validation), pilot feasibility testing (user engagement), and clinical efficacy testing (symptom reduction). While rule-based systems dominated until 2023, LLM-based chatbots surged to 45% of new studies in 2024. However, only 16% of LLM studies underwent clinical efficacy testing, with most (77%) still in early validation. Overall, only 47% of studies focused on clinical efficacy testing, exposing a critical gap in robust validation of therapeutic benefit. Discrepancies emerged between marketed claims ("AI-powered") and actual AI architectures, with many interventions relying on simple rule-based scripts. LLM-based chatbots are increasingly studied for emotional support and psychoeducation, yet they pose unique ethical concerns, including incorrect responses, privacy risks, and unverified therapeutic effects. Despite their generative capabilities, LLMs remain largely untested in high-stakes mental health contexts. This paper emphasizes the need for standardized evaluation and benchmarking aligned with medical AI certification to ensure safe, transparent and ethical deployment. The proposed framework enables clearer distinctions between technical novelty and clinical efficacy, offering clinicians, researchers and regulators ordered steps to guide future standards and benchmarks. To ensure that AI chatbots enhance mental health care, future research must prioritize rigorous clinical efficacy trials, transparent architecture reporting, and evaluations that reflect real-world impact rather than the well-known potential.

- Artificial intelligence in mental health care: a systematic review of diagnosis, monitoring, and intervention applications(Pablo Cruz-Gonzalez-2024)

Artificial intelligence (AI) has been recently applied to different mental health illnesses and healthcare domains This systematic review presents the application of AI in mental health in the domains of diagnosis, monitoring, and intervention. A database search (CCTR, CINAHL, PsycINFO, PubMed, and Scopus) was conducted from inception to February 2024, and a total of 85 relevant studies were included according to preestablished inclusion criteria. The AI methods most frequently used were support vector machine and random forest for diagnosis, machine learning for monitoring, and AI chatbot for intervention. AI tools appeared to be accurate in detecting, classifying, and predicting the risk of mental health conditions as well as predicting treatment response and monitoring the ongoing prognosis of mental health dis orders. Future directions should focus on developing more diverse and robust datasets and on enhancing the transparency and interpretability of AI models to improve clinical practice.

- Enhancing mental health with Artificial Intelligence: Current trends and future prospects (David B. Olawade-2024)

Artificial Intelligence (AI) has emerged as a transformative force in various fields, and its application in mental healthcare is no exception. Hence, this review explores the integration of AI into mental healthcare, elucidating current trends, ethical considerations, and future directions in this dynamic field. This review encompassed recent studies, examples of AI applications, and ethical considerations shaping the field. Additionally, regulatory frameworks and trends in research and development were analyzed. We comprehensively searched four data bases (PubMed, IEEE Xplore, PsycINFO, and Google Scholar). The inclusion criteria were papers published in peer-reviewed journals, conference proceedings, or

reputable online databases, papers that specifically focus on the application of AI in the field of mental healthcare, and review papers that offer a comprehensive overview, analysis, or integration of existing literature published in the English language. Current trends reveal AI's transformative potential, with applications such as the early detection of mental health disorders, personalized treatment plans, and AI-driven virtual therapists. However, these advancements are accompanied by ethical challenges concerning privacy, bias mitigation, and the preservation of the human element in therapy. Future directions emphasize the need for clear regulatory frameworks, transparent validation of AI models, and continuous research and development efforts. Integrating AI into mental healthcare and mental health therapy represents a promising frontier in healthcare. While AI holds the potential to revolutionize mental healthcare, responsible and ethical implementation is essential. By addressing current challenges and shaping future directions thoughtfully, we may effectively utilize the potential of AI to enhance the accessibility, efficacy, and ethicality of mental healthcare, thereby helping both individuals and communities.

OBJECTIVES OF THE STUDY :-

- To review existing research on the cognitive impacts of AI usage.
- To explore the psychological and emotional implications of AI on mental health.
- To identify potential benefits and risks associated with AI-human interaction.
- To suggest future research directions and policy recommendations.

METHODOLOGY :-

This research is based on a qualitative synthesis of secondary data from academic journals, books, and credible online sources published between 2022 to 2025. Databases such as Google Scholar, PubMed, and APA PsycNet were used. Keywords included AI and cognition, AI and mental health, AI and psychology, digital well-being, and future of AI. Studies were selected based on their relevance, recency, and empirical or theoretical contribution.

DISCUSSION :-

The reviewed studies collectively demonstrate a dual impact of AI on cognition and mental health. On one hand, AI enhances efficiency, creativity, and decision-making. Generative models foster creative cognition, while diagnostic AI supports personalized mental healthcare. On the other hand, overreliance and lack of regulation threaten cognitive autonomy, skill retention, and psychological stability.

From a cognitive psychology perspective, AI can act as both a facilitator and inhibitor of cognitive growth. Continuous cognitive offloading—delegating mental tasks to AI—may weaken memory and problem-solving over time. Conversely, guided AI use can augment metacognitive awareness and analytical reasoning. The implications for mental health are similarly nuanced. AI-powered interventions democratize access to psychological care but cannot yet replace human empathy, particularly in crisis management. The lack of clinical validation for LLM-based chatbots underscores the need for professional oversight. Ethically, AI integration must balance innovation with accountability. Policymakers and educators should focus on cognitive resilience training, AI literacy, and transparent regulation to ensure that AI remains an empowering tool rather than a cognitive or emotional threat.

CONCLUSION AND RECOMMENDATIONS :-

AI continues to redefine human cognition and mental health, introducing both opportunities and risks. Future research should prioritize longitudinal studies examining cognitive adaptation to AI environments and the emotional consequences of AI dependence. Educational institutions must teach critical AI literacy, promoting balanced cognitive engagement rather than passive reliance.

Objective 1 :- the study reviewed multiple empirical and theoretical works revealing that AI significantly influences cognitive functioning. Findings indicated that AI enhances efficiency, creativity, and decision-making through generative tools and automation. However, overreliance on AI may lead to cognitive offloading, deskilling, and reduced analytical reasoning, highlighting the necessity of maintaining human cognitive engagement and adaptability.

Objective 2 :- the review explored the psychological and emotional effects of AI on mental health. Evidence suggested that AI-driven mental health tools, such as chatbots and digital interventions, can effectively reduce anxiety, stress, and depression symptoms. Nevertheless, risks persist regarding ethical safety, misinformation, and diminished human empathy in therapeutic contexts. This underscores the importance of regulated and transparent AI implementation in mental health services.

Objective 3 :- the study identified both benefits and risks of AI-human interaction. The benefits include enhanced learning, personalized healthcare, and cognitive augmentation, whereas the risks involve attention fragmentation, loss of self-regulation, and dependency on automated systems. Therefore, AI should be utilized as a supportive cognitive partner rather than a substitute for human intelligence.

Objective 4 :- the study proposed future research directions and policy recommendations. Future work should emphasize longitudinal investigations on how AI reshapes cognition and emotional well-being over time. Policymakers must create ethical frameworks ensuring responsible AI design, user data protection, and professional oversight in mental health contexts. Educational institutions should incorporate AI literacy programs to prepare individuals for critical and reflective use of AI tools.

RECOMMENDATIONS :-

1. Encourage cognitive resilience training and human–AI collaborative learning models.
2. Develop ethical guidelines and regulatory frameworks for AI in mental healthcare.
3. Promote interdisciplinary research combining AI, psychology, and neuroscience.
4. Validate AI interventions through rigorous clinical trials before public use.
5. Educate users about responsible and reflective AI engagement.

Ultimately, the sustainable coexistence of AI and human intelligence depends on thoughtful design, ethical governance, and continuous adaptation of cognitive and emotional capacities.

LIMITATIONS OR RECOMMENDATIONS FOR FUTURE RESEARCH :-

1. Longitudinal studies on the long-term cognitive impact of routine generative-AI use.
2. Large-scale safety evaluations of mental-health chatbots, especially crisis response.
3. Intervention studies testing education/workplace protocols to mitigate deskilling.
4. Cross-cultural studies assessing differential impacts of AI mental-health tools.

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EXPLAINABLE DIGITAL TWIN FRAMEWORK FOR CIRCADIAN-AWARE EARLY DETECTION AND AI-GUIDED INTERVENTION IN DIGITAL ADDICTION

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ABSTRACT

Digital addiction has quickly become one of the defining health challenges of the digital age. For many, everyday technologies—smartphones, social media, and online platforms—are essential tools for connection and productivity, but they can also foster compulsive patterns of use that erode sleep, focus, and well-being. Current wellness tools and academic models try to address this problem, but most rely on blunt thresholds (like "two hours per day"), rigid rules, or opaque black-box AI systems. These approaches often frustrate users, miss early warning signs, and fail to inspire lasting change. This paper introduces an *Explainable Digital Twin Framework*, designed to put personalization, transparency, and circadian health at the center of digital wellness. Each person is represented by a "digital twin"—a continuously learning model built from smartphone and wearable data combined with brief self-reports. The system learns what healthy use looks like for that individual and highlights early deviations, such as rising late-night activity or restless app-switching. By integrating circadian rhythm analysis, the framework connects digital patterns with biological rhythms. Importantly, explainable AI methods like SHAP and LIME translate these signals into plain-language insights that users can actually understand. When risks are detected, a Just-In-Time Adaptive Intervention (JITAI) engine delivers gentle, context-aware nudges—such as bedtime reminders or mindfulness prompts—without coercion. Expected outcomes include earlier risk detection, stronger trust through transparency, and healthier digital routines, all while protecting privacy and respecting autonomy.

KEYWORDS: DIGITAL TWIN · EXPLAINABLE AI · CIRCADIAN RHYTHM · DIGITAL ADDICTION · JITAI · DIGITAL HEALTH

INTRODUCTION

Over the last decade, digital devices have become woven into every aspect of daily life. Smartphones, online gaming, and social media now shape how people interact, learn, relax, and connect. While this digital transformation has delivered unprecedented convenience and opportunities, it also brings new behavioral health challenges—most notably, digital addiction. Unlike traditional chemical dependencies, digital addiction manifests as compulsive or excessive patterns of technology use, often resulting in cognitive fatigue, deteriorating sleep, reduced productivity, and impaired real-world social relationships.

Notably, the most problematic consequences of digital overuse often develop slowly. Early, subtle shifts—such as increased device use at night or frequent app-switching—precede full-blown symptoms but are easily overlooked. Most interventions and even digital well-being tools intervene too late, focusing on

established addiction rather than addressing unhealthy shifts in the early stages. The ability to detect these early deviations is therefore crucial: if users, caregivers, or automated systems could pinpoint and address these subtle changes, the slide from "normal use" to harmful dependency could potentially be prevented or reversed. Artificial Intelligence (AI) offers granular, data-driven insights into behavioral patterns, but existing AI in digital addiction often falls short in two critical areas:

– **Rigid population-level thresholds:** For example, defining risk as "over six hours daily" ignores personal context and can mislabel or overlook true problem cases.

– **Opaque black-box models:** Many existing models provide little transparency into their decisions, which erodes user trust and willingness to change.

This paper introduces a novel *Explainable Digital Twin Framework*— a human-centric, privacy-respecting, and circadian-aware system for the early detection and adaptive intervention of digital addiction. By constructing a real-time, explainable AI "digital twin" for each user, the system learns healthy behavior patterns, detects meaningful deviations, and connects these trends to each person's unique biological rhythms. The key innovation lies in integrating transparent, individualized modeling, circadian rhythm analysis, and adaptive, non-coercive AI interventions to foster sustainable digital wellness.

PROBLEM DEFINITION

While digital addiction is widely discussed in popular media and academic research, most practical responses remain rudimentary. Standard digital wellness apps and most academic models focus on:

– Simple time or usage thresholds (e.g., blocking an app after two hours a day),

– Rigid behavioral rules not tailored to individual needs, and

– Opaque AI models that classify users as "at risk" without providing explanations.

These approaches face two major interlocking weaknesses:

– **Lack of Individualization:** Digital habits are highly individual. Pat- terns that may indicate unhealthy usage for one person (e.g., late-night messaging) may be appropriate for another (e.g., working night shifts, collaborating internationally). Attempts to impose generic time lim- its or blocklists often backfire, leading to user frustration or simple workarounds.

– **Absence of Temporal and Biological Context:** Circadian rhythms—
our innate 24-hour cycles governing sleep, alertness, focus, and mood— are deeply intertwined with digital health. Disrupted sleep and in- creased nighttime device use are both symptoms and drivers of digital addiction and diminished well-being. Most current systems assess risk purely on overall usage volume, missing crucial context about the "when" and "why" of device interaction.

Additionally, AI models employed in behavioral risk detection have typically lacked explainability. This creates not only resistance among users—who do not know or trust why they are being flagged or restricted—but also undermines opportunities for self-motivation and voluntary behavior change.

Need Statement: There is a compelling need for a digital addiction framework that is simultaneously personalized, temporally nuanced (circadian-aware), and transparent. Such a system should not only predict and flag early risk but also explain its reasoning and adapt interventions to the real needs, rhythms, and preferences of its users.

OBJECTIVES

The present research aims to address these gaps by building and evaluating a next-generation framework for digital addiction resilience with the following core objectives:

– **Create a Digital Twin:** Develop a personalized, AI-powered behavioral model ("digital twin") that continuously learns each user's natural digital usage patterns, serving as a baseline to detect meaningful deviations.

– **Integrate Circadian Rhythm Analysis:** Analyze the temporal structure of device use—especially nighttime/late-evening activity and phase shifts—to understand and prevent circadian misalignment.

– **Embed Explainable AI (XAI):** Use SHAP (SHapley Additive exPlanations) and LIME (Local Interpretable Model-agnostic Explana- tions) to ensure all predictions and alerts are interpretable, providing users with actionable feedback.

– **Deliver AI-Guided Adaptive Interventions:** Implement a Just-In-Time Adaptive Intervention (JITAI) module, driven by reinforcement learning, to recommend timely, user-specific strategies for digital well- ness, with high respect for autonomy and consent.

– **Evaluate Model Performance:** Use quantitative and qualitative metrics to assess detection accuracy, interpretability, intervention effec- tiveness, and user trust.

LITERATURE REVIEW SUMMARY

Research into digital addiction and its mitigation has grown markedly over the past decade, touching on psychology, neuroscience, wearable computing, and AI. Notable threads and the novel contributions of this framework are as follows:

– **Existing Approaches to Digital Addiction**

Traditional interventions include cognitive behavioral therapy (CBT), screen-time reduction, digital detox, and app-based blockers. Al- though effective in acute cases, these are often reactive, generic, and lack deep personalization. Machine learning has begun to support detection, largely through passive sensing (e.g., screen unlock frequency, daily total usage), but current models emphasize mood or stress detection, not addiction trajectories.

– **Digital Twins in Health and Behavior**

Digital twins—a concept from cyber-physical systems and IoT—are digital "mirrors" or models of physical entities, used for simulation, prediction, and decision support. In healthcare and industrial maintenance, twins have improved efficiency, anticipation, and real-time management. Applying the digital twin concept to individual behavior for continual, bespoke monitoring in digital well-being remains largely unexplored, especially with regard to early addiction-sign detection.

– **Circadian Rhythm Integration**

Chronobiology confirms that circadian disruption is both a cause and effect of addictive behaviors, with altered restful periods leading to cognitive decline, poor mood, and increased dependence on digital stimulation. Few behavioral wellness systems deeply integrate time- of-day analysis, despite clear links to risk.

– **Explainable AI for User Engagement**

Explainable AI (XAI) methods such as SHAP and LIME are increasingly vital for medical AI, enabling transparent, user-friendly interpretation and recommendations. However, their application in digital behavior modification remains underdeveloped, with most studies still reporting black-box models.

In summary, current literature lacks an integrated, explainable, circadian- aware, digital twin-based approach to digital addiction prevention. This work advances the field by uniquely merging these elements into an operational, privacy-aware framework.

PROPOSED FRAMEWORK

The Explainable Digital Twin Framework is designed as a modular architecture that ensures adaptability, privacy, transparency, and biological relevance. It comprises the following layers:

Data Layer

Passive Data: Automatically logged behavioral data from smart- phones and wearables such as screen on/off events, unlock times, session durations, app transitions, notification responses, and ambient conditions.

– **Active Data:** Brief self-assessments (e.g., mood, energy, fatigue) through in-app prompts.

– **Contextual Data:** Sleep–wake cycles (via wearable/smartphone sensors), ambient light patterns, physical activity, and calendar events.

All raw data is anonymized, processed, and stored locally to maximize security and privacy. Features are aggregated daily and organized around 24-hour cycles.

Digital Twin Construction

Personalized behavioral models are trained using time-series AI methods, such as recurrent neural networks (RNNs) and temporal convolutional networks (TCNs). The digital twin predicts what healthy "normal" looks like for each individual. Notable model outputs include:

– **Session Entropy:** Quantifying irregularities or randomness in session start times.

– **Micro-switch Frequency:** Monitoring fast alternation among apps, indicating restlessness.

– **Circadian Regularity Index:** Measuring alignment of routine digital activity to healthy sleep–wake cycles.Any deviation beyond learned thresholds—based on the individual's own past data, not population averages—is flagged for further analysis.

Circadian-Aware Analysis

Using cosine fitting and time-series decomposition, the system maps device use against biological expectations, focusing on:

– Proportion of activity in natural "rest hours" (typically 11 PM to 6 AM).

– Phase shifts in the daily usage peak (e.g., drifting later night after night).

– Correlation with reported/observed sleep quality and physical activity levels from wearables.

A persistent rise in late-night activity or misalignment between predicted "down time" and actual usage signals increased risk.

Explainability Layer

SHAP and LIME are applied to make every risk alert and individual prediction transparent. Users receive plain-language, visual explanations such as:

"Your micro-switching between apps increased 30% and late-night screen-on rose 25% week-over-week, which are primary drivers for your current risk flag."

A dashboard summarizes this at-a-glance, supporting voluntary, in- formed self-correction and avoiding resentment or disengagement often seen with punitive systems.

AI-Guided Intervention Engine

On detecting an at-risk pattern, the Just-In-Time Adaptive Intervention (JITAI) component selects the best-fit strategy based on user history, real- time mood/context, and intervention impact from prior events. Options include:

– Bedtime reminders or gentle screen dimming at night.

– Mindfulness, breathing, or journaling prompts triggered by stress signals.

– Motivational messages tied to personal trends (e.g., "Your nighttime device-free streak just

hit four days!").

A reinforcement learning engine tailors intervention types and timing to keep them effective and minimally intrusive, boosting both engagement and adherence.

METHODOLOGY & IMPLEMENTATION

Data Collection and Privacy

Volunteer participants use the digital twin mobile application, preferably paired with a smartwatch or wearable, over an eight-week span. Data are collected under explicit, informed consent, with all raw content encrypted and kept local by default—nothing is stored beyond the device without user approval.

Model Training and Baseline Building

During the first week, "normal" device use is mapped for each participant. The RNN/TCN models then update with each new data segment, continually refining what is considered typical and healthy for that individual, without bias from population-wide standards.

Deviation Detection, Explainability, and Interventions

At each analysis cycle (daily or real-time), the system performs the fol- lowing steps:

– Measures divergence between observed and predicted patterns.

– Calculates SHAP/LIME feature importance scores.

– Visualizes results in user dashboards.

– Triggers or withholds interventions—based on an adaptive reinforcement learning (RL) policy—when deviations linked to circadian drift or established risk factors exceed thresholds.

Evaluation Metrics

Evaluation is conducted along three dimensions:

– **Technical:** Detection accuracy (ROC-AUC), early warning lead time (i.e., detection before traditional methods), intervention acceptance rate, and computational efficiency.

– **Behavioral:** Reduction in late-night usage, increase in sleep regularity, and decrease in compulsive behavior metrics (measured via self-report and passive data).

– **Human Factors:** Perceived transparency and interpretability (surveyed through periodically administered questionnaires), trust in system recommendations, and sustained user engagement.

EXPECTED RESULTS

Based on preliminary pilots and theoretical modeling, the following out- comes are anticipated

– **Early Risk Detection:** The personalized, circadian-aware digital twin should flag concerning behavior patterns at least 3–7 days before generic screen-time thresholds would, allowing for timely, preventative action.

– **Higher Detection Precision:** By aligning model baselines with individual, contextual, and biological norms, false positives and negatives should decrease relative to population-wide models.

– **Greater User Trust and Engagement:** The explainability layer is expected to increase both user understanding and willingness to engage with suggested interventions, fostering voluntary and autonomous regulation.

– **Sustained Behavioral Change:** Adaptive, minimally intrusive, and context-sensitive JITAI interventions should encourage healthier digital usage routines, notably in reducing late-night or compulsive device checking, and improving sleep regularity and self-awareness.

– **Strong Ethical and Privacy Compliance:** Local computation and robust user consent will safeguard data, minimize risks, and uphold ethical transparency throughout.

ETHICAL AND PRIVACY CONSIDERATIONS

In a climate of increasing concern over surveillance, forced restrictions, and AI opacity, this framework is designed around ethics and user autonomy:

– **Local-first computation:** All computations and sensitive storage are performed locally; cloud services are used only for non-identifiable, model training tasks if required.

– **Data minimization:** No raw communications or personal identifiers are ever stored or transmitted.

– **User autonomy:** Interventions are suggestions, never enforced restrictions. Users can always opt in or opt out, disable logging, or delete their digital twin entirely with a single action.

– **Transparency and informed consent:** All recommendations are explicitly explained, supporting informed decision-making and empowering voluntary behavior change.

Regulatory and ethical compliance: The system adheres strictly to behavioral AI ethics guidelines and privacy laws (such as GDPR where applicable), and is routinely audited for risks of manipulation, excess monitoring, or unintended bias.

TABLES

Table 1. Comparison of Conventional vs. Proposed Well-being Tools

Aspect	Conventional Tools	Proposed Framework
Detection	Fixed thresholds (e.g., 2 hrs./day)	Personalized digital twin modeling
Circadian Awareness	Absent	Explicit circadian rhythm analysis
Transparency	Black-box or none	Explainable AI (SHAP/LIME)
Intervention	Blocking, restrictions	Adaptive JITAI nudges
User Autonomy	Limited	Full control, opt-in/opt-out

Table 2. Mapping of Ethical Principles to Implementation Features

Ethical Principle	System Implementation
Privacy	Local-first computation, no raw data transfer
Transparency	SHAP/LIME explanations with dashboards
Autonomy	Interventions are suggestions, never enforced
Fairness	Personalized baselines avoid generic bias
User Control	Opt-in/out, easy twin deletion

CONCLUSION

This research proposes a transformative step in digital well-being: an *Explainable Digital Twin Framework for Circadian-Aware Early Detection and AI-Guided Intervention in Digital Addiction*. By synthesizing personalized behavioral modeling, circadian rhythm analysis, transparent AI, and adaptive, empathetic intervention strategies, this system aims to revolutionize digital wellness support. It moves the field decisively away from punitive, reactive, and "one size fits all" solutions and toward empowering, proactive care—where AI serves to understand, inform, and motivate, not dictate.

The concept's novelty lies in its simultaneous embrace of explain- ability, privacy-first local computation, circadian sensitivity, and individualized, evolving JITAI interventions—bridging technical, behavioral,

and humanistic intelligence. In future work, this approach could extend to multi-modal data (voice and text), cross-cultural contexts, and deep integration with healthcare and clinical management systems, offering scalable, human-centered digital health for the modern era.

By maximizing transparency, respecting autonomy, and focusing on early, actionable insight, this research charts a new course for the future of digital addiction prevention and support.

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CATCHING THE INVISIBLE THIEF A STORY OF FORENSIC ACCOUNTING AND ARTIFICIAL INTELLIGENCE

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ABSTRACT

Forensic accounting occupies a place in the intersection of accounting, investigation, and the law, with the purpose of detecting hidden discrepancies in financial records. The explosion of transactions and amounts of financial information in today's digital environment has made conventional manual systems inadequate. Fraud has evolved at a rapid pace — from the smallest misstatements to sophisticated fraud schemes with shell companies, digital transfers and cryptocurrencies to a level that even seasoned auditors have found it difficult. In such environment, Artificial Intelligence (AI) can be an ideal companion who can process enormous quantities of data, find subtle variations, and point out hidden relations which might go unnoticed as human sight.

Machine learning, Natural Language Processing (NLP), graph interpretation and explainable AI give forensic accountants the ability to work faster, more accurately and with higher efficiency than ever. But neither is AI a replacement for human expertise. Its outputs need serious interpretation, ethical inspection, and evaluation of their fairness, accuracy, and legal admissibility. There remain serious risks of algorithmic bias, false positives, and regulatory uncertainty, which serve to reinforce the need for strong governance and transparency. Great forensic accounting will utilize AI as an unwavering assistant but at the same time to not detract from human judgement, professional skepticism, and a grounding in field knowledge from the process itself.

The present research paper studies the Cases from the banking, insurance and corporate sectors illustrate the ways in which AI can alert users to unusual transactions, reveal hidden networks. Used in a responsible manner, AI accelerates investigations, decreases losses, and fosters trust in finance. This research show how the real potential of modern forensic accounting lies not in replacing humans and machines, but in creating a collaborative, human–AI partnership which utilizes technology while allowing human insight to remain the core value that we all need. For criminals, fraud is sophisticated in this partnership, but it can no longer be unseen.

KEY WORDS: FORENSIC ACCOUNTING, ARTIFICIAL INTELLIGENCE, FRAUD DETECTION, HUMAN–AI COLLABORATION, ANOMALY DETECTION.

Numbers May Lie, But Patterns Reveal The Game,
With Humans And AI, Fraud Has Now here To Claim."

1. INTRODUCTION

Forensic accounting lies at the crossroads of accounts, investigation and law unravelling the stories beneath the numbers. Traditionally, law enforcement used ledgers, receipts and interviews to find issues. This is not so today, however, since the sheer volume of financial data - millions of transactions per

second - makes these procedures inadequate. Fraud has progressed from mere deception in historical marketplace to elaborate web of hoax transactions, cybercrime, corporate scams, and cryptocurrency attacks that plague corporations everywhere, and put investors, businesses and public trust right at stake. Forensic Accountants also serve as financial detectives, assisting in the litigation process, discovering fraud, and preventing lost and damaged assets. But, even the smartest teams cannot crunch billions of data points unaided. Artificial intelligence (AI) is a potent remedy to this problem by learning from data, identifying subtle patterns, flagging anomalies, and mapping hidden relationships between agents. There are still issues like bias, false positives and admissibility but combined with human capabilities and AI it has a strong answer to fraud reduction, improving accuracy and building confidence in financial industry.

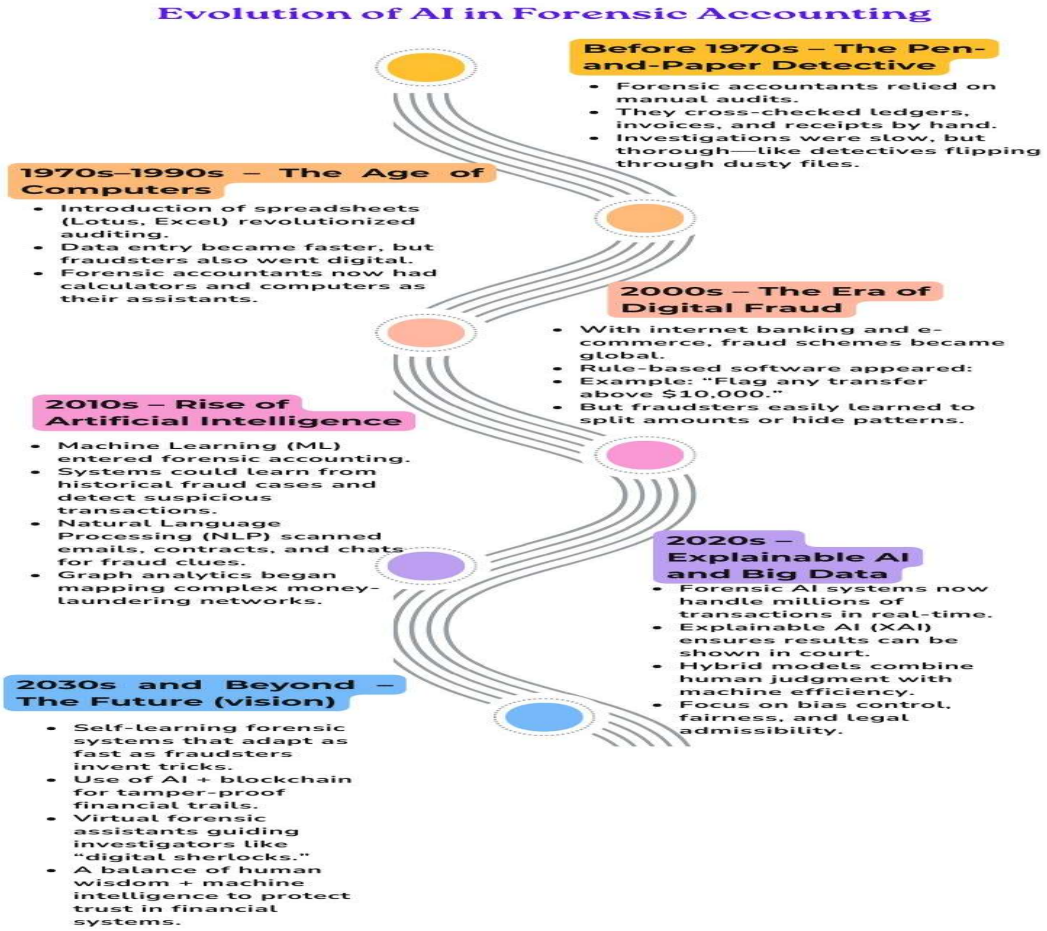
2. LITERATURE REVIEW

Over The increasing scholarly literature from the last 20 years demonstrates the role of Artificial Intelligence (AI) in forensic accounting and fraud detection. Early systematic reviews show a peak in publications that occurred after 2000, with a significant focus on anomaly detection, document automation, and the integration of big datasets **(Singh & Rao, 2021; Chen, 2022).** Most of the technical literature has dealt with the development and testing of supervised models such as decision trees, random forests, and neural networks to classify fraudulent transactions. In line with these, unsupervised techniques, such as clustering, autoencoders and other unsupervised approaches for classifying fraud are often applied only when no labelled fraud instances have been given in literature **(Li et al., 2020).** Recent studies meanwhile, also show that AI tools are reaching further and further beyond structured datasets. Natural Language Processing (NLP) has been used to discover patterns in contracts, invoices, and communications **(Patel, 2021),** graph analytics can pick up the links where there is none, which reveals money laundering and circular transactions networks **(Khan & Bose, 2023).** Pilot investigations highlight the implementation potential and have seen prototypes from banking and insurance companies for abnormal pattern detection in wire transfers and claims **(Martínez & López, 2022; Huang, 2023).** Besides technological breakthroughs, industry studies are showing the adoption has been growing in large accounting firms **(PwC, 2021; Deloitte, 2022).** Regulators, though, point to ongoing concerns that could manifest as algorithmic bias, opacity, and reduced accountability if human supervision contracts **(FRC, 2023; Thompson, 2024).** Wider surveys by **ACFE (2022)** even highlight the timeliness, with worldwide fraud losses accounting for close to 5% of annual sales. In general, the literature depicts AI as a transformative, but emerging collaborator in forensic accounting. Its opportunities to provide better fraud detection are evident, unresolved issues around accountability, ethics and governance are persistent points of scholarly debate.

3. EVOLUTION OF AI IN FORENSIC ACCOUNTING

Forensic Forensic accounting is one thing that has always been the focus: to see the truth buried in the numbers. When the profession first appeared, accountants sat with ledgers, manually tracing each entry to identify fraud. It was a slow process, the slow and unhurried searching of thousands and thousands of pages of data by candlelight, like a detective. Then there were computers at the end of the 20th century. Suddenly, spreadsheets superseded manual ledgers, and auditors could scour their computer feeds for anomalies at the push of a button. But the fraudsters were changing as the technology advanced, with shell companies, digital transfers and cross-border accounts that could trick computer-based checks about a single operation. Artificial Intelligence (AI) started to take over here. Initially, it only consisted of small rules: “flag any transaction of more than ₹10,00,000” or “alert if the payment is made outside of work hours.” These early systems, however, were reminiscent of night guards with flashlights: practical but

easy for crafty thieves to escape. As statistics increased, and fraud got better, so did machine learning. Now systems could not only follow rules; they learned from patterns. If a thief moved money in unusual ways, the AI caught it. If emails between staff hinted at collusion, that's what Natural Language Processing (NLP)



picked up because things were going wrong. Fraudsters could no longer hide in plain sight. Now, the AI in forensic accounting has become a digital detective. It uses:

- **Graph analysis** to uncover hidden links between people, companies, and accounts.
- **Anomaly detection** to catch unusual spending behaviour.
- **Explainable AI** to make findings stand up in court rather than just a laboratory.

The evolution shows a clear path:

- **From ledgers to spreadsheets → From spreadsheets to AI-powered detection → From AI to explainable, courtroom-ready intelligence.**

For the future: self-learning forensic systems — AI that automatically learns how to work new fraud and new cases more quickly than criminals have the ability to create them. In short, forensic accounting has transformed from paper-and-pencil detectives to AI-driven truth-seekers. And the journey is far from over.

4. CORE AI TECHNIQUES RELEVANT TO FORENSIC ACCOUNTING

- **Supervised learning (classification/regression):** Using labelled historical examples (fraudulent/legitimate transactions) to identify recognized fraud patterns. Good for transaction scoring and alert prioritization.

- **Unsupervised learning & anomaly detection:** Detect anomalies when labeled fraud data is limited (clustering, isolation forest, autoencoders). Required for detecting new schemes.
- **Natural Language Processing (NLP):** Take entities, relations and sentiment from raw data—emails, contracts, chat logs and open source intelligence—all of which are unstructured and allow for the identification of evidence and a timeline.
- **Graph / network analysis:** Construct relationship graphs (owners, entities, transactions) to help expose concealed networks (money laundering, collusion). Suspicious clusters are also detected while network centrality and community detection.
- **Robotic Process Automation (RPA) + Intelligent Document Processing (IDP):** Automate routine data ingestion, reconciliation and document extraction to free humans for their analysis at a higher level.
- **Explainable AI (XAI):** Methods to derive human explanations (SHAP, LIME, rule extraction) necessary for professional skepticism, internal verification, and courtroom admissibility.

5. BENEFITS OF USING AI IN FORENSIC ACCOUNTING

Here are a few of the key ways in which AI underpins forensic accounting:

✓ **Detecting Unusual Transactions**

- AI can scan thousands of everyday transactions and flag the ones that "don't look normal."
- For example, if a vendor usually sends bills for ₹50,000 but suddenly submits one for ₹5,00,000, AI will flag it.

✓ **Spotting Hidden Connections**

- Fraud usually involves many people or companies collaboratively. AI could even create relationship maps between accounts, emails and companies that display hidden connections.
- It's connecting dots humans wouldn't recognize.

✓ **Reading Documents and Emails**

- Forensic teams are often confronted with millions of emails and documents in large cases — or similar ones. AI can rapidly read this, recognize the critical names, dates, and suspicious terms and provide investigators a shortlist to hone in on.

✓ **Learning From the Past**

- If investigators feed AI earlier cases of fraud, the system "learns" these patterns and in future cases is able to adapt as well.
- AI gains the same skills as an experienced accountant who over time gradually makes more and more data.

✓ **Helping in Court Cases**

- AI can write clear reports and create timelines that will help evidence in the courtroom. But investigators must still be able to explain the results in layman's terms for judges and attorneys.

✓ **Speed:** AI saves humans time reviewing millions of records in minutes, speeding up the human response.

✓ **Accuracy:** AI can see patterns humans tend to overlook in general—or miss altogether.

✓ **Cost Savings:** : People spend less money than if they can catch people the minute they spot problems quicker.

✓ **Stronger Evidence:** AI can draw together various forms of data — numbers, text, emails — to paint a fuller picture.

6. ILLUSTRATIVE (HYPOTHETICAL) CASE EXAMPLES

- **Transactional anomaly detection:** An ML ensemble trained on 3 years of payment data spotted a small aggregation of vendor payments with odd routing and round-dollar sums. An overview of beneficiary accounts on various subsidiaries tied beneficiary accounts together to a single third party. The jointly AI+graph workflow cut triage time down from a few weeks to days.
- **Email contract extraction + NLP:** An NLP pipeline used to extract suspicious clauses and to map signature timelines of thousands of vendor contracts, combined with payment traces, was used to establish a changed pattern of contracts used to justify fraudulent disbursements.
- **Contract Risk Extraction via NLP:** Alvanchi et al. (2024) investigated how voluminous contracts — particularly those written in complex or non-English scripts — mask "risky" or unfair clauses. Their NLP pipeline performed tasks on thousands of contract texts; e.g., extracted entities, clauses and signature timelines mapping. The precision of their model demonstrates that AI-based document review is more than just theoretical – it can uncover contracts that in their view have been altered, misaligned or subtly manipulated that went unnoticed under manual review.
- **Systematic review of graph-based anomaly detection:** Pourhabibi et al. (2020) presented a meta-review with a general overview of all academic and scientific literature on Graph-Based Anomaly Detection (GBAD) used in fraud detection. Their results indicate that GBAD methods become more and more employed to model the links from network (people, companies, accounts) connections for fraud detection.
- **Bank Fraud Case:** A big bank detected suspicious remittances at midnight. AI flagged them, and the investigators discovered an employee was wiring small amounts into personal accounts. This pattern might have gone unnoticed for years without AI.
- **Graph computing for financial crime detection:** Kurshan & Shen (2021) provide an overview of trends and challenges in using graph-based AI for detection of financial crime. They suggested that traditional rule-based fraud detection fails in complex transaction networks and graph methods can reveal hidden connections between entities.
- **Vendor Overbilling:** A company deployed AI to scan years of vendor bills. The system discovered one vendor who charged 10% more than average for the same materials. This led to the discovery of a bribery scheme between the vendor and a company manager.
- **Graph-based detection of shell companies:** Silva, Felix & Carvalho (2024) studied fraud supported by shell companies issuing "cold" invoices (invoices for operations that never occurred). They used supervised and semi-supervised machine learning techniques to flag suspicious groups of companies issuing such invoices, achieving high recall in unbalanced datasets.
- **Email Collusion:** for example, read through 50,000 emails in a single night and identified a group of employees planning to manipulate invoices. Human investigators could never have done this in time. Apurv Mittal et al. (2022) developed a framework applying natural language processing and machine learning to detect phishing emails. Their "DARTH" framework processed email body text and metadata to classify emails as phishing or legitimate, achieving over 99% precision and F1-score.

7. LEGAL, ETHICAL AND GOVERNANCE CHALLENGES

- **Admissibility & Transparency:** Judges and lawyers are increasingly interrogating how AI models arrive at conclusions — and, in courtrooms, how they reach them. They want evidence to be replicable and well-documented to satisfy discovery rules.
- **Bias & Fairness:** Certain types of vendors, regions, or cases might be flagged improperly if their training data includes hidden bias. Consistently testing biases and using balanced datasets are critical to

establishing credibility.

- **Regulatory Oversight:** Regulators have cautioned that many firms do not measure how AI impacts audit or investigative quality. This highlights the need for clear KPIs, independent checks, and strong governance to ensure accountability.
- **False Positives:** Poorly tuned systems may raise workloads, damage reputation, and even risk flawed legal outcomes.
- **Cybersecurity & Privacy:** Forensic data is highly sensitive, demanding strict protections against leaks, tampering, and full compliance with laws such as GDPR.

8. BEST PRACTICE RECOMMENDATIONS

- **Blend Human Insight with AI Power:** AI alone provides speed and scale, but ensure that human experts remain involved to provide judgment, context, and ethical balance. A mixture of human insight with AI will help ensure fairness.
- **Keep Clear Documentation:** Record every step—model design, data sources, validation results, and investigator notes—so audits and legal reviews remain transparent.
- **Monitor Continuously:** Ensure key performance indicators are regularly tracked, and model drift is detected to confirm reliability over time.
- **Use Independent Reviews:** Engage external auditors to validate AI systems, notably in sensitive or high-risk cases.
- **Build Staff Literacy:** Train forensic teams in basic data science so they can interpret and challenge AI outputs when necessary.
- **Demand Explainability:** Require transparent, explainable AI (XAI) outputs whenever findings may enter litigation.

9. RISKS AND LIMITATIONS OF CURRENT AI APPROACHES

- **Data Scarcity:** Successful supervised learning relies on very large numbers of labelled fraud cases, which are often scarce. Without sufficient examples, AI models will fail to accurately identify fraudulent patterns, limiting their usefulness in practical investigations.
- **Evolving Fraud Techniques:** Fraudsters constantly change their methods. AI models must be regularly updated to adapt to new schemes, or older detection patterns will become obsolete.
- **Explainability vs. Performance:** Explainable models tend to be simpler and may sacrifice accuracy. Maintaining the balance between transparency and predictive power is a continual challenge.
- **Legal and Regulatory Uncertainty:** Courts are still trying to establish consistent standards for AI-derived evidence. Questions about reliability and admissibility can arise if investigators cannot clearly explain how models arrive at conclusions.
- **Over-reliance and Human Oversight:** Blind trust in AI can allow mistakes to be overlooked. Human analysts need to review outputs to ensure errors or anomalies are properly interpreted.
- **Bias in Historical Data:** If training data has biases—such as over-representing certain regions or vendors—the AI system may perpetuate those biases, flagging some entities unfairly.
- **False Positives:** AI may incorrectly flag legitimate transactions as suspicious. While these errors help ensure nothing is missed, they also increase workload and can divert investigative resources.

10. POLICY AND PROCEDURES FOR SAFE AI USE FUTURE DIRECTIONS

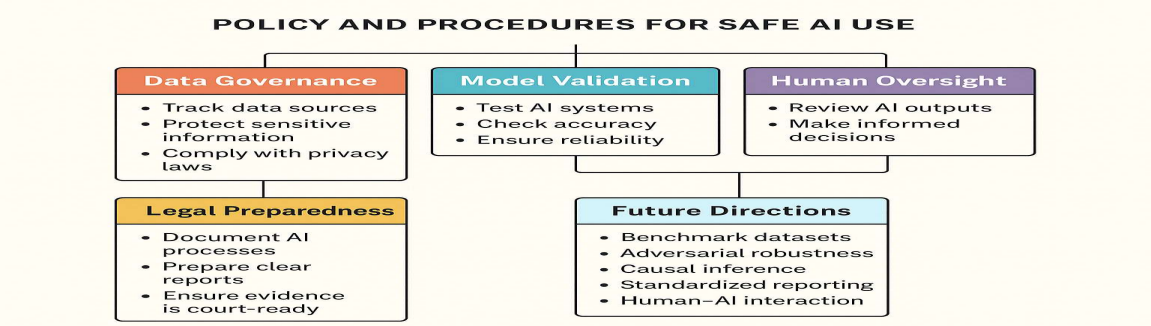
✓ **Data Governance:** Organizations should closely track where their data comes from and ensure that this data is accurately recorded. We need strong passwords, access control, and encryption to protect sensitive information. Compliance with privacy laws for storing secure, responsible data minimizes risk of breaches or legal concerns.

✓ **Model Validation:** AI systems should have valid tests before usage to see if they are accurate and what is incorrect. The models must be retested regularly and perform checks, especially as fraud patterns evolve over time, in order to help ensure their continued reliability.

✓ **Legal Preparedness:** Clear documentation of AI processes, including model logic, training data, and analysis methods is essential. The reports need to be accessible to lay people and presented to court in a way which allows AI-powered content to be reviewed and presented for legal action.

✓ **Human Oversight:** AI outputs should never be blindly acted upon. The forensic accountants have to go through and read and interpret them.

✓ **Future Directions:** Benchmark datasets will enable more comparable methods. Research in adversarial robustness assists models in resisting manipulation. Causal inference approaches explain the presence of anomalies, and the following can be employed in courts using standardized reporting templates. Human–AI interaction makes it more optimal for analysts in optimizing workflows and feedback to avoid risks associated with any AI tool making tools ineffective, unreliable, or ill-suited to solve real-world problems so it becomes reliable, responsible, and useful.



11. THE BALANCE – HUMANS AND MACHINES

AI is quick, powerful and tireless. But it occasionally makes mistakes — occasionally flagging normal behaviour as fraud or overlooking sly tricks. Which is why the future isn't about replacing accountants with machines. Rather, it's to help create a partnership:

- **AI = the tireless assistant** (who never sleeps and can scan endless data 24/7).
- **Forensic accountant = the wise detective** (who knows the law, ethics, and human psychology).

Together, they make fraudsters' lives much harder.

✓ **A Safer Tomorrow**

Fraud will never disappear completely—just like crime never vanishes from stories. But with **forensic accounting + AI**, we can catch fraudsters faster, save companies from losses, and protect society's trust. **AI is not the detective. AI is the magnifying glass. The real detective is still human.**
Together, they can ensure that the invisible thief has nowhere left to hide.

12. CONCLUSION

Artificial Intelligence is changing forensic accounting by improving analysis, identifying hidden patterns, and accelerating investigations. Still, AI can never replace expert insight and judgment. Well-designed forensic exams depend on harmonizing the knowledge of the domain and of the tool which can employ AI, and on the right combination of regulation, transparency and legal preparedness. With proper

validation, the ability to follow up and proper documents — organizations that use AI responsibly and with a degree of responsibility — the fraud detection can be more efficient with the minimum legal/reputational risks. Fraud poses a global challenge to businesses, and methods remain traditionally ineffective on their own. Forensic accountants offer vital human judgement, and AI gives us the ability to process and analyze data from huge databases at record speed. Together they constitute a strong team: AI is an on-the-job assistant and humans are the "strategic actors." Forensic accounting's future isn't people replacing machines but a trustful, team-based process, powered by humans and AI, that improves fraud detection and maintains effective financial control.

"Fraud may hide in the shadows, but with vigilance and intelligence, it cannot escape the light."

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પ્રવાસન ઉદ્યોગના વિકાસમાં કચ્છ જિલ્લાનો ફાળો

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સારાંશ

કચ્છ જિલ્લો તેની વૈવિધ્યસભર ભૌગોલિક રચના, સંસ્કૃતિ અને ઐતિહાસિક વારસાને કારણે ગુજરાતના મહત્વના પર્યટન સ્થળોમાં સ્થાન ધરાવે છે. આ સંશોધનનો મુખ્ય હેતુ કચ્છ જિલ્લાના પ્રવાસન ઉદ્યોગના વિકાસમાં થયેલા યોગદાનને અનુસંધાનમાં રાખીને વિદેશી અને સ્થાનિક પર્યટકોના અભિપ્રાયો, વલણો અને પ્રવાસન માર્ગમાં આવતા વિઘ્નોનું મૂલ્યાંકન કરવાનું છે. સંશોધન માટે કચ્છના મુખ્ય પ્રવાસન સ્થળો જેવા કે ધોળાવીરા, માંડવી બીચ, લક્ષ્મી વિલાસ પેલેસ, કાળોડુંગર, રોયલ ચાર્ટર્ડ હાઉસ, આયનામહેલ સંગ્રહાલય અને મ્યુઝિયમની મુલાકાત લેનાર 220 પ્રવાસીઓ પાસેથી માહિતી એકત્રિત કરવામાં આવી.

અધ્યયન દર્શાવે છે કે કચ્છનો પ્રવાસન ઉદ્યોગ સતત વિકાસ પામતો રહ્યો છે, પરંતુ હજુ પણ પરિવહન, રહેઠાણ, સ્વચ્છતા અને સ્થાનીક સંસાધનોની અછત જેવી કેટલીક મુશ્કેલીઓ છે. સંશોધનના તારણો સૂચવે છે કે કચ્છના પર્યટન વિકાસ માટે સુવિધાઓમાં સુધારો, પ્રવેશ માર્ગોની ઉપલબ્ધતા અને યાત્રીઓ માટે માર્ગદર્શક વ્યવસ્થાઓમાં સુધારાની તાતી જરૂર છે.

ચાવીરૂપ શબ્દો: કચ્છ જિલ્લો, પ્રવાસન ઉદ્યોગ, ધોળાવીરા, રણ ઉત્સવ, પર્યટન વિકાસ, ગુજરાત પ્રવાસન

1. પ્રસ્તાવના

ભારતમાં પ્રવાસન ઉદ્યોગ સૌથી ઝડપી વિકસતા ક્ષેત્રોમાંનું એક છે. ગુજરાત રાજ્ય ખાસ કરીને પર્યટન ક્ષેત્રે વિકાસશીલ છે, જેમાં કચ્છ જિલ્લાનું મહત્વપૂર્ણ યોગદાન છે. કચ્છ તેની અનન્ય પ્રાકૃતિક સૌંદર્ય, ઐતિહાસિક સ્થળો, સંસ્કૃતિ અને લોકજીવન માટે પ્રસિદ્ધ છે. દર વર્ષની જેમ, રણ ઉત્સવ અને કચ્છના વિવિધ ઐતિહાસિક અને ધાર્મિક સ્થળો હજારો પર્યટકોને આકર્ષે છે (Gujarat Tourism, 2020).

કચ્છ જિલ્લાની ભૌગોલિક રચના, જેમાં રણ, દરિયા કિનારા અને ઐતિહાસિક કિલ્લાઓનો સમાવેશ થાય છે, એ પ્રવાસન ઉદ્યોગ માટે અનુકૂળ પરિસ્થિતિઓ ઉભી કરે છે (Sharma & Patel, 2019). ધોળાવીરા જેવા વિશ્વ વારસા સ્થળ અને માંડવી બીચ જેવા લોકપ્રિય પ્રવાસન સ્થળો કચ્છને રાષ્ટ્રીય અને આંતરરાષ્ટ્રીય સ્તરે નોંધપાત્ર બનાવે છે (UNESCO, 2021).

આ સંશોધન કચ્છના પ્રવાસન ઉદ્યોગના વિકાસ, તેના પર્યટકોના અભિપ્રાયો અને વલણો તેમજ પ્રવાસન ક્ષેત્રે રહેલા પડકારોને વિશ્લેષિત કરે છે. કચ્છની મુલાકાત લેતા 220 પ્રવાસીઓના અભિપ્રાયના આધારે, પ્રવાસન

ઉદ્યોગના વિકાસમાં રહેલી તકો અને અવરોધોનું વિશ્લેષણ કરવામાં આવ્યું છે. આ અભ્યાસની મુખ્ય ઉદ્દેશ્ય કચ્છના પ્રવાસન ઉદ્યોગને વધુ સુદૃઢ બનાવવાના માર્ગો અને વિકાસ માટે જરૂરી સુધારા માટે સુચનાઓ પ્રદાન કરવાનો છે.

2. સંશોધનના હેતુઓ

- પ્રવાસન ઉદ્યોગના વિકાસમાં કચ્છ જિલ્લાનો ફાળો તપાસવો અને તેના તારણો રજૂ કરવા.
- વિદેશી અને સ્થાનિક પર્યટકોની આકર્ષવા માર્ગદર્શિક થવા માટે થઈ ને કચ્છ જિલ્લાની મુલાકાત લેતા પ્રવાસીઓના અભિપ્રાયો, વલણો અને પ્રવાસન માર્ગમાં આવતા વિઘ્નો તપાસવા અને તેના નિરાકરણો આપવા.

3. સાહિત્ય સમીક્ષા

કચ્છ જિલ્લો તેની વૈવિધ્યસભર ભૌગોલિક રચના, સંસ્કૃતિ અને ઐતિહાસિક વારસાને કારણે ગુજરાતના મહત્વના પ્રવાસન સ્થળોમાં સ્થાન ધરાવે છે. આ જિલ્લો રણ ઉત્સવ, ધોળાવીરા જેવા સિંધુ સંસ્કૃતિના અવશેષો, ભુજના દરબારગઢ, માનકેશ્વર મહાદેવ અને અનેક મંદિરો તથા કિલ્લાઓ માટે પ્રસિદ્ધ છે. કચ્છ જિલ્લામાં પ્રવાસન ઉદ્યોગનો વિકાસ પ્રાદેશિક અર્થતંત્ર અને સામાજિક-સાંસ્કૃતિક પ્રગતિ માટે મહત્વપૂર્ણ બન્યો છે.

પ્રવાસન ઉદ્યોગની વ્યાખ્યા અને મહત્વ અંગે વિવિધ અભ્યાસો જણાવે છે કે કોઈ પણ પ્રદેશમાં પ્રવાસન ઉદ્યોગનું વિકાસ પાયકીય માળખાં, સરકારની નીતિઓ, પર્યટક માટે ઉપલબ્ધ સુવિધાઓ અને સંસ્કૃતિવશિષ્ટ આકર્ષણો પર આધાર રાખે છે (Smith, 2018).

વર્ષો દરમિયાન કચ્છ જિલ્લાનું પર્યટન ઉદ્યોગ તરીકેનું મહત્વ વધ્યું છે. ભારત સરકાર અને ગુજરાત ટૂરિઝમ બોર્ડ દ્વારા રણ ઉત્સવની શરૂઆત (Gujarat Tourism, 2020) અને ધોળાવીરા જેવા સ્થળોને વિશ્વ વારસા સ્થળ તરીકે માન્યતા મળવાથી (UNESCO, 2021), કચ્છનું પર્યટન વૈશ્વિક સ્તરે પ્રભાવશાળી બન્યું છે.

ગુજરાત સરકાર દ્વારા 2005 પછી રાજ્યમાં પર્યટન ઉદ્યોગને પ્રોત્સાહન આપવા માટે વિવિધ યોજનાઓ અમલમાં મૂકી છે (Sharma & Patel, 2019). ખાસ કરીને, કચ્છ જિલ્લામાં ઈન્ફ્રાસ્ટ્રક્ચર અને હોટેલ ઉદ્યોગ માટે મોટી રોકાણ યોજના અમલમાં મુકવામાં આવી છે.

પર્યટન ઉદ્યોગ કચ્છના સ્થાનિક આર્થિક વિકાસમાં મુખ્ય ભૂમિકા ભજવે છે (Bhatt, 2017). રણ ઉત્સવ જેવી પ્રવૃત્તિઓ હસ્તકલા ઉદ્યોગ, સ્થાનિક વેપાર અને રોજગાર વધારવામાં મદદરૂપ બની છે.

કચ્છ જિલ્લો ગુજરાતના મહત્વના પર્યટન સ્થળ તરીકે વિકસિત થયો છે. ગુજરાત સરકાર અને કેન્દ્ર સરકારની નીતિઓ, ઈન્ફ્રાસ્ટ્રક્ચર વિકસાવવા માટેના પ્રયાસો અને સ્થાનિક પર્યટન હેતુઓએ કચ્છને વિશ્વના પ્રવાસન નકશા પર મૂક્યો છે.

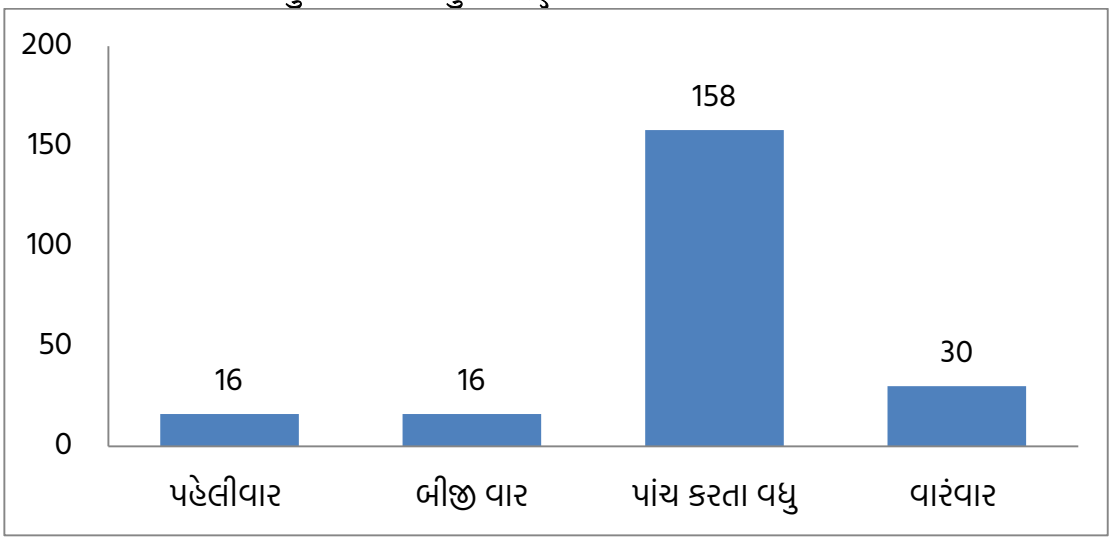
4. સંશોધન પદ્ધતિશાસ્ત્ર

પ્રસ્તુત સંશોધનમાં કચ્છ જિલ્લામાં ધોળાવીરા, માંડવી બીચ, લક્ષ્મી વિલાસ પેલેસ, કાળોડુંગર, રોયલ ચાર્ટર્ડ હાઉસ, આયનામહેલ સંગ્રહાલય અને કચ્છના મ્યુઝિયમ જેવા અનેક લોકપ્રિય સ્થળોની મુલાકાત લેવામાં આવેલા 220 પ્રવાસીઓ પાસેથી તેમના અભિપ્રાયોને જાણી, તેમના વલણોનું મૂલ્યાંકન કરવામાં આવ્યું છે.

આ સાથે જ કચ્છના પ્રવાસન માર્ગમાં આવતા વિવિધ વિઘ્નો, જેમાં પરિવહન સુવિધાઓની અછત, રહેઠાણ અને સફાઈ જેવી મૌલિક જરૂરીયાતોનો અભાવ, તેમજ સ્થાનીક સંસાધનો અને મૌસમી પરિસ્થિતિઓના પડકારોનો પણ વિશ્લેષણ કરવામાં આવ્યો છે.

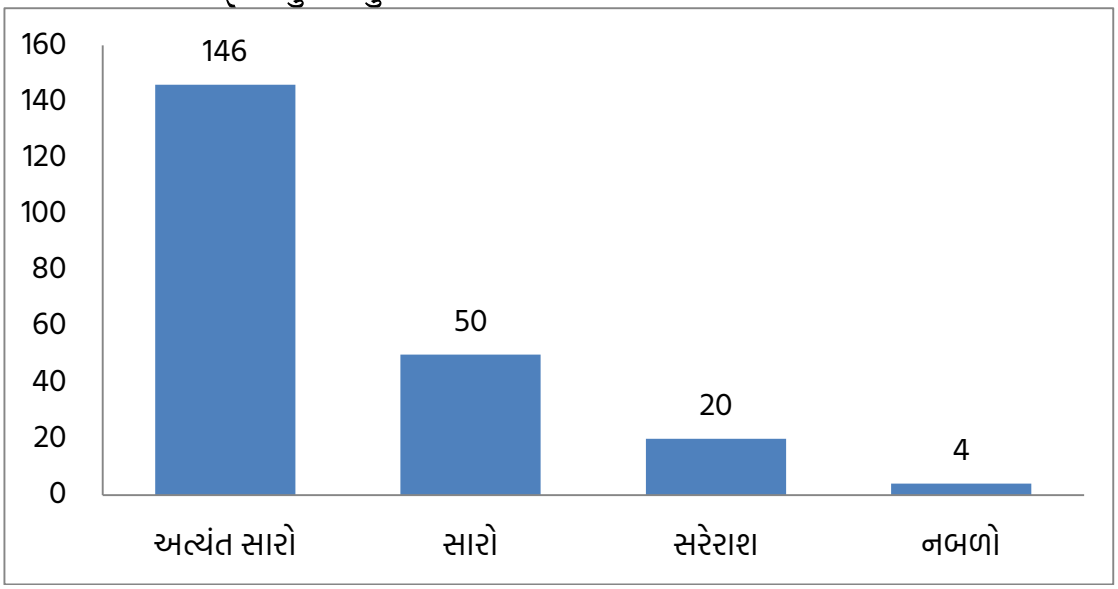
5. પૃથક્કરણ અને અર્થઘટન

- **કચ્છ માટેની સંખ્યાબંધ મુલાકાતો અંગેનું વિવરણ**



ઉપરોક્ત ગ્રાફ પરથી જાણવા મળે છે કે 158 પ્રવાસીઓએ કચ્છની પાંચ કરતા વધુ વખત મુલાકાત લીધી છે, જે દર્શાવે છે કે તેઓ કચ્છના પ્રવાસન સ્થળોથી ખૂબ પ્રભાવિત થયા છે અને વારંવાર અહીંની મુલાકાત લેવાની તેમની ઈચ્છા છે. 30 પ્રવાસીઓએ વારંવાર કચ્છની મુલાકાત લીધી છે, જે તેમના કચ્છ પ્રત્યેના આકર્ષણ અને આ પ્રદેશમાં પ્રવાસન સુવિધાઓ માટેની સંતુષ્ટિ તરફ ઈશારો કરે છે. 16 પ્રવાસીઓએ પ્રથમવાર કચ્છની મુલાકાત લીધી હતી, જ્યારે 16 અન્ય પ્રવાસીઓએ બીજીવાર કચ્છની મુલાકાત લીધી છે, જેનો અર્થ એ છે કે આ વિસ્તાર નવા પ્રવાસીઓને પણ આકર્ષે છે અને તેમને ફરીથી આવીને અન્વેષણ કરવા માટે પ્રોત્સાહિત કરે છે.

- **કચ્છ જિલ્લાની સફરમાં કુલ અનુભવ**



ઉપરોક્ત કોષ્ટક પરથી જાણવા મળે છે કે 146 પ્રવાસીઓએ તેમના પ્રવાસને 'અત્યંત સારો' ગણાવ્યો છે, જેનો અર્થ એ છે કે કચ્છના પ્રવાસન સ્થળોએ તેમને ખૂબ જ સારા અનુભવ સાથે સમૃદ્ધિ મળી. 50 પ્રવાસીઓએ તેમના અનુભવને 'સારો' તરીકે વર્ણવ્યો છે, જ્યારે 20 પ્રવાસીઓએ 'સરેરાશ' અનુભવ કર્યો. માત્ર 4 પ્રવાસીઓએ 'નબળો' અનુભવ દર્શાવ્યો છે, જે કચ્છના પ્રવાસન માટેની કેટલીક ચુનૌતીઓને સૂચવે છે. આંકડા દર્શાવે છે કે કુલ મળીને 89% જેટલા પ્રવાસીઓએ કચ્છમાં સારો અથવા અત્યંત સારો અનુભવ કર્યો છે, જે કચ્છના પ્રવાસન ઉદ્યોગની યશસ્વિતા અને પ્રવાસીઓ માટેની આકર્ષણ ક્ષમતાને દર્શાવે છે. તથાપિ, 'નબળો' અને 'સરેરાશ' અનુભવ કરનારા થોડા પ્રવાસીઓ દ્વારા સૂચવાયેલા થોડાક વિઘ્નો અથવા અડચણોને સમાધાન કરવા માટે પ્રયત્ન કરવાની જરૂરિયાત જણાઈ છે

6. ઉપસંહાર

કચ્છ જિલ્લાનો પ્રવાસન ઉદ્યોગ વિકાસમાં નોંધપાત્ર છે, પરંતુ વિવિધ પ્રસંગોમાં કચ્છના પ્રવાસીઓના અભિપ્રાયોએ કેટલીક જરૂરીયાતોને આદર્શ રીતે પ્રગટ કર્યો છે. 220 પ્રવાસીઓ દ્વારા ભેગા કરવામાં આવેલ પ્રશ્નાવલીઓના આધારે, માર્ગ અને પરિવહન વ્યવસ્થાની સ્થિતિમાં સુધારવાની જરૂરિયાતને સારી રીતે વ્યક્ત કરવામાં આવી છે. તેમજ, રોડ અને માર્ગોની મૌલિક સુવિધાઓમાં સુધારો કરવો, જેઓ પ્રવાસીઓને મુસાફરીમાં મદદરૂપ બને, તે મહત્વપૂર્ણ છે.

આ ઉપરાંત, એ વૈશ્વિક પુરાણિત્વની સફરે સામેલ જગ્યાઓની સફાઈ, જાળવણી અને સંરક્ષણ માટે યોગ્ય વ્યવસ્થા કરવાના અભાવની પણ નોંધ લેવામાં આવી છે. ઐતિહાસિક સ્થળોના ધ્યાનમાં રાખતા, પ્રવાસીઓને સાચું અને યોગ્ય માહિતી આપવા માટે કુશળ ગાઈડ્સની જરૂરીયાત છે, જેથી તેઓ સ્થાનીક ઈતિહાસને સારી રીતે સમજી શકે.

વૈવિધ્યપૂર્ણ સ્થળો, જેમ કે ધોળાવીરા, જામ અબડાની જગ્યા, અને હાજી પીરની જગ્યા જેવી ઓછા જાણીતા ઐતિહાસિક સ્થળોને વધારાની જાહેરકારી અને મુસાફરી માટેની સુવિધા વધારવા પર ભાર મૂકવામાં આવ્યો છે. સાથે જ, ખાદ્ય અને રહેઠાણની સુવિધાઓમાં સુધારો કરવાની જરૂરિયાત પણ જણાવી છે, જેથી પ્રવાસીઓ માટે પ્રાથમિક જરૂરિયાતો પૂરી કરી શકાય.

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શિક્ષણ અને ICT

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એબસ્ટ્રેક :

વર્તમાન યુગને 'માહિતી યુગ' (Information Age) તરીકે ઓળખવામાં આવે છે, જ્યાં શિક્ષણ પ્રણાલી ત્રણ મુખ્ય પરિબળોના પ્રભાવ હેઠળ કાર્યરત છે. જ્ઞાન વિસ્ફોટ, વસ્તી વિસ્ફોટ અને અપેક્ષાઓનો વિસ્ફોટ. જ્ઞાનનો ભંડાર અભૂતપૂર્વ ગતિએ વિસ્તરી રહ્યો છે, વિદ્યાર્થીઓની સંખ્યામાં સતત વધારો થઈ રહ્યો છે અને સમાજની શિક્ષણ પાસેથી અપેક્ષાઓ પણ વધી રહી છે. આ બદલાતા પરિદ્રશ્યમાં, માહિતી અને જ્ઞાન જીવનનું એક અનિવાર્ય પરિબળ બની ગયું છે. કમ્પ્યુટર ટેકનોલોજીના વિકાસની અસર જ્યારે જીવનના તમામ ક્ષેત્રો પર સ્પષ્ટપણે જોવા મળી રહી છે, ત્યારે શિક્ષણનું ક્ષેત્ર તેનાથી અળગું રહી શકે નહીં તે સ્વાભાવિક છે. શિક્ષણ પ્રણાલી માટે આ માત્ર સુધારાનો વિકલ્પ નથી, પરંતુ બદલાતા સમય સાથે તાલમેલ સાધવાની અનિવાર્યતા છે. આ પરિવર્તનની કેન્દ્રવર્તી ભૂમિકામાં માહિતી અને સંચાર તકનીકી (Information and Communication Technology - ICT) રહેલી છે. ICT એ માત્ર એક સાધન નથી, પરંતુ શિક્ષણના ઉદ્દેશ્યો, પદ્ધતિઓ અને પરિણામોને પુનઃવ્યાખ્યાયિત કરવાની ક્ષમતા ધરાવતું એક શક્તિશાળી માધ્યમ છે. શિક્ષણનો મૂળભૂત ઉદ્દેશ વિદ્યાર્થીઓની શૈક્ષણિક સિદ્ધિને ઉચ્ચ સ્તરે લઈ જવાનો હોય છે. આ ઉદ્દેશની પૂર્તિ માટે, પરંપરાગત શિક્ષણ પદ્ધતિઓની સાથે ICT જેવી આધુનિક પ્રવિધિઓની અસરકારકતા ચકાસવી અને તેને શિક્ષણ પ્રક્રિયામાં સંકલિત કરવી અત્યંત આવશ્યક બની ગયું છે. આ સંદર્ભમાં, ICT નો સમન્વય એ શિક્ષણને વધુ જીવંત, પ્રાસંગિક અને અસરકારક બનાવવાની ચાવી છે.

શિક્ષણ એટલે શું?

શિક્ષણની સંકલ્પના અત્યંત વ્યાપક અને બહુઆયામી છે. સામાન્ય રીતે, શિક્ષણનો સંકુચિત અર્થ ભણતર, એટલે કે વાંચન, લેખન અને ગણન જેવી પાયાની કુશળતા અથવા ઇતિહાસ, ભૂગોળ અને વિજ્ઞાન જેવા વિષયોનું જ્ઞાન મેળવવા તરીકે કરવામાં આવે છે. જોકે, શિક્ષણનો સાચો અર્થ આ સંકુચિત વ્યાખ્યાથી ઘણો વિશાળ છે. તે માત્ર માહિતીનો સંગ્રહ નથી, પરંતુ વ્યક્તિના વર્તનમાં થતો સકારાત્મક અને કાયમી ફેરફાર છે. સાચું શિક્ષણ ત્યારે જ પ્રાપ્ત થયું ગણાય જ્યારે મેળવેલા જ્ઞાનને દૈનિક જીવનમાં અપનાવવામાં આવે અને તેના ફળસ્વરૂપે વ્યક્તિના વર્તનમાં પરિવર્તન આવે.

વિવિધ કેળવણીકારોના મંતવ્યો :

વિશ્વભરના મહાન ચિંતકો અને કેળવણીકારોએ શિક્ષણને અલગ-અલગ દ્રષ્ટિકોણથી વ્યાખ્યાયિત કર્યું છે, જે તેના વ્યાપક સ્વરૂપને ઉજાગર કરે છે.

ભારતીય દ્રષ્ટિકોણ

ભારતીય પરંપરામાં શિક્ષણને આત્મ-વિકાસ અને ચારિત્ર્ય નિર્માણનું સર્વોચ્ચ સાધન માનવામાં આવ્યું છે. સ્વામી વિવેકાનંદના મતે, "માણસની અંતર્ગત પૂર્ણતાને વ્યક્ત કરવી એ શિક્ષણ છે". તેમનું માનવું હતું કે જ્ઞાન વ્યક્તિમાં પહેલેથી જ વિદ્યમાન છે, શિક્ષણનું કાર્ય માત્ર તેને પ્રગટ કરવાનું છે. તેઓ શિક્ષણને માત્ર રોજીરોટી કમાવવાનું સાધન ગણતા ન હતા, પરંતુ જે શિક્ષણ વ્યક્તિને જીવન-સંગ્રામમાં સમર્થ બનાવે, ચરિત્રબળ અને પરહિતની ભાવના જગાવે તેને જ સાચું શિક્ષણ માનતા હતા. મહાત્મા ગાંધીજીએ શિક્ષણને સર્વાંગી વિકાસ સાથે જોડ્યું હતું. તેમના મતે, "શિક્ષણનો અર્થ એ છે કે બાળક અને માણસના શરીર, મન અને આત્માનો સર્વાંગી અને ઉત્તમ વિકાસ". ડૉ. સર્વપલ્લી રાધાકૃષ્ણને પણ શિક્ષણને માનવ નિર્માણકારી પ્રક્રિયા ગણાવી હતી, જેનો ઉદ્દેશ માત્ર કુશળ કારીગરો નહીં, પણ સભ્ય માનવનું નિર્માણ કરવાનો છે.

પાશ્ચાત્ય દ્રષ્ટિકોણ

પાશ્ચાત્ય ફિલસૂફીમાં પણ શિક્ષણને માનવ વિકાસની એક ગહન પ્રક્રિયા તરીકે જોવામાં આવે છે. પ્લેટોના મતે, શિક્ષણ એ આત્માની વાતાવરણ તરફની પ્રતિક્રિયા છે જે જીવનપર્યંત ચાલે છે અને જેના ફળસ્વરૂપે વ્યક્તિત્વમાં નિરંતર પરિવર્તન અને વિકાસ થતો રહે છે. પ્રકૃતિવાદી ચિંતક રૂસો માનતા હતા કે શિક્ષણ એ બાળકોની જન્મજાત આંતરિક શક્તિઓનો વિકાસ છે. તેમણે શબ્દાળુ અને પુસ્તકિયા જ્ઞાનનો વિરોધ કરી, ક્રિયા દ્વારા અને પ્રકૃતિના સાનિધ્યમાં અપાતા શિક્ષણની હિમાયત કરી હતી.

શિક્ષણના ઉદ્દેશ્યો :

ઉપરોક્ત વ્યાખ્યાઓના આધારે, શિક્ષણના ઉદ્દેશ્યો સ્પષ્ટ થાય છે. શિક્ષણનો પ્રાથમિક ઉદ્દેશ માત્ર જ્ઞાન પ્રાપ્તિ કે રોજગારી મેળવવાનો નથી, પરંતુ વ્યક્તિનું બહુમુખી ઘડતર કરવાનો છે. તેનો હેતુ વ્યક્તિને પોતાની જાત સાથે, સમાજ સાથે અને પર્યાવરણ સાથે અનુકૂલન સાધતા શીખવવાનો છે, જેથી તે સ્વસ્થ અને સંતોષપૂર્વક જીવી શકે. શિક્ષણ વ્યક્તિમાં સિદ્ધિ પ્રેરણા જગાવે છે, જેનાથી તે બાહ્ય પુરસ્કાર માટે નહીં, પરંતુ આત્મસંતોષ અને સ્વ-સ્પર્ધા માટે ઉચ્ચ સ્તરની સફળતા પ્રાપ્ત કરવા પ્રયત્નશીલ બને છે. શિક્ષણનું સર્વોચ્ચ લક્ષ્ય માનવીના વ્યક્તિત્વના ભૌતિક અને માનસિક પરિમાણોથી આગળ વધીને તેના આત્માને સંસ્કારિત કરવાનું છે. તે વ્યક્તિમાં દિવ્ય ચેતના જગવીને તેને પરમ તત્વની અનુભૂતિ કરાવે છે, આમ તે વ્યક્તિનું 'પુરુષ' માંથી 'પુરુષોત્તમ'માં રૂપાંતર કરનારી શક્તિ છે.

પરંપરાગત શિક્ષણ :

શિક્ષણના ઇતિહાસમાં પરંપરાગત શિક્ષણ પદ્ધતિએ સદીઓથી જ્ઞાનના પ્રસારમાં મુખ્ય ભૂમિકા ભજવી છે. પ્રાચીન ગુરુકુળ પ્રણાલીથી લઈને આધુનિક વર્ગખંડ સુધી, આ પદ્ધતિનું માળખું મોટે ભાગે સમાન રહ્યું છે. આ પદ્ધતિને સમજવી એ ICT-આધારિત શિક્ષણના મહત્વ અને આવશ્યકતાને સમજવા માટેનો પાયો છે.

પરંપરાગત શિક્ષણ પદ્ધતિના લક્ષણો :

પરંપરાગત શિક્ષણ પદ્ધતિ મુખ્યત્વે શિક્ષક-કેન્દ્રિત (teacher-centric) અને વિષય-કેન્દ્રિત (content-centric) હોય છે. તેના મુખ્ય લક્ષણો નીચે મુજબ છે.

- **શિક્ષકની કેન્દ્રીય ભૂમિકા :** આ પદ્ધતિમાં શિક્ષક જ્ઞાનના મુખ્ય અને સક્રિય સ્ત્રોત તરીકે કાર્ય કરે છે. શિક્ષણ પ્રક્રિયાનું સંપૂર્ણ સંચાલન શિક્ષકના હાથમાં હોય છે.

- **વિદ્યાર્થીઓની નિષ્ક્રિય ભૂમિકા :** વિદ્યાર્થીઓ મોટે ભાગે નિષ્ક્રિય શ્રોતાની ભૂમિકામાં હોય છે. તેમનું મુખ્ય કાર્ય શિક્ષક દ્વારા અપાતી માહિતીને શાંતિથી સાંભળવી અને તેની નોંધ લેવાનું હોય છે. આ પદ્ધતિમાં વિદ્યાર્થીને માહિતી ભરવાના ગોદામ તરીકે જોવામાં આવે છે.
- **એકમાર્ગીય પ્રત્યાયન :** જ્ઞાનનો પ્રવાહ મુખ્યત્વે શિક્ષકથી વિદ્યાર્થી તરફનો, એટલે કે એકમાર્ગીય હોય છે. વિદ્યાર્થીઓ દ્વારા પ્રશ્નોત્તરી માટે મર્યાદિત અવકાશ હોય છે.
- **ચોક-ડસ્ટર અને પાઠ્યપુસ્તક :** આ પદ્ધતિના મુખ્ય શૈક્ષણિક સાધનો બ્લેકબોર્ડ/વ્હાઇટબોર્ડ, ચોક/માર્કર અને પાઠ્યપુસ્તક છે. જ્ઞાનનો આધાર મોટે ભાગે પાઠ્યપુસ્તકમાં રહેલી સામગ્રી પર નિર્ભર હોય છે.
- **નિશ્ચિત માળખું :** શિક્ષણ એક નિશ્ચિત સ્થળ (વર્ગખંડ) અને નિશ્ચિત સમયપત્રક મુજબ જ થાય છે. તેમાં લવચીકતાનો અભાવ જોવા મળે છે.
- **શિક્ષણનું સમીકરણ :** પરંપરાગત પદ્ધતિને આ સમીકરણ દ્વારા સમજી શકાય છે: શિક્ષણ = શાળા, શીખવવું = કહેવું, શીખવું = સાંભળવું.

પરંપરાગત શિક્ષણ પદ્ધતિની મર્યાદાઓ :

જ્યારે પરંપરાગત પદ્ધતિએ પેઢીઓનું ઘડતર કર્યું છે, ત્યારે આધુનિક સમયના સંદર્ભમાં તેની કેટલીક ગંભીર મર્યાદાઓ સ્પષ્ટપણે ઉભરી આવી છે

- **વ્યક્તિગત ભિન્નતાની અવગણના :** વર્ગખંડમાં ઉચ્ચ, મધ્યમ અને નિમ્ન બુદ્ધિસ્તર ધરાવતા, તેમજ ભિન્ન રસ, રુચિ અને શીખવાની શૈલી ધરાવતા વિદ્યાર્થીઓ હોય છે. શિક્ષક-કેન્દ્રિત પદ્ધતિમાં દરેક વિદ્યાર્થી પર વ્યક્તિગત ધ્યાન આપવું અને તેમની જરૂરિયાતોને સંતોષવી લગભગ અશક્ય બની જાય છે.
- **નિષ્ક્રિય શિક્ષણ અને ગોખણપટ્ટી :** વિદ્યાર્થીઓની નિષ્ક્રિયતાને કારણે તેઓ જ્ઞાનના નિર્માણમાં ભાગીદાર બનવાને બદલે માત્ર તેના ગ્રાહક બની રહે છે. આનાથી વિષયની ઊંડી સમજ કેળવવાને બદલે ગોખણપટ્ટીને પ્રોત્સાહન મળે છે.
- **મર્યાદિત સંસાધનો :** જ્ઞાનનો સ્ત્રોત માત્ર શિક્ષક અને પાઠ્યપુસ્તક સુધી સીમિત રહી જાય છે, જે જ્ઞાન વિસ્ફોટના યુગમાં અત્યંત અપૂરતું છે.
- **આંતરવૈયક્તિક સંવાદનો અભાવ :** ભલે શિક્ષક અને વિદ્યાર્થીઓ એક જ સ્થળે હાજર હોય, પરંતુ એકમાર્ગીય પ્રત્યાયનને કારણે તેમની વચ્ચે સાચા અર્થમાં આંતરવૈયક્તિક સંવાદ અને વૈચારિક આદાન-પ્રદાનનો અભાવ રહે છે.

ICT એટલે શું?

માહિતી અને સંચાર તકનીકી (Information and Communication Technology - ICT) એ એક વ્યાપક અને ગતિશીલ સંકલ્પના છે જેણે આધુનિક વિશ્વના દરેક પાસાને પ્રભાવિત કર્યું છે. સરળ શબ્દોમાં, ICT એ એવા તમામ તકનીકી સાધનો, સંસાધનો અને પ્રણાલીઓનો સમૂહ છે જેનો ઉપયોગ માહિતીને ડિજિટલ સ્વરૂપમાં દાખલ કરવા, સંગ્રહ કરવા, તેના પર પ્રક્રિયા કરવા, તેને પ્રસ્તુત કરવા અને તેનું પ્રત્યાયન (આદાન-પ્રદાન) કરવા માટે થાય છે. તે મુખ્યત્વે કમ્પ્યુટર હાર્ડવેર, સોફ્ટવેર, નેટવર્કિંગ અને ટેલિકમ્યુનિકેશન તકનીકોનું સંયોજન છે જે ડિજિટલ વિશ્વ સાથેની આપણી આંતરક્રિયાને શક્ય બનાવે છે.

ICT ના મૂળભૂત ઘટકો :

ICT ની સંકલ્પના ત્રણ મૂળભૂત ઘટકો પર આધારિત છે, જે નીચે મુજબ છે

1. **માહિતી (Information) :** માહિતી એ પ્રક્રિયા થયેલ ડેટા (Processed Data) છે. જ્યારે અવ્યવસ્થિત ડેટાનું એકત્રીકરણ, વિશ્લેષણ અને સંયોજન કરવામાં આવે છે, ત્યારે તેમાંથી અર્થપૂર્ણ અને સંદર્ભયુક્ત નીપજ પ્રાપ્ત થાય છે, જેને માહિતી કહેવાય છે. ઉદાહરણ તરીકે, વિદ્યાર્થીઓના કાચા ગુણ એ ડેટા છે, પરંતુ તે ગુણ પરથી તૈયાર થયેલું પરિણામપત્રક, જેમાં ટકાવારી અને શ્રેણી જેવી વિગતો હોય, તે માહિતી છે.

2. **પ્રત્યાયન (Communication) :** પ્રત્યાયન એ જ્ઞાન, વિચારો, ખ્યાલો, લાગણીઓ અને માહિતીને યોગ્ય સંકેતો અને માધ્યમો દ્વારા એક વ્યક્તિ કે સ્થળેથી બીજા વ્યક્તિ કે સ્થળ સુધી પહોંચાડવાની પ્રક્રિયા છે. તે માત્ર માહિતીનું પ્રસારણ નથી, પરંતુ તેના મૂળ અર્થમાં તેની સમજણ અને સ્વીકૃતિ પણ સામેલ છે. શિક્ષણના સંદર્ભમાં, શિક્ષક દ્વારા અપાતું જ્ઞાન વિદ્યાર્થીઓ સુધી યોગ્ય રીતે પહોંચે અને તેઓ તેને સમજી શકે, ત્યારે સફળ પ્રત્યાયન થયું ગણાય.

3. **તકનીકી (Technology) :** તકનીકી એટલે વૈજ્ઞાનિક જ્ઞાન અને સિદ્ધાંતોનો વ્યવહારુ ઉપયોગ કરીને માનવજીવનને વધુ ઉન્નત અને ઉત્કૃષ્ટ બનાવવા માટે સાધનો, ઉપકરણો અને પદ્ધતિઓનો વિકાસ કરવાની પ્રક્રિયા. કમ્પ્યુટર, સ્માર્ટફોન, ઈન્ટરનેટ, સેટેલાઈટ વગેરે તકનીકીના ઉદાહરણો છે જે માહિતીના સર્જન, સંગ્રહ અને પ્રસારને અભૂતપૂર્વ ગતિ અને વ્યાપ આપે છે.

ICT પ્રણાલીના ઘટકો :

એક સંપૂર્ણ ICT પ્રણાલીને પાંચ મુખ્ય કાર્યાત્મક ઘટકોમાં વિભાજિત કરી શકાય છે.

1. **એકત્રિત કરવાની ટેકનોલોજી (Input Technology) :** આ ટેકનોલોજી દ્વારા માહિતીને એકઠી કરી તેને ડિજિટલ સ્વરૂપમાં પરિવર્તિત કરવામાં આવે છે. દા.ત. કીબોર્ડ, માઉસ, સ્કેનર, માઈક્રોફોન.

2. **સંગ્રહ કરવાની ટેકનોલોજી (Storage Technology) :** આ ટેકનોલોજી ડિજિટલ માહિતીનો સંગ્રહ કરે છે. દા.ત. હાર્ડ ડિસ્ક, પેન ડ્રાઈવ, ક્લાઉડ સ્ટોરેજ.

3. **પ્રોસેસિંગ ટેકનોલોજી (Processing Technology) :** સોફ્ટવેર અને એપ્લિકેશન્સની મદદથી સંગ્રહિત માહિતી પર પ્રક્રિયા કરી તેને ઉપયોગી સ્વરૂપમાં ફેરવવામાં આવે છે. દા.ત. માઈક્રોપ્રોસેસર (CPU).

4. **પ્રત્યાયન ટેકનોલોજી (Communication Technology) :** આ ટેકનોલોજી ડિજિટલ માહિતીને એક ઉપકરણથી બીજા ઉપકરણ સુધી પહોંચાડે છે. દા.ત. ઈન્ટરનેટ, Wi-Fi, મોડેમ, નેટવર્ક કેબલ્સ.

5. **ડિસ્પ્લે ટેકનોલોજી (Output Technology) :** આ ટેકનોલોજી દ્વારા પ્રોસેસ થયેલી માહિતીને માનવ સમજી શકે તેવા સ્વરૂપમાં (દ્રશ્ય કે શ્રાવ્ય) રજૂ કરવામાં આવે છે. દા.ત. મોનિટર, પ્રિન્ટર, સ્પીકર, પ્રોજેક્ટર.

આમ, ICT એ એક સંકલિત પ્રણાલી છે જે માહિતીના જીવનચક્રના દરેક તબક્કાને આવરી લે છે અને જ્ઞાનના સર્જન અને વિનિમય માટે એક મજબૂત પ્લેટફોર્મ પૂરું પાડે છે.

શિક્ષણ અને ICT નો સમન્વય :

પરંપરાગત શિક્ષણ પદ્ધતિની મર્યાદાઓ અને 'માહિતી યુગ'ના પડકારોએ શિક્ષણ પ્રણાલીને પુનર્વિચાર કરવા માટે મજબૂર કરી છે. આ સંદર્ભમાં, શિક્ષણ અને માહિતી અને સંચાર તકનીકી (ICT) નો સમન્વય એ માત્ર એક વિકલ્પ નથી, પરંતુ એક અનિવાર્ય જરૂરિયાત બની ગયો છે. ICT ના ઉપયોગથી શિક્ષણ પ્રક્રિયાને વધુ અસરકારક,

ગુણવત્તાસભર, વિદ્યાર્થી-કેન્દ્રિત અને આધુનિક સમયની જરૂરિયાતોને અનુરૂપ બનાવી શકાય છે. આ સમન્વયે શિક્ષણના નવા મોડેલોને જન્મ આપ્યો છે, જે અધ્યયન-અધ્યાપન પ્રક્રિયાને વર્ગખંડની ચાર દીવાલોની બહાર લઈ જાય છે.

સમન્વયની આવશ્યકતા :

શિક્ષણમાં ICT ના સમન્વયની આવશ્યકતા પાછળના મુખ્ય કારણો નીચે મુજબ છે:

- **વૈશ્વિક જ્ઞાન સુધી પહોંચ :** ICT, ખાસ કરીને ઈન્ટરનેટ, વિદ્યાર્થીઓ અને શિક્ષકોને જ્ઞાનના અમર્યાદિત ભંડાર સાથે જોડે છે, જે પાઠ્યપુસ્તકોની મર્યાદાઓને દૂર કરે છે.
- **વ્યક્તિગત શિક્ષણ :** ICT દરેક વિદ્યાર્થીને તેની પોતાની ગતિ, શૈલી અને સ્તર અનુસાર શીખવાની સુવિધા પૂરી પાડે છે, જે પરંપરાગત વર્ગખંડમાં શક્ય નથી.
- **સક્રિય અને સહયોગી શિક્ષણ :** ઈન્ટરેક્ટિવ સાધનો અને ઓનલાઈન પ્લેટફોર્મ વિદ્યાર્થીઓને નિષ્ક્રિય શ્રોતામાંથી જ્ઞાનના નિર્માણમાં સક્રિય ભાગીદાર બનાવે છે અને સહયોગી શિક્ષણને પ્રોત્સાહન આપે છે.
- **અસરકારકતામાં વધારો :** મલ્ટીમીડિયા અને સિમ્યુલેશન જેવા સાધનો દ્વારા જટિલ અને અમૂર્ત ખ્યાલોને સરળ અને દ્રશ્ય સ્વરૂપમાં રજૂ કરી શકાય છે, જેનાથી વિદ્યાર્થીઓની સમજણ વધે છે અને શૈક્ષણિક સિદ્ધિમાં સુધારો થાય છે.

નૂતન શિક્ષણ મોડેલ્સ :

શિક્ષણ અને ICT ના સમન્વયથી મુખ્યત્વે ત્રણ પ્રકારના શિક્ષણ મોડેલ્સ ઉભરી આવ્યા છે:

1. **ઈ-લર્નિંગ (E-learning) :** આ મોડેલમાં શિક્ષણ સંપૂર્ણપણે ઓનલાઈન માધ્યમ દ્વારા આપવામાં આવે છે. તેમાં ભૌતિક વર્ગખંડની કોઈ ભૂમિકા હોતી નથી. વિદ્યાર્થીઓ ગમે ત્યાંથી, ગમે ત્યારે ડિજિટલ સામગ્રી, વિડિયો લેક્ચર્સ અને ઓનલાઈન મૂલ્યાંકન દ્વારા શિક્ષણ મેળવી શકે છે. આ મોડેલ ઉચ્ચ શિક્ષણ અને દૂરવર્તી શિક્ષણ (distance education) માટે ખૂબ જ ઉપયોગી છે.
2. **બ્લેન્ડેડ લર્નિંગ (Blended Learning) :** આ મોડેલને 'મિશ્રિત શિક્ષણ' તરીકે પણ ઓળખવામાં આવે છે. તે પરંપરાગત, રૂબરૂ (face-to-face) વર્ગખંડ શિક્ષણ અને ઓનલાઈન શિક્ષણ પદ્ધતિઓનું સુનિયોજિત મિશ્રણ છે. આ મોડેલમાં, ઓનલાઈન શિક્ષણ એ વર્ગખંડ શિક્ષણનું સ્થાન લેતું નથી, પરંતુ તેને વધુ સમૃદ્ધ અને વિસ્તૃત બનાવે છે. ઉદાહરણ તરીકે, શિક્ષક વર્ગમાં કોઈ ખ્યાલ સમજાવે અને પછી વિદ્યાર્થીઓને ઘરેથી તે વિષય પર ઓનલાઈન ક્વિઝ આપવા અથવા ચર્ચા-મંચમાં ભાગ લેવા માટે કહે. આ મોડેલ પરંપરાગત શિક્ષણના માનવીય સ્પર્શ અને ઓનલાઈન શિક્ષણની લવચીકતા, બંનેના શ્રેષ્ઠ તત્વોને જોડે છે. ઘણા શિક્ષણશાસ્ત્રીઓ તેને ભવિષ્યના પ્રભાવી શિક્ષણ મોડેલ તરીકે જુએ છે.
3. **હાઈબ્રિડ લર્નિંગ (Hybrid Learning) :** આ શબ્દનો ઉપયોગ ઘણીવાર બ્લેન્ડેડ લર્નિંગના સમાનાર્થી તરીકે થાય છે, પરંતુ તેમાં એક સૂક્ષ્મ તફાવત છે. હાઈબ્રિડ લર્નિંગ મોડેલમાં સામાન્ય રીતે એક જ સમયે કેટલાક વિદ્યાર્થીઓ ભૌતિક વર્ગખંડમાં હાજર હોય છે અને કેટલાક વિદ્યાર્થીઓ દૂરથી ઓનલાઈન માધ્યમથી તે જ વર્ગમાં જોડાય છે. આ મોડેલ શિક્ષણની પહોંચને ભૌગોલિક સીમાઓથી પર લઈ જાય છે.

આ ત્રણેય મોડેલો શિક્ષણમાં ટેકનોલોજીના સંકલનના અલગ-અલગ સ્તરો અને અભિગમો દર્શાવે છે. તેમની તુલનાત્મક સમીક્ષા નીચેના કોષ્ટકમાં રજૂ કરવામાં આવી છે.

શિક્ષણમાં ICT નો ઉપયોગ :

શિક્ષણમાં ICT નો ઉપયોગ હવે માત્ર પ્રાયોગિક તબક્કે નથી, પરંતુ તે અધ્યયન-અધ્યાપન, મૂલ્યાંકન અને વહીવટ જેવા શિક્ષણના તમામ પાસાઓમાં ઊંડે સુધી વણાઈ ગયો છે. ICT સાધનો અને એપ્લિકેશન્સ શિક્ષણ પ્રક્રિયાને વધુ ગતિશીલ, પારદર્શક અને કાર્યક્ષમ બનાવે છે. ભારતમાં અને ખાસ કરીને ગુજરાતમાં, સરકારી સ્તરે પણ ICT ના વ્યાપને વધારવા માટે અનેક પહેલ કરવામાં આવી છે.

અધ્યયન-અધ્યાપન પ્રક્રિયા :

1. **સ્માર્ટ ક્લાસરૂમ :** આધુનિક વર્ગખંડ હવે માત્ર પાટલીઓ અને બ્લેકબોર્ડ પૂરતો સીમિત નથી. સ્માર્ટ ક્લાસરૂમમાં ઈન્ટરેક્ટિવ વ્હાઈટબોર્ડ (સ્માર્ટ બોર્ડ), પ્રોજેક્ટર, કમ્પ્યુટર, સ્પીકર્સ અને હાઈ-સ્પીડ ઈન્ટરનેટ જેવી સુવિધાઓ હોય છે. શિક્ષકો આ સાધનોનો ઉપયોગ મલ્ટીમીડિયા પ્રસ્તુતિઓ, શૈક્ષણિક વિડિયો દર્શાવવા અને ઈન્ટરેક્ટિવ પ્રવૃત્તિઓ દ્વારા જટિલ વિષયોને સરળતાથી સમજાવવા માટે કરે છે.
2. **શૈક્ષણિક સોફ્ટવેર અને એપ્લિકેશન્સ :** આજે બજારમાં અસંખ્ય શૈક્ષણિક સોફ્ટવેર અને મોબાઈલ એપ્લિકેશન્સ ઉપલબ્ધ છે જે શીખવાની પ્રક્રિયાને રસપ્રદ અને ગેમિફાઈડ બનાવે છે. Kahoot! જેવી એપ્સ દ્વારા રમત-રમતમાં ક્વિઝનું આયોજન કરી શકાય છે. Google Classroom દ્વારા શિક્ષકો સરળતાથી ગૃહકાર્ય સોંપી શકે છે, ઓનલાઈન ચર્ચાઓનું સંચાલન કરી શકે છે અને વિદ્યાર્થીઓના કાર્યનું મૂલ્યાંકન કરી શકે છે. Khan Academy જેવા પ્લેટફોર્મ ગણિત અને વિજ્ઞાન જેવા વિષયો પર હજારો વિનામૂલ્યે વિડિયો અને અભ્યાસ સામગ્રી પૂરી પાડે છે.
3. **ડિજિટલ સંસાધનો :** ICT વિદ્યાર્થીઓને ઈ-બુક્સ, શૈક્ષણિક વેબસાઈટ્સ, ઓનલાઈન જર્નલ્સ, શૈક્ષણિક વિડિયો (YouTube), ઓનલાઈન ક્વિઝ અને ડિજિટલ લાયબ્રેરી જેવા જ્ઞાનના વિશાળ ભંડાર સાથે જોડે છે. આનાથી વિદ્યાર્થીઓ વર્ગખંડની બહાર પણ સ્વ-અધ્યયન કરી શકે છે અને પોતાની જિજ્ઞાસાને સંતોષી શકે છે.

ICT દ્વારા અસરકારક અને રસપ્રદ શિક્ષણ :

શિક્ષણમાં ICT નો સમન્વય માત્ર એક તકનીકી સુધારો નથી, પરંતુ તે અધ્યયન-અધ્યાપન પ્રક્રિયાની ગુણવત્તા અને સ્વરૂપમાં આમૂલ પરિવર્તન લાવવાની ક્ષમતા ધરાવે છે. જ્યારે ICT નો ઉપયોગ યોગ્ય શિક્ષણશાસ્ત્ર સાથે કરવામાં આવે છે, ત્યારે તે શિક્ષણને વધુ અસરકારક, જીવંત, રસપ્રદ અને વિદ્યાર્થી-કેન્દ્રિત બનાવે છે.

શિક્ષણની ગુણવત્તામાં સુધારો :

અસંખ્ય સંશોધનોએ પુરવાર કર્યું છે કે ICT-આધારિત શિક્ષણ પરંપરાગત પદ્ધતિઓ કરતાં વધુ અસરકારક સાબિત થઈ શકે છે. શિક્ષણની કોઈ પણ પ્રક્રિયાનો અંતિમ ઉદ્દેશ વિદ્યાર્થીઓની શૈક્ષણિક સિદ્ધિ ઊંચી લાવવાનો હોય છે. આણંદ જિલ્લાની એક શાળામાં ધોરણ-11 ના અર્થશાસ્ત્રના વિદ્યાર્થીઓ પર થયેલા એક પ્રાયોગિક અભ્યાસમાં જાણવા મળ્યું કે જે જૂથને ICT કાર્યક્રમ દ્વારા 'બેરોજગારી' એકમ ભણાવવામાં આવ્યું હતું, તેમની શૈક્ષણિક સિદ્ધિ પરંપરાગત વ્યાખ્યાન પદ્ધતિથી ભણતા જૂથ કરતાં નોંધપાત્ર રીતે ઊંચી હતી. આ દર્શાવે છે કે ICT માત્ર વિષયવસ્તુને

રજૂ કરવાની રીત નથી બદલતું, પરંતુ તે વિદ્યાર્થીઓની ગ્રહણશક્તિ અને સમજણ પર સીધી હકારાત્મક અસર કરે છે. માહિતીની વૈવિધ્યસભર અને દ્રશ્ય-શ્રાવ્ય રજૂઆત વિદ્યાર્થીઓની સમજશક્તિમાં અપેક્ષિત પરિવર્તન લાવવામાં મદદરૂપ થાય છે.

વ્યક્તિગત શિક્ષણ અને સ્વ-અધ્યયનની તકો :

દરેક બાળકની શીખવાની ગતિ અને શૈલી અલગ હોય છે. ICT વ્યક્તિગત શિક્ષણ (Personalized Learning) ની સંકલ્પનાને વાસ્તવિક બનાવે છે. શૈક્ષણિક સોફ્ટવેર અને ઓનલાઈન પ્લેટફોર્મ વિદ્યાર્થીઓના પ્રદર્શનનું વિશ્લેષણ કરી શકે છે અને તેમની જરૂરિયાત મુજબની અભ્યાસ સામગ્રી અને કસરતો પૂરી પાડી શકે છે. આ ઉપરાંત, કમ્પ્યુટર સહાયિત અનુદેશન (Computer Assisted Learning - CAL) જેવી પદ્ધતિઓ વિદ્યાર્થીઓને શિક્ષકની ગેરહાજરીમાં પણ પોતાની મેળે શીખવાની (સ્વ-અધ્યયન) તક પૂરી પાડે છે. આ પ્રક્રિયામાં કમ્પ્યુટર એક ટ્યુટર તરીકે કાર્ય કરે છે અને વિદ્યાર્થીને સૂચનાઓ આપીને તબક્કાવાર રીતે આગળ વધારે છે.

ICT ના અસંખ્ય ફાયદાઓ હોવા છતાં, તેના અમલીકરણમાં કેટલાક ગંભીર પડકારો પણ રહેલા છે. આ ફાયદાઓ અને પડકારોની સંતુલિત સમજ કેળવવી અત્યંત આવશ્યક છે.

મુખ્ય તારણોનો સારાંશ :

વર્તમાન જ્ઞાન-આધારિત સમાજમાં, શિક્ષણમાં ICT નો સમન્વય એ વૈકલ્પિક સુધારો નથી, પરંતુ એક અનિવાર્ય જરૂરિયાત છે. પરંપરાગત, શિક્ષક-કેન્દ્રિત પદ્ધતિઓ આધુનિક યુગના પડકારોને પહોંચી વળવા માટે અપૂરતી છે.

1. **અસરકારકતા:** સુનિયોજિત રીતે ઉપયોગમાં લેવાતી ICT-આધારિત અધ્યાપન પદ્ધતિઓ પરંપરાગત પદ્ધતિઓ કરતાં વિદ્યાર્થીઓની શૈક્ષણિક સિદ્ધિ સુધારવામાં વધુ અસરકારક સાબિત થઈ છે.
2. **શિક્ષણનું રૂપાંતર:** ICT શિક્ષણને શિક્ષક-કેન્દ્રિતમાંથી વિદ્યાર્થી-કેન્દ્રિત બનાવે છે. તે નિષ્ક્રિય શ્રવણને બદલે સક્રિય ભાગીદારી, ગોખણપટ્ટીને બદલે સંકલ્પનાત્મક સમજ અને એકમાર્ગીય પ્રસારણને બદલે સહયોગી જ્ઞાન નિર્માણને પ્રોત્સાહન આપે છે.
3. **નીતિ અને અમલીકરણ વચ્ચે અંતર:** સરકારી સ્તરે ICT ને પ્રોત્સાહન આપવા માટે અનેક નીતિઓ અને યોજનાઓ અસ્તિત્વમાં હોવા છતાં, તેના વાસ્તવિક અમલીકરણમાં માળખાકીય સુવિધાઓનો અભાવ, શિક્ષકોની અપૂરતી તાલીમ અને ટેકનિકલ સપોર્ટની ઉણપ જેવા ગંભીર અવરોધો રહેલા છે. આ 'નીતિ-અમલીકરણ અંતર' ICT ના લાભોને મર્યાદિત કરે છે.
4. **સંતુલિત અભિગમની જરૂરિયાત:** ICT ના અસંખ્ય ફાયદાઓની સાથે ડિજિટલ ડિવાઈડ, સાધનોનો ખર્ચ અને વિદ્યાર્થીઓનું ધ્યાન ભટકવા જેવા પડકારો પણ સંકળાયેલા છે. આથી, ટેકનોલોજીના આંધળા અનુકરણને બદલે એક સંતુલિત અને વિવેકપૂર્ણ અભિગમ અપનાવવો જરૂરી છે.

ભવિષ્યનો દ્રષ્ટિકોણ :

શિક્ષણનું ભવિષ્ય નિઃશંકપણે ટેકનોલોજી સાથે ગાઢ રીતે જોડાયેલું છે. બ્લેન્ડેડ લર્નિંગ એ ભવિષ્યનું પ્રભાવી શિક્ષણ મોડેલ બનવાની પૂરી સંભાવના ધરાવે છે, કારણ કે તે પરંપરાગત શિક્ષણના માનવીય સ્પર્શ અને ઓનલાઈન શિક્ષણની લવચીકતા વચ્ચે ઉત્તમ સંતુલન સ્થાપિત કરે છે. આ ઉપરાંત, આર્ટિફિશિયલ ઈન્ટેલિજન્સ (AI), વર્ચ્યુઅલ

રિયાલિટી (VR) અને ઓગમેન્ટેડ રિયાલિટી (AR) જેવી ઉભરતી તકનીકો શિક્ષણમાં ક્રાંતિ લાવવાની ક્ષમતા ધરાવે છે. AI-આધારિત પ્લેટફોર્મ દરેક વિદ્યાર્થી માટે સંપૂર્ણપણે વ્યક્તિગત શિક્ષણનો અનુભવ પ્રદાન કરી શકશે, જ્યારે VR/AR દ્વારા વિદ્યાર્થીઓ ઇતિહાસના સ્થળોની વર્ચ્યુઅલ મુલાકાત લઈ શકશે અથવા જટિલ વૈજ્ઞાનિક પ્રક્રિયાઓને ત્રિ-પરિમાણીય સ્વરૂપમાં અનુભવી શકશે.

અંતે, એ યાદ રાખવું મહત્વપૂર્ણ છે કે ICT એ શિક્ષણનો વિકલ્પ નથી, પરંતુ શિક્ષણને વધુ સક્ષમ બનાવતું એક શક્તિશાળી સાધન છે. શિક્ષણના કેન્દ્રમાં હંમેશા શિક્ષક અને વિદ્યાર્થી વચ્ચેનો માનવીય સંબંધ જ રહેશે. ટેકનોલોજીની સફળતાનો અંતિમ માપદંડ એ છે કે તે આ સંબંધને કેટલો મજબૂત અને અર્થપૂર્ણ બનાવે છે.

ઉપસંહાર :

આ અભ્યાસપત્રમાં શિક્ષણ અને ICT ના આંતરસંબંધની વિસ્તૃત છણાવટ કરવામાં આવી. શિક્ષણની મૂળભૂત સંકલ્પના અને તેના માનવતાવાદી ઉદ્દેશ્યોથી શરૂ કરીને, પરંપરાગત શિક્ષણ પદ્ધતિની મર્યાદાઓ અને ICT ના આગમનથી ઉદ્ભવેલા નવા શૈક્ષણિક મોડેલોનું વિશ્લેષણ કરવામાં આવ્યું. ICT ના વ્યવહારુ ઉપયોગો અને શિક્ષણને વધુ અસરકારક તથા રસપ્રદ બનાવવામાં તેની ભૂમિકાની ચર્ચાની સાથે-સાથે તેના અમલીકરણમાં રહેલા પડકારોને પણ ઉજાગર કરવામાં આવ્યા. આ સમગ્ર વિશ્લેષણના આધારે કેટલાક મુખ્ય તારણો અને ભલામણો રજૂ કરી શકાય છે.

સંદર્ભ સૂચિ :

આ અભ્યાસપત્ર તૈયાર કરવા માટે ઉપયોગમાં લેવાયેલા સ્ત્રોતોની યાદી નીચે મુજબ છે:

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ધોરણ અગિયારના વાણિજ્ય વ્યવસ્થા અને સંચાલન વિષયના "આંતરિક વેપાર" એકમના અધ્યાપન માટે નાટ્યકરણ પદ્ધતિની અસરકારકતા

ખેતાણી રવિ હસમુખલાલ
પીએચ.ડી. સ્કોલર,શિક્ષણશાસ્ત્ર ભવન, સૌરાષ્ટ્ર યુનિવર્સીટી, રાજકોટ.

સારાંશ :

પ્રસ્તુત અભ્યાસનો ઉદ્દેશ્ય નાટ્યીકરણ કાર્યક્રમની રચના અને તેના દ્વારા અધ્યાપન કાર્યની વિદ્યાર્થીઓની શૈક્ષણિક સિદ્ધિ પર થતી અસર ચકાસવાનો હતો. સંશોધકે તે માટે નાટયીકરણ કાર્યક્રમની રચના અને શિક્ષક રચિત ઉત્તરકસોટીનું નિર્માણ કર્યું હતું. પ્રયોગના અંતે ઉત્તરકસોટી આપવામાં આવી હતી. ઉત્તરકસોટીના પ્રાપ્તાંકોની સરાસરી, પ્રમાણવિચલન અને ટી-મૂલ્યની ગણતરી કરવામાં આવી હતી. ગણતરીના અંતે ટી-મૂલ્યના આધારે શૈક્ષણિક સિદ્ધિના સંદર્ભમાં કઈ પદ્ધતિ અસરકારક છે તે ચકાસવામાં આવ્યું હતું.

1. પ્રસ્તાવના

શિક્ષણ એ માત્ર માહિતી આપવાની પ્રક્રિયા નથી, પરંતુ તે વિદ્યાર્થીના સર્વાંગી વિકાસ તરફ દોરી જતી સજીવ યાત્રા છે. પરંપરાગત શિક્ષણ પદ્ધતિઓ જેમ કે વ્યાખ્યાન પદ્ધતિ દ્વારા વિષયજ્ઞાન આપવામાં આવે છે, પરંતુ આધુનિક સમયમાં વિદ્યાર્થીઓને વિષય સાથે સંકળાવવા માટે નવીન અભિગમો જરૂરી બની ગયા છે. વાણિજ્ય વ્યવસ્થા અને સંચાલન વિષયમાં "આંતરિક વેપાર" એકમના અધ્યાપનમાં એક અગત્યનું સ્થાન ધરાવે છે. આ અધ્યાપન દ્વારા વિદ્યાર્થીઓ હોલસેલ વેપાર, રીટેલ વેપાર, સુપર માર્કેટ, મોલ, સ્ટોર્સ જેવી વ્યવસાયિક પદ્ધતિઓ વિશે જ્ઞાન પ્રાપ્ત કરે છે. પરંતુ ઘણી વાર આ વિષયને માત્ર પુસ્તકીય રૂપે શીખવવામાં આવે છે.

અહીં નાટ્યીકરણ પદ્ધતિ એક નવી દિશા આપે છે. નાટ્યીકરણ એટલે વિષયવસ્તુને જીવંત રૂપ આપીને, પાત્રો, સંવાદ અને પરિસ્થિતિઓ દ્વારા વર્ગખંડમાં જ એક નાનકડું મંચ સર્જવું. જ્યારે વિદ્યાર્થીઓ જાતે વેપારી, ગ્રાહક, બેન્કર કે પરિવહનકર્તાની ભૂમિકા ભજવે છે, ત્યારે તેઓને માત્ર જ્ઞાન જ નહીં પરંતુ અનુભવ પણ પ્રાપ્ત થાય છે. આ રીતે શિક્ષણ માત્ર વાંચન પૂરતું ન રહી, પરંતુ અનુભવ આધારિત અને યાદગાર બની જાય છે. અથવા કહી શકાય કે, નાટ્યીકરણ પદ્ધતિ શિક્ષણમાં રસપ્રદતા, ભાગીદારી અને સમજણ વધારવામાં એક અસરકારક સાધન છે. આ સંશોધન પત્રમાં ધોરણ 11 ના કોમર્સ વિષયના આંતરિક વેપાર એકમના અધ્યાપન માટે નાટ્યીકરણ પદ્ધતિનો પ્રયોગાત્મક અભ્યાસ કરવામાં આવ્યો છે, જેમાં તેનો પ્રભાવ, મર્યાદાઓ અને શૈક્ષણિક યોગદાનને ઉજાગર કરવામાં આવ્યું છે.

2. સમસ્યા કથન

પ્રસ્તુત અભ્યાસની સમસ્યાને આ પ્રમાણે શબ્દબદ્ધ કરવામાં આવી હતી.

ધોરણ અગિયારના વાણિજ્ય વ્યવસ્થા અને સંચાલન વિષયના "આંતરિક વેપાર" એકમના અધ્યાપન માટે નાટ્યકરણ પદ્ધતિની અસરકારકતા

ચાવીરૂપ શબ્દો : નાટ્યીકરણ, આંતરિક વેપાર, આયાત-નિકાસ, પ્રયોગાત્મક અભ્યાસ.

3. અભ્યાસના હેતુઓ.

પ્રસ્તુત અભ્યાસમાં આ પ્રમાણેના હેતુઓ નિશ્ચિત કરવામાં આવ્યા હતા.

1. ધોરણ અગિયારના વાણિજ્ય વ્યવસ્થા અને સંચાલન વિષયના "આંતરિક વેપાર" એકમનું નાટ્યીકરણમાં રૂપાંતર કરવું.
2. ધોરણ અગિયારના વાણિજ્ય વ્યવસ્થા અને સંચાલન વિષયના "આંતરિક વેપાર" એકમ ઉપર વિદ્યાર્થીઓની શૈક્ષણિક સિદ્ધિના સંદર્ભમાં નાટ્યીકરણ પદ્ધતિની અસરકારકતા તપાસવી.

4. સંશોધનની ઉત્કલ્પનાઓ

H^1 સંશોધન ઉત્કલ્પના

નાટ્યીકરણ કાર્યક્રમ દ્વારા અભ્યાસ કરતા પ્રાયોગિક જૂથના વિદ્યાર્થીઓની ઉત્તરકસોટી પરની શૈક્ષણિક સિદ્ધિ, પરંપરાગત પદ્ધતિથી અભ્યાસ કરતા નિયંત્રિત જૂથના વિદ્યાર્થીઓની ઉત્તરકસોટી પરની સરેરાશ શૈક્ષણિક સિદ્ધિ વચ્ચે સાર્થક તફાવત હશે.

H^0 શૂન્ય ઉત્કલ્પના

નાટ્યીકરણ કાર્યક્રમ દ્વારા અભ્યાસ કરતા પ્રાયોગિક જૂથના વિદ્યાર્થીઓની ઉત્તરકસોટી પરની શૈક્ષણિક સિદ્ધિ, પરંપરાગત પદ્ધતિથી અભ્યાસ કરતા નિયંત્રિત જૂથના વિદ્યાર્થીઓની ઉત્તરકસોટી પરની સરેરાશ શૈક્ષણિક સિદ્ધિ વચ્ચે સાર્થક તફાવત નહીં હોય.

5. અભ્યાસમાં સમાવિષ્ટ ચલો

પ્રસ્તુત સંશોધનમાં સમાવિષ્ટ ચલો આ પ્રમાણે હતા.

ક્રમ	ચલ	ચલની કક્ષા
1	સ્વતંત્ર ચલ	1. નાટ્યીકરણ પદ્ધતિ 2. પરંપરાગત પદ્ધતિ દ્વારા અધ્યાપન
2	પરતંત્ર ચલ	શૈક્ષણિક સિદ્ધિ
3	અંકુશીત ચલ	માધ્યમ, વિસ્તાર, શાળા, અભ્યાસની કક્ષા, ધોરણ
4	આંતરવર્તી ચલ	જૂથો વચ્ચેની આંતરક્રિયા, બૌદ્ધિક કક્ષા, પ્રયોગનું નાવીન્ય પાત્રોના મનોવલણ, કાર્ય ઉત્સાહ

6. સંશોધનનું ક્ષેત્ર

શિક્ષણમાં સંશોધન હાથ ધરવા માટે પસંદગીના ક્ષેત્રો ઘણા છે તેમાંથી પ્રસ્તુત સંશોધનનું ક્ષેત્ર "શૈક્ષણિક ટેકનોલોજી" અને શૈક્ષણિક સિદ્ધિને સ્પર્શતું હતું. કારણ કે અહીં નાટ્યીકરણ કાર્યક્રમ અને પરંપરાગત પદ્ધતિની અસરકારકતા યોગ્ય પ્રાયોગિક યોજનાના અમલીકરણથી તપાસવામાં આવી હતી.

7. સંશોધન પ્રકાર અને પદ્ધતિ

પ્રસ્તુત સંશોધન સંખ્યાત્મક અભ્યાસ ગણી શકાય કારણ કે વાણિજ્ય વ્યવસ્થા અને સંચાલનની શૈક્ષણિક સિદ્ધિ વિશે સંખ્યાત્મક માહિતી એકત્ર કરી હતી. અને અભ્યાસના હેતુઓના સંદર્ભમાં પ્રાયોગિક સંશોધન પદ્ધતિ પસંદ કરી હતી.

8. પદોની વ્યવહારુ વ્યાખ્યા

- **નાટ્યીકરણ પદ્ધતિ**

ધોરણ અગિયારના વાણિજ્ય વ્યવસ્થા અને સંચાલન વિષયના 'આંતરિક વેપાર' એકમના અધ્યાપન માટે એકમનું નાટ્યીકરણમાં રૂપાંતર કરવામાં આવ્યું હતું. આ માટે એકમ માટે Script તૈયાર કરવામાં આવી હતી. જેમાં પ્રત્યક્ષ દ્રશ્ય-શ્રાવ્ય, હાવ-ભાવ, વિવિધ રીતે રજૂઆત થતી અધ્યાપન પદ્ધતિ એટલે નાટ્યીકરણ પદ્ધતિ.

- **પરંપરાગત પદ્ધતિ**

કોઈપણ માધ્યમ દ્વારા જ્યારે કોઈપણ વ્યક્તિ કે વિદ્યાર્થીને વિષયવસ્તુ શીખવવામાં આવે ત્યારે માધ્યમોને કારણે તેના અધ્યાપન પર થતી અસર વચ્ચેના તફાવતને અસરકારકતા તરીકે સ્વીકારેલ હતું.

- **અસરકારકતા**

પ્રયોગના અમલીકરણને અંતે પ્રાયોગિક જૂથ અને નિયંત્રિત જૂથના વિદ્યાર્થીઓએ શિક્ષક નિર્મિત ઉત્તર કસોટી પરના શૈક્ષણિક સિદ્ધિ પ્રાપ્તાંકોના સાર્થક તફાવતને કાર્યક્રમની અસરકારકતા તરીકે સ્વીકારેલ હતી.

9. અભ્યાસનું મહત્વ

- પ્રસ્તુત અભ્યાસ વર્ગખંડના શિક્ષણને રસપ્રદ અને જીવંત બનાવી શકાશે.
- નાટ્યયીકરણ પ્રયુક્તિ દ્વારા વિદ્યાર્થીમાં રહેલ કળા વિકસાવી શકાય.
- ભવિષ્યમાં સંશોધકોને આ ક્ષેત્રે આગળ વધવા પ્રેરણા પ્રાપ્ત થઈ શકાશે.
- નાટયીકરણની અધ્યાપન સામગ્રી વિકસાવવા માંગતા પ્રયોજક અને શિક્ષકોને પ્રસ્તુત અભ્યાસ માર્ગદર્શક બની રહેશે.

10. ઉપકરણ

વાણિજ્ય વ્યવસ્થા અને સંચાલન વિષયના શૈક્ષણિક સિદ્ધિનું માપન કરવા માટે શિક્ષક નિર્મિત કસોટીની રચના કરવામાં આવી હતી. આ કસોટી 25 ગુણની હતી. કસોટીનો સમય 45 મિનીટનો હતો. બંને જૂથને એક જ સમયે કસોટી આપવામાં આવી હતી.

11. વ્યાપવિશ્વ અને નમૂનો

પ્રસ્તુત સંશોધનમાં વ્યાપવિશ્વ તરીકે રાજકોટ શહેરના ધોરણ અગિયારના વર્ષ 2025-26માં અભ્યાસ કરતા વિદ્યાર્થીઓનો સમાવેશ થયેલ હતો.નમૂના તરીકે 38-38 એમ કુલ 76 વિદ્યાર્થીઓનો નમૂના તરીકે સમાવેશ કરવામાં આવ્યો હતો.

12. સંશોધનમાં માહિતીનું એકત્રીકરણ

પ્રસ્તુત અભ્યાસમાં નાટ્યીકરણ અને પરંપરાગત પદ્ધતિ દ્વારા અધ્યાપન કરાવવામાં આવેલું હતું. પાંચ તાસના પ્રાયોગિક કાર્યને અંતે એકમની શૈક્ષણિક સિદ્ધિના માપન માટે શિક્ષક દ્વારા સ્વરચિત સિદ્ધિ કસોટી આપવામાં આવી હતી.

13. સંશોધનમાં માહિતીનું પૃથક્કરણ અને અર્થઘટન

સારણી – 1

પ્રયોગના અંતે વિદ્યાર્થીઓની સરાસરી, પ્રમાણ વિચલન અને ટી-મૂલ્ય

ક્રમ	જૂથ	સંખ્યા	સરાસરી	પ્રમાણ વિચલન	ટી-મૂલ્ય
1.	નાટ્યીકરણ પદ્ધતિ	38	41.2092	3.035	6.412**
2.	પરંપરાગત પદ્ધતિ	38	32.9246	3.743	

*0.01 કક્ષાએ સાર્થક

સારણી-1 પરથી જોઈ શકાય છે કે નાટ્યીકરણ પદ્ધતિ શીખવવામાં આવતા જૂથ દ્વારા પ્રાપ્ત ગુણનો સરેરાશ 41.2092 હતી. જ્યાં પ્રમાણભૂત વિચલન 3.035 હતું. પરંપરાગત પદ્ધતિ દ્વારા શીખવવામાં આવતા જૂથ દ્વારા પ્રાપ્ત ગુણનો સરેરાશ 32.9246 હતી. જ્યાં પ્રમાણભૂત વિચલન 3.743 હતું. બંને જૂથ વચ્ચે ટી-મૂલ્ય 6.412 મળ્યું હતું. આમ, આ અભ્યાસની પૂર્વધારણા નાટ્યીકરણ પદ્ધતિ અને પરંપરાગત પદ્ધિત દ્વારા શીખવવામાં આવતા વિદ્યાર્થીઓના સરેરાશ ગુણ વચ્ચે કોઈ નોંધપાત્ર તફાવત રહેશે નહીં" સ્વીકારવામાં આવી નથી એટલે કે

નાટ્યીકરણ પદ્ધતિ દ્વારા શીખવવામાં આવતા વિદ્યાર્થીઓની સિદ્ધિ વધુ હતી. નાટ્યીકરણ પદ્ધતિ એ પરંપરાગત પદ્ધતિ કરતાં વધુ અસરકારક હતી.

14. અભ્યાસના તારણો

પ્રસ્તુત અભ્યાસમાં માહિતીના અર્થઘટનને આધારે પ્રાપ્ત થયેલા તારણ આ મુજબ હતા ધોરણ અગિયારના વાણિજ્ય વ્યવસ્થા અને સંચાલન વિષયના 'આંતરિક વેપાર' એકમ માટે નાટ્યીકરણ પદ્ધતિ વધુ અસરકારક હતી.

15. સંશોધનના શૈક્ષણિક ફલિતાર્થો

1. નાટક દ્વારા વર્ગખંડમાં વાસ્તવિક પરિસ્થિતિ જેવી જ પરિસ્થિતિ ઊભી કરી શકાય છે.
2. નાટ્યીકરણ પદ્ધતિ દ્વારા વિદ્યાર્થીની અર્થગ્રહણ ક્ષમતામાં વધારો કરી શકાય છે.
3. માધ્યમિક કક્ષાએ નાટક દ્વારા પસંદિત એકમોમાં વિદ્યાર્થીઓને રસ જગાવી શકાય.

16. સંદર્ભસૂચી

ઠાકર, જે. (1956). નાટ્ય શિક્ષણનાં મૂળતત્વો. વડોદરા: મહારાજા સયાજીરાવ વિશ્વવિદ્યાલય ગુજરાત રાજ્ય

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वर्तमान समस्या प्रदूषण और जलवायु परिवर्तन के विनाशकारी खतरे

किंजल जमनादास टिलावत
शोधछात्रा, हिंदी भवन, सौराष्ट्र विश्वविध्यालय, राजकोट

आधुनिक विज्ञान ने हमारी आंखों चका चौध पैदा कर दी है| किंतु उसी विज्ञान के विकासने हमें विनाश के उस कगार परभी लाकर खड़ा कर दिया जहां हमें अपनी आश्रयदात्री पृथ्वी का अस्तित्व ही संकटमैं दृष्टिगोचर हो रहा है आधुनिक विज्ञान द्वारा दी गई जीवनशैली का विकल्प क्या है? इस विज्ञान में पृथ्वी के बारे में कई जानकारियां भी लिखी है |

21 सी सदी में अनेक चुनौतियां तेजी से अपना ज़ाल फैला रही है| इसमें जनसंख्यावृद्धि,कृषि,भूमि व अन्य प्राकृतिक संसाधनों में गिरावट सम्मिलित है| इनमें प्रमुख पर्यावरणीय समस्याएं है , जलवायु परिवर्तन , प्राकृतिकआपदाएं , मिट्टी और भूमि की दुर्गति , जैव विविधता, वायु एवं जल प्रदूषण | यह सभी जीवंत पर्यावरण के संतुलन को विचलित कर रहे हैं| पृथ्वी का तापमान एक ऐसे नाजुक मोड़ पर पहुंच चुका है, जिसका बदला हुआ रुख पृथ्वी के विनाश का कारण बन सकता है| इस संदर्भ में दुनिया के लगभग सभी वैज्ञानिक चिंतित है| वायुमंडल में ग्रीनहाउस गैस का उत्सर्जन पृथ्वी की हरियाली के लिए वनों वनों, कृषि तथा सामानता पूर्ण जीवन के लिए भारी खतरा है| जलवायु परिवर्तन के प्रमुख कारक कार्बन डाइऑक्साइड की अधिक मात्रा से गरमाटी धरती का कहर बढ़ते तापमान के रूप में अब दृष्टिगोचर होने लगा है|

- **वैश्विक सम्मेलन के केंद्र में विकास एवं पर्यावरण**

जब मानव का अस्तित्व खतरे में पड़ता है, तब वह एक जुट होकर उसे समस्या पर विजय प्राप्त करने का प्रयास करने लगता है, जिससे समग्र मानवता का भविष्य जुड़ा हुआ है|

- स्टॉकहोम अंतर्राष्ट्रीय शिखर सम्मेलन 1972 (यु. ऐन. ई . पी .) इस सम्मेलन में संयुक्त राष्ट्र पर्यावरण कार्यक्रम का गठन किया गया, जिसका उद्देश्य विकासशील देशों को पर्यावरण संरक्षण के लिए आवश्यक तकनीकी एवं पूंजी देना था। इस सम्मेलन में 5 जून को विश्व पर्यावरण दिवस मनाने का निर्णय लिया था।
- मां ट्रीयल प्रोटोकॉल 1987 मैं कनाडा में क्लोरो फ्लोरो कार्बन केउत्पादन एवं खपत में अगले 10 वर्षों में पर्याप्त कटौती करने तथा मिठाईल ब्रोमाइड के उत्पादन को रोकने के लिए एक समझौता हुआ, ताकि ओजोनक्षरण को रोका जा सके। मा ट्रीयल प्रोटोकॉल पर भारत ने 1992 कोपेनहेगेन सम्मेलन के दौरान हस्ताक्षर किया।
- पृथ्वी सम्मेलन 1992 ब्राजील की राजधानी रियो डी जीनेरियो में हुआ, पृथ्वी सम्मेलन में 21वीं सदी के लिए पर्यावरणय विकास हेतु कार्यक्रम निर्धारित किया, इसे एजेंडा-2 नाम दिया गया।

इसमें तापमान नियंत्रण, वन संरक्षण एवं विकास के मुद्दे प्रमुखता दी गई है। अतः सारे देश इस मंच पर किए गए वादों के प्रति गंभीरता दिखाते हैं।

- **औधयोगिक विकास का पर्यावरण पर प्रभाव**

औद्योगिकरण वह प्रक्रिया है, जिसके अंतर्गत किसी देश की आर्थिक व्यवस्था में यंत्रीकरण के द्वारा आधारभूत परिवर्तन किए जाते हैं। भारत भी ऐसा ही एक भाग्यशाली राष्ट्र है, जहां प्रकृति द्वारा मानव के कल्याण के कई साधन उपलब्ध है, इसको मानव के कल्याण में उपयोगी बनाया जाए, वह एक प्रश्न भारत के औद्योगीकरण के लिए चुनौती बन गई है।

पिछले तीन दशकों में पश्चिम के देशों में तीव्रता के साथ उद्योगों का विकास हुआ है, इस प्रकार प्रदूषण की मात्रा बढ़ती जा रही है। पर्यावरण प्रदूषण औद्योगिक प्रबंधशास्त्र की एक महत्वपूर्ण शाखा बन चुकी है और संपूर्ण विश्व में इस विषय पर व्यापक अनुसंधान एवं अध्ययन किया जा रहा है। दिल्ली महानगर के वायु प्रदूषण एवं ध्वनि प्रदूषण से कौन परिचित नहीं होगा। वायु प्रदूषण से स्वास नलिका से संबंधित अनेक प्रकार से रोग यहां के नागरिकों को हो रहे हैं। उद्योगों के कारण वायुमंडल में निष्कासिन विषैली गैसों एवं हानिकारक रासायनिकतत्वों के कारण अति औद्योगिक क्षेत्रो तथा महानगरों में दम एवं स्वास नलिका के रोगों में तीव्र गति से वृद्धि हुई है।

- **ग्रीन हाउस प्रभाव से बचाना**

विकास एवं पर्यावरण प्रदूषण एक ही सिक्के के दो पहलू माने जाते हैं। बढ़ते औद्योगीकरण से जहां एक और विकास हुआ है। वही पर्यावरण को अनेक प्रकार से हानि भी पहुंची है, उद्योगों से निकलनेवाले प्रदूषण ने जल, वायु तथा स्थल को अत्यधिक प्रदूषित कर दिया है। बढ़ता प्रदूषण किसी न किसी रूप में मानव व अन्य जीवजंतुओं के लिए चिंता का विषय बन गया है।

ग्रीन हाउस प्रभाव को कम करने से ही वैश्विक उष्णता कम होगी। इसका अर्थ यह है, हमें वायुमंडल
की कार्बन डाइऑक्साइड की मात्रा को कम करना होगा। इसके लिए पेड़ पौधे व जंगल बढ़ाने होंगे, ताकि वो कार्बन डाइऑक्साइड की अतिरिक्त मात्रा का शोषण कर सके। ग्रीनहाउस के विभिन्न कारणों को दृष्टिगत रखते हुए विशेषगनो द्वारा गए अनेक सुझाव इस प्रकार है।

- जीवाश्मईंधन, जैसे कोयला,तेल,पेट्रोल आदि का उपयोग काम किया जाए।
- व्यक्तिगत ऊर्जा व्यय के खपत काम करने की आदत डाली जाए। उदाहरण के तौर पर कारों की बजाय सार्वजनिक परिवहन का अधिकाधिक प्रयोग किया जाए।
- जनता को ऊर्जा का महत्व और उससे होने वाले दुष्परिणाम से परिचित कराया जाए। साइकिल का प्रयोग उत्तम एवं श्रेष्ठ है।
- अधिकाधिक वृक्षारोपण के साथ तत्कालीन वनों की रक्षा की जाए। यह वृक्ष कार्बन डाइऑक्साइड के अवशोषित कर हरितगृह प्रभाव की समस्या को काम करेंगे।
- क्लोरोफ्लोरो कार्बन के स्रोत साधनों पर रोक लगाई जाए।
- ऊर्जा के वैकल्पिक साधनों के प्रयोग में वृद्धि की जाए।

इस प्रकार मानव पृथ्वी के तापमान को ज्यादा गर्म होने से रोक सकता है।

- **वैदिक रूप में पर्यावरण संरक्षण**

भारतीय संस्कृति यज्ञ प्रधान रही है, यज्ञो के द्वारा जहां वायुमंडल पवित्र होता था,वहां पर्यावरण संरक्षण भी होता था। इस समस्त पर्यावरण का आधार वर्षा है। सब ऋतुओं का भी आधार वर्षा ही है, वर्षा कम होने पर जनजीवन अस्त व्यस्त हो जाता है। पर्यावरण के लिए वर्षा समय पर होना आवश्यक है। यजुर्वेद में नियमित वर्षा के लिए प्रार्थना की गई है, जिससे न केवल मानव जीवन अपितु पृथ्वी पेड़ पौधे एवं अरण्य-प्राणियों की सर्वाधिक रक्षा हो सके।

ऋग्वेद का संपूर्ण नवम मंडल (114 सूक्त) वन देवता औषधिपति सोम को समर्पित है, जिसका रस बलदायक,अमृत्वदायक, स्फूर्तिदायक जीवानानन्द दायक है। इस प्रकार मानव तथा नदी की परसपरिकता का वर्णन संवाद सूक्त में करते हुए वेदों में नदी को चराचर जगत की जननी के पद पर प्रतिष्ठित किया गया है।

वक्त सूक्त में वायु से दिरधायुष्य की प्रार्थना करते हुए, उसे हृदय के लिए परम औषधि, कल्याणकारी आनंददायक कहां गया है। "आपो वा सर्वस्य जगत: प्रतिष्ठा "। अर्थात जल ही जगत की प्रतिष्ठा है। क्योंकि जल के बिना जीवन असंभव है,जल सब औषधियो वाला है।

पर्यावरण संरक्षण के संबंध में श्रीमद् भागवत गीता में कहां गया है, संपूर्ण प्राणी अन्ना से उत्पन्न होते हैं। अन्न उत्पत्ति वृष्टि से होती है, और वृष्टि यज्ञ से होती है, और वह यज्ञ कर्मों से उत्पन्न होने वाला है, अर्थात पृथ्वी पर जितने अधिक यज्ञ होंगे पर्यावरण उतना ही शुद्ध होगा । प्राचीन काल में भारतवर्ष में यग्नो की विशेष प्रधानता और मान्यता थी, उस समय समस्त भारत में यज्ञ का इतना अधिक प्रचार था कि यह देश याग्निय देश कहलाता था। वर्तमान में यज्ञों की परंपरा कम हो रही है, जिससे पर्यावरण दूषित हो रहा है।

- **पर्यावरणसंरक्षण हेतु भारत का प्रयास**

भारत में पर्यावरण के विशेष संरक्षण के लिए विगत तीन दशकों में सराहनीय प्रयास किए गए हैं, भारत के संविधान में सन 1976 में 42 वा संशोधन जल,वायु, वन और वन्य जीव सुरक्षा हेतु किया गया है।

- भारतीय वन अधिनियम - 1927
- मोटर वाहन अधिनियम - 1939
- कारखाना अधिनियम -1948
- वन्य जीव संरक्षण अधिनियम - 1972
- जल प्रदूषण संरक्षण अधिनियम - 1974
- वन संरक्षण अधिनियम - 1980
- वायु संरक्षण अधिनियम - 1981
- पर्यावरण संरक्षण अधिनियम - 1986 आदि

पर्यावरण संरक्षण अधिनियम 19 नवंबर 1986 में लागू किया गया। यह अधिनियम संपूर्ण भारत में लागू किया गया है। न्यायालय में सदैव ही पर्यावरण संरक्षण को इसी अधिनियम के अंतर्गत सर्वोच्च प्राथमिकता प्रदान की है।

- **उद्देश्य**

नए-नए विकास करके पर्यावरण का संतुलन बिगाड़ दिया और पर्यावरण का रूप इतना भयानक हो गया की सारी मानव जाति इससे भयभीत होने लगी, क्योंकि मानव अपनी जीवन प्रणाली में प्रत्येकक्षण प्रकृति से कुछ ना कुछ प्राप्त करता था, परंतु उसके बदलते वह प्रकृति को कुछ नहीं देता था। संपूर्ण विश्व में पर्यावरण असंतुलन के अनेक कारण जैसे औद्योगिकरण, शहरीकरण, जनसंख्या विस्फोट, गरीबी,संसाधनों काअति दोहन, ऊर्जा के पारंपरिक स्रोतों की क्षीणता और कच्चे माल का निःशेषण इत्यादि प्रमुख है। इन कारणों से तथा मनुष्य की प्रकृति के प्रति लापरवाही ने मानव जीवन और पर्यावरण के बीच के संतुलन को डावा डोल कर दिया, जिससे वर्तमान समय में वातावरण को लेकर अनेक समस्याओं ने जन्म लिया तथा हमारे जीवन को प्रभावित किया है। इसलिए पर्यावरण को बचाना हमारी नैतिक जिम्मेदारी है।

संदर्भ सूची

1 *विकास और पर्यावरण डॉ. जी. पी. शर्मा अल्फा पब्लिकेशन नई दिल्ली*
2 *विकास और पर्यावरण संकट डॉक्टर मधुसूदन मिश्रा अल्फा पब्लिकेशन नई दिल्ली*
3 *विकास और पर्यावरणमें ग्रीन हाउस प्रभाव भगवान सिंह अल्फा पब्लिकेशन नई दिल्ली*
4 *वेद-पर्यावरण-नवीनतममें पर्यावरण संरक्षण डॉ शंभूनाथ मिश्रा हंसा प्रकाशन जयपुर*
5 *मानव एवं पर्यावरण डॉ. दीप्ति शर्मा & डॉ. महेंद्रकुमार अर्जुन पब्लिशिंग हाउस नई दिल्ली*