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From the Editor
Intelligent Hospitality: Technology, Well-Being
and Sustainable Futures

Volume VIII, Issue I of the Indian Journal of Hospitality Management brings together nine research contributions that reflect a defining transition in hospitality, tourism, food systems, education, public health, and service management. Across the issue, Artificial Intelligence emerges as a recurring thread; however, the contributions go beyond technology itself. They examine how intelligent systems can be made useful, responsible, culturally sensitive, health-oriented, and sustainable in real-world settings.

The issue is particularly relevant at a time when hospitality and allied sectors are being reshaped by data-driven decision-making, changing consumer expectations, growing concerns about physical and mental well-being, and the need for sustainable development. The papers collectively demonstrate that innovation is most meaningful when it remains connected to human judgement, culture, ethics, inclusion, and long-term societal value.

The opening study examines the use of AI and wearable technologies in identifying early signs of unhealthy eating and lifestyle patterns among night-shift employees. By connecting work schedules, sleep, dietary behaviour, and circadian disruption, the study highlights the potential of data-supported lifestyle management for employees working in demanding 24-hour service environments.

The second paper revisits Satvik Aahar through the contemporary lens of mental well-being and Artificial Intelligence. It connects traditional Indian dietary thought with modern digital tools such as personalised meal planning, wellness applications, and AI-supported dietary guidance, illustrating how indigenous knowledge systems can remain relevant in technology-enabled lifestyles.

The third contribution explores the smart and sustainable development of Buddhist pilgrimage tourism in Maharashtra. It considers AI-supported visitor-flow management, environmental monitoring, digital interpretation, and phased technology adoption while emphasising heritage conservation, cultural sensitivity, stakeholder readiness, and the sanctity of pilgrimage destinations.

The fourth paper turns to education and examines AI-supported, student-led learning models. It reflects on blended and flipped learning, digital literacy, inclusive pedagogy, ethical concerns, and the continuing importance of teachers. The study reinforces the view that AI should augment rather than displace human facilitation in the learning process.

The fifth article focuses on digital journaling among school students and its relationship with self-reflection, emotional growth, and mental well-being. It draws attention to the growing need for reflective, student-centred approaches to emotional development and to the responsible use of digital tools in educational well-being initiatives.

The sixth study investigates AI-enabled robotic cooking and its implications for Indian households. Alongside convenience, consistency, food quality, and nutritional considerations, the paper addresses affordability, market readiness, and the emotional and cultural dimensions of cooking. It presents an important reminder that automation in food systems must respect the social meaning of food and culinary traditions.

The seventh paper evaluates public awareness and behavioural responses to FSSAI's "Stop Obesity" campaign. Through its focus on dietary behaviour, sugar boards, public communication, and regulatory interventions, the study places preventive health and responsible food choices within the broader discourse of hospitality and food-service management.

The eighth contribution examines how government reforms, public-health priorities, and changing consumer behaviour are influencing the rise of zero-alcohol beverages. It highlights the interaction between regulation, market innovation, wellness-oriented consumption, and the strategic repositioning of the global beverage industry.

The final paper provides a conceptual review of human-technology collaboration in hotel service systems. It addresses changing job roles, human-AI cooperation, reskilling, employee well-being, and ethical governance, offering a workforce-readiness perspective for technology-intensive hospitality environments.

Taken together, the nine papers present a coherent message: the future of hospitality and allied sectors will not be shaped by technology alone. It will depend on how effectively technology is integrated with human capability, health, culture, sustainability, responsible governance, and meaningful service. This issue therefore represents not merely a collection of studies on AI and innovation, but a broader reflection on how intelligent and human-centred systems can contribute to a more resilient and responsible future.

We invite our readers - academics, practitioners, policymakers, students, and industry professionals - to engage critically with these contributions and to carry forward the dialogue on innovation that is technologically progressive, socially responsive, and grounded in the values that define hospitality.

Dr. Jagat Krushna Mangaraj, Chief Patron

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AI Interpretation in Diagnosing Early Signs of Bad Eating Habits of the Employees Working in the Night Shifts – A Global Perspective

Saanjjhi Bobariya ¹, Kapilesh Mangal ²

ABSTRACT. Artificial intelligence is the fastest-growing data-driven technology, and the healthcare and personal care sectors have not been untouched by it. Today, various options are available for individuals to track their daily lifestyle, including their wake-up and sleep cycles, eating/dietary habits, blood sugar levels, blood pressure, and heart rate. Furthermore, it has shown strong potential for identifying early signs of malnutrition, obesity, and metabolic disorders associated with unhealthy eating patterns and meal timing. These applications are very helpful for people who have to adjust their work shift timings. People working night shifts experience significant stress and irregular sleep schedules, leading to disturbances in their Circadian Rhythms. Methodology: The objective of this research is to understand the importance of AI in managing lifestyle, for which we will collect data from individuals who use such applications and those who are not aware of them. The data will be collected using a random sampling technique through a survey administered via a questionnaire consisting of both open- and closed-ended questions. Result: This shall enable us to understand the extent of individuals' awareness of available applications, their effective utilisation, and the significant results achieved over time. Also, it will help us understand how many people have downloaded the application and whether they are following it or have logged in. Conclusion: Based on the collected data, applications will be suggested for managing daily routines, specifically sleep timings and dietary intake, along with how they can be extracted and whether they require subscriptions. Also, easy snack options will be provided for different shift times that can be consumed globally.

Keywords: Wearable sensor data, Circadian Rhythm, Lifestyle-related diseases, Daily routine organisation, Night shifts, Eating habits

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1 INTRODUCTION

In corporate, hospitality, aviation and many other sectors, working night shifts is very common. People are assigned to night shifts in accordance with the duty roster prepared by their supervisors. In recent days, people have been preparing to work night shifts because of the benefits and allowances offered by the company. People who are satisfied with their lifestyle are forgetting the disadvantages of working the night shift. Moreover, those who are aware of it say it is difficult for them to integrate health, shifts, and dietary patterns.

Artificial intelligence (AI) is becoming increasingly integrated into people's daily lives. Since the development and adoption of smartphones and smart home appliances, human activity and lifestyle patterns are tracked, stored, and saved in the cloud. In addition, numerous wearable devices have been developed to continuously monitor human health and wellness.

Harrington, J. M. (2001). According to the author, "You are what you eat" is a phrase often used to describe compromised metabolic health associated with excessive intake of foods with limited nutritional value. Our endogenous circadian clocks may reflect what we eat and our ability to adjust to shift-lag after a sleepless night. Shift workers develop 'shift-lag' syndrome and recover within a few days, depending on the duration of the imposed shift phase, personal characteristics (e.g., age), and their coping strategies. Night work, e.g., the period of at least 7 consecutive hours between midnight and 5 a.m., poses a risk to workers' health. In fact, the human body is more vulnerable during those hours, which are usually when one should be sleeping. The various negative effects on the human body can be grouped into three levels: working, social and familial, and biological (Costa, 2003). Working shifts, especially night work, might alter eating behaviours. It has been suggested that night work causes a conflict between socially determined meal schedules and the circadian rhythms of hunger, satiety, and metabolism. Nocturnal eating causes disorders of intestinal motility, affecting the digestion, absorption, and utilisation of pharmacological drugs and nutrients. Hunger and satiety hormones are linked to circadian rhythms in metabolism, facilitating nocturnal fasting and sleep. This may account for the depressed appetite that is often observed during night work. Effects have been observed on people's circadian rhythms, which are affecting Shift workers' eating behaviour. Short-term effects are related to a lack of energy supply. In contrast, long-term effects involve a lack of essential nutrients (i.e., vitamins, minerals, and essential amino and fatty acids) necessary for the functioning of the senses and biochemical processes (Lowden, 2010). As previously seen, an increased prevalence of poor eating habits and gastrointestinal distress among shift workers likely contributes to hypertension, obesity, metabolic syndrome, cardiovascular disease (CVD), diabetes and cancer (Gill, 2013).

The human body relies on an energy supply from food to sustain life. The energy derived from food is used to perform daily functions. However, if the body's energy production and demand do not meet, a person's metabolic state may become unbalanced, leading to a metabolic disorder. Most of these disorders can be misdiagnosed until severe health problems occur, such as liver and kidney problems, vascular dysfunction, and heart disease. Treatment for metabolic disorders can be achieved through

a multidisciplinary approach that includes lifestyle changes. Such beneficial factors include food symmetry assessment, a personalised diet plan, preventing weight gain, increasing physical activity, and monitoring circadian rhythm variations.

In the past few years, healthcare has become a field of interest for big data, artificial intelligence, and data science. AI algorithms have been trained with deep learning to outperform human performance in several medical and clinical tasks, including disease detection, radiology image tissue classification, diagnosis, and therapeutic planning. AI has been shown to have potential applications in cancer diagnosis, drug administration prediction, and other early prognosis tasks, including mental conditions. There are also several commercial AI applications already available for healthcare providers to reduce healthcare costs and improve patient outcomes. However, the adoption of AI by the healthcare industry is progressing.

IMARC has presented a report under the ID: SR112026A21830, stating that the Indian artificial intelligence in healthcare market size was valued at USD 333.16 Million in 2024. IMARC Group estimates the market to reach USD 4,165.26 Million by 2033, exhibiting a CAGR of 30.78% from 2025-2033. North India dominates the market, holding 33.8% of market share in 2024. The market is evolving rapidly as AI technologies are increasingly integrated into diagnostics, treatment planning, patient monitoring, and hospital management systems. The need for improved healthcare efficiency, better patient outcomes, and enhanced data utilisation drives this transformation. With growing investment and innovation, AI is becoming a cornerstone of modern healthcare delivery, contributing to its expansion in India.

AI systems can interpret multi-source and complex data patterns that may not be evident through traditional monitoring. However, AI can be applied in two ways: sensor-based and data interpretation. The data sources used by AI include dietary logs (manual or application-based food tracking), wearable device data (sleep duration, activity levels, heart rate), cafeteria or vending machine purchase records, work schedule and shift rotation data, and self-reported mood and fatigue levels. Skipping meals, prolonged fasting during shifts, frequent late-night consumption of high-calorie foods, declining sleep quality paired with increased snacking, reduced physical activity combined with poor nutrition, and consistent deviations from recommended dietary patterns are the early warning indicators that AI can identify. This diagnosis can benefit from early intervention, personalised dietary recommendations, improved employee productivity and health, reduced long-term healthcare costs, and data-driven workplace wellness programs.

2 Objective

The main purpose of the present study is:

- Use of AI gadgets to identify typical lifestyle patterns
- Management of sleep of night shift workers using AI Gadgets

3 Hypothesis

H1: Individuals using AI-powered wearable devices globally exhibit a higher degree of identifiable lifestyle patterns, such as sleep schedules, physical activity levels, and dietary habits, compared to individuals not using such devices, as measured over a 30-day observational period.

Table 1.

Independent Variable	Dependent Variable	Rationale
Use of AI-powered wearable devices	Sleep quality and duration, step count, energy expenditure, dietary intake patterns	AI gadgets continuously collect and process physiological and behavioural data, enabling the identification of patterns that would be difficult to detect without such tools.

4 Methodology

Due to disrupted circadian rhythms, workers on the night shift are at higher risk of irregular meals, poor food choices, and metabolic and lifestyle-related disorders. In identifying early indicators like unhealthy eating habits, Artificial Intelligence can play a significant role. It can also help analyse behavioural, dietary, and psychological data to detect these risks early. The research was survey-based, collecting data from people who work night shifts or have worked them to understand the use of AI in managing their lifestyles. The targeted sample was people working night shifts.

Research type: The study was a Qualitative Study to assess the quality of awareness of the correct use of AI devices.

Sampling Type & Size: A random sampling method was used to collect data from a sample of 200.

Stakeholders: The data was collected globally from people working across the hospitality industry, including hotels, aviation, and travel and tourism.

Data collection tool and method: A questionnaire was used as the data collection tool, including both open- and closed-ended questions. The questionnaire was circulated through different media platforms.

Data type: Both primary and secondary data were used to support the research's suggestions and conclusions.

The parameters checked during the data collection were:

- Meal Irregularities
- Increased attraction towards processed and high sugar foods
- Limited access to healthy food options
- Increased chances of obesity, diabetes and CVD (cardiovascular diseases)
- Management of the night shifts via AI gadgets

5 Review of Literature

Lowden, Moreno, Holmbäck, Lennernäs, and Tucker (2010) highlight, in a recent review, increased consumption of calories, fats, carbohydrates, and sweets among shift workers compared to non-shift workers. Shift workers' diets were found to be richer in animal fats and proteins. However, night workers consumed more energy at work (due to a larger proportion of fat and carbohydrate intake) when compared to the other workers; instead, the consumption of dietary fibre was reduced due to a reduction in the consumption of green vegetables and an increase in sucrose from a higher intake of soft drinks.

Linseisen & Wolfram (1994) found that the intake of dietary fibre and sources of zinc and vitamins A and D was reduced to below the daily recommended levels in a group of permanent night workers. This might be an effect of altered meal patterns or food choices, in which, for example, the preparation of hot meals with a variety of foods is reduced and replaced by single-food items or bread-based meals. Several studies have reported a greater tendency to eat small amounts frequently ("nibbling behaviour") during the night shift. Nyberg (2009). Additionally, eating tends to be more irregular during the night shift; there may also be increased consumption of coffee and other substances intended to help maintain wakefulness at night, which may contribute to the development of gastric problems or other illnesses.

Costa (2010) notes that the synchronisation of human life is associated with meal times, which are physiological and social regulators. Shift work can alter meal timing, making it difficult to maintain a healthy diet. Research has shown that shift workers had more eating events per day than day workers. Ferri, Cavone, Intranuovo, and Macinagrossa (2017) Found That Night shift workers ate more snacks than day workers.

Polineni, Ganti, Maguluri (2024) Case 1. Corporate Employees. It is getting ever harder to combine a high-paid and satisfying career with a healthy and harmonious lifestyle. The pressures of daily life, career demands, long, busy workdays, and extensive business travel schedules often lead to metabolic stress, especially when combined with irregular daily rhythms and poor dietary habits. That is why we decided to implement the promised diagnostics for the healthcare departments of our corporate clients. As expected, deviations were observed. Analysing their lifestyle and daily rhythms, we organised our recommendations for optimising an individual plan. The demonstrated health potential speaks volumes about the feasibility of Lifestyle programs.

Linseisen (1994), in his study, stated that eating tends to be more irregular during the night shift, leading to increased consumption of coffee and other substances that are supposedly meant to help maintain wakefulness at night, thereby contributing to the development of gastric problems and/or other illnesses. The synchronisation of human life is associated with meal times, which serve as physiological and social regulators. Night-shift workers ate more snacks than day workers (Linseisen, 1994).

6 Key Findings

Based on a sample size of 200, the mean and mode were calculated to characterise age groups, meal patterns, beverages, sleep, and acceptance of AI in lifestyle management.

Table 2.

Category	Mode	Me- dian	Mean	Key remarks
Age	26- 35 years	26-35 years	35 years	26-35 years being the most common age among professional re- spondents.
Meals				Fast food turned out to be the most common choice and the most readily available option; 60% skipped their meals to avoid un- healthy choices.
Beverages	1-2 cups	0	2.1 cups	80% consumed 4 cups per night.
Sleep	4-6 hours	4-6 hours	5.6 hours	90% have reported poor sleep quality and sleep levels below healthy levels.
Health	Weight gain	-	Slight weight gain	70% reported fatigue, 45% reported weight gain, and 60% faced digestive issues.
AI Ac- ceptance	-	-	-	70% were aware, willing, and supportive of AI Gadgets; 30% were aware but showed no interest, citing it as not very lifestyle- friendly and, at times, unreliable.

6.1 Age

Age is very important, as it can affect acceptance at times. The 26-35 age group comprises industry professionals, 70% of whom use AI devices to manage their lives. Age is the most important factor: we see the younger group using gadgets, not the older ones or those over 35.

6.2 Meals

Given that the timing did not align with meal times, 60% of individuals skipped their meals at night. 40% of them did not get the healthy food choices available around them. They also mentioned that they were living away from their family, making it difficult for them to manage meals, especially during night shifts, which made their daily chores more challenging, and they tended to choose the easy options.

6.3 Beverages

80% of the samples indicate consuming around 4 cups of caffeine during the night shift, whether tea or coffee. They also said that this is an addiction they have gained after starting work, as it has been something very easily available and provided thrice in almost 95% of companies without any charges. 30% of people also said that caffeine intake was not for them before they started hanging out with certain people at work. It

has also been seen that sleep awakenings increased for individuals after consuming caffeine. Moreover, some people said they are so used to consumption that it no longer affects them.

6.4 Sleep

90% of individuals report that working night shifts have disrupted their sleep cycles. However, the incentives and rewards for working individuals on night shifts are what keep them motivated to work this shift. 30% of employees have also reported declines in vitamin and multivitamin levels, leading to fatigue, increased stress, and burning sensations in the legs and calf muscles. Moreover, to overcome the same, they had to take supplements and seek medical care.

6.5 Health

70% of individuals experienced fatigue after working night shifts for an extended period. 60% faced digestive issues (constipation 90%), and 45% have seen an increase in their weight. The data providers also mentioned that physical activity and daily chores have decreased after returning home from night shifts. Their primary focus and bodily needs are on sleep, which is causing them to skip meals and limiting their ability to meet their daily protein intake as adults.

6.6 AI Acceptance

People have said that AI has helped them manage their lifestyle while working night shifts. 70% of individuals are aware of, willing to adopt, and supportive of AI gadgets, and they also noted differences in the gadgets' affordability and acceptance. However, in one way or another, AI has become a part of their lifestyle. 60% of individuals use smartwatches, of whom 10% subscribe to lifestyle applications. The remaining 30% said that AI is unreliable and not for everyone. The users used AI applications to request healthy meal and snack options, create diet plans, and understand the calorie content of various foods. However, in many cases, the AI gave repeated options and solutions.

7 Suggestions

The collected data indicate that AI has captured over 75% of the market in terms of usage, acceptability, and reliability. However, there is still 25% of the market that is not very open to, accepting of, or reliable with AI and Gadgets.

The impression that the smartwatches carried during the launch reflected style. This impression can be modified by helping individuals learn how to use AI properly and understand its boundaries. Product marketing can be done by explaining their proper use, not by presenting them as stylish products. These objects can focus on the major ones, like water intake; the sleep cycle should be monitored.

Hotels and airports can conduct health checkups for staff to support their welfare and understand their health status. Also, before assigning nights for individuals for more than a month, the companies should take initiatives to understand the employee's health and fitness to work in the night shifts. This will help managers easily allocate staff for night shifts.

The staff canteens should provide balanced meals and sell healthy snack options through vending machines. Easy access to caffeine and fried foods should be controlled in staff canteens and replaced with healthy options.

AI workshops can be a part of the staff training program. Subscriptions to applications that help in lifestyle management can be given to staff members. The AI gadgets can be given to the employees as a part of their jobs. These smartwatches can be programmed to collect data that is visible to managers, helping them decide whether an employee is fit to be assigned to night shifts.

Table 3.

Table 3. Dietetic and organizational guidelines for the prevention of chronic diseases due to shift works.

Maintain regular eating patterns as much as possible.	Balanced, varied meals are very important. Keep family meal times the same even though the work routine constantly changes. Family meals may need to be altered in content to suit the shift worker.
Time meals carefully.	Afternoon workers should have the main meal in the middle of the day instead of the middle of the work shift. Night workers should eat lightly throughout the shift and have a moderate breakfast. This way they should not get too hungry while sleeping during the day and digestive discomfort should be minimal.
Pay careful attention to the type of food eaten.	Drink lots of water and eat the usual balance of vegetables, fruit, lean meat, poultry, fish, dairy products, grains and bread. Eat crackers, nuts and fruit instead of pop and candy bars during work breaks. Reduce the intake of salt, caffeine, and alcohol. Avoid greasy foods, particularly at night.
Avoid excessive use of antacids, tranquilizers and sleeping pills.	It is healthier to watch what and when you eat, and use relaxation techniques to aid sleep.
Relax.	Relax during meals and allow time for digestion.
Restrict energy intake.	Avoid eating, or at least restrict energy intake, between midnight and 06.00 hours, and try to eat at the beginning and end of the shift.
Avoid large meal.	Avoid "large meals" (>20% of daily energy intake) 1-2 hours prior to the main daily sleep episode.
Provide a variety of food choices.	Complete or vegetarian meals and high-quality snacks are recommended.
Avoid low quality snacks.	Avoid foods and beverages classified as low-quality snacks.
Provide appropriate dining facilities.	For example, allow a meal to be eaten away from the workplace, with colleagues, in as pleasant a surrounding as possible.
Maintain a healthy lifestyle	Exercise, regular meal times, and good sleep hygiene when not working.
Avoid wakening due to hunger.	Eat breakfast before day sleep.
Divide the energy 24-hour intake.	Divide into eating events with three satiating meals each contributing 20-35% of 24-hour intakes. The higher the energy needs, the more frequent the eating should be.
Avoid high energy foods.	Avoid over-reliance on (high-energy content) convenience foods and high-carbohydrate foods during the shift
Choose quality foods.	Choose vegetable soups, salads, fruit salads, yoghurt, wholegrain sandwiches, cheese or cottage cheese (topped with slices of fruits), boiled egg, nuts, and green tea (promoting antioxidant activity), although this may not be palatable to some.
Design proper shift schedules.	To allow adequate time between shifts for sleep, meal preparation, amongst others, avoid quick returns.

(Source: Lowden, A.; Moreno, C.; Holmbäck, U.; Lennernäs, M.; Tucker, P. Eating and shift work - effects on habits, metabolism and performance. *Scand J Work Environ Health*, 2010, 36(2), 150-62.)

8 Conclusion

AI interpretation offers a proactive, data-driven approach to diagnosing early signs of unhealthy eating habits in night-shift employees if used properly. By leveraging AI

responsibly, organisations can support healthier lifestyles, improve well-being, and reduce health risks associated with night-shift work by relying on data on specific aspects of night-shift work.

9 Limitations

The hospitality and corporate sectors are where day and night are not clearly distinguished, operating 24 hours a day. So, this could be a limitation: night shifts cannot be stopped but can be managed using AI, provided it is used properly. Certain issues like ethical and privacy considerations, such as consent, transparency and security.

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A Study on Satvik Aahar Influence on Mental Health and Integration with Artificial Intelligence

Vaibhav Ravindra Joshi¹, Kapilesh Mangal²

ABSTRACT. Mental health is increasingly recognised as a crucial aspect of overall well-being in today's fast-paced and stressful society. Food plays a significant role in maintaining emotional stability, alertness, and concentration. Satvik Aahar, a traditional Indian dietary system, emphasises natural, fresh, and predominantly plant-based foods believed to nurture the body and mind and promote purity, balance, and calmness. This study explores the relationship between Satvik Aahar and mental health and examines the potential integration of Artificial Intelligence (AI) to enhance awareness, accessibility, and personalisation. The study seeks to connect traditional nutritional knowledge with contemporary digital solutions such as mobile applications, virtual diet guides, and customised meal planners. These tools may help consumers understand and incorporate Satvik food principles into their daily lives. The study draws on relevant secondary sources, including research papers, theses, journals, and magazines, to examine the relationship between Satvik dietary practices and mental well-being.

Keywords: Satvik Aahar, Artificial Intelligence, Mindful Nutrition, Emotional Stability

1 INTRODUCTION

Food is one of the fundamental needs of human life. It provides us with energy, supports bodily growth, and maintains proper functioning. However, food is more than just sustenance; it affects our mind, emotions, behaviour, and overall quality of life. According to Indian tradition, food is not merely fuel for the body; it is a formative influence on thinking, nature, and consciousness. Ancient Indian texts emphasise that

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the content and purity of food are crucial for thinking, acting, and spiritual growth (Bhagavad Gita, 2008; Charaka Samhita, 2015).

Saatvik Aahar is a traditional dietary system rooted in Indian philosophical and spiritual practices. It emphasises foods believed to enhance Sattva by nourishing the body, calming the mind, and supporting inner awareness. The World Health Organisation (2022) has also emphasised the importance of healthy dietary practices for overall well-being (Patel & Singh, 2021).

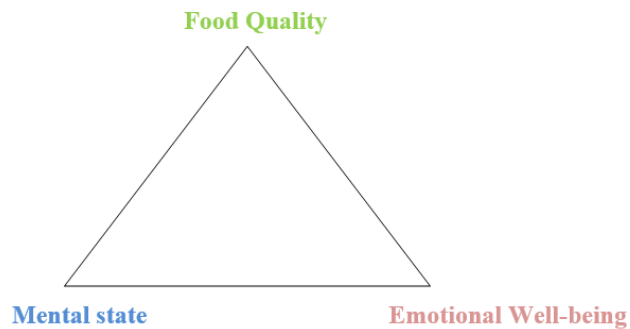


Fig. 1.

As people increasingly rely on fast food because of modern lifestyle demands, dietary habits have changed considerably. Greater consumption of processed foods, fast foods, synthetic additives, and added sugar contributes to lifestyle-related health concerns such as obesity, diabetes, cardiovascular disease, digestive problems, anxiety, and stress. Social media and digital platforms also influence food choices, making it important to understand how traditional dietary systems can remain relevant in contemporary settings.

2 OBJECTIVES OF THE STUDY

- To study and understand Satvik Aahar and its influence on mental health.
- To understand the role of Artificial Intelligence in promoting awareness and adoption of Satvik Aahar.

2.1 Saatvik Aahar: Concept and Principles

Saatvik Aahar consists of food that is pure, fresh, light, nourishing, and prepared with care and positive intention. In Indian philosophy, food is believed to influence not only the body but also the mind and consciousness. Saatvik food is associated with balance, inner harmony, and mental clarity.

2.2 The Three Gunas: Sattvik, Rajasik, and Tamasik

Indian philosophy describes three gunas that influence nature and human behaviour, including thoughts and food choices:

- Sattva: Purity, balance, wisdom, clarity, and calmness
- Rajas: Activity, passion, ambition, restlessness, and desire
- Tamas: Inertia, ignorance, darkness, lethargy, and confusion

Saatvik Aahar enhances the Sattva guna, leading to clear thought, emotional stability, and self-discipline. Rajasic foods overly stimulate the body and mind, causing frustration and aggression. Consuming Tamasic food results in weakness, drowsiness, lack of motivation, and reduced productivity. The ultimate goal of Saatvik Aahar is to maintain Sattva while controlling Rajas and Tamas.

Table 1. Food Type Classification based on the Three Gunas (Sharma, 2014; Taimni, 2013; Sivananda, 2004).

Features of the Guna type	Certain Examples of Foods	Impact on Mental Health
Saatvik	Clear, fresh, light, nourishing	Fruits, vegetables, whole grains, milk, ghee, nuts
Rajasic	Spicy, stimulating, heavy	Fried foods, strong spices, tea, coffee, salty foods
Tamasic	Stale, processed, dull	Packaged food, alcohol, meat, reheated food

3 RESEARCH DESIGN

3.1 Research Design

A mixed-method research design was employed, incorporating both quantitative and qualitative methods to gain comprehensive insights into the subject.

3.2 Sample Size and Sampling Technique

A sample of 120 respondents was selected through purposive sampling. The sample included:

- College students
- Teaching professionals
- Health-conscious individuals
- Yoga and wellness practitioners

3.3 Data Collection Tools

Data were collected using the following methods:

- Structured questionnaire: to assess dietary habits and mental health measures.
- Review of classical sources such as the Bhagavad Gita and Ayurveda, along with contemporary scholarly research papers.
- Case studies involving practitioners of Satvik dietary practices.
- Observational study of eating behaviour, food choices, and lifestyle.

3.4 Data Analysis Techniques

Descriptive statistics, including percentage analysis and mean scores, were used for quantitative analysis. Qualitative data were analysed thematically.

3.5 Fresh and Natural Foods

Consuming fresh, natural foods is one of the underlying principles of Saatvik Aahar. Fresh fruits and vegetables, whole grains, and dairy products are commonly included. Food is preferably prepared daily and consumed soon after preparation. Stale, reheated, frozen, or highly preserved foods are generally avoided.

3.6 Seasonal and Local Foods

Saatvik Aahar favours locally grown and seasonal foods. Seasonal foods are considered better aligned with changing climatic and bodily needs. For example, cooling fruits and vegetables may be preferred in summer, while grains and milk-based foods may be more suitable in winter. Local food consumption can also support local producers and reduce environmental impact.

3.7 Simple and Light Methods of Cooking

Saatvik cooking emphasises simple, gentle methods such as boiling, steaming, pressure cooking, and light sautéing. Excessive frying, heavy spices, artificial flavours, and chemical additives are generally avoided. The objective is to retain the natural taste, texture, and nutritional quality of food while keeping it easy to digest.

3.8 Conscious Cooking and Consumption

Saatvik Aahar also emphasises the mental state of the person preparing and consuming food. Food is ideally prepared in a peaceful and positive environment and consumed mindfully, with gratitude and without unnecessary distractions. Mindful eating may improve awareness, digestion, and satisfaction.

3.9 Moderation and Balance

Moderation is a central principle of Saatvik Aahar. Both overeating and undereating may disturb bodily balance and digestion. Food quantity should therefore be appropriate to age, activity level, and digestive capacity. Regular meal timings may also support metabolic well-being.

Table 2. Core Principles of Saatvik Aahar and Their Health Outcomes

Principle	Description	Physical Health Outcome	Mental Health Outcome
Freshness	Daily prepared natural foods	Improved digestion	Mental clarity
Seasonal Eating	Foods according to climate	Metabolic balance	Emotional stability
Simple Cooking	Minimal oil and spices	Nutrient preservation	Calmness
Mindful Eating	Conscious food intake	Better absorption	Reduced stress
Moderation	Balanced portion control	Disease prevention	Emotional balance

4 FINDINGS AND INTERPRETATION

4.1 Questionnaire-Based Findings (n = 120)

Table 3.

Mental Health Indicator	Positive Response (%)	Interpretation
Reduced Stress Levels	78%	Satvik diet helps manage stress
Improved Concentration	82%	Enhanced mental clarity
Emotional Stability	75%	Better emotional control
Sleep Quality	70%	Improved relaxation and sleep

4.2 Observational Analysis

Observational data indicated that individuals following Satvik Aahar tended to maintain more disciplined eating habits and regular meal timings. Compared with those consuming processed, fast, or junk foods, they appeared calmer, less irritable, and more emotionally balanced.

4.3 Case Studies

Case 1: A 28-year-old yoga practitioner reported reduced anxiety and improved focus after following Satvik Aahar for six months.

Case 2: A 35-year-old teacher reported improved sleep quality and emotional balance after adopting a Satvik diet.

These cases indicate a positive association between Satvik dietary practices and mental well-being.

4.4 Fruits and Vegetables

Saatvik Aahar is based substantially on fresh fruits and vegetables, which provide vitamins, minerals, dietary fibre, and antioxidants. Common examples include apples, bananas, papaya, oranges, seasonal berries, leafy greens, gourds, carrots, beans, and root vegetables. These foods support digestion, immunity, and overall energy levels.

4.5 Whole Grains and Cereals

Rice, wheat, millets, oats, and other cereals are common components of Saatvik Aahar. They provide complex carbohydrates for sustained energy and are important sources of fibre, B-complex vitamins, and minerals that support digestion and metabolic health.

4.6 Dairy Products

When consumed in moderation, milk, curd, ghee, and butter from natural and ethical sources are considered Saatvik. Dairy products provide nutrients that support the nervous system and overall health. Traditionally, warm milk is also associated with relaxation and better sleep.

4.7 Nuts and Seeds

Nuts and seeds such as almonds, walnuts, sesame seeds, and flaxseeds are included in small quantities. They provide healthy fats, protein, and essential minerals that support brain function and overall health.

4.8 Foods to Avoid

Saatvik Aahar generally avoids foods that are excessively spicy, oily, stale, fermented, or highly processed. Onion, garlic, meat, fish, eggs, alcohol, caffeine, and packaged foods are also commonly excluded because they are traditionally associated with Rajasic and Tamasic qualities.

Table 4. Components of Saatvik Aahar and Nutritional Benefits

Food Group	Examples	Key Nutrients	Health Benefits
Fruits & Vegetables	Apple, spinach, gourd	Vitamins, antioxidants	Immunity, vitality
Whole Grains	Rice, millets, wheat	Fibre, B-complex	Sustained energy
Dairy	Milk, curd, ghee	Calcium, healthy fats	Nervous system support
Nuts & Seeds	Almonds, flaxseeds	Omega-3, protein	Brain health

5 ARTIFICIAL INTELLIGENCE INTEGRATION WITH SATVIK AAHAR

Younger respondents also showed high acceptance of AI-enabled tools. AI applications can support meal planning, dietary reminders, awareness-building, and personalised guidance while respecting traditional dietary values (Davenport & Kalakota, 2019; Topol, 2019).

5.1 Improved Digestion

Saatvik foods are generally light, fresh, and easy to digest. Their fibre content can support regular digestion and may help reduce constipation, acidity, and bloating. Simple cooking methods may further reduce digestive burden (Luxton, 2016; Bhuiyan et al., 2025; Varayil et al., 2025).

5.2 Enhanced Energy Levels

Whole grains, fruits, and vegetables provide steady energy without excessive heaviness. These foods can support sustained activity throughout the day.

5.3 Disease Prevention

A natuA whole and minimally processed dietary pattern may help reduce the risk of lifestyle-related diseases such as obesity, diabetes, cardiovascular disease, and hypertension. Antioxidants in fruits and vegetables can also help protect the body from inflammation and oxidative stress.

5.4 Strengthened Immunity

Saatvik Aahar includes foods rich in vitamins A, C, and E, as well as minerals such as iron and zinc. A healthy digestive system may also contribute to better immune function.

6 Limitations of the Observations

- Limited sample size.
- Self-reported responses may be subject to bias.
- The AI tools discussed are largely conceptual.

7 MENTAL HEALTH BENEFITS OF SATVIK AAHAR

7.1 Clarity and Focus of Mind

Saatvik foods are traditionally associated with calmness and concentration. Individuals following this dietary pattern may experience improved focus, memory, and learning ability, which can be relevant for students, teachers, and professionals.

7.2 Emotional Balance

Saatvik Aahar may support emotional balance by limiting the intake of Rajasic and Tamasic foods. It is traditionally associated with reduced restlessness and greater patience, stability, and tranquillity.

7.3 Stress Reduction

Natural, nourishing foods can support the nervous system and help the body cope with stress. Mindful eating practices may further promote relaxation and mental well-being.



Fig. 2. Health Effects of Saatvik Aahar on Physical and Mental Health

Table 5. Impact of Saatvik Aahar on Mental Health Indicators

Mental Health Indicator	Observed Impact
Stress Levels	Reduced
Anxiety	Controlled
Concentration	Improved
Emotional Stability	Enhanced
Sleep Quality	Better

8 SPIRITUAL AND ETHICAL ASPECTS OF SAATVIK AAHAR

Saatvik Aahar is not only a dietary practice but also a spiritual and ethical framework. Ancient texts such as the Vedas, Upanishads, and the Bhagavad Gita describe food as influencing thoughts, behaviour, and consciousness.

Saatvik Aahar promotes sustainable living through greater reliance on plant-based foods, respect for nature, responsible use of resources, and ethical food practices.

From a spiritual perspective, Saatvik Aahar is associated with calmness and clarity of mind. Yogic teachings connect a balanced diet with mental discipline and purification. Common mindful practices include expressing gratitude before eating, eating slowly, being attentive to hunger and fullness, respecting food, and maintaining positive thoughts while eating. Such practices may support a healthier emotional relationship with food, ethical living, and spiritual growth.

8.1 Role of AI in Mental Health and Nutrition

AI is creating new opportunities in dietary planning, lifestyle modification, stress management, and preventive healthcare. Mobile applications, wearable devices, and virtual assistants can support the tracking of dietary practices, wellness indicators, and physical health metrics (Iyer et al., 2025; Arefeen et al., 2025).

8.2 AI-Based Saatvik Diet Applications

The integration of AI with Saatvik Aahar offers new ways to promote traditional dietary principles in a modern, technology-oriented environment. AI can provide information on Satvik food principles, personalised meal plans, and tools to monitor dietary adherence.

Potential application features include:

- Personalised Satvik meal planners based on age, occupation, stress level, and digestive capacity.
- Virtual diet assistants providing real-time guidance on Satvik food choices.



Fig. 3. Integration of Traditional Diet with Modern Technology

8.3 AI and Mental Health Monitoring

AI-based programs can analyse user preferences, lifestyle habits, and mental health indicators to generate more specific recommendations while remaining aligned with Satvik Aahar principles.

AI systems can also support mental health monitoring by analysing mood patterns, stress levels, sleep quality, and emotional responses. When combined with dietary information, such systems can help identify associations between food habits and mental well-being. Appropriate dietary guidance aligned with Satvik principles may then be suggested as part of a broader wellness approach.

Table 6. Role of Artificial Intelligence in Saatvik Diet Adoption

AI Application	Function	Benefit
Diet Recommendation Systems	Personalized Saatvik meal plans	Improved adherence
Mobile Wellness Apps	Awareness and tracking	Lifestyle modification
Virtual Assistants	Real-time guidance	User engagement
Data Analytics	Pattern recognition	Mental-diet correlation

9 RESEARCH METHODOLOGY

9.1 Research Design

The study adopts a mixed-method approach to examine associations among Satvik Aahar, mental health, and AI-based dietary interventions.

9.2 Sampling Technique

Purposive sampling was used to include health-conscious respondents, students, instructors, teachers, health educators, wellness specialists, and individuals interested in nutrition and mental well-being. This approach ensured that respondents had relevant knowledge or experience related to the subject.

9.3 Data Collection Methods

Data were collected through:

- Structured questionnaires.
- Classical texts and contemporary studies.
- Case studies of individuals following Satvik dietary practices.
- Observation of food consumption practices (Patel & Singh, 2021; WHO, 2022).

The questionnaire covered dietary habits, mental health indicators, stress, awareness of Satvik Aahar, and willingness to use AI-based dietary tools.

9.4 Data Analysis

Quantitative data were analysed using descriptive statistics, while qualitative data were interpreted through thematic analysis. The analysis focused on trends, relationships, and attitudes concerning Satvik dietary practices and mental well-being.

10 RESULTS AND DISCUSSION

The findings indicate a positive association between Satvik dietary practices and well-being. Survey participants also expressed interest in AI-powered dietary tools that could simplify meal planning and improve awareness of traditional food systems. Integrating AI with Satvik Aahar may improve accessibility, particularly among younger, technology-oriented users, while cultural authenticity and ethical values can be retained through responsible adoption of contemporary technology (Bhattacharya & Pandey, 2019; Jacka et al., 2017).

11 CONTEMPORARY RELEVANCE OF SATVIK AAHAR

In today's fast-paced and competitive environment, mental health concerns are increasing across age groups. Stress, emotional exhaustion, and mental fatigue affect students, professionals, and families alike. Satvik Aahar offers a culturally rooted and relatively accessible approach that aligns with growing global interest in plant-based diets, mindfulness, holistic wellness, and preventive health. When thoughtfully integrated with AI, Satvik Aahar can be adapted to contemporary lifestyles while retaining its traditional principles. This gives it potential relevance in urban communities, educational institutions, healthcare settings, and wellness programs.

12 LIMITATIONS OF THE STUDY

Although the study provides useful insights, the following limitations should be acknowledged:

- Limited geographic coverage and sample size.
- Self-reported data may be subject to respondent bias.
- Limited time was • Limited availability of data for collection, and the biological effects of Satvik Aahar on humans were not directly examined.

13 CONCLUSION

Satvik Aahar appears to support mental well-being by promoting calmness, emotional balance, and clarity of thought. Artificial Intelligence offers new possibilities for adapting this traditional dietary system to contemporary lifestyles. The study highlights the

potential of technology to complement traditional dietary knowledge while enhancing awareness, personalisation, and accessibility (Jacka et al., 2017; Bhuiyan et al., 2025).

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Integrating Artificial Intelligence for Smart and Sustainable Development of Buddhist Pilgrimage Tourism in Maharashtra

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ABSTRACT. Buddhist pilgrimage destinations in Maharashtra attract large numbers of visitors because of their spiritual importance, rich cultural heritage, and historical significance. Major sites include Ajanta, Ellora, Deeksha Bhoomi, Chaitya Bhoomi, Karla, Bhaja, the Global Vipassana Pagoda, and Dragon Palace Temple. Improved infrastructure and accessibility have increased tourist footfall, placing considerable pressure on local infrastructure, environmental systems, and the ecosystems surrounding these pilgrimage sites. Against this backdrop, the present study examines how Artificial Intelligence (AI) can support the smart, long-term, sustainable development of Buddhist pilgrimage destinations in Maharashtra. From a tourism development perspective, integrating modern technologies, particularly AI, can enhance visitor management and help preserve Buddhist heritage sites. The study adopts a mixed-method approach comprising visitor surveys, stakeholder interactions and interviews, and analysis of secondary data. It explores current management challenges, stakeholder readiness, and potential AI-enabled interventions, and identifies ways to improve the visitor experience. Tools such as predictive analytics, environmental monitoring sensors, digital queue management systems, and intelligent interpretation systems can improve visitor management and conservation outcomes. Stakeholders generally recognise the potential benefits of AI, although concerns about cost, privacy, digital skills, and cultural sensitivity remain significant. The study proposes a SMART-based framework for the phased adoption of AI. It concludes that responsible, context-sensitive integration of AI can help transform Buddhist pilgrimage destinations in Maharashtra into sustainable, inclusive, and future-ready heritage destinations.

Keywords: Buddhist Pilgrimage, Sustainability, Artificial Intelligence, Smart Tourism, Visitor Management, Maharashtra

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1 INTRODUCTION

Pilgrimage tourism has played a central role in India's cultural and spiritual life. Although the term "pilgrimage tourism" was not commonly used in earlier periods, people across India have long travelled to spiritually significant sites. Pilgrimage tourism helps shape spiritual life, belief systems, collective identity, and community livelihoods. In Maharashtra, Deeksha Bhoomi at Nagpur represents a major modern Buddhist pilgrimage destination. At the same time, the ancient rock-cut cave complexes of Ajanta, Ellora, Karla, Bhaja, and Pitalkhora hold exceptional historical and cultural value. These sites attract not only Buddhist pilgrims but also heritage enthusiasts, researchers, and international travellers seeking historical and spiritual knowledge. Their significance lies in their architectural and artistic value, the teachings of the Buddha, and the social reform legacy of Dr B. R. Ambedkar. Every year in October, on the occasion of Dussehra, Deeksha Bhoomi receives very large numbers of followers, researchers, pilgrims, and tourists. The site is especially significant because Dr B. R. Ambedkar embraced Buddhism there, along with many of his followers.

Despite their cultural and spiritual relevance, these sites increasingly face management challenges. Visitor surges during peak periods often lead to congestion, waste accumulation, and pressure on basic facilities. At cave sites, fluctuations in temperature and humidity caused by heavy foot traffic may pose risks to ancient sculptures and murals. Traditional management practices, such as manual crowd control and routine maintenance, are increasingly inadequate to address these pressures. As visitor expectations evolve, the need for more responsive and data-driven management approaches has become evident.

Artificial Intelligence is emerging as a valuable tool for addressing similar challenges in tourism and heritage management globally. AI-enabled systems are being used to forecast visitor flows, observe movement patterns, improve interpretation, and monitor environmental changes. In India, particularly at pilgrimage destinations, adoption of such technologies remains limited. This gap provides an opportunity to explore the applicability of AI in culturally sensitive environments without compromising the spiritual atmosphere of pilgrimage destinations.

Stakeholders are crucial to this transition. Its success depends on tourism officials, site managers, local communities, and visitors. Their understanding of technology, awareness, attitudes, and digital capabilities will influence whether AI-based systems can be implemented effectively. At pilgrimage destinations, where spiritual values are central to the visitor experience, technological solutions must be introduced respectfully and with considerable care.

Rapid digital transformation across the global tourism industry has increased the need for pilgrimage destinations to modernise while remaining receptive to technological advancement. In the era of AI, visitor expectations increasingly align with smart services, real-time information, and seamless experiences. Destinations that fail to adopt appropriate technological advances risk reduced competitiveness. Integrating Artificial Intelligence can therefore be viewed as a strategic step toward the long-term sustainability, resilience, and global relevance of Buddhist pilgrimage destinations in Maharashtra.

2 REVIEW OF LITERATURE

Over the past three decades, technology has expanded spontaneously into the tourism industry. Now, Artificial Intelligence is occupying a central position in discussions related to destination management. Earlier research, which primarily focused on information and communication technology, was largely a story of previous decades. Decision-making and visitor experience are core areas of tourism. Recent studies emphasise the value of AI-driven analysis, sensors, and intelligent platforms in improving core areas of tourism. The studies are mostly focused on improving decision-making and the visitor experience using AI. This shift in technology in the tourism sector is the foundation of smart tourism, where destinations use integrated data systems to improve efficiency and responsiveness (Gretzel et al., 2015).

The idea of smart tourism destinations further builds on this concept of Artificial Intelligence. Buhalis and Amaranggana (2015) stated that smart tourist destinations rely on interconnected technologies to provide sustainability, accessibility and stakeholder collaboration. Empirical studies to date suggest that such systems can help manage congestion at sites, optimise resource use, and improve service quality, particularly in high-pressure destinations.

In pilgrimage and heritage content, technological innovation and sustainable tourism are the core concerns in today's world. According to UNWTO (2019), sustainability requires a balance between cultural integrity, economic benefits, and environmental protection. Research on heritage sites in India found ongoing challenges at these destinations, including overcrowding, inadequate waste management, and insufficient visitor interpretation. These concerns, according to Singh and Mishra (2020), threaten the long-term conservation of heritage destinations.

Artificial Intelligence is a potential enabler of sustainability. This has been viewed in today's day and age. Various studies demonstrate that machine learning models can forecast visitor demand (Li et al., 2018). For environmental monitoring, AI-based sensor support is helpful in sensitive heritage environments (Gretzel, 2022).

To enhance visitor learning without increasing on-site physical pressure, digital interpretation tools such as chatbots and virtual guides have shown promising results (Morosan & Bowen, 2018).

There are benefits of artificial intelligence, no doubt, but literature also highlights crucial limitations of this technology. Most importantly, ethical concerns related to data privacy, unequal access to technology, and the risk of over-technology at sacred places are frequently noted (Kaur & Singh, 2021; Tussyadiah, 2020). These concerns raised by the researchers are relevant to pilgrimage destinations, cultural values, and spiritual ambience and must therefore be prevented. According to UNESCO (2021), the SMART framework (Specific, Measurable, Achievable, Relevant, and Time-bound) has been applied in tourism planning to structure development goals and evaluate outcomes. When combined with AI-based tools, the SMART principles provide a systematic approach to implementing technology in a context-specific and controlled manner.

Pilgrim tourism in India has received scholarly attention; most of the studies have focused on major Hindu destinations. The present research specifically addresses Bud-

dhist pilgrimage sites in Maharashtra. Research on artificial intelligence-enabled sustainability remains limited. This is the gap that underlines the relevance of the present study.

In recent years, advancements in digital transformation have proliferated the evolution of tourism destinations into data-driven eco-systems. The smart tourism concept has increasingly emphasised the integration of the Internet of Things (IoT), big data analytics, cloud computing, and artificial intelligence to develop responsive and adaptive destination management Systems. Research Scholars stated that such technologies enable real-time monitoring of visitor responses, environmental conditions, and resource consumption, thereby facilitating proactive planning rather than reactive management. Therefore, smart destinations are distinguished not only by technological infrastructure but also by improved governance, evidence-based decision-making processes and collaboration among stakeholders.

In recent years, within the tourism and hospitality domain, applications of Artificial Intelligence have expanded rapidly. Machine learning algorithms are now used to forecast tourist demand, optimise pricing strategies, personalise the visitor experience, and automate service delivery. Recommender systems, virtual assistants, and Chatbots have improved information accessibility, while computer vision technologies assist in crowd management, including crowd density analysis. They also assist in security monitoring of the destination. Many studies have proved that these tools tremendously improve Operational efficiency, reduce costs, and increase tourist/visitor satisfaction. Researchers warned that technological implementation must be content-sensitive, particularly in heritage and religious environments where excessive digitisation may disrupt authenticity and visitors' perception.

From a sustainability perspective, heritage destinations face a delicate balance between conservation and commercialisation. According to UNESCO and other international bodies, unmanaged visitor growth can cause irreversible damage to cultural assets and natural ecosystems. In pilgrimage tourism, overcrowding, infrastructural strain and waste management are the cited challenges. Research scholars advocate for the adoption of SMART monitoring systems that regulate carrying capacity at destinations, minimise environmental footprints, and Support Long-term preservation for the sustainable development of destinations. AI-based environmental sensors and predictive analytics are steadily recognised as effective tools for protecting delicate monuments and archaeological sites.

Despite these developments, research that specifically addresses the intersection of Artificial Intelligence, sustainability, and pilgrimage tourism remains limited. Urban or leisure tourism contexts are empirically more focused than religious destinations, according to scholars. In fact, Buddhist pilgrimage destination sites in Maharashtra, in particular, have been underrepresented in technology-oriented tourism research. This Lack of localised, evidence-based studies creates a great research gap. Therefore, the present study contributes to the literature by examining how AI-based, AI-enabled solutions can be adopted in the most culturally sensitive pilgrimage settings and by proposing a structured framework for sustainable management tailored to regional realities.

2.1 AI, Sustainability and Buddhist Pilgrimage

In view of this content, Artificial Intelligence functions as an enabling tool that supports sustainable pilgrimage destination management through predictive visitor flow analysis, resource optimisation and data-driven decision-making. The term sustainability in pilgrimage destination tourism extends beyond basic concerns like environmental ones. It includes cultural continuity, community participation and ethical governance of the sites. Hence, the intersection of Artificial Intelligence, sustainability and pilgrimage forms the conceptual foundation of the study. This conceptual linkage process further informs the field-based investigation and interpretations of findings.

3 RESEARCH OBJECTIVES AND METHODOLOGY

3.1 Research Objectives

The objectives of the study are as follows: -

- To study how Artificial Intelligence can contribute to the smart and sustainable development of Buddhist Pilgrimage tourism in Maharashtra
- To assess existing management practices and sustainability challenges at selected pilgrimage sites.
- To analyse stakeholder and visitor perceptions regarding the adoption of AI-based technology.
- To identify opportunities, barriers and ethical considerations associated with Artificial Intelligence implementation.
- To propose a SMART-based framework for integrating Artificial Intelligence into Buddhist pilgrimage site management.

3.2 Methodology

To find both measurable and contextual insights, a mixed-methods research design was adopted. The quantitative data were collected through structured visitor surveys, whereas qualitative data were obtained through semi-structured interviews with key stakeholders.

3.3 Sample Study Area

The selected Buddhist pilgrimage destinations constitute a purposive sample to understand the integration of Artificial Intelligence within the specific socio-cultural and heritage context of Maharashtra. The study focuses on major Buddhist pilgrimage destinations in Maharashtra, which include: 1. Deeksha Bhoomi (Nagpur) 2. Ajanta Caves (Chhatrapati Sambhajanagar) 3. Ellora Caves (Chhatrapati Sambhajanagar) 4. Pandavleni Caves (Nashik) 5. Karla and Bhaja (Lonavala) 6. Chaitya Bhoomi (Mumbai) 7. Global Vipassana Pagoda (Mumbai) 8. Pitalkhora (Chhatrapati Sambhajanagar)

These sites were selected due to their historical importance, visitor volume and different management challenges.

3.4 Data Collection and Analysis

Primary data were collected through visitor surveys and stakeholder interviews, while secondary data were taken from government reports, international guidelines and academic literature.

The quantitative responses were analysed using descriptive statistics, and qualitative data were examined through thematic analysis. All the findings were interpreted within the SMART framework to assess feasibility and relevance.

3.5 Sampling Technique

Purposive sampling was used to select eight major Buddhist pilgrimage destinations based on visitor volume, historical significance and management complexity. A total of 200 visitors were surveyed using structured questionnaires, while 40 stakeholders, including site managers, tourism officials, local vendors and guides, were interviewed using semi-structured schedules.

3.6 Research Instruments

Three Instruments were developed:

1. Visitor questionnaire (Likert scale and multiple choice questions)
2. Stakeholder Interview guide
3. Observation checklist for four site conditions.

3.7 Reliability and validity

The content validity was ensured through expert review by tourism academics and heritage professionals. Pilot testing was conducted with 20 respondents, and required modifications were made. The Cronbach's Alpha reliability coefficient for the survey instrument was 0.82, indicating acceptable internal consistency.

3.8 Data Analysis Techniques

- Descriptive statistics (frequency, Percentage, mean)
- Thematic analysis for Interviews
- Comparative interpretation within the SMART framework
- Tabular and graphical representation of results.

3.9 Framework Application

The SMART (specific, Measurable, Achievable, Relevant, Time-Bound) framework was used as an evaluative tool. This will help to assess the feasibility of Artificial Intelligence Interventions and develop policy recommendations.

The triangulation of qualitative and quantitative findings enhanced the robustness of the study. The survey responses were cross-verified with stakeholder interviews and on-site observations to minimise bias and improve interpretive accuracy. The conclusions drawn were based on both statistical evidence and contextual realities, using multi-source validation of Buddhist Pilgrimage site management.

4 ANALYSIS, FINDINGS AND DISCUSSION

The research analysis, based on real-world data, highlights highly important patterns. The visitor surveys suggest that spiritual motivation remains dominant. A substantial proportion of visitors seek heritage and educational experiences. Satisfaction levels indicate appreciation for the spiritual environment. There are also concerns about crowding, cleanliness, and limited information resources.

Visitors' awareness of Artificial Intelligence appears moderate, suggesting openness to digital tools. However, they should be simple and clearly explained. The responses from stakeholders reveal a positive approach to AI adaptability. Many of them focused on the need for training and institutional support. Concerns about cost, cultural sensitivity and data privacy also emerge.

The findings indicate that AI-based interventions such as environmental monitoring sensors, predictive crowd management, digital interpretation tools, and decision support dashboards can address many of these challenges. However, the discussion underscores that technological solutions must be introduced slowly and applied with local capabilities and cultural values in mind.

The findings also reveal a critical service quality gap between visitor expectations and current site management practices. The spiritual and cultural dimensions of the Buddhist Pilgrimage destinations remain strong. The shortcomings, such as congestion, limited interpretation and inconsistent maintenance, negatively affect overall visitor satisfaction.

Optimised resource allocation, enabled by AI-driven systems, has the potential to transform weaknesses into strengths from a managerial perspective, enabling predictive planning and evidence-based decision-making. Thus, Artificial Intelligence can serve as both a technical tool and a strategic governance mechanism for sustainable pilgrimage tourism.

When viewed through the SMART framework, the results suggest that Artificial Intelligence adoption should start with achievable, low-risk applications and expand over time as stakeholder confidence and capacity grow.

5 Discussion

The discussion of the study research is based on observations and interactions with visitors and stakeholders at selected Buddhist pilgrimage destinations in Maharashtra.

The findings indicate that artificial intelligence has Potential to support sustainability objectives. However, the application remains sensitive to the spiritual and cultural nature of pilgrimage sites. Interactions with visitors in the field revealed that spiritual motivation dominates visitor behaviour. The respondents expressed a preference for a calm and sacred environment. This explains that AI-based systems should operate cautiously in the background. This could take the form of supporting functions such as visitor flow regulation and environmental monitoring, rather than appearing as visible technological features that might disrupt the spiritual ambience.

Particularly during the peak pilgrimage periods, moderate levels of visitor satisfaction were observed across the study sites. The on-site observations highlighted congestion, uneven crowd movement, and pressure on facilities at peak times. This indicates the scope for improvement through AI-enabled visitor management systems.

Stakeholder interactions showed an overall positive attitude towards AI adoption. The emphasis is on training and capacity building.

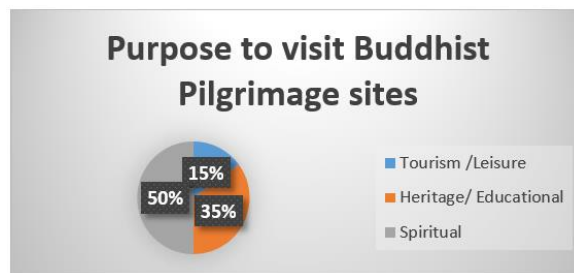


Fig. 1. Purpose of Visit to Buddhist Pilgrimage Sites

Table 1. Summary of Data Analysis and Key Findings

Sr. No.	Variable Analysis	Sample size	Key Findings	Interpretation
1	Purpose of Visit	200 Visitors	50%Spiritual, 30% Heritage, 20%Leisure	Confirms pilgrimage-centric nature; AI must respect sanctity
2	Visitor Satisfaction	200 Visitors	Majority rated experience as average to good	Scope of operational improvement
3	Crowd Management	200 Visitors	Moderate dissatisfaction at peak time	Supports AI-based crowd prediction
4	Cleanliness & waste	200 Visitors	Moderate dissatisfaction at peak time	Justifies smart waste monitoring

5	Information Availability	200 Visitors	Linked signage & interpretation	Need for AI-based digital guides
6	Awareness of AI	200 Visitors	Mostly low to moderate awareness	AI tools must be simple
7	Willingness to use technology	200 Visitors	High openness to QR/ Apps	Acceptance of non-intrusive technology
8	Stakeholder Readiness	40 Stakeholders	82.5% supportive or positive	High feasibility with training
9	Training Requirement	40 Stakeholders	45% require skill development	Capacity building essential
10	Ethical Concerns	40 Stakeholders	Privacy & spiritual concerns	Ethical guidelines mandatory

Table 2. SMART Framework for AI Integration in Buddhist Pilgrimage Tourism

Smart Element	Application Area	AI Intervention	Expected Outcome
Specific	Visitor Flow, heritage Protection	Crowd Analytics, sensors	Reduced congestion, Conservation
Measurable	Footfall, Wait time, Satisfaction	Dashboards, real-time data	Performance tracking
Achievable	Phased AI Adoption	Pilot Projects	Practical implementation
Relevant	Sustainability & Heritage	AI-based decision making	Balanced tourism growth
Time - Bound	Short & long term goals	Scheduled roll out	Timely, controlled adoption

5.1 Findings of the Study

The findings of the present study are derived from field-based observations, interactions with stakeholders and data collected at the selected Buddhist Pilgrimage destinations in Maharashtra. The analysis presents site-specific results related to visitor behaviours, site management practices, and the emerging role of Artificial Intelligence in pilgrimage tourism.

The Important findings obtained from the field investigation are as follows:

1. The Buddhist pilgrimage destinations in Maharashtra are dominantly visited for a spiritual purpose. The secondary purposes of visit are heritage and educational motivations. During field interactions with visitors, it has been observed that spiritual intent remains central. After asking about technology intervention, they are ready to support it. They do not feel it interferes with the sanctity of the Buddhist Pilgrimage sites.

2. Observations at sites such as Deekshabhoomi, Ajanta, Ellora and Chaitya Bhoomi indicate congestion, unequal visitors and heavy pressure on facilities during festivals and on special occasions. The existing management of these sites is facing many challenges during peak periods.
3. Onsite visitors and staff are moderately aware of Artificial Intelligence but evolving. The study shows that stakeholders are familiar with basic digital tools but have a limited understanding of advanced AI applications. According to them, they are open to technology that will help enhance convenience and safety.
4. Stakeholders considering and accepting Artificial Intelligence as a supportive management tool instead of a replacement for human decision-making. Interactions with site managers and tourism officials indicate that AI-based solutions, such as digital information systems, visitor flow monitoring, and environmental sensors, are generally well received when aligned with heritage protection objectives.
5. We see that sustainability concerns are closely linked to visitor management and conservation of heritage sites. The findings from field visits highlighted problems related to cleanliness, waste management, and environmental stress, particularly at Cave sites. The AI-enabled monitoring arm is the key to addressing these concerns efficiently.
6. For implementing an AI-enabled system successfully, Capacity building and institutional support are severely important. The study finds that effective integration of new Artificial Intelligence-embedded systems depends solely on staff training, policy support, and coordination among tourism authorities and heritage conservation officials.

5.2 AI, Sustainability and Pilgrimage

After the survey, this study reveals important patterns observed in many other pilgrimage destinations in India and abroad. We have to agree on one point: the dominance of spiritual motivation among visitors confirms that Buddhist pilgrimage destinations in Maharashtra are fundamentally sacred spaces rather than purely tourism-driven destinations. This observation is crucial when considering the application of Artificial Intelligence. The implementation of AI in urban or leisure tourism content differs entirely. However, when it is part of the content of pilgrimage destinations, it should be operated subtly in the background without intruding upon visitors' spiritual experiences.

During the study, the researcher observed moderate satisfaction levels of visitors. They are happy with the core spiritual atmosphere. However, operational inefficiencies reduced the overall quality of their experience. So what are those operational inefficiencies? These included long queues, congestion at famous cave points, inconsistent cleanliness and limited interpretive support. These operational inefficiencies are not merely service-related concerns; indeed, they directly affect heritage conservation and visitor behaviour. This contributes to visitors' dissatisfaction. Here is the important role that Artificial Intelligence has to play. AI-based visitor crowd management systems, when properly designed, can address these challenges by early predicting peak periods, redistributing crowds and reducing physical pressure on sensitive Structures at sites.

Another important insight from the analysis concerns awareness of Artificial Intelligence. The low to moderate awareness among visitors supports that technology implementations must be intuitive and non-disruptive. This finding suggests AI adoption in pilgrimage tourism should prioritise transparency, simplicity and trust. Instead of focusing on a complex system, we can use tools such as digital signage, basic crowd alerts, or optional mobile-based guides, which may be more effective.

The most decisive factor in the research is stakeholder readiness for successful artificial integration. They are supportive but need requisite training. Adequate digital skills and institutional support are necessary; otherwise, AI systems risk remaining underutilised or misaligned with sites. This crucial finding underscores existing literature highlighting the importance of human capital in SMART tourism development in Maharashtra.

Overall, the discussion confirms that AI should be regarded as a supportive decision-making tool that enhances sustainability, heritage protection, and the visitor experience, and that clear ethical and cultural principles must guide it.

6 STUDY FINDINGS FOR MAHARASHTRA: IMPLICATIONS AND ACTION PLAN

Drawing on the empirical findings of this study, Maharashtra can adopt a structured, phased strategy for implementing AI-based pilgrimage management across various Buddhist pilgrimage sites.

6.1 Phase-I Foundation Phase Digital Infrastructure (Short term: 1-2 years)

In the first phase, the program's focus should be on low-cost, low-risk technologies that deliver immediate benefits. These include QR-based information systems, Online ticketing, digital signage, and crowd-monitoring cameras as prime examples. These interventions enhance visitor convenience without disturbing the sacred ambience of the sites. The training and skill development programs must be conducted for Staff and local guides to build digital literacy.

6.2 Phase II Decision Support and Smart Monitoring (Medium Term: 3-5 years)

In the second phase, environmental sensors and AI-based analytics can be introduced. Forecasting peak footfall would be possible through a predictive crowd management system. It will assist in redistributing visitors. The smart waste-monitoring tools and microclimate sensors can help protect cave paintings and structures. The use of real-time dashboards supports administrators in making evidence-based decisions.

6.3 Phase-III Preparation of Integrated Intelligent Ecosystem (Long Term: 5 plus years)

The final phase may involve advanced Artificial Intelligence solutions, including virtual guides, multilingual chatbots, automated heritage interpretation, and integrated destination management platforms. This System can reduce manual workload and create seamless experiences.

6.4 Development of Mechanism

To ensure sustainability, the following suggestions can be considered by the Government of Maharashtra:

- Dedicated SMART Pilgrimage cell
- Public-Private partnership for funding technology
- Collaboration with various Universities for research support
- To keep a check on ethical review committees for data governance

Expected Outcomes

Systematic implementation results in: -

- Reduce congestion by 25%. to 40%.
- Visitor satisfaction level will improve
- Protection of fragile heritage assets.
- Generation of local employment opportunities
- Promote sustainable tourism growth

Thus, Maharashtra state has the potential to emerge as a national model for AI-embedded pilgrimage tourism destination management.

7 CONCLUSION AND RECOMMENDATIONS

The present research study has examined the role of Artificial Intelligence in supporting the smart and sustainable development of Buddhist pilgrimage tourism in Maharashtra through a field survey. The present study concludes that Artificial Intelligence has tremendous potential in enhancing Buddhist Pilgrimage site management. AI can play a crucial role by supporting visitor flow regulation, heritage conservation and informed decision-making. The findings from the field survey clearly indicate that AI must function as assistive, background technology while respecting the spiritual and cultural character and sanctity of Buddhist pilgrimage destinations.

The present study concludes that technological solutions are not alone responsible for addressing sustainability challenges. Instead, AI must be integrated within a broader Framework of institutional capacity, ethical governance and community involvement. The applicability of these conclusions is limited to pilgrimage destinations with similar cultural and spiritual content.

7.1 Recommendations

- At high-traffic sites, introduce an AI-based visitor flow and queue management system.
- In cave complexes, install environmental monitoring sensors to support conservation.
- For staff and local communities, implement capacity-building programmes.
- Phase-based implementation strategies are best suited and are low-cost interventions.
- For data privacy and culturally sensitive AI usage, establishment of ethical guidelines is preferable.
- Strengthen coordination among MTDC, archaeology and local governance bodies.
- For effective monitoring, align AI initiatives with SMART Sustainability.

7.2 Limitations

- The sample size is adequate for exploratory analysis, but may not fully represent all visitors across different seasons.
- The cross-sectional design captures perceptions at a single point in time and does not account for long-term behavioural changes.
- Resources and time are the major constraints.
- All the findings are from pilgrimage destinations in Maharashtra. It cannot be generalised to other religious pilgrimage destinations.

7.3 Future Scope

Future research may build upon the framework presented in this study by incorporating larger stakeholder samples and evaluating the long-term impact of AI-embedded interventions on heritage conservation. Comparative studies of other Buddhist pilgrimage sites in India could further enrich understanding by comparing places of pilgrimage in Maharashtra with similar destinations worldwide.

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Reimagining Pedagogical Practices through AI-Supported, Student-Led Learning Models

Salla Vijay Kumar¹

ABSTRACT. Background – Indian education system has been phenomenal in its approach of the disciples tutored at the mentors' place, Guru Kul (Hindi meaning school set up) for not just education but societal values and life lessons with a tremendous built-up of peer groups, team work, and student-teacher relationship as a whole. This may have given way to the institutionalized schooling models of metropolitan culture.

Problem Statement – We are going through a fast pace technological advancement and innovation in education and the entire dissemination process, making it more student-centric and most importantly treating them as adults with digging-in attitude than giving-in. Every style of learning essentially abides by a structured syllabus, methodology, teaching aids and scope of study but it doesn't restrict the facilitator to cultivate their academic freedom amidst limitations of technology, environment and management.

Methodology – The study engages in a non-probability convenience sampling technique, a descriptive research design approach to extract the data pertaining to the traditional revamping AI innovation in India today. There is a structured Questionnaire that address the four major aspects – advent, use, barriers and future scope. The study is open to inputs from both of the major stakeholders namely, teachers and students alike on the various degree of implementation at their end.

Results - The results received are a mixed lot including the extent and intensity of the hands-on exposure. Overall majority of the respondents are positive on the inclusion or implantation of AI to the ongoing traditional process and very many have agreed to reaching out in benefit of the needy and inclusivity. The teachers and students are equipping themselves accordingly in AI too.

Conclusion – On observing the student behaviour, approach and willingness to adept to adapt the AI-augmented learning seems a transformative positive move in education at all levels. As a result, research continues even today to better understand the innovation in education continuing for knowledge sharing, and impartial access to high-quality education.

Keywords: Metropolitan Culture, AI-Augmented, Coaching, Transformative, Knowledge

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1 INTRODUCTION

Education with the incredible value system and knowledge empowerment has been ever changing for good with the traditionalist approach and the paradigm shift from the teacher-centered to the student-centered institutionalized models seen in modern metropolitan schooling systems. Indian education system has been phenomenal in its approach of the disciples tutored at the mentors' place, Guru Kul (Hindi meaning school set up) for not just education but societal values and life lessons with a tremendous built-up of peer groups, team work, and student-teacher relationship as a whole. This may have given way to the institutionalized schooling models of metropolitan culture. These exercises emphasize personal interaction, experiential learning, and holistic development. The technological and societal advancement with global standardized curricula, formal assessment systems, and classroom structures and judiciously designed to address the larger segment of student beneficiaries including inclusivism creating a more complex landscape that continues to evolve with rapid global and technological changes.

The priorities of innovation in education, the teaching and learning sync may not be parallel but, the adaptation needs to be more scalable than effective. The world is adjusting to a rapid pace of exposure to digital media, technological tools, and innovative pedagogical practices, learners' expectations and cognitive processes. The pedagogical delivery may no longer fully address the diverse needs of contemporary students but the educators and students see opportunities to use AI-powered capabilities not over but with the traditional approaches with emerging methodologies such as blended learning, AI-assisted coaching, experiential education, and competency-based outlines. Being in the noble profession of learning facilitation, it is crucial to directly impact students' academic outcomes, motivation levels, social-emotional development, and future readiness into the technology-driven world. The transformation potential should be transformative positive, manifold and not static. The fraternity should adapt to align with heterogeneous demands with the evolved instructional practices on today's learning population, adaptive educators and policy makers to design more effective, unbiased, and contextually pertinent learning environments. This research has been conducted in the same lines, balancing tradition and modernism, ensuring that the varying degree of innovation in education retains its implementation practicalities while embracing the advantages of contemporary progressions.

2 LITERATURE REVIEW

Abualrob (2025) study explores AI implantation into the thinking process of the students who may not have previously considered. It would reduce time and effort, align with learner heterogeneous needs, and at the same time, raise concerns about growing dependence.

Chaudhary et al. (2025) study reviews the outline of classroom with AI in education - advantages and challenges. This paper also discussed ethical issues such as privacy, fairness, user-friendliness, and the responsible role of teachers in promoting responsible

AI. Gao, Min (2025) paper surveys Human–AI Teaching contexts, with a structured analysis to assess the degree of instruction innovation and refinement.

Guan et al. (2020) through his paper analysed the shifts in educational research, and concluded a decline in traditional instructional design with the technological innovation surging student analytics, profiling models, and data-driven learning approaches.

Khatter et al. (2025) determined that AI- assistance did bring major changes to conservative classrooms, expanding learning opportunities. This study drew a limitation of the student’s learning with the influence of Generative AI learning and the progressing role of teachers.

Li & Long (2025) with their paper endorsed that find that the quality of interactions was affecting with AI for a meaningful feedback and self-directed improvement—rather than the frequency of the technology usage.

Mananay (2024) positively states that overcoming barriers like improper technology accessibility and pedagogical challenges, teachers and student engagement, competence, and independence have seen opportunities through intentional AI use.

Ortiz et al. (2025) paper digs on the fact that the implementation of AI- assisted learning could be towards improvement but may site difficulties for teachers in deciding on suitable instructional and assessment strategies and accomplishing student’s needs. Excessive resentment to AI is also seen as a barrier towards non-aligned learning effectiveness. Siddiqui et al. (2025) paper states that the AI-enabled teaching approaches help customize the learning experiences and promote creative, and higher-order intellectual skills. Solanki (2025) concludes that the adaptation of AI can reform classroom learning by making the learning process more inclusive and adapting to each learner’s preferred style—visual, auditory, or hands-on.

3 PROBLEM STATEMENT

We are going through a fast pace technological advancement and innovation in education and thee entire dissemination process, making it more student-centric and most importantly treating them as adults with digging-in attitude than giving-in. Every style of learning essentially abides by a structured syllabus, methodology, teaching aids and scope of study but it doesn’t restrict the facilitator to cultivate their academic freedom amidst limitations of technology, environment and management. The gap in between the expectations/ prospective takeaways and the actual resultant needs to be bridged with interpersonal structured learning and AI-augmented hybrid learning. This study aims to draw the influential factors addressing the gap and balancing the academic inputs to be industry-ready accomplishing the right fit.

4 OBJECTIVES

- To examine AI innovation in the traditional education system.
- To explore the factors influencing students' learning in AI-led environment
- To balance the gap between academic inputs and industry readiness.

5 METHODOLOGY

The study engages in a non-probability convenience sampling technique, a descriptive research design approach to extract the data pertaining to the traditional revamping AI innovation in India today. There is a structured Questionnaire that addresses the four major aspects – advent, use, barriers and future scope of technological impediments. The sample stakeholder viewpoints (n = 26) are collected on aspects related to implementing AI-driven education. The study is open to inputs from both of the major stakeholders namely, teachers and students alike on the various degree of implementation at their end. By using structured questionnaires.

Table 1. The profile of the respondents of the study are as follows:

Category	%
Teachers/ Professors	61.5
Students / Scholars	30.8
Others	7.7

Table 2. The AI awareness among the respondents of the study are as follows:

Category	%
Yes	80.8
Not sure	15.4
No	3,8

This study dwells on a large share of the beneficiaries at the receiving end, the students, to draw a closer picture. Note that a meagre % of them are still not hands-on with AI.

6 FINDINGS OF THE STUDY

The findings of the study have been designed in four categories namely,

6.1 Real-time Ground Zero Data of Innovation

Real-time classroom observations reveal strong support for AI-enhanced learning, growing acceptance of blended and flipped models, and firm belief that technology improves instruction while human teachers remain central to educational decision-making.

6.2 Impact and Ethical Effect with AI in Education

AI implementation have known to have ethical concerns as areas of threat in the public domain like data privacy, fair-mindedness, improper internet accessibility, financial implications on the adaptation, and unequal resource distribution. E-learning can help foster social skills through concerted and customized group-based activities.

6.3 Scope of AI in Education

The pedagogical delivery may no longer fully address the diverse needs of contemporary students but the educators and students see opportunities to use AI-powered capabilities not over but with the traditional approaches with emerging methodologies such as blended learning, AI-assisted coaching, experiential education, and competency-based outlines.

6.4 AI in Education and Way Forward

Future directions emphasize student-centric AI tools, multilingual accessibility, virtual learning environments, hybrid collaboration, and responsible use of generative AI. Enhanced engagement, better outcomes, inclusive practices, and technology-supported assessments drive the next phase of educational innovation.

Accordingly, the survey was conducted and the findings are appended below for information and discussion.

The findings of the study have been designed in four categories namely:

Real-time Ground Zero Data of Innovation: Real-time classroom observations reveal strong support for AI-enhanced learning, growing acceptance of blended and flipped models, and firm belief that technology improves instruction while human teachers remain central to educational decision-making.

Impact and ethical effect with AI in education: AI implementation have known to have ethical concerns as areas of threat in the public domain like data privacy, fair-mindedness, improper internet accessibility, financial implications on the adaptation, and unequal resource distribution.

Scope of AI in education: The pedagogical delivery may no longer fully address the diverse needs of contemporary students but the educators and students see opportunities to use AI-powered capabilities not over but with the traditional approaches with emerging methodologies such as blended learning, AI-assisted coaching, experiential education, and competency-based outlines.

AI in education and way forward: Future directions emphasize student-centric AI tools, multilingual accessibility, virtual learning environments, hybrid collaboration, and responsible use of generative AI. Enhanced engagement, better outcomes, inclusive practices, and technology-supported assessments drive the next phase of educational innovation.

7 RESULTS

The results received are a mixed lot including the extent and intensity of the hands-on exposure. Overall majority of the respondents are positive on the inclusion or implantation of AI to the ongoing traditional process and very many have agreed to reaching out in benefit of the needy and inclusivity. The teachers and students re equipping themselves accordingly in AI too. But whether it will reduce administrative duties for the teachers, looks like a win-win situation for the engagement and coaching.

AI implementation have known to have ethical concerns as areas of threat in the public domain like data privacy, fair-mindedness, improper internet accessibility, financial implications on the adaptation, and unequal resource distribution. E-learning can help foster social skills through concerted and customized group-based activities.

The respondents of the study majorly agree to the need for strong digital literacy among all stakeholders in education, thus encouraging critical thinking, and creativity. It is not far to witness virtual learning environments envisaging student-centric AI innovations, AI-enabled assessments, hybrid learning models, equitable access and responsible use of generative AI for visibly improved learning outcomes.

The results express variant viewpoints concerning AI aided fundamental education, potent addition to speed to each student's needs. With the consistent upgradation of instructors to the offline, remote to AI-assistance may resent to reduce administrative duties and as to students increasing and flexible platform that looks an effective and beneficial engagement.

This study infers AI-aided traditional education dissemination process to transform learning through counselled student behaviour, personalized tutoring strategy, and providing real-time constructive feedback for the digital learning with traditional in-person instruction, combine.

8 LIMITATIONS & SUGGESTIONS

On observing the student behaviour, approach and willingness to adept to adapt the AI-augmented learning seems a transformative positive move in education at all levels. No system is flawless, there will be limitations and barriers only to overcome slow and steady being in the so called battlefield of learning, accomplishing to develop the future citizens of the country. As a result, research continues even today to better understand the innovation in education continuing for knowledge sharing, and impartial access to high-quality education.

9 CONCLUSION

The findings of the study draw the promise of strengthening traditional education, with AI. It is further examined that the AI-assistance has a key role in enhancing learning effectiveness amidst the heterogeneous barriers including student's reduced engagement – seen as a universal quotient.

Blended learning / Hybrid mode integrates both the remote and classroom elements while allowing learner freedom of choosing their platform as per their need, thereby taking greater control over their learning curve. It is to accept and acknowledge that the human teachers are indispensable and continue with the virtue of their judgment and guidance in everyday schooling and societal decision making processes.

The learning model on inclusivity and needy ascertained through Individualized Concentrated Education dissemination as a powerful driver of personalized learning, improved outcomes, at the same time engaging in hypermedia environments, while also widening the digital divide. Finally, the flipped classroom concept ensures to engage students learning new concepts at physical environment and remote options alike both using face-to-face time for more interactive, student-centered learning with tutor supervision.

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ANNEXURES

The Questions in 04 categories drafted in the structured questionnaire are as follows:

- A1. Do you think artificial intelligence has the potential to improve the traditional education system?
- A2. What is the use of multimedia in Classroom education?
- A3. What is Blended Learning in our education system?
- A4. What is the meaning of a Flipped Classroom concept?
- A5. Which aspects of education do you think artificial intelligence should not be involved in? (Select all that apply)
- B1. How do you think artificial intelligence can impact the future of education?
- B2. Which ethical considerations should be taken into account when using artificial intelligence in education? (Select all that apply)
- B3. Which is a disadvantage of e-learning? (Select all that apply)
- B4. What are the elements of cooperative learning?
- B5. What is the main role of technology in inclusive education?
- C1. Which areas of education do you think artificial intelligence can be most beneficial? (Select all that apply)
- C2. Which skills or competencies do you think should be prioritized when using artificial intelligence in education? (Select all that apply)
- C3. Which statement about interactive multimedia is correct?
- C4. What do you mean by the term “digital divide”?
- C5. In the Gen Z World, what is required to ensure the responsible use of generative AI?
- D1. Which are the most common reason for AI innovation to the traditional learning methods?
- D2. What potential benefits do you foresee in integrating artificial intelligence in higher education? (Select all that apply)
- D3. What are the Technology-supported formative assessment enablers? (Select all that apply)
- D4. What is the purpose of AI Augmentation in education? (Select all that apply)
- D5. What is Collaborative / Hybrid Learning best supported by? (Select all that apply)

List of Figures

A1. Do you think artificial intelligence has the potential to improve the traditional education system?
26 responses

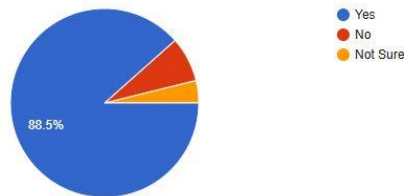


Fig. 1.

A2. What is the use of multimedia in Classroom education?
26 responses

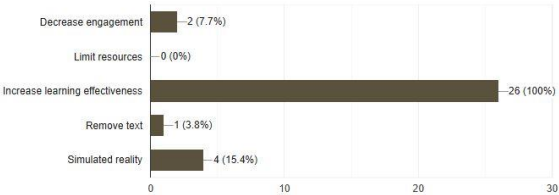


Fig. 2.

A3. What is Blended Learning in our education system?
26 responses



Fig. 3.

A4. What is the meaning of a Flipped Classroom concept?
26 responses

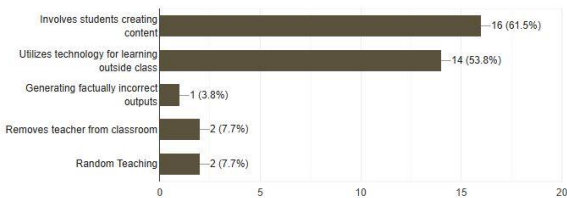


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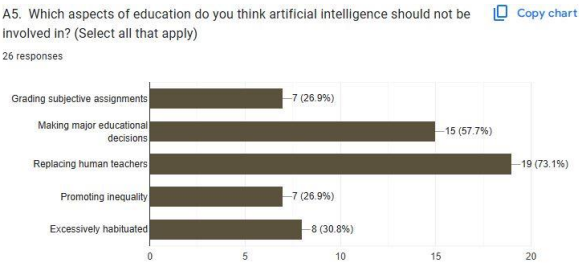


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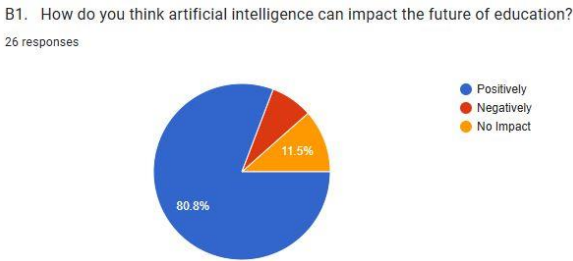


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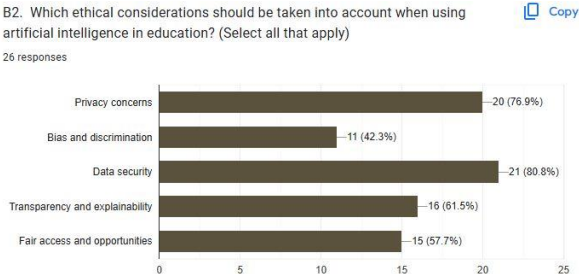


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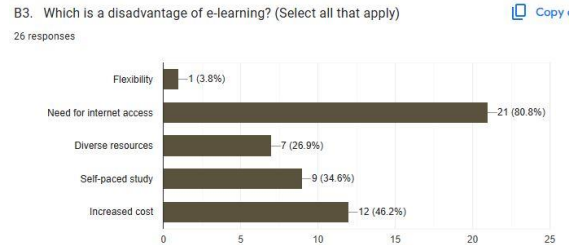


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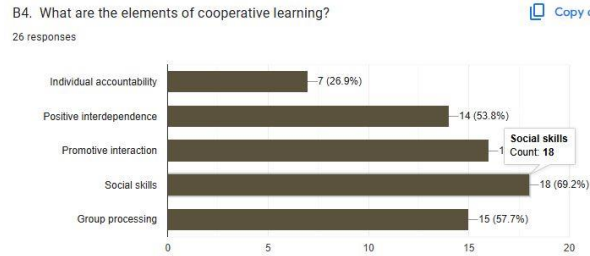


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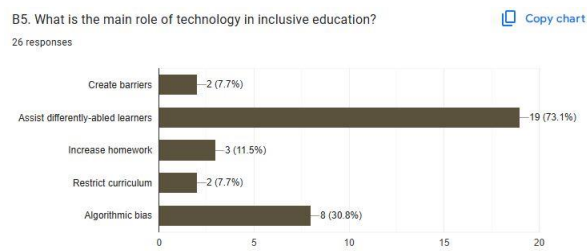


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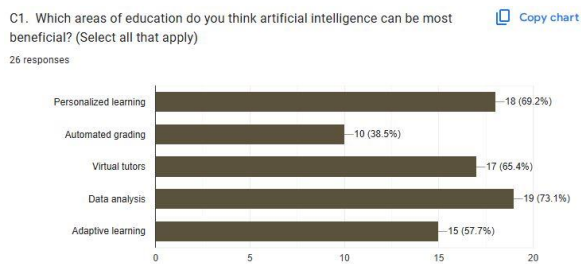


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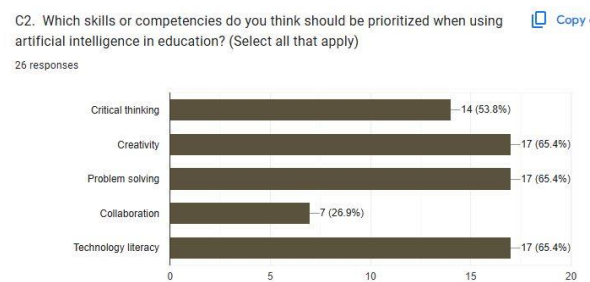


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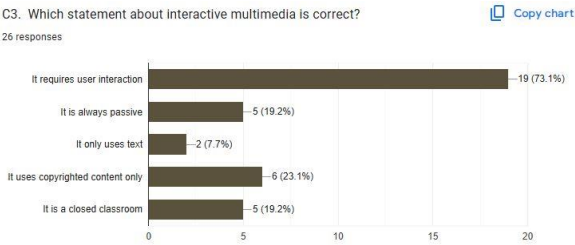


Fig. 13.

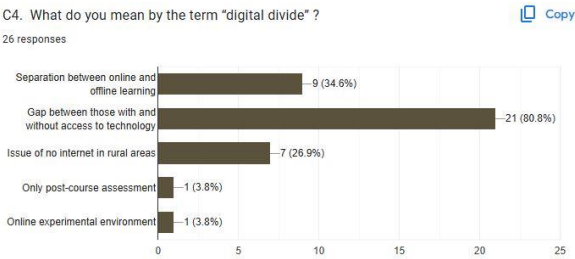


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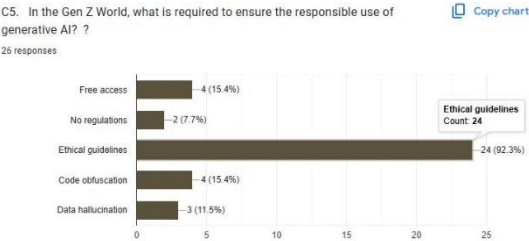


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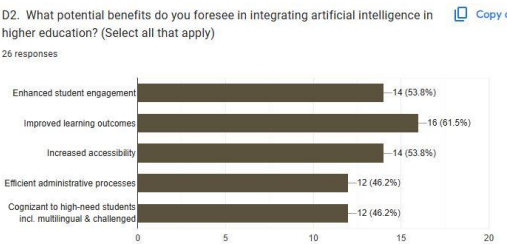


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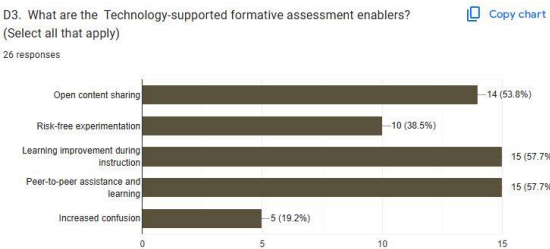


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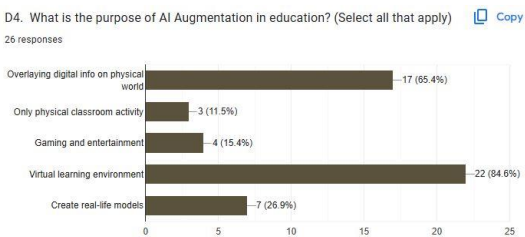


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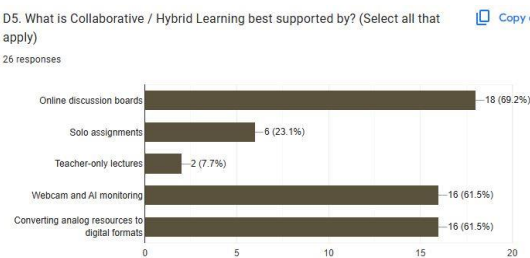


Fig. 19.

Exploring Digital Journaling for Enhancing Self-Reflection and Emotional Well-Being among School Students

Harmanpreet Bhatia¹, Dilraj Singh Shadav², Ashwani Kachroo³

ABSTRACT. Mental well-being has been one of the major concerns in modern school education, particularly for teenagers who face frequent academic pressure, social identity challenges, and emotional instability. Increasing levels of stress and emotional outrage among students have prompted contemporary education policymakers to seek preventive strategies that can be implemented within regular school operations. Digital technologies have changed the way school students express their emotions and communicate, especially during stress and anxiety. Since digital journaling is low-cost, measurable, and student-centric, it can be utilised by schools as a well-being initiative. This study examines how digital journaling can improve self-reflection, emotional development, and mental health of school students. A structured questionnaire will be given to secondary school students to gather data in a quantitative approach. The constructs related to digital journaling practice, self-reflection, emotional growth, and mental well-being were then tested for interrelationships using multiple regressions. The results will be used to generalise the use of digital journaling as an effective approach to enhancing self-awareness and emotional control, leading to better mental well-being outcomes. The paper presents the promise of online journaling as an affordable, contemplative, and curative learning modality for establishing mental well-being in schools. To incorporate journaling interventions into student well-being programs, we discuss practical implications for educators, counsellors, and policymakers.

Keywords: Digital Journaling, Self-Reflection, Emotional Growth, Mental Well-Being, School Students, Adolescent Psychology, Digital Learning Tools

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1 INTRODUCTION

The most crucial phase of human development is adolescence, a multidimensional transitional phase, emotionally, cognitively, and socially. In this phase, the child has to navigate the struggle of forming their identity, developing emotional intelligence, academic or study skills, and facing social pressure from peers and relatives. In the modern world, as children grow up at a fast pace and information is readily available to them, schools are also adopting new methods of teaching and supporting adolescents, using Socio-emotional learning and digital tools to promote adolescents' mental health. In this digitalised world, digital journaling is a prominent method for enhancing a child's perspective on self, emotions, and society. Journaling is not a new concept; it is an age-old way to express oneself on paper with words that cannot be spoken. However, the traditional method of journaling is not as safe as digital journaling, which offers privacy, personalisation, and support through a range of tools.

This review provides a basis for further finding out the efficacy of digital journaling among school-age adolescents by synthesising theoretical underpinnings, empirical evidence, mechanisms of impact, research on digital mental health interventions (DMHI), measurement concerns, and practical considerations.

2 Review of Literature

(Deci, 2000) The theory advanced by these two authors was that mental well-being and intrinsic motivation depend on the 3 basic needs for inner satisfaction: self-reliance, capability, and relatedness.

(Baikie, 2005) journaling is a expressive writing where a writer its own thought without any hesitation and here the author tells about expressive writing which is more or less related to a pain of related trauma however it also suppress the distress, it suggested that journaling helps in venting out the anger or uncomfortably, which is going within, they also suggest that 20 minutes of journaling is enough however the time may go beyond that without any limit.

(Kiki Metsäranta, 2019) These days, adolescents are struggling with depression. Nowadays, these adolescents are seeking mental care treatments where success rates are very low; here, adolescents need a safe zone where they can share their thoughts, and according to various studies, writing thoughts in diaries is a useful tool to fight depression. In search of a safe zone for sharing thoughts, web-based interventions are a novel method; however, they require more attention during use. This line of treatment (Web-based interventions) is widely used among teenagers struggling with depression; these internet-based interventions include a variety of tools like diaries, email reminders, discussion forums and many more. They aid in tackling behaviours. The author of this study found that an e-diary is a kind of internet-based treatment for teenagers. They also state that school-going children become more involved in sharing their thoughts about their lives. They get enough opportunity to share their viewpoints and can write freely about what they think in their e-diary through expressive writing.

Furthermore, they found that expressive writing is the best-suited way for various mental treatments, and it is one of the tried-and-tested methods in mental health treatments like anxiety and depression. Writing can help someone deal with their feelings or help those who might not

be as aware of them control their emotional intensity. Additionally, writing can produce the desired transformation and reduce tension.

Generally speaking, journaling may help teenagers in addressing several developmental obstacles. Diary writers explore their emotions that arise practically simultaneously with writing in the diary and describe or comment on an incident that has occurred. Writing in a diary may help an adolescent to narrate the story of their thoughts, feelings, hopes, and experiences. Thus, journaling may be viewed as a way to reflect on one's own life. On the other hand, nothing is known about the potential applications of a Web-based e-diary for depressed teens.

(Shilagh A. Mirgain, 2016) Writing down our feelings and ideas about our own experiences is the practice of therapeutic journaling. This kind of journaling is different from the kind of diary writing we generally do at the end of the day. Therapy-based journaling involves writing words that reflect our emotions, reactions, and mindset about life events.

(Pennebaker, 1997) The author conducted his study in a real-time setting with participants ranging from children to adults and found that they wrote about whatever they had gone through. It is traumatic for them to forget or take out of their mind, ultimately hampering their mental health, like failing in studies, incidents of physical abuse or sexual abuse, etc. This kind of prototype helps them vent. They express their pain by crying once they write it down, and it is very close to their mind and heart once they write it down and feel light.

(Garg, 2025) In the 30-minute read time, she writes why journaling is necessary because these school-going teenagers go through too many mental stress issues like studies, future goals and anxiety about self-development; somewhere these feelings impact Friendships, familial ties, and academic achievement. They might be overpowering if they have nowhere to go. In order to manage stress and emotional difficulties, journaling offers a quiet setting for thought expression, stress release, and the development of healthy coping strategies.

Teens can better understand their emotions by writing, as it engages the brain's emotional control centres. Journaling offers emotional comfort, encourages awareness, and lowers stress hormones like cortisol. Over time, it develops a more balanced perspective, increases self-awareness, and improves problem-solving skills, making it easier to handle life's challenges.

She further describes various types of journaling, such as expressive Journaling, Gratitude journaling, guided journaling, Bullet Journaling, and art journaling; all of these help adolescents express their viewpoints.

In this, she also states the benefits of journaling among adolescents, which are as follows: -

- Decreases the level of stress and too much of over thinking
- Through expressive writing, they come to know the emotional triggers and patterns at which they break down.
- It helps in becoming more introspective and promotes personal development and emotional intelligence.
- It helps with positive thinking by writing about good experiences and shifts thoughts from negative to gratitude.
- Whenever they write about their experiences, they refer to the journal and improve their problem-solving techniques.
- Lastly, it aids in addressing mental health in a positive way with professional support.

(Creswell, 2017) The ultimate goal of mindfulness therapies is to cultivate greater awareness and attention to the present moment. Over the past 20 years, with the help of various randomised controlled studies, mindfulness therapies have dramatically increased. By repetitive reviewing and discussing he found that:- (a) the effects of mindfulness interventions on health, cognitive, affective, and interpersonal outcomes; (b) evidence-based applications of mindfulness interventions to new settings and populations (e.g., the workplace, military, schools); (c) psychological and neurobiological mechanisms of mindfulness interventions; (d) mindfulness intervention dosing considerations; and (e) potential risks of mindfulness interventions. RCTs using rigorous methodology have shown that mindfulness therapies enhance outcomes in several categories, including addiction, depression, and relapse. Opportunities and challenges for mindfulness intervention research, as well as for community applications, are the main topics of discussion.

(Geraldine., 2010) Human-computer interaction (HCI) scholars are increasingly interested in defining reflections in which technology provides more precise and professional answers to life challenges, and in how to improve it in the future. Here, the word "reflection" is used in a way similar to its widespread use outside Human Computer Interaction. Nonetheless, the word "reflection" is used and intended for a variety of purposes, sometimes with no regard to the extensive body of literature on the subject outside of HCI. Here, we synthesise this literature into a framework that includes elements such as levels of reflection (which represent the behaviours and activities associated with contemplation), circumstances for reflection, and reasons for reflection. We next demonstrate how these many features can be supported by technology, and we conclude with open-ended questions that might guide a more methodical approach to understanding and building support for reflection.

(Gilani, 2025) mental health of adolescents has become more and more crucial with the increased struggles after COVID-19, with the digital dependency of students increasing more and more, as they feel alone and unattended during this phase of life, which ultimately affects the mental health of the student. The needs of the students change from time to time, and the kind of support also changes; here, the students find their own ways of self-reflection and tools towards self-reflection to have healthy mental health.

After a thorough analysis, the author found that most students journal or express their thoughts on paper; however, they also use other methods for self-reflection. (Abby Grammer Horton, 2021) To cope with mental health issues and create a stress-free environment for students, reflective journaling is one way to keep them engaged. Students can write their thoughts, ideas, and innovative techniques, which help them think beyond limitations and support their mental health in many ways.(Angela MacIsaac, 2022) The study was based on 152 participants over 28 days using an app-based mental health monitoring app, and the results were based on self-regulation and psychological wellness. He found that journaling is consistently linked to gains in psychological health, as predicted, but only when baseline self-reflection was average or higher. When time spent using other app functions was taken into account, the initial association between journaling and gains in self-regulation decreased. Results indicate that when self-reflection is used constructively, it may be a strength for promoting wellbeing.

One of the behaviours that is relevant to the accumulation of self-reflection is journaling. We may not find much research on naturalistic journaling, and experimental studies have evaluated the impact of writing about events and emotions. For example, participants in the expressive writing framework write about a stressful event, emphasising their innermost feelings and ideas,

which has several advantages, including self-regulation and psychological wellness. (Bellinger, 2024) According to U.S. human and health support, schools are where students can be inculcated for good well-being, which needs to be encouraged, and adolescents today need mental health help. Although social and emotional learning (SEL) programs may be used, educators are urged to figure out how to incorporate SEL into the classroom. In his studies, he found that daily journaling is directly linked to SEL and that it can be incorporated into academic content to help students become good human beings. Teachers can broaden social and emotional learning in the classroom by incorporating writing techniques originally linked to SEL. He further identified three studies that emphasise the benefits of 12-year-old students writing about emotional and social content in the classroom, thereby enhancing students' satisfaction through journaling and increasing their positive emotions and overall development as adolescents.

(Gabriele Travagin, 2015) In the meta-analysis, evaluations were conducted among teenagers to assess the effects of expressive writing. Twenty-one separate studies found that expressive writing is associated with reduced misery or suffering, troublesome behaviour, social adaptation, and school participation. Larger effects on academic performance were shown in studies including teenagers who had significant levels of emotional difficulties at baseline. Larger effects on somatic complaints were observed in studies that used a higher-dose intervention (i.e., more sessions and, to some extent, more spacing between sessions). Benefits were more pronounced when writing addressed recent emotional events and when tasks were repeated over several sessions. Similarly, it found improvements in mood, stress, and cognitive processing among users of expressive writing.

3 Research Objectives

- To assess the impact of digital journaling on mental well-being among school students.
- To identify the academic benefits and challenges of introducing digital journaling among students for emotional and reflective learning.
- To provide recommendations for educators and school authorities on using digital journaling as a tool for promoting student development.

Digital journaling serves as a reflective learning tool that encourages self-expression and emotional awareness, fostering emotional growth and ultimately improving students' mental well-being.

Digital Journaling → Self-Reflection → Emotional Growth → Mental Well-Being
(Independent Variable) (Mediating Variables) | (Dependent Variable)

4 Research Methodology

This study adopts a Quantitative Phase to statistically examine the relationships between digital journaling frequency, self-reflection, emotional growth, and mental well-being.

4.1 Population and Sampling

The target population includes school students aged 13–18 years enrolled in middle and secondary schools of Gurdaspur and Pathankot who have access to digital learning tools or online journaling platforms. Student selection was conducted using purposive sampling, focusing on institutions that integrate digital tools into classroom settings. The total sample size used for the study is 121 students.

4.2 Data Collection Methods

- Primary data was collected first through a survey questionnaire filled out by the selected students. The questionnaire consists of 20 Likert-scale items designed to measure students' responses regarding journaling as a reflective and emotional outlet, including Digital Journaling Practices, Self-Reflection, Emotional Growth, and Mental Well-Being. All items were rated on a **5-point Likert scale** ranging from *Strongly Disagree* (1) to *Agree* (5) Strongly.
- Secondary data was gathered from the academic literature, reports on digital exposure and mental well-being.

5 Data Analysis and Findings

5.1 Demographic Profiles of Respondents

Table 1 presents demographic statistics for school students with access to digital learning tools or online journaling platforms. The demographic components include gender, age, class grade, type of school and duration of usage. The majority of respondents in this study are between 16 and 18 years old. The total number of respondents is 54 (44.6%). As for gender, female respondents are 65 (53.7%), and male respondents are 56 (46.3%). Respondents are evenly distributed across 8th to 12th classes, with the largest share from 12th class (32 or 26.6%), followed by 10th class (26 or 21.5%). Duration of use of less than six months has the highest number of users (70 or 57.9%). The largest number of respondents is from private schools (103, 85.1%), indicating students' exposure to digital journaling.

Table 1. Demographic profiles of respondents (N=121)

Demographic variable	Frequency	Percentage
Gender		
Male	56	46.3%
Female	65	53.7%
Age		
Below 13	2	1.7%
13-15	47	38.8%
16-18	54	44.6%
Above 18 years	18	14.9%
Class grade		
8th	25	20.7%
9th	21	17.4%
10th	26	21.5%
11th	17	14%
12th	32	26.4%
Type of school		
Government	11	9.1%
Private	103	85.1%
International	7	5.8%
Duration of usage		
less than six months	70	57.9%
Six months	18	14.9%
One year	16	13.2%
More than one year	17	14%

5.2 Students' Responses for Journaling

Table 2 presents the items asked of the respondents regarding the Students' responses to journaling. As the means for all items are greater than 3, it is apparent that all items make a significant contribution to mental well-being through respondents' digital practices. A significant digital practice response is for helping to express the respondent's emotions and feelings clearly (3.50). Self-reflection response for digital journaling is the encouragement gained to see different perspectives of self (3.50). The highest emotional growth is in the ability to empathise with other people's feelings (3.59). Mental well-being is achieved by handling stress and difficult situations effectively (3.65).

The most prominent pedagogical benefit for the respondents is finding it easier to express themselves in writing than in class discussion (3.60). A challenge faced by the respondents is the privacy of their digital journal entries (3.62).

Table 2. Student's responses for journaling

Digital Journaling Practices	Items	Mean	Standard Deviation	Cronbach's Alpha
DJP1	I write in my digital journal regularly to reflect on my thoughts and experiences.	3.26	1.24	.805
DJP2	Digital journaling helps me express my emotions and feelings clearly.	3.50	1.24	
DJP3	I prefer digital journaling over traditional paper journaling.	3.02	1.26	
DJP4	I use prompts or guided questions in my digital journal to help me reflect.	3.18	1.25	
DJP5	Writing in a digital journal makes me feel more organized and in control of my thoughts.	3.45	1.14	
Self-Reflection				
SR1	I often think about why I feel a certain way in different situations.	3.28	1.19	.871
SR2	I reflect on my actions to understand how I could improve.	3.78	1.12	
SR3	Digital journaling helps me gain insight into my personal strengths and weaknesses.	3.42	1.23	
SR4	I spend time analyzing my decisions and their outcomes.	3.49	1.17	
SR5	Writing in my journal encourages me to consider different perspectives about myself.	3.50	1.19	
Emotional Growth				
EG1	Digital journaling helps me manage my emotions better.	3.36	1.23	.896
EG2	Writing about my feelings makes it easier to cope with challenges.	3.61	1.11	
EG3	Journaling helps me understand how my actions affect others.	3.53	1.04	
EG4	Through journaling, I have become more aware of my emotional patterns.	3.56	1.19	
EG5	Journaling has improved my ability to empathize with other people's feelings.	3.59	1.17	
Mental Well-Being				
MWB1	I feel positive and optimistic about my life.	3.54	1.15	.881
MWB2	I can handle stress and difficult situations effectively.	3.65	1.15	
MWB3	Writing in a journal contributes to my overall sense of well-being.	3.55	1.07	
MWB4	I feel satisfied with my daily activities and accomplishments.	3.50	1.15	
MWB5	Journaling helps me feel relaxed and balanced emotionally.	3.55	1.15	
Pedagogical Benefits and Challenges				
PBC1	Teachers encourage journaling as part of reflective classroom activities.	3.29	1.16	.877
PBC2	Digital journaling helps me connect academic lessons to personal experiences.	3.55	1.18	
PBC3	I find it easier to express myself in writing than in class discussions.	3.60	1.09	
PBC4	I face technical difficulties (e.g., app issues, device access) while journaling digitally.	3.25	1.21	
PBC5	I am concerned about the privacy of my digital journal entries.	3.62	1.13	
PBC6	Journaling activities make classroom learning more engaging.	3.55	1.21	
Recommendations and Educational Support				
RES1	Teachers should provide structured journaling prompts for reflection.	3.56	1.22	.905
RES2	Schools should include journaling as part of emotional well-being programs.	3.63	1.18	
RES3	Guidance counselors could use students' journaling insights to support mental health.	3.60	1.12	
RES4	Training sessions on journaling could help students express emotions better.	3.60	1.16	
RES5	I would recommend digital journaling to my peers for self-growth and reflection.	3.64	1.21	

Table 3. Model Fit Measures

Model	R	R ²	Adjusted R ²
1	0.774	0.600	0.589
Note. Models estimated using a sample size of N=121			

To analyse the relationship between Digital journaling, self-reflection, and emotional growth in predicting mental well-being, multiple linear regression was conducted. The multiple correlation coefficient ($R = 0.77$) indicates a strong positive relationship between the predictors and mental well-being. The coefficient of determination ($R^2 = 0.60$) suggests that 60.0% of the variance in mental well-being is explained collectively by Digital journaling, Self-reflection, and Emotional Growth.

Table 4. Model Coefficients - MWB

Predictor	Estimate	SE	t	p
Intercept	3.762	1.1086	3.39	<.001
DJP	0.122	0.0968	1.26	0.212
SR	0.326	0.1043	3.13	0.002
EG	0.359	0.1197	3.00	0.003

1. Mental well being is significantly predicted by Self-reflection $B = 0.33$, $SE = 0.10$, $t = 3.13$, $p = .002$.
2. Mental well-being is also predicted by Emotional growth, $B = 0.36$, $SE = 0.12$, $t = 3.00$, $p = .003$.
3. Digital journaling practices did not significantly predict mental well-being, $B = 0.12$, $SE = 0.10$, $t = 1.26$, $p = .212$.

The regression equation is:

Mental well being = $3.762 + 0.122(\text{Digital journaling practice}) + 0.326(\text{Self Reflection}) + 0.359(\text{Emotional Growth})$

6 Interpretation

6.1 Impact of Digital Journaling on Mental Well-Being

The coefficient for digital journaling practices is positive but not statistically significant, indicating that journaling alone does not directly enhance mental well-being without accompanying psychological development of self-reflection and emotional growth among the respondents.

6.2 Pedagogical Benefits and Challenges of Integrating Digital Journaling in Classroom Practice

Pedagogical Benefits.

- Reflecting on classroom learning by the students through digital journaling helps them to relate their academic content with their academic experiences.
- Digital journaling has been seen as a more comfortable medium to express their thoughts and feelings as compared to discussing their emotions vocally in classrooms.
- Students find it easier to link the classroom concepts with the hands-on experiences through digital journaling, thereby uplifting the meaning of their learning process.
- Digital journaling contributes to an increase in classroom activities for a more interactive environment and diverts the learning process with self-reflection.

6.3 Pedagogical Challenges

- Technical factors that may make the efficient use of digital journaling problematic may include inadequate access to the gadget, app-specific problems, or unsteady internet connectivity that can interfere with student participation in the activity.
- Also, issues of privacy and confidentiality tend to inhibit the open expressiveness of students who may fear who would get access to the entries they make in their digital journals. These fears may diminish their genuine, in-depth reflective responses.

6.4 Recommendations for Educators and School Counsellors

- Well-structured prompts should be shared with the students in the classroom to promote emotional awareness, self-reflection and critical thinking among the students.
- School curriculum should include digital journaling for regular exposure and practice to meet the students' social, emotional and self-introspection progress.
- While keeping confidentiality and ethical usage, the school authorities should use the journaling information to make available help and guidance to the students for their mental well-being.
- Effective training sessions should be provided to the students for effective usage of digital journaling practices to develop predictors such as emotional strength and self-awareness for all-round mental health.

7 Discussion

The results of regression analyses highlight the significant role of processes in explaining the relationship between mental well-being and digital journaling practices. The results align with the well-being theories that support the need for emotional and self-introspection as the main predictors of mental health outcomes. Therefore, it is important to inculcate the well-structured practice of reflective and emotional support for users of digital journaling.

8 Conclusion

Summing up, the results indicate that mental well-being is determined more by internal emotional processes than by behavioural practices. Digital journaling practices are found to be effective only when they allow users to progress in self-reflection and emotional growth. These psychological mechanisms emerged as the most significant predictors, highlighting their key role in translating journaling activities into relevant well-being outcomes.

The findings are experimental in nature and support the well-being models that place cognitive and emotional activity as the primary contributors to mental health. The use of digital tools, however, is best understood as a means of facilitating more profound psychological processing, rather than as the tools themselves.

The study concludes that the usefulness of digital journaling is achievable only when internal reflection and emotional growth are also developed during the journaling process. Interventions and programs designed to incorporate reflective cues and emotional expression are more likely to yield long-term changes in mental well-being, providing useful recommendations to researchers, practitioners, and mental health educators.

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An Overview of Robotic Cooking Using AI and Its Impact on the Market and Food Quality in Indian Households

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ABSTRACT. Introduction: The integration of Artificial Intelligence (AI) and robotic innovations into modern kitchens is transforming everyday cooking methods, offering greater ease and efficiency for individuals with hectic schedules. Intelligent cooking systems can replicate and adjust elements such as flavour, texture, aroma, and visual appeal—enhancing the overall experience. Additionally, these technologies contribute to enhanced nutrient preservation, reduced energy consumption, and reduced food wastage across various cuisines. Significance of the Study: The current study addresses the growing importance of AI-based robotic cooking systems in Indian homes and their expected ability to improve food quality, nutritional content, and consistency in food preparation. It also explores how customers feel about kitchen automation and whether they believe it can support and preserve traditional cooking practices and food culture. Methodology: The study employs a quantitative research design, using a structured questionnaire as the primary data-collection tool. Data will be collected from working individuals and respondents with limited experience in traditional cooking to understand their attitudes toward and willingness to adopt AI-based kitchen technologies. A simple random sampling method will be used to ensure that the data collected is fair, unbiased, and representative of the target population. Results: The study is expected to provide meaningful insights into consumer acceptance of AI-enabled cooking technologies, including perceptions of food quality and overall satisfaction. These findings will help assess the market's readiness to adopt such innovations in everyday domestic cooking. Conclusion and

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Suggestions: The research seeks to determine whether AI-assisted cooking devices represent a practical and sustainable solution for modern households or merely an expensive technological novelty. It will also explore changes in the overall cooking experience, particularly the potential reduction in the personal touch and emotional connection that traditionally accompany human-led cooking.

Keywords: Robotic Cooking, Sensory Appeal, Food Quality, AI-Enabled Kitchen, Nutrient Preservation, Consumer Perception

1 INTRODUCTION

Artificial Intelligence (AI) is rapidly reshaping how people work, live, and interact with technology across various industries. From healthcare to manufacturing, AI has brought increased automation, precision, and efficiency. In recent years, these advancements have extended into domestic spaces—most notably the kitchen. AI-powered robotic cooking represents a new phase in household innovation, integrating machine learning, computer vision, and robotics to support more efficient and consistent cooking processes.

In a country like India, where cooking is deeply rooted in emotion, tradition, and cultural identity, the introduction of robotic kitchens presents both opportunities and challenges. For generations, cooking in Indian households has been more than a daily chore; it has been an expression of care, creativity, and family bonding. Culinary knowledge is often passed down orally, flavours are perfected through experience, and spices are adjusted through intuition rather than precise measurement. However, contemporary lifestyles have significantly altered this traditional rhythm. Rapid urbanisation, demanding work schedules, and the rise of dual-income households have increased the demand for time-saving, convenient, and health-conscious cooking solutions.

AI-driven cooking technologies such as Rotimatic, Samsung SmartThings Kitchen, and Moley Robotics Kitchen are gradually entering the Indian market, offering automated solutions for meal preparation without compromising consistency and quality. These systems are capable of measuring, chopping, stirring, and plating food autonomously. Using sensors and learning algorithms, they can adapt recipes to individual preferences, cooking habits, and ingredient availability. This evolution suggests that AI has the potential not only to enhance convenience but also to redefine the concept of home-cooked food.

However, the adoption of AI in Indian kitchens extends beyond technological advancement; it signifies a broader social and emotional shift. Therefore, the study of robotic cooking must consider multiple dimensions, including technological innovation, consumer acceptance, food quality perception, and cultural adaptation. The purpose of this research is to examine how Indian households perceive AI-based cooking technologies, assess their impact on food quality, and explore whether such innovations support or challenge traditional cooking practices that remain central to Indian culture.

2 Objective of the Study

- To study the level of awareness and usage of AI-based robotic cooking systems among Indian households, with special reference to Aurangabad, Maharashtra.
- To understand consumer perception of food prepared using robotic cooking systems, particularly in terms of food quality, taste consistency, and nutritional value.
- To examine consumer acceptance of AI-based cooking systems, focusing on perceived benefits, challenges, and the impact on traditional and emotional aspects of Indian cooking.

3 LITERATURE REVIEW

3.1 AI evolution in culinary technology

Early studies on kitchen automation focused mainly on mechanical devices that reduced physical effort, such as automatic mixers or programmable stoves (Kumar et al., 2020). The introduction of AI has significantly expanded this scope. AI-enabled systems now use machine learning to predict cooking times, computer vision to recognise ingredients, and sensor feedback to control texture, aroma, and taste (Zhou & Chen, 2023). According to Li et al. (2021), modern culinary AI can analyse past user behaviour and ingredient data to automatically modify recipes to improve nutritional balance and taste.

In advanced systems like Moley Robotics Kitchen, robotic arms replicate a human chef's movements, performing tasks such as chopping, stirring, and plating with precision. These advancements bridge the gap between industrial automation and domestic utility, allowing machines to assist rather than replace the human cook.

3.2 Consumer adoption and market trends

Consumer adoption of smart kitchen technologies has been steadily increasing worldwide, with India emerging as a particularly promising market. The growth of dual-income households, the expansion of remote work culture, and rising levels of digital literacy have significantly boosted the demand for cooking automation (Nair & Thomas, 2023). Studies indicate that more than 60% of Indian millennials are willing to invest in smart kitchen appliances if such technologies can save time and reduce daily cooking effort (Gupta & Jain, 2022).

Despite this growing interest, several barriers to adoption remain. For many Indian consumers, cooking continues to be an emotionally meaningful activity—one that reflects care, family values, and cultural identity. Ramaswamy (2021) highlights that although efficiency and convenience are appreciated, there is a persistent concern about losing the “human touch” that defines traditional cooking practices. As a result, emotional and cultural considerations are as crucial as technological benefits in shaping consumer acceptance of smart kitchen technologies.

3.3 Influences on Food Quality and Nutrition

AI-based cooking systems have also been linked to improved food consistency and nutrient retention. Automated cooking processes maintain stable temperature and timing, ensuring that meals are evenly cooked while retaining essential nutrients (Chakraborty et al., 2022). Wang et al. (2023) reported that robotic cooking methods could reduce oil use by 20–25% without affecting flavour. This has implications for public health, as Indian diets often struggle with excessive oil and spice consumption.

Moreover, AI cooking systems can tailor meals based on user health data, such as calorie requirements and dietary restrictions, aligning with the growing trend toward personalised nutrition. This integration between technology and diet science positions AI cooking as a potential tool for promoting healthier eating habits.

3.4 Cultural implications in the Indian context

The diversity of Indian cuisine makes it one of the most complex culinary systems to automate. With thousands of regional recipes, intricate spice blends, and varied cooking techniques, replicating cultural authenticity through machines presents a significant challenge. However, recent research indicates that AI systems are increasingly capable of learning these culinary nuances. Adaptive learning models can modify spice intensity, flavour balance, and cooking duration based on regional styles and individual preferences (Gore et al., 2023).

Such culturally responsive systems have the potential to make AI-enabled kitchens more acceptable to Indian users by preserving culinary heritage while delivering modern convenience. Therefore, designers of smart kitchen technologies must prioritise not only automation and efficiency but also cultural sensitivity by embedding India's rich and diverse food traditions into intelligent kitchen ecosystems.

4 METHODOLOGY

4.1 Research Design

The present study adopted a quantitative research design to examine consumer awareness, perception, and acceptance of AI-based robotic cooking systems in Indian households. A descriptive approach was used because the study aimed to understand existing attitudes and opinions rather than manipulate variables. This method was considered suitable because it allows the collection of numerical data that can clearly represent consumer trends related to emerging kitchen technologies.

The research focused on understanding how people perceive robotic cooking in terms of convenience, food quality, cultural acceptance, and willingness to adopt such technology in everyday life.

4.2 Study Area and Sample Size

The study was conducted in Aurangabad, Maharashtra, a growing urban city that reflects changing lifestyles, increasing technological exposure, and a mix of traditional and modern household practices. Aurangabad was selected as the study area because it represents a developing urban population in which smart home technologies are gradually gaining visibility and acceptance. A structured questionnaire was administered to 250 respondents, including working professionals, homemakers, and individuals with limited time for traditional cooking. A simple random sampling technique was employed to ensure fairness and minimise selection bias. This method facilitated a balanced representation across different age groups, genders, and occupational backgrounds.

4.3 Data Collection Tool

Primary data for the study were collected using a structured questionnaire designed specifically for this research.

The questionnaire was designed to be simple, clear, and easy for respondents to understand. It was divided into four main sections.

- The first section collected demographic information, including age, gender, occupation, and household type.
- The second section focused on awareness and usage, assessing respondents' knowledge of AI-based cooking systems and their prior experience with smart kitchen appliances.
- The third section examined perception and satisfaction, capturing opinions related to ease of use, time-saving benefits, food quality, and nutritional value.
- The final section addressed cultural and emotional aspects, exploring respondents' views on how robotic cooking influences traditional cooking practices and emotional attachment to food preparation.

Most items were measured using a five-point Likert scale, ranging from Strongly Disagree (1) to Agree (5) Strongly. This scale enabled respondents to express the intensity of their opinions in a consistent and structured manner.

4.4 Data Collection Procedure

The questionnaires were distributed both online and offline to ensure better reach and participation. Respondents were informed of the study's purpose and assured that their responses would be used only for academic research. Adequate time was given to participants to complete the questionnaire, and only fully completed responses were included in the analysis.

4.5 Data Analysis

The collected data were coded and analysed using descriptive statistics, including percentages, frequencies, and means. These methods helped in identifying patterns related to consumer awareness, adoption levels, perceived benefits, and concerns associated with AI-based robotic cooking systems. The results were presented using tables and figures for better clarity and interpretation.

4.6 Ethical Considerations

Ethical guidelines were strictly followed throughout the research process. Participation was voluntary, and no personal or sensitive information was collected from respondents. Confidentiality and anonymity were maintained, ensuring that individual responses could not be identified.

5 RESULTS AND DISCUSSION

5.1 Awareness and Adoption Levels

The study found that 71.2% of respondents were aware of AI-based robotic cooking systems, while 34.8% had either used such systems or observed them in use. Awareness was higher among younger respondents and working professionals, suggesting that those more exposed to technology are more familiar with robotic cooking concepts.

However, actual usage remains limited, mainly because many respondents felt that such systems are expensive or not yet necessary for daily cooking. This shows that while interest in robotic cooking is growing, widespread adoption remains in its early stages.

5.2 Consumer Perception of Food Quality and Overall Cooking Experience

Among respondents who had used or observed AI-based cooking systems, overall perception of food quality and cooking experience was largely positive. About 66% of respondents reported that robotic cooking saved time, making it suitable for busy lifestyles. Regarding food quality, 63% felt that taste and consistency were maintained, while 57% believed that nutrients were better preserved due to controlled cooking conditions.

However, emotional and creative aspects showed mixed responses. Around 40% of respondents felt that robotic cooking reduced the personal and emotional touch associated with traditional Indian cooking, and 31% believed that creativity in meal preparation was limited. These findings suggest that while AI-based cooking systems are appreciated for efficiency and consistency, emotional involvement remains an important concern for consumers.

Table 1. Benefits and Perceived Concerns (n = 250)

Parameter	Positive Response (%)	Negative Response (%)
Time efficiency	66	15
Food quality consistency	63	10
Nutrient preservation	57	13
Emotional connection retained	46	40
Creativity in cooking	39	31

The findings indicate that although most respondents were enthusiastic about AI cooking for its efficiency and reliability, emotional detachment from the cooking process still poses a considerable psychological obstacle to broader acceptance.

5.3 Market Readiness & Product Comparison

The respondents were asked about their current familiarity with popular AI cooking gadgets. The best-known brands were Rotimatic and Samsung SmartThings Kitchen, with low awareness of premium systems (less than 10%), such as Moley Robotics Kitchen. Price was cited as the major deterrent for 72% of potential users, followed by perceived maintenance complexity (54%).

Table 2. AI-Enabled Cooking Systems comparative data

Brand/Product	Core Function	Price Range (INR)	Awareness (%)	Key Features
Rotimatic	Automatic roti maker	1,50,000	62	IoT-enabled, flour-to-roti automation
Samsung Smart Things	Smart kitchen ecosystem	80,000–2,00,000	48	App-based cooking automation
Moley Robotics Kitchen	Full robotic chef system	25,00,000+	9	Dual robotic arms, chef recipe library
Suvie Smart Oven	Automated multi-zone cooking	60,000	27	Temperature precision, meal planning

These insights suggest that mid-range smart kitchen devices will drive rapid market growth, particularly among middle- and upper-middle-income households in urban Maharashtra.

5.4 Market Growth Projection

According to market-level data and consumer feedback, the Indian smart kitchen market is expected to grow at a compound annual growth rate (CAGR) of 16.8%, reaching approximately 45,000 crores by 2028. Attention and cost will play a role in accelerating the upward trend.

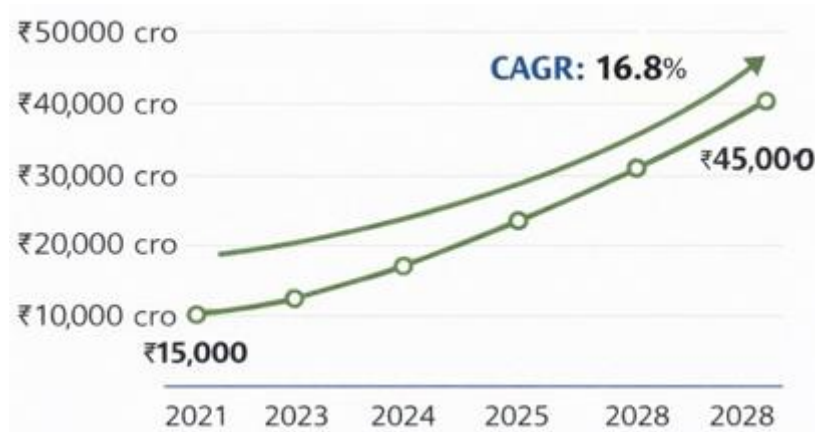


Fig. 1. Forecasted Growth of Smart Kitchen Market in India (2021–2028)

5.5 Cultural and Emotional Component

Qualitative data showed that the majority of respondents in the study associated home cooking with family and heritage. As one respondent put it, “AI can help make food faster, but it cannot replicate the emotion of a family meal here.” This resonates with Ramaswamy’s (2021) thesis that automation brings efficiency yet erodes the sensory and cultural rituals embedded in Indian food making. Still, younger respondents (aged 22–35) showed interest in considering AI “co-cooking” assistants that can be taught regional recipes or work under manual override to customise spices—suggesting that cultural adaptation will be key to acceptance.

5.6 Nutritional and Environmental Effects

The research reported that AI-driven kitchens in the studied population resulted in reduced oil and ingredient waste, as described previously (Chakraborty et al., 2022; Wang et al., 2023). Respondents to smart ovens noticed a 20% reduction in cooking oil used and a 15% reduction in food waste due to portion control and automated cooking cycles. These outcomes are evidence of the technology’s compatibility with sustainable cooking methods and nutritional efficiency.

5.7 Summary of Main Findings

- Awareness of AI cooking systems in Aurangabad: 71.2%
- Adoption (use or experiment): 34.8%
- High perceived benefit: time saving (66%), food quality (63%)
- Key barriers: emotional disengagement (40%), diminished creativity (31%)
- Market growth forecasting: CAGR 16.8%, to reach 45,000 crores by 2028
- Cultural sensitivity and pricing strategy are necessary to drive acceptance.

6 Discussion

The results indicate a significant relationship between professional lifestyles and willingness to use AI-based cooking solutions. Being employed also helped working people (especially dual-income families) who viewed these technologies as time-saving tools that give them consistency. However, it is moderated by cultural perceptions of cooking as expressive. This indicates that the use of AI in domestic kitchens is not just a technical problem but also a cultural battle. Successful commercialisation relies on localisation—imbuing AI models with Indian culinary intelligence, dialectal recipe inputs, and adaptive spice tuning.

7 CONCLUSION & SUGGESTIONS

The study provides a comprehensive understanding of the growing role of AI-based robotic cooking systems in Indian households, with specific reference to Aurangabad, Maharashtra. The findings indicate that robotic cooking technologies are gradually gaining acceptance, particularly among working individuals and urban families who face time constraints and seek convenience in daily meal preparation. High levels of awareness and moderate adoption suggest that Indian consumers are open to technological support in the kitchen, provided it offers real value.

The results clearly show that AI-enabled cooking systems are appreciated for their time efficiency, consistent food quality, and potential for improved nutrient preservation. Automated control of temperature, cooking time, and ingredient measurement helps minimise errors and reduce food waste, making AI-enabled cooking systems well-suited to modern lifestyles. From a health perspective, features such as reduced oil usage and improved portion control further increase their appeal.

However, the study also brings attention to important emotional and cultural concerns. A considerable number of respondents expressed discomfort with the idea that robotic cooking could diminish the personal involvement and emotional satisfaction traditionally associated with cooking. In Indian households, cooking is not merely a functional activity but a meaningful expression of care, identity, and cultural continuity. This strong emotional connection continues to play a crucial role in shaping consumer acceptance of automated cooking technologies.

Overall, the findings suggest that AI-assisted cooking should be viewed not as a replacement for traditional cooking practices, but as a supportive tool that can coexist with human participation. Its successful adoption in Indian households will largely depend on the technology's ability to strike a balance between operational efficiency and respect for cultural and emotional values.

7.1 Suggestions

Based on the findings of the study, the following recommendations are proposed:

7.2 Cultural Customisation

Developers of AI-based kitchen systems should prioritise customisation for Indian regional cuisines by incorporating adjustable spice levels, traditional cooking techniques, and region-specific recipes. Such customisation can help users feel a stronger emotional and cultural connection with the technology.

7.3 Hybrid Cooking Models

Rather than promoting complete automation, manufacturers should encourage hybrid cooking models that support human–AI collaboration. This approach allows users to remain involved in key stages of cooking while AI handles repetitive or time-consuming tasks.

7.4 Affordability and Accessibility

High costs continue to be a significant barrier to adoption. Introducing more affordable product variants, modular systems, and flexible payment options could improve accessibility for middle-income households.

7.5 Awareness and Consumer Education

Limited understanding of AI-based cooking technologies remains a challenge. Conducting product demonstrations, interactive workshops, and digital awareness campaigns that highlight health, time-saving, and sustainability benefits can enhance consumer trust and confidence.

7.6 Health-Oriented Features

Incorporating health-focused features such as calorie monitoring, diet-specific meal planning, and controlled oil usage can further increase the appeal of AI-enabled kitchens, particularly among health-conscious consumers.

8 Scope for Future Research

Future research may broaden the scope of this study by incorporating larger sample sizes across multiple cities and rural regions to enable comparative analysis of adoption patterns. Qualitative research methods, such as in-depth interviews and focus group discussions, could be employed to gain deeper insights into the emotional and cultural perceptions associated with AI-based cooking technologies. Additionally, longitudinal studies may be conducted to assess the long-term impact of robotic cooking on health outcomes, dietary habits, and lifestyle changes.

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Impact of FSSAI's "Stop Obesity" Campaign on Public Awareness and Behavioural Modification: An Empirical Study

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ABSTRACT. The "Stop Obesity campaign launched by the Food Safety and Standards Authority of India (FSSAI) on World Food Safety Day 2025 represents a significant national effort to address the rising burden of obesity and lifestyle-related disorders. The campaign advocates a 10% reduction in nationwide salt and oil consumption. It reinforces behavioural modification through its Aaj se Thoda kam' initiative, which encourages the gradual reduction of fat, sugar and salt intake. Leveraging extensive mass media outreach including FM radio, railway announcements, and digital platforms, the campaign actively disseminates its message to diverse demographic groups. Complementary interventions, such as introducing "sugar boards" in schools and providing educational resources on the Eat Right India portal, aim to cultivate healthier food choices among children and the general public. Additionally, FSSAI has directed state authorities to strengthen surveillance measures on obesity and curb malpractices such as the use of illegal ripening agents and synthetic fruit coatings. To assess the campaign's public relevance and reception, a cross-sectional survey was conducted among 300 adults aged 18-80 years in Pune city, comprising educators, healthcare practitioners, nutritionists and members of the general population. Responses were collected using a structured Google Forms questionnaire. Analysis of the data revealed that the majority of participants viewed the campaign positively, expressing confidence that sustained public messaging would enhance dietary awareness, promote healthier decision-making, and contribute to a decline in obesity prevalence. This campaign by FSSAI is a welcoming step by the responders and fitness enthusiasts towards making India fitter and healthier.

Keywords: Obesity, Public Health campaign, FSSAI, Weight Management, Dietary behaviour.

1 INTRODUCTION

Obesity has become a global epidemic, posing severe challenges to public health systems worldwide. The World Health Organisation (WHO) characterises obesity as a

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chronic, complex and relapsing disease resulting from an interplay of biological, behavioural, environmental and socio-economic determinants. Once regarded as a condition afflicting affluent societies, Obesity has now proliferated rapidly in low- and middle-income countries, including India, and hence created a dual burden of malnutrition characterised by the coexistence of undernutrition and overnutrition.

India is currently witnessing a significant epidemiological transition, marked by changing dietary patterns, reduced physical activity, and increased reliance on processed and convenience foods. According to the National Family Health Survey (NFHS-5), nearly one-fourth of Indian adults aged 15-49 years are overweight or obese. (1) The prevalence of obesity among children and adolescents has also risen alarmingly, with recent global reports indicating that obesity has surpassed underweight as the most common form of malnutrition among school-aged children.

The economic and social consequences of obesity are profound. The World Obesity Federation estimates that obesity related costs accounted for nearly 1% of India's GDP in 2019 and are projected to rise substantially by 2060 if immediate corrective measures are not implemented (2). Obesity significantly increases the risk of non-communicable diseases (NCDs) such as Type-2 diabetes mellitus, cardiovascular diseases, hypertension, and certain cancers, thereby placing immense strain on healthcare infrastructure.

In response to this escalating crisis, the Food Safety and Standards Authority of India (FSSAI), the apex regulatory body governing food safety and standards in India, has undertaken several initiatives under the Eat Right India Movement. Among these, the "Stop Obesity campaign, launched in 2025, represents a strategic policy intervention aimed at fostering healthier dietary practices through awareness generation, behavioural nudges and regulatory surveillance.

This study seeks to empirically assess the effectiveness of this campaign by examining public awareness and perceptions, thereby offering insights into the role of policy-led behavioural interventions in addressing obesity in urban India.

2 REVIEW OF LITERATURE

The global rise in obesity has been extensively documented in public health literature. The NCD Risk Factor Collaboration (2024) reported a steady increase in obesity prevalence across all age groups from 1990 to 2022, attributing this trend to globalisation, urbanisation, and industrial food systems (3).

In the Indian context, studies by the Indian Council of Medical Research, National Institute of Nutrition (ICMR, NIN) have identified unhealthy diets as the leading contributor to the national disease burden. Increased intake of refined carbohydrates, saturated fats, and added sugars, coupled with declining physical activity, has been identified as a critical driver of obesity (4). Behavioural change theories emphasise that gradual, sustained modifications in dietary habits are more effective than abrupt restrictions. Research indicates that public health campaigns employing nudges, such as portion-control messaging and visual cues, can positively influence food choices. Initiatives such as front-of-pack labelling, sugar reduction policies, and restrictions on junk food marketing have demonstrated measurable outcomes in several countries.

UNICEF's Child Nutrition Global Report, 2025, highlights the alarming rise in childhood obesity and underscores the importance of school-based interventions, such as nutrition education and food environment regulation (5).

The introduction of sugar boards in schools as proposed by FSSAI aligns with these global best practices.

This study builds upon existing research by providing empirical evidence on public perception of a national obesity prevention campaign in India.

3 OBJECTIVES OF THE STUDY

The present study was undertaken with the following objectives:

- To assess the level of public awareness regarding FSSAI's "Stop obesity" campaign.
- To evaluate public perception of the "Aaj Se Thoda Kam" behavioural initiative.
- To analyse attitudes towards regulatory measures, such as sugar boards in schools.
- To examine perceptions regarding the effectiveness of FSSAI's initiatives in enforcing behavioural modification.
- To assess public opinion on the sustainability of obesity prevention strategies.

4 RESEARCH METHODOLOGY

The present study employed a cross-sectional descriptive and analytical research design and was conducted in Pune, a rapidly urbanising metropolitan area in Maharashtra, India. Pune was selected due to its heterogeneous population comprising diverse socio-economic groups, high literacy levels and significant exposure to digital and mass media campaigns. The target population for the study comprised adults aged 18 to 80 years, including the general population, such as educators and healthcare professionals. The inclusion of respondents from varied professional backgrounds ensured a comprehensive understanding of public perception across demographic and occupational strata.

A sample size of 300 respondents was selected for the study. The sample size was considered adequate for both descriptive and inferential statistical analyses with acceptable precision.

A simple random sampling technique was employed to minimise selection bias and to ensure that each individual in the target population had an equal probability of inclusion.

A structured questionnaire was designed specifically for this study to collect the primary data through face-to-face interviews and Google Forms. The questionnaire comprised both closed-ended and scaled questions. Prior to final data collection, a pilot study involving 30 respondents was conducted to test the clarity, relevance and reliability of the questionnaire. Feedback obtained from the pilot study was used to refine questions, wording and structure. The collected data were coded and analysed using statistical techniques commonly used in social science research.

The following results are derived from the collected data.

Awareness of campaign

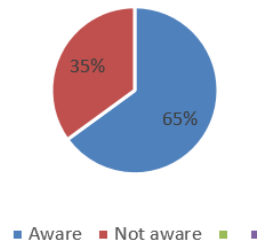


Fig. 1. Awareness of FSSAI Stop Obesity Campaign

65% of respondents were aware of the FSSAI Stop Obesity Campaign, and 35% were not.

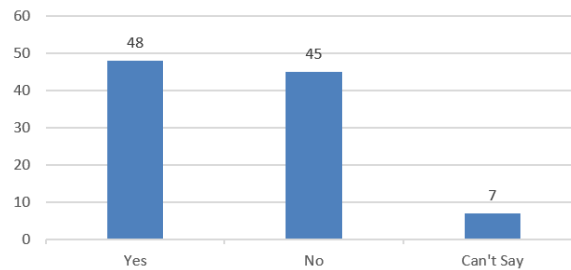


Fig. 2. Bar graph depicting respondents' perception of the Aaj se Thoda Kam Initiative

48% of the respondents have a positive perception of this FSSAI initiative, 45% have a negative perception, and 7% are neutral.

Introduction of sugar Boards in Schools

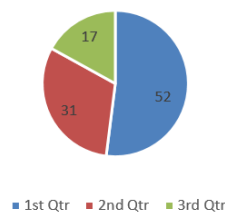


Fig. 3. Introducing sugar boards in schools will help develop healthy eating habits among school-children.

52% of respondents welcomed this FSSAI initiative, 31% were not very happy with it, and 17% were neutral.

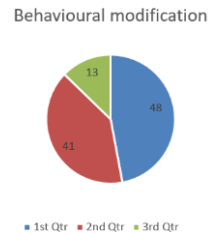


Fig. 4. Will FSSAI be able to enforce behavioural modification through this campaign?

48% of the respondents were positive about the behavioural modification through this effort by FSSAI. 41% of the respondents were not very sure about this step, while 13% remained neutral.

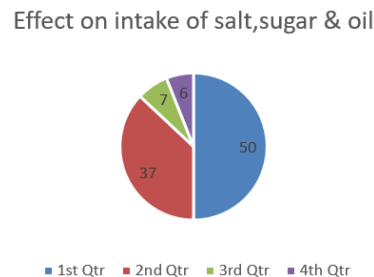


Fig. 5. Will the general population reduce their intake of salt, sugar and oil?

Responding to the question, will the general population reduce their intake of salt, sugar, and oil after the implementation of the FSSAI initiative? 50% of the respondents were quite positive about this initiative. 37% of the respondents responded negatively. In comparison, 7% of respondents remained neutral, and 6% could not express an opinion.

Table 1. Mean scores of Attitudinal statements

Statement	Mean	Standard Deviation
Sugar boards promote healthy habits	2.41	.61
Surveillance by FSSAI is necessary	2.80	0.44
Campaign can modify behaviour	2.12	0.73
Reduction of salt/sugar/oil helps obesity control	2.30	0.69
Continuous efforts are essential	2.71	0.51

(Scale: Agree=3, neutral=2, Disagree=1)

All mean values exceed the neutral midpoint (2.0), indicating an overall favourable attitude, particularly toward regulatory enforcement and sustainability.

5 IMPLICATIONS

The findings of the present study have significant implications for public health policy, regulatory governance, behavioural change communication, and future research initiatives aimed at addressing the growing burden of obesity in India. The moderate support for sugar boards in schools suggests that, while the concept is gaining acceptance, greater sensitisation is required. Educational institutions represent a critical intervention point for instilling healthy habits at an early age.

6 LIMITATIONS OF THE STUDY

The findings of the study should be interpreted in light of certain limitations. Data were based on self-reported responses, which may be influenced by social desirability and recall bias. While awareness is a significant predictor, additional determinants such as socio-economic factors, cultural practices, food environment and physical activity were not captured in this study. The population is very small to derive proper conclusions.

7 CONCLUSION

The study provides empirical evidence supporting the effectiveness of FSSAI's "STOP OBESITY" campaign in influencing public behavioural intent through awareness generation. Sustained implementation, broader outreach, and integration with structural and environmental strategies are essential to translate awareness into long-term behavioural outcomes. The study contributes valuable evidence to the preventive public health policy discourse and supports continued investment in institutional obesity-control initiatives.

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Government Reforms and the Rise of Zero-Alcohol Beverages: Reshaping Market Dynamics in the Global Beverage Industry

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ABSTRACT. Change begins where policy meets choice - governments reshape drinking patterns through stricter drink-driving rules, higher alcohol taxes, and warnings tied to public wellness. These moves quietly steer markets away from strong drinks, making space for lighter options. Health awareness grows at the same time, feeding demand without needing loud slogans. New regulations act like quiet signals, altering what people reach for on store shelves. Choices shift not because of trends, but due to steady pressure from law and information. Lighter beverages gain ground while old favorites lose grip, step by unnoticed step. What stands out here? The way government changes are seen shifts - less about tight controls, more about guiding markets forward. Seeing them this way helps leaders balance stronger economies with healthier populations. From a business standpoint, such moves reveal how customer choices evolve over time. This study uses a qualitative descriptive method, relying on existing information such as government documents, public health records, sector evaluations, commercial insights, alongside scholarly articles. By comparing regions and themes, the analysis follows how rules, awareness about well-being, ecological priorities, together shape progress. Though focused on patterns, it remains grounded in observable trends across sources. What emerges is shaped by context - each factor influencing outcomes differently depending on location and conditions. Clear trends emerge when looking at how rules shape markets - places with easier regulations see faster growth in non-alcoholic drinks. Younger groups, especially those born between 1980 and now, increasingly prefer choices aligned with health and awareness, strengthening this shift. Because of these changes, companies making beverages pour resources into better methods for removing alcohol while keeping taste intact. Where laws support innovation, the range of available products widens, pulling in different types of buyers over time. What began as regulation soon evolved into encouragement. Instead of merely setting rules, officials helped spark competition, fuel new ideas, fast. Over time, policies didn't

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just limit old habits - they built something lasting in their place. A marketplace emerged, strong on its own, shaped by foresight. Zero-alcohol drinks now thrive globally, not by accident, but through steady redirection. Behind today's choices lies years of quiet restructuring - economic, social, behavioral. This shift was never about saying no; it became about making space.

Keywords: Zero Alcohol Drinks, Policy Shifts, Health Trends

1 INTRODUCTION

A quiet revolution reshapes how people drink worldwide. Once seen as odd choices, non-alcoholic drinks now sit comfortably on dinner tables and bar counters alike. Because lifestyles evolve, preferences change - but policy decisions push this trend forward just as strongly. New rules targeting alcohol's risks - tighter limits for drivers, updated tax structures, widespread health messaging - slowly alter when, where, and why people reach for a drink. The result? A different relationship with what flows into glasses. Costlier booze and trickier access in some places did more than curb drinking - they quietly boosted the status of non-alcoholic drinks as smart, normal picks. According to the World Health Organization (2023), near-zero and light-alcohol options now fit into wider strategies aimed at cutting harm. With fresh rules reshaping the game, drink makers are adjusting what they offer. This trend, far from being just a passing wave pulled by buyers, stems largely from government moves. Yet one uneasy issue lingers: Can today's label regulations keep up with where things stand now?

One way governments affect drink choices is by changing prices, access, or what people know. When taxes go up or minimum pricing starts, buying regular drinks feels less worthwhile compared to non-alcoholic options. Instead of just adding costs, these financial moves tilt the balance toward lighter substitutes. Restrictions on ads, event backing, or shelf placement also reshape how companies reach buyers - altering attention without raising voices. Policy coordination, notes the Organisation for Economic Co-operation and Development (2025), stands out in shifting mass drinking habits meaningfully. Rather than isolated steps, layered strategies tend to leave deeper marks on everyday decisions. When rules shift, companies often respond by spreading efforts across new areas - especially where non-alcoholic products are concerned. Predictability matters greatly to producers; it comes through consistent policies that make future moves easier to map out. Uncertainty fades when expectations stabilize, allowing firms to commit resources wisely instead of reacting constantly. Scattered standards, on the contrary, create uneven playing fields while weakening health goals over time. Structural change emerges quietly here - not through force but by adjusting how rewards align across markets. Risk gets reassessed slowly, value transforms gradually, and what counts as acceptable evolves under steady pressure from updated laws.

What drives change isn't only rules. Younger generations care more about health, balance, and what they consume - this mindset lifts demand for non-alcoholic options. These drinks now stand apart; once seen as backups, they're chosen freely. Taste matters more today, packaging too, helping reshape how people view them. Growth con-

tinues worldwide, figures confirm, thanks in part to better taste and sharper brand identities. Data from IWSR in 2025 underline steady momentum across major regions. Now shaping up fast, the non-alcoholic drinks market sees brands turn to advanced methods for removing alcohol, eye-catching containers, one-of-a-kind unboxing moments, alongside messaging tied closely to current cultural shifts. Backed strongly through government measures aimed at reducing heavy drinking, these moves gain extra momentum. Fierce rivalry grows as giants from worldwide corporations meet nimble startups chasing smaller but devoted followings. Shifts in laws blend with changing daily habits, pushing this segment into sharper focus - altering paths to profit while forcing firms to rethink identity and long-term play.

Still, the rise of non-alcoholic drinks brings complications along with it. Whether people truly swap alcohol for these alternatives remains uncertain - sometimes, similar packaging and taste may just keep old habits alive under new labels. What pushes someone to choose them differs greatly depending on where they live. As Ford et al. (2025) showed, success depends less on the product itself and more on how rules shape its role in daily life. Behind the scenes, companies could reshape policies to benefit profits, even if public well-being takes a back seat. What happens when rules meet real-world choices becomes clear only through careful attention to policy structure alongside human behavior. By looking at how official changes influence worldwide patterns of avoiding alcohol entirely, this work connects discussions across governing bodies, business decision makers, and researchers studying actions people take. Rather than assuming outcomes, it traces how interventions unfold in practice, offering grounded insight into interactions often overlooked.

1.1 Background of Study

Though often overlooked, alcohol remains a persistent challenge for public health systems worldwide due to ties with chronic illness, accidents, and societal strain. With growing clarity, authorities now treat drinking more seriously within frameworks meant to improve population well-being. Evidence gathered over decades points firmly toward high rates of illness tied to alcohol use, reinforcing arguments for stronger preventive steps. From low- to high-income nations alike, early death and lost healthy years are frequently shaped by consumption patterns revealed in recent global studies (GBD 2021 Alcohol Collaborators, 2023). One result of these findings is new interest in rules that limit exposure but avoid banning products completely. Instead of strict bans, officials now look at options like zero-alcohol drinks, which fit within current policies. These beverages help lower risks yet still let people make their own decisions about what to consume. A growing number of health strategies include such drinks, not as replacements for alcohol alone, but as part of broader changes in how regulations evolve. Shifting away from total avoidance, the focus turns toward safer substitutes that maintain freedom and economic flow.

Though policies once focused on single fixes, today's global and domestic approaches now build broader frameworks across sectors. Take the 2022 WHO Global Alcohol Action Plan - it pushes limits on access while also promoting non-intoxicating

drinks. In such a system, zero-proof products slip in quietly, yet play a key role: supporting wellness without harming commerce. Changes including adjusted taxes, tighter ads rules, and required caution tags do more than shrink drinking rates - they tilt consumer interest toward sober substitutes. Faced with these shifts, companies tend to adapt through new ideas instead of pushback. Because of shifting rules, space opens up for non-alcoholic options to grow. Set inside this framework, the research looks at how policy pushes change in markets - clarity here shapes what comes next for business and public well-being alike.

Looking ahead, the worldwide drink sector keeps changing fast while businesses adjust to new rules and what people now care about. Because of city growth, better health knowledge, and more acceptance around skipping alcohol, non-drinking options gain ground - this trend shows up clearly across rich nations and developing ones alike. Data from Euromonitor International (2024) underlines how daily habits shift when alcohol isn't part of the picture. Firms pour time and money into research, upscale image work, and wider reach for these alternatives. Far from being minor shifts, such efforts tie directly to broader policies aiming to reduce heavy drinking. Nowhere is change more evident than in how new ideas link tightly to rules and lasting impact. Far from being niche, alcohol-free options anchor brand strength today. Where once regulation and demand moved separately, they now push together, shifting what comes next across the sector.

One way to see rising demand for alcohol-free drinks is through habits and group behavior. Not every decision happens alone - each reflects shared expectations, fears about health, what rules allow. When people face strong limits on drinking, their actions shift based on what else feels satisfying. Evidence shows that offering tasty low-risk options softens pushback against new laws. Work by researchers like Marteau and team in 2023 reveals how small changes in available picks steer users quietly toward better outcomes. A setting shapes choice more than most admit. Behind the wheel, at work, or during public events, non-alcoholic drinks fit into structured environments where alcohol is restricted. Shaped by rules, industry shifts, and changing habits, the rise of these products reflects overlapping forces rather than isolated trends.

1.2 Scope and Importance of the Study

Looking closely at how government changes affect drink markets worldwide, this work tracks the rising popularity of non-alcoholic options. Because of measures like higher taxes on alcohol, limits on advertising, stricter driving rules, and health messaging, choices are shifting. From rich nations to fast-growing ones, the strength and reach of these policies vary widely. Instead of just following what buyers seem to prefer, it zeroes in on how laws reshape entire markets. Seen this way, the discussion around drinks moves beyond personal taste into broader economic change. One way to look at it is through how makers adapt - shifting product lines, exploring new formulas, or reworking brand messages to meet rules. According to Babor and colleagues from 2022, efforts to control drinking function like large-scale changes affecting where people drink and how companies act. Zero-alcohol drinks fit right into this setup, treated as approved

alternatives under current policies. With that lens, regulation, business moves, and what consumers choose come together, showing how markets shift shape over time.

One reason this work matters? It adds to a kind of market analysis aimed at shaping policy - rarely covered well in past studies. Although many earlier papers charted how drinking affects health, few examined whether rule changes open doors for different kinds of products. Instead of treating non-alcoholic drinks as just consumer trends, this project sees them as shaped by rules. When officials look for options beyond strict penalties, such results can help inform choices. As shown by Anderson and colleagues in 2023, controlling alcohol use may depend on tools that reshape markets alongside behavior. One way to maintain options without increasing harm comes through drinks free of alcohol. So it follows that matching rules to real-world motives might sharpen policies - guiding systems that balance well-being with financial sense.

One step ahead, those in the sector find real value here. Firms making drinks, teams handling promotion, people moving products - each faces tighter rules shaping their moves. When policies shift, knowing their effect on what sells, at what cost, who trusts which name - that knowledge grounds smarter choices. Not an afterthought anymore, alcohol-free ranges now anchor future plans. Regulatory changes shape how companies invest within the beverage industry, according to Deloitte (2024). Because policies evolve, understanding them allows firms to adjust product development ahead of new rules. Insights tied to legislation uncover paths for expansion that follow laws while supporting societal needs. Far from staying inside scholarly discussion, these findings influence real-world planning. Strategic moves now depend heavily on legal foresight rather than market intuition alone.

Putting theory into practice, this work bridges conversations across public policy, marketing, and how people make consumption decisions. Rather than treating government changes as mere background rules, it frames them as active forces shaping markets. By situating individual behaviors inside structured settings where alternatives are encouraged, it adds depth to behavioral studies. When regulations push certain habits, choices shift - this idea anchors the analysis here. Recent appeals, such as those by Petticrew and colleagues in 2023, stress examining how industries adjust under new policies to reflect actual impacts. Linking oversight mechanisms with commercial results meets that need without overstating claims. Though built around drinks, its structure fits neatly into areas like low-sugar goods or nicotine substitutes. This approach strengthens policy decisions with solid research, balancing precision and practical insight. Scholars find it useful. So do regulators. Even business experts gain perspective from its careful design.

1.3 Objectives of Study

- Examining how policy shifts shape expansion in alcohol-free drinks worldwide - government actions quietly reshape market paths. While rules evolve, new directions emerge across international markets. Reform impacts unfold through subtle pressures rather than sudden force. Regulatory steps guide development without announcing intent. Growth follows frameworks built behind the scenes. Change arrives

via quiet redesigns of standards. Oversight becomes a hidden driver beneath rising demand patterns.

- Examining how non-alcoholic drinks influence shifts in competition worldwide. What changes occur in market value when alcohol-free options grow? As these products gain space, traditional players adjust strategies unexpectedly. Growth patterns suggest a redefinition of consumer priorities across regions. New offerings challenge long-standing industry norms quietly. With rising demand, innovation becomes less optional than inevitable. Market reactions reveal subtle but meaningful transformations beneath the surface.
- Examining how rising demand for alcohol-free drinks might shape long-term habits around mindful consumption. One way governments encourage lower-risk drinking is through policy backing - this trend could align with those efforts. Shifts in consumer behavior often reflect deeper social changes, sometimes supporting public health goals. Without assuming cause or effect, patterns in market choices may reveal useful insights over time. Focus remains on understanding outcomes, not predicting them.

2 REVIEW OF LITERATURE

One reason behind the fast growth of no- and low-alcohol drinks may lie in how product features connect with personal values and surroundings. Instead of just taste, what matters often includes how genuine a drink feels or whether people trust the maker. On a personal note, choices tend to reflect concerns about well-being, efforts to manage habits, or ways of expressing who someone is. Availability in regular stores helps too, especially when these options appear where alcohol usually dominates. Social settings play a role - not only at home but also during gatherings where drinking used to be expected. When non-alcoholic versions show up on menus or get served without stigma, more individuals begin to try them. Growth doesn't stop at innovators; it spreads once context supports change. Occasion shapes NoLo drinking more than habit does, Waehning and Wells (2024) argue, since choices emerge alongside social cues rather than fixed preferences. Instead of viewing it as one trend, research frames it as shifting patterns tied to context - what people do around drinks matters just as much as what they drink. Because these behaviors settle into everyday life differently across groups, their rise reflects something deeper: a quiet redefining of categories within beverage culture itself. With time, such shifts could reshape expectations about alcohol's role - if policies begin aligning with actual usage instead of assumptions.

Another branch of study looks into how advertising shapes when people drink NoLo beverages, sometimes clashing with efforts to reduce harm. According to Nicholls (2023), certain ad strategies present these drinks not as swaps for alcohol but as fresh options within a person's routine - opening up more times and places they might be consumed. Because of this shift, users may find it easier to fit in socially without feeling judged for avoiding alcohol altogether. Yet such framing risks keeping alive visual themes and branding styles tied closely to drinking culture. Scholars increasingly agree: promoting non-alcoholic brands walks a fine line - offering safer alternatives on one

hand, yet strengthening familiarity with alcohol-linked identities on the other. What becomes clear is that oversight must distinguish campaigns encouraging full replacement from those simply adding new settings where near-beer products appear.

Looking into how rules are written uncovers ongoing differences across countries. Work from Okaru and Lachenmeier (2022) highlights uneven cutoffs - what counts as "alcohol-free," "zero," "low," or "reduced" shifts drastically depending on location, muddying legal expectations while leaving buyers uncertain. Such mismatched terms ripple through packaging labels, tax policies, and cross-border commerce, possibly tilting fairness among producers. Because these non-alcoholic offerings frequently appear alongside traditional alcoholic drinks, experts suggest separate oversight is needed; their image as inherently safe might overlook subtle risks like minimal alcohol traces, attraction to younger audiences, or challenges faced during recovery. Clarity in naming standards and strong label controls emerge here - not just as administrative details - but as necessary safeguards so expansion of this product category aligns with broader health goals instead of working against them.

Population-wide data now shows people actually using NoLo beverages to cut down on alcohol. In Great Britain, research by Buss and colleagues from 2025 reveals a clear rise from 2020 to 2024 in choosing non-alcoholic options when trying to reduce drinking, especially within older age groups. What makes this shift meaningful is that it reflects behavior change rather than just commercial trends, linking more directly to health outcomes. Still, researchers warn: higher usage does not necessarily mean better results. Putting better assessment methods into practice could clarify if choosing NoLo leads to lasting drops in drinking. Evidence like this supports studying policies more closely - especially how changes affect access and promotion, yet also what happens once those shifts reach everyday use.

3 RESEARCH METHODOLOGY

This work used a qualitative approach, relying on existing information drawn only from official government channels. National policies, global guidelines, administrative updates, and health summaries formed the core material, alongside figures issued by recognized state bodies. To explore links among rules, wellness goals, environmental factors, and new developments in alcohol-free drinks, a structured comparison across regions and user patterns was carried out - guided by recurring themes.

4 DISCUSSION AND ANALYSIS

It turns out government changes do more than restrict - they actively reshape markets. Instead of just setting rules, actions like higher taxes on alcohol, tougher penalties for impaired driving, and tighter ad limits shift how appealing regular drinks seem compared to non-alcoholic ones. According to Rehm and Manthey (2023), there is a ripple beyond intended goals - efforts targeting harm also create room for alcohol-free options in everyday spaces such as offices, public transit, or family events. As a result, these alternatives grow not simply because people choose them, but because systems around

behavior have changed shape. What we see now is shaped heavily by how rules are applied across regions. Where standards hold firm, expansion follows more clearly. Scattered control weakens overall results. Shifts in policy do not just influence change - they sit at its core within the drinks sector. Structure changes because authority adapts.

One way firms respond: they're folding non-alcoholic options into central business plans. This isn't just trend-following - it ties to expected rules years ahead. Behind the scenes, money flows toward removing alcohol efficiently, standing out in crowded shelves, and building upscale image. Such moves point to companies bracing for tighter limits on regular drinks. According to Porter and Kramer (2023), clearer regulations reduce guesswork, making bold investments feel less risky. What emerges? A market reshaping itself before laws arrive. Meanwhile, companies use non-alcoholic options to preserve brand value where standard alcohol ads face limits. Regulatory shifts appear to influence both range of products and market structure - favoring those able to adapt quickly and operate widely.

Looking closer, how people accept non-alcoholic drinks often ties back to rules shaping their choices. When policies make drinking harder or riskier, they push alcohol-free options into everyday settings - slowly making them feel ordinary. According to White and Signal (2024), offering swaps works better than just saying no. Instead of cutting out experiences, zero-proof beverages let users follow guidelines while staying socially engaged. Behind this lies an important point: what makes policy work emerges from how laws, business actions, and personal views shape one another.

Although the study points to wider effects on sustainable habits and health oversight, changes favoring alcohol-free options contribute to environmental targets through reduced health burdens plus encouragement of mindful consumer behavior. Shaped by insights from Room et al. (2023), this marks a move away from strict bans toward flexible rules using market forces for collective benefit. Still, it remains clear - effective outcomes depend on more than intent alone. Because oversight never stops, labels must be precise - while rules block kids' access plus false wellness messaging. So shifts toward non-alcoholic drinks unfold through regulation, reshaping how markets operate, how people drink, even where health policy heads next.

5 FINDINGS OF STUDY

Evidence shows government changes strongly shape how fast people accept non-alcoholic drinks. Because of higher taxes on alcohol, tighter rules for driving after drinking, along with stronger health warnings, situations where drinking once felt normal now feel less inviting. According to the World Health Organization (2023), such actions give zero-proof options more credibility in places like offices, buses, and festivals. Rather than just replacing old habits, these policies open fresh opportunities where demand grows independently. What emerges is not substitution, but expansion into areas previously dominated by alcoholic choices. This finding shows how non-alcoholic drinks often emerge from structured policy environments. Where rules around alcohol are clear and reliably applied, the market for alcohol-free options tends to grow steadily over time.

A shift among drink makers stands out, prompted by tightening rules. Data from 2024 collected by Euromonitor shows companies now treat non-alcoholic options as essential, not just trial products. When regulations feel stable, businesses commit more resources - improving taste, adopting advanced removal methods, aiming higher in pricing. These alcohol-free versions help maintain public recognition when ads for regular drinks face bans. Innovation under policy pressure has become a quiet force altering how brands compete.

One key takeaway stands out: people's willingness to embrace non-alcoholic drinks often depends less on personal preference, more on how rules shape available choices. When policies make alcohol-free options part of daily routines, uptake rises - suggesting external structures matter just as much as individual mindset. According to Nicholls (2023), many now see these beverages not as odd replacements but as normal alternatives fitting both law and lifestyle. In settings where drinking could lead to penalties or judgment, skipping alcohol feels safer, even routine. Behavior shifts like this reveal a pattern - not pure freedom of choice, rather decisions molded quietly by laws, peer cues, and what companies offer.

One last thing stands out - the growing presence of non-alcoholic drinks matters more than it first appears. When policies support these options, they quietly line up with wider environmental targets because fewer alcohol-linked harms emerge. This connection gains strength through recent work by Room and colleagues in 2023. Instead of leaning on strict penalties, fresh approaches now bend toward flexible oversight shaped by how markets actually behave. What we see unfolding is deeper than numbers - regulatory shifts pull not just supply chains but shared ideas about drinking into new territory across international drink sectors.

6 CONCLUSION

This research shows how state-led changes strongly influenced the worldwide drink sector, speeding up acceptance and expansion of non-alcoholic options. Rather than just limiting behavior, such policies reshape where and how people consume, shift norms in commerce, and guide new product development. Through taxes on alcohol, limits on advertising, and stricter traffic laws, public attitudes about cost and danger begin to shift - opening space for alternatives. Evidence supports a key point: drinks without alcohol emerge less from personal choice alone, more from structured rules woven into broader systems of control. This view highlights how rules shift market rewards while altering who competes and how they do it. Emerging prominence here signals a trend - not rigid control, but flexible oversight - matching societal health goals with economic forces instead of relying on bans.

Despite the changes, reactions within the sector differ sharply depending on who is involved. Shifting toward non-alcoholic drinks now shapes much of what beverage makers prioritize, influenced less by momentary preferences and more by steady policy directions. Backed by upgrades in production methods, higher-end brand development, and expanded reach, this shift appears durable. Still, adjusting effectively depends

heavily on available resources, which may favor global players while narrowing competition among smaller ones. Though rules can spark new ideas, they unfold alongside tougher market rivalry. According to the research, steady policies matter most in guiding the sector toward change that accounts for long-term impacts. What drives progress isn't just pressure - it's clarity over time.

Looking at things through the eyes of people who drink, whether they pick non-alcoholic drinks often hinges on how rules shape their options. When laws treat alcohol-free choices as ordinary, those choices slip more easily into everyday routines - especially in places where drinking is limited or frowned upon. As such habits gain ground, skipping alcohol feels less unusual, letting people stay part of shared moments while following guidelines. Still, one thing bears watching: what really shapes long-term health outcomes is the way these drinks are presented - not just in ads, but in stories society tells about them. Most of the time, drinks without alcohol could lead people to drink more often if nobody watches how they are used. Good management matters because it shapes whether such products actually lower harm. Rules need to fit together, paying attention to how users react just as much as what happens in stores.

One way to look at it: rising demand for non-alcoholic drinks reflects deeper shifts shaped by policy, touching health, environment, and commerce. Instead of blocking options, government actions often open space - supporting mindful use without limiting freedom or growth. Still, these products work best when treated as part tools, not magic fixes. Success depends less on popularity, more on clear rules, honest packaging, fair promotion, ongoing oversight. From another angle, the interplay between rule-making and market behavior shows progress isn't random - it emerges through design. This case adds weight to conversations where research meets real-world decisions. Starting fresh, this work opens paths for later studies on controlled markets, extending past alcoholic drinks. In the end, findings show policy changes are redefining both how beverages are bought and sold - alongside shifting views on when and why people drink.

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A Conceptual Review of Human–Technology Collaboration in Hotel Service Systems and Future-Ready Implications

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ABSTRACT. Hotels today are undergoing rapid changes due to the adoption of artificial intelligence (AI), automation and digital services as part of their daily business operations. This change will not only impact how hotels operate but also change the roles and interactions of the employees who work at those hotels. The key themes identified include the redesigning of employee job functions through automation; the increasing use of AI and humans working together; the emergence of blended or hybrid job positions; the ongoing need for training and development for employees to remain relevant within the industry; and the ethical considerations of managing these changes. Based on the above ideas, we propose a framework demonstrating how hotels can combine organisational practices and new technology in preparing their employees for a digital- or technology-first environment. This proposal focuses on creating a holistic perspective that combines existing literature on this topic rather than viewing them as isolated studies. The ultimate goal is to produce practical recommendations for managers, educators, and policymakers to assist employees in adapting to an AI-automated service-based hospitality ecosystem. In order for hotels to prepare for the employees of tomorrow's hospitality workforce successfully, they must provide the opportunity for employees to participate in the implementation of emerging technologies, develop innovative and responsible governance structures to support new technology adoption, and create employee learning experiences through smart reskilling programs.

Keywords: Artificial Intelligence, Human-Technology, Hospitality, Adoption, Reskilling

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1 INTRODUCTION

The subsidization of technologies such as self-service kiosks, service robots, smart revenue management systems, predictive analytics for demand forecasting, and AI-powered customer relationship management platforms has led to significant changes to how hotels are operated and to the manner in which hotels increase the productivity and visitor experience in a digital era. In addition, the hospitality industry is experiencing a digital transformation due to the growing number of hotels' utilization of automation, robots, artificial intelligence, and data-driven service systems to increase guest satisfaction, drive revenue, and provide operational efficiencies. Historically, providing guests with great experiences was the responsibility of the hospitality industry through high touch, high emotion service encounters; however, there are great challenges related to the coordination of machine/technology and human skill/expertise now arising from the advent of new technology in these engagements. Using technology, hotel systems today have chosen to emphasize cooperation between employees on the front lines and advanced technology versus replacing employees altogether. Many aspects of technology adoption in the hotel sector have been examined by previous studies, such as the determinants of AI adoption, customer responses to automated processes, and employee attitudes toward service robots and algorithmic management systems.

In light of these developments, many managers now consider the “future-ready workforce” to include employees who have both the technical skill needed to be successful in today’s high tech service settings as well as the adaptability, relationship-building and ethical skills needed to be able to work effectively in this environment. In order to support this type of readiness within the hospitality industry, it is necessary for managers to make significant investments in learning infrastructures, leadership development, reskilling programs, and organizational cultures that encourage employees to work effectively with technology. In response to this call, the current study carries out a conceptual review of academic scholarship on human-technology collaboration in hotel service systems and its impact on workforce readiness. The current study seeks to go beyond the current descriptive approach to particular technologies and instead seeks to systematically integrate concepts from previous academic scholarship on the hospitality industry and service-oriented studies to better understand workforce change in AI-enabled hotel service operations.

There are three main contributions from this piece of research. First, it provides a summary of how hospitality technology has developed over time and places it into relevant categories on how humans will be able to interact with intelligent systems of various types in a face-to-face manner. Second, it provides a perspective shift from operational efficiency to employee development, organisational structure, and social responsibility as the focus of workforce development. Third, it provides a framework to assist hotel managers, educators and policy makers with developing strategies that will enable their employees to thrive in a technology supported hospitality environment. The information contained within this research paper will assist hospitality organisations and industry leaders by clearly establishing methods to connect employee development with the rapid growth of technological advancements.

2 OBJECTIVES

- To synthesise scholarly contributions on human–technology collaboration in hotel service systems.
- To examine workforce transformation in roles, competencies, training, and job design under AI-enabled operations.
- To create an integrated framework for workforce readiness in technology-intensive hotel service environments.

3 CORE CONCEPTS AND PERSPECTIVES

3.1 AI-Enabled Hotel Service Systems

The rise of digital service systems in hotels is creating a more powerful and interconnected set of tools that leverage technology and artificial intelligence to enhance both hotel operations and guest interactions. These technologies are used in an array of ways, such as using kiosks for self-service check-in and check-out, mobile concierge applications, facial recognition systems, service robots that deliver or clean, bots that book reservations, and utilizing predictive analytics for revenue management and demand forecasting. However, since the service aspect of hospitality often requires great deal of personalization and timeliness, these intelligent technologies do not exist in a vacuum and also operate as part of a larger socio-technical system in which employees and intelligent technologies collaborate to create value together.

The way that hotels operate will change significantly when the use of AI enhances daily operations. More routine, repetitious, and physically demanding duties will be taken on by machines and therefore allow staff to concentrate on doing things that they do best—making connections with guests, resolving concerns, and addressing unanticipated occurrences. This change means that not only may efficiencies be gained but also that the way in which hotels strategically arrange their workforce, create new job classifications, and provide high-quality service will also evolve.

3.2 Human–Technology Collaboration in Service Contexts

Human-technology cooperation characterizes the relationship between hotel employees as well as intelligent systems. By combining human judgement, empathy and situational awareness with the speed, accuracy and analytical ability of computers, the end result will be a more effective and balanced way to provide services.

Various studies presented on this topic have shown that successful cooperation of individuals and technology has a few primary components; staff members must possess faith in the systems that they use, comprehend the circumstances around the production of algorithmic decisions, consider the user interface easy to use and believe they still have a measure of autonomy over technology-related decisions.

3.3 Workforce Readiness in Hospitality

The level of readiness and ability of employees to perform their jobs will depend on their skills, attitudes, and the amount of support provided by their organisations to help them succeed in. Employees should be digitally literate, flexible, emotionally intelligent, ethically aware, and continuously learning; our customers expect us to provide them with all of these qualities each time they have an interaction with us. For frontline employees, digital readiness means determining how to interpret and implement data-based recommendations provided by an automated system; successfully using automated equipment when operational problems occur; and still being able to provide excellent guest service through a digital system.

Workforce readiness is and will continue to be dependent upon training programs provided by hospitality education institutions and employers themselves—regardless of the type or delivery. The overall concept of workforce readiness is thus understood to be a multi-dimensional entity with three major sources of influence: individual employee competencies, human resource management practices, and organisational culture.

3.4 Supporting Perspectives

Different conceptual lenses can be used to better understand human and technological interaction in hotel service systems. From a socio-technical perspective, the goal is to create optimal results when work processes, skill sets of employees, and digital tools used in a workplace complement one another. This perspective illustrates how Artificial Intelligence (AI) influenced solutions are changing the relationship between the guests, staff and the organization, thus developing brand new ways to work together and interact with each other.

For effective collaboration, it is also important to maximize these three enabling features: flexible interfaces; providing continual feedback and developing a consistent viewpoint of situations. The current research will help to build a framework whereby the hotel industry can integrate new technologies into their service delivery and train their associates for future jobs.

4 REVIEW OF LITERATURE

Recently, there has been a change among researchers toward studying how technology can help solve human related problems rather than on how humans use technology. Additionally, researchers are concentrating their investigations on understanding the changing trends of hotel worker employment and how this impacts the way they do their jobs today with respect to human to intelligent systems interactions. The research efforts have revealed there are still many areas of research which have not been adequately covered through current knowledge of hospitality organisations. This project will address the aforementioned by integrating the available research into an integrated

framework for the hotel industry to help further develop a workforce that can provide a technology-driven service to the customer.

According to (Spektor et al., 2023), the development of alternative systems for providing service has substituted previously performed manual tasks with new automated processes. By reviewing examples of these changes in various areas of hospitality operations such as solving guest issues through algorithm-based scheduling, using robotic assistants for services, digital monitoring of work performance, etc., They have identified positive implications on overall management; however, management needs to consider individuals' behaviours and the associated attitudes to effectively integrate this new technology into existing workplaces redesigning work flow processes, otherwise there will be resistance towards or unintentional outcomes resulting from the implementation of technology within hotels.

As AI-based solutions develop rapidly in the hospitality industry, there has been an assessment of their overall impact on both employee performance/motivation and employee well-being. When observing workers from the perspective of the organisation as a whole it allows us to develop greater insight about how people and technology relate to one another in the service context within hotels (Bankins et al., 2024). Though not limited to just the hospitality sector, this research is also of considerable interest due to its focus on how AI can enhance employee performance through technology in service delivery processes (Bankins et al., 2024) found that collaboration between workers and intelligent systems is influenced at various levels, including: (1) workers' attitudes towards AI, (2) how teams work together, and (3) the types of governance structures that organizations have put in place.

Hospitality industry employee training and development have become significantly dependent upon how employers use the partnership between humans and technological advances. The use of artificial intelligence in the workplace is being emphasized in the article by (Wang et al., 2025) that found the top three skills required for employees today include digital literacy, analytical ability and adaptability. Creating an organizational environment that supports continual learning and promotes honest and open communication may help reduce the level of resistance and/or fear to automation by employees according to research by (Ersoy & Ehtiyar, 2023).

While in recent years an increasing number of authors have taken into consideration the role of the workforce when assessing the application of technology, (Spektor et al., 2023) and (Wang et al., 2025) both recommend adopting an integrated model that evaluates job design, employee career development, human resource management practices, and technology functionality.

The literature reviewed shows continued development from an earlier focus on the technology itself to a greater focus on how people work with intelligent systems, and how the hotel workforces are changing. The research in this area is not fully developed or complete and varies between different industries.

5 RESEARCH METHODOLOGY

Through the systematic literature review process, we examined the collaborative nature of humans and technologies in the hotel industry, specifically pertaining to how technologies impact training for hotel employees and the outcomes of that training. Our intended outcome is to explore the extant literature pertaining to the hotel industry and to identify key topic areas as well as connect those topics across studies.

Relevant studies were provided by major academic databases, including Scopus, Web of Science, Google Scholar, ScienceDirect, and Emerald Insight. By using search phrases regarding digital technologies within hotels and changing workforce, publications that examined how these systems are integrated into hospitality practices and the effects of these systems on staff were discovered. The first step involved reviewing titles and abstracts to find research on AI in hotel services, its impact on hotel operations, and its implications for staff.

The research that was examined was evaluated based on its relevance to technology-intensive hotel settings with regards to the roles of workforce, skills necessary for the roles, training, well-being of employees, and the organisational structure of the organisation. The articles reviewed were based mainly on peer-reviewed literature and a few conference papers.

Thematic synthesis was used to group key observations related to the transformation of the workforce, interaction between humans and technology, how training to be used in the future, and how employees have reacted to adopting new technologies. We grouped these points based on their similarities to identify the primary research areas. These insights allowed us to create a framework that links the collaboration between humans and technology to how prepared employees are for service systems in the hotel industry.

6 THEMATIC ANALYSIS

The most prominent factors present in the study were automation-driven reconfiguration of service work, creation of new types of humans–AI collaboration, redefining of employee roles, reskilling and creation of new skill development and training programs, and issues related to employee well-being and ethical governance.

6.1 Reconfiguration of Service Work Due to Automation

Academic studies have found that these different types of technologies will create new forms of digital supervision over employees, change who makes decisions about service delivery as well as establish new norms for how services are delivered. Automating industry will also affect the way organizations evaluate their employees' performance, schedule services, and supervise employees. Because of this change in approach, there will be a need to evaluate existing operational processes for frontline managers and existing hospitality workflows.

6.2 Collaborative Agreements - New Models of Human-Ai Cooperation

As work arrangements become more reliant on machines, the collaboration agreement between employees and machines will be increasingly important. Research shows that frontline employees will incorporate human reasoning with machine action through evaluating algorithms, monitoring automated machines, and directly intervening when service discrepancies occur. Usability of digital interfaces, system transparency, and trust in technology create facilitating conditions for this type of collaboration. On the other hand, inadequate system matching creates barriers to cooperation, role ambiguity, and increases the workload on frontline employees; thus, creating the need to intentionally develop collaborative efforts between machine and employee by establishing rules of behaviour and methods for collaborative implementation within the organization.

6.3 Reconfiguring Hotel Jobs and Worker Roles

The dynamic nature of employment in the hotel industry and the identity of hotel employees in a technologically advanced environment is a third major topic. There is literature on the emergence of new management work involving data interpretation and system management, and new jobs that integrate technological knowledge with knowledge of the hospitality industry. Ongoing education and skills development encompass the fourth auxiliary element of preparedness for the workforce. Researchers agree that four key areas are most critical for individuals to perform well at their job in an AI enabled work environment: digital literacy; analytical thinking skills; adaptability; and cross-functional knowledge. Participatory learning; training opportunities; and/or organizational learning infrastructure are all necessary factors for assisting individuals in transitioning into new jobs with the effective use of technology.

6.4 Employee Wellbeing and Ethical Governance

Recent research has focused on the ethical and psychological issues involved in human/machine working relationships and is now addressing employee wellness as a critical component of workforce readiness. The analysis of current research on the hospitality sector, however, has shown that numerous issues exist regarding technostress monitoring, job security and cultural bias in relationships with employment practices, creating a necessity for good ethical governance, democratic decision-making processes and fair performance management systems for the effective use of technology. Researchers indicate the development of a service environment within the design of a hospitality establishment, which meets the aforementioned principles, will promote the establishment of trust between humans and intelligent systems, therefore fostering the creation of a sustainable and long-term partnership.

7 PROPOSED FRAMEWORK AND DISCUSSION

The research shows how closely tied our ability to work with technology is creating a workforce ready for hotel jobs in the hotel industry. The rapid speed of change in the hotel industry due to multiple uses of AI technologies has provided hotels with more options for using technological tools to deliver hotel services. In addition, these technologies do not just augment the hotel business; they reshape how people will find jobs and how they will deliver hospitality to others by interacting with customers and suppliers, and how management will make decisions about operations. Finally, these technologies are connected with the other management functions in the hotel industry and will also impact the work of hotel employees from now into the future. The conceptual framework recommended by this paper is provided in Figure 7.1, which shows how Organizational procedures, Human-technology collaboration, and AI-enabled hotel service systems create an interaction effect on employee readiness at work.

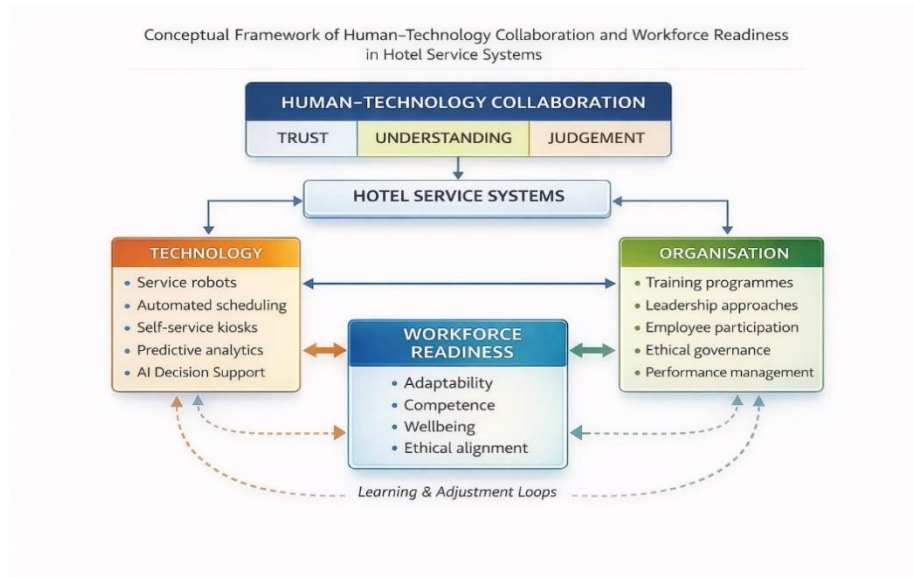


Fig. 1. A Conceptual Framework of Employee Readiness and Human-Technology Collaboration in Hotel Services

The main idea of this framework is that how well people work with technology depends on how much the employee trusts automated systems that can understand what the algorithms are saying and can figure out when and how to use those suggestions. If we set up these collaborations in a way employees will have more time to talk to guests, fix problems when things go wrong and solve issues because they will not have to spend all their time doing routine tasks every day. Conversely, poorly designed systems may create additional pressure to work, cause resistance to the organisation's services and negatively impact employee engagement, the impact on the organisation's culture of

service and performance. The framework consolidates the technological, organisational and human elements of digital adoption, thus advancing the field of hospitality research beyond disparate studies of digital adoption.

Being 'workforce' ready requires several things; being adaptable to changing situations, possessing the necessary skills for the job, having job satisfaction and doing the right thing. When we discuss 'workforce readiness' we are looking at what creates 'readiness' for a given job. In essence, it is about being 'ready to go to work'. It includes being able to adapt to things. The ability to adapt is about how well employees can adjust to jobs that require different skills. These new jobs need people to combine the skills they already have with skills they need to learn. Workforce readiness means you have the skills you need. You also need to be able to think. You need to be able to understand how people feel. All of these things are necessary for workforce readiness. This way workforce readiness can deliver services. A lot of technology is used in this system.

Well-being is about how employees feel. It is about the issues they face. These issues include technostress. They also include job security. They include how engaged employees are in their work. Workforce readiness and well-being are important for employees. Employees need to have workforce readiness and well-being. Ethical alignment refers to trust in the governance of an organisation, as well as the perception of fairness and transparency in algorithmic-based decision-making. When hotels work together with these four things they will be able to keep giving service to people and they will be able to adapt fast to new technology that is changing very quickly. Hotels will keep doing a job and these four things will help them do that. Hotels and these four things will work together. The structure has lots of ideas for leaders and decision makers in hotels, education and government.

This means hotel leaders must make sure their organisation is ready by helping staff learn skills involving them in the process and making sure the human resources systems are working well everywhere in the organisation. People who teach hospitality can do a job of getting students ready for work. They do this by teaching students about Decision Support Data and data analytics. This is important because it shows students how humans and Artificial Intelligence can work together.

The industry and associations and regulators can also use this information. They can use it to develop policies and regulations. These policies and regulations should promote the use of technology in a way. At the time they should protect employees. Decision Support Data and data analytics are important for the hospitality industry. Hospitality teachers should teach students; about how humans and Artificial Intelligence can work using Decision Support Data and data analytics. Finally, there is potential for future empirical research to investigate how combinations of technology, organisational practices and collaborative approaches are affecting workforce outcomes in the changing hotel sector.

8 CONCLUSION

The purpose of this study is to investigate the relationship between people and technology in hotels that leverage intelligence. The study looks at how collaboration helps

employees prepare for a future with technology in the workplace. The study will not focus only on how to implement new technologies, but how hotels are using employees as the centrepiece of all the changes being made with technology. The research findings illustrate the significance of hotels operating successfully. Findings include how employees work together to ensure that employees are clearly performing the duties associated with their roles and responsibilities. The research demonstrates that the elements previously referred to in this research can serve as bridges between the employee and new technologies, including artificial intelligence (AI), to help facilitate the operation of hotels.

The connection of previously disconnected research provides the hotel industry with ways to utilise digital innovation through the analysis of productivity to create a positive influence on the performance of hotel employees. Innovative thinking and support from employees are critical to the hotel. This research does not demonstrate how an aspect of training future employees will be completed merely by purchasing products like AI technology. Hotels must not only invest in artificial intelligence technology, but they must also make other investments beyond simply possessing AI Technology. In order for hotels to develop employees who can satisfy future employment demands, hotels must also train employees in the purposeful development of their skills, involve workers in change processes, provide employees with supportive leaders, and create equitable and transparent working conditions for all employees.

To summarize, the research supports the need for hotels to provide employees with purposeful skill development through employee participation in change processes, supportive leadership, and equitable and transparent working conditions to promote a productive collaboration between employees and AI technology. The framework created by the research will help managers, educators, and policymakers to reassess training and human resource development strategies to ensure they align with the reality of the service industry in a digitally enhanced hospitality environment.

9 LIMITATIONS

There are several limitations that should be considered; even though this research provides an integrated synthesis of research concerning collaboration between humans and technology within hotel service systems, there are still many studies that have been carried out in large metropolitan areas or luxury properties whereby it would be difficult for these findings to be generalizable across smaller hotels, and/or emerging destinations. As such, the literature on hospitality is not equally represented across various hotel categories and geographic areas. The studies reviewed for this analysis are also published using a variety of methodologies, complicating the ability to compare study findings directly. Due to the rapid pace at which technology has advanced over the past few years it is very likely that technology-based organisational procedures, and systems, will outpace academic research documenting these changes.

These limitations provide a number of areas for further exploration. Knowledge about the preparedness of the workforce could be enhanced by empirical research ex-

amining the manner in which hotels use human-technology collaboration method approaches in different organizational and cultural contexts. Longitudinal research that tracks employee skill levels, physical and mental wellbeing, and career paths after implementing technologies can assist in the discovery of dynamic organisational adjustment processes following technological implementation. Further research should validate and enhance the conceptual model discussed in this paper, with an emphasis placed on leadership responsibilities, ethical standards, and training programs.

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