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Date: 27 – 28 December, 2024

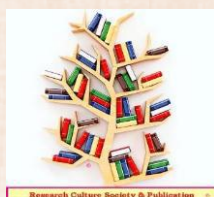
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Conference Proceedings / Special Issue

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About the University:

Shri Vivek Bharti Trust, led by four visionary philanthropists, proudly established Noble Group of Institutions (NGI) in Junagadh, Gujarat, to provide quality education in Engineering, Science, Management, Pharmacy, Education, and Nursing. Since 2007, NGI has been a hub for technological and scientific growth, offering modern labs, a world-class library, spacious classrooms, green playgrounds, a gym, and strong industry connections.

In 2022, NGI became Noble University (NU), expanding across 30 scenic acres near Girnar Hill, fostering innovation and creativity in a serene environment. NU is dedicated to empowering students with ethical, high-quality education to serve society and advance humanity.

With partnerships across academia and industry, NU nurtures skilled, compassionate individuals ready to lead globally. Focused on interdisciplinary learning, NU harmonizes intellect, emotion, and action to shape a brighter, sustainable future for India and the world.

Faculty of Ayurveda

The main aim of Noble University is to impart to the students high-quality technical & scientific knowledge with ethics, so as to serve society and mankind through Ayurveda with full devotion, dedication, and commitment. It is the dream of the management to take this institute to a greater height in order to achieve a "Centre for Excellence" in teaching-learning, research, and innovative activities within and outside the campus.

Faculty of Homeopathy

NU ensures student welfare with comfortable accommodations, nutritious meals, recreational facilities, and a ragging-free environment. We nurture healers by fostering self-awareness, self-expression, and mastery of homeopathic knowledge. As a retreat for personal growth, NU provides diverse tools and methods, empowering students to craft their unique healing journey.

Faculty of Pharmacy

- Work within the digital sectors
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- Think differently do different and get different

Faculty of Engineering

At NU, we prioritize a student-centric education system designed to meet industrial standards through a carefully crafted syllabus. Our campus offers state-of-the-art laboratories, modern infrastructure, and a comprehensive library to support hands-on training and skill development. We nurture entrepreneurial ambitions with start-up and incubation facilities, alongside placement and internship opportunities in multinational organizations. Our highly qualified and dedicated faculty focus on recognizing and cultivating each student's true potential, ensuring their 360-degree development. With strong corporate tie-ups, we bridge the gap between education and industry, while encouraging holistic growth through extracurricular activities.

Faculty of Nursing

Noble Nursing College aims to deliver high-quality theoretical and practical knowledge through a "learning by doing" approach. Our dedicated faculty go beyond teaching, offering

personalized support and expert instruction. Nursing education here emphasizes clinical skills, critical thinking, communication, leadership, and ethical decision-making. We prepare students to excel in diverse healthcare settings, working collaboratively to provide exceptional patient care. With a focus on evolving healthcare technology and policies, our programs ensure students are equipped for the future of nursing.

Faculty of Science

The Faculty of Science is a complete, student-oriented science faculty where research and education are closely related. The faculty aims to be an academic community with an international character, where staff members from different backgrounds can combine their talents with the common goal of being a leading faculty of science in India.

Our study programmes prepare students for positions in scientific research and professional careers related to societal themes such as energy, food, water, health, or innovation, as well as careers in entrepreneurship or teaching.

Faculty of Management and Commerce

NU is a buzzword for its cutting-edge education in the management domain. Every single tenet of management at NU is holistic and erudite in every prism of management. At NU, we encompass every single detail of management education in a nitty-gritty way making our students head and shoulder in the vista.

Faculty of Computer Applications

Our programs focus on industry-relevant subjects, offering specializations in Web Development, Data Science, and Full Stack Development. With innovative assessment methods and an emphasis on practical learning aligned with market trends, students gain hands-on experience in highly equipped labs under the guidance of experienced faculty. We foster holistic development through academic and cultural events, various seminars, workshops, and diverse student development clubs, creating a vibrant and enriching learning environment.

Faculty of Humanities/ Arts/ Education

Our University is proud to have a team of qualified, accredited, and doctorate-degreed staff who provide personalized guidance to students, ensuring each individual receives the attention they deserve. We emphasize experimental work in high-quality schools to offer practical learning experiences, and we integrate advanced technology into education to enhance the learning process. Face-to-face visits to specific nominated school institutions are conducted to provide students with real-world exposure. We also place great importance on co-curricular activities, encouraging students to engage in them alongside their studies. Furthermore, we offer free pre-preparation for the TET and TAT exams to help students succeed in their future careers.

Faculty of Library Science

The Faculty of Library Science is a complete, student-oriented science faculty where research and education are closely related. The faculty aims to be an academic community with an international character, where staff members from different backgrounds can combine their talents with the common goal of being a leading faculty of science in India.

Our study programmes prepare students for positions in scientific research and professional careers related to societal themes such as energy, food, water, health, or innovation, as well as careers in entrepreneurship or teaching.

About the Conference :

ICRIMD-2024 is a good platform for fostering collaboration and innovation by bringing together students, researchers, academicians, and industry professionals from diverse fields. It provides an excellent opportunity to present original research, exchange ideas, and explore advancements across multidisciplinary domains such as engineering, sciences, management, healthcare, humanities, and more. The event not only facilitates the dissemination of knowledge through paper presentations and discussions but also encourages networking and collaboration among participants.

Conference Objectives:

- Facilitate knowledge exchange and the presentation of innovative research across various disciplines such as engineering, sciences, humanities, management, healthcare, and vocational studies.
- Encourage the development and dissemination of multidisciplinary research that addresses global challenges.
- Provide a platform for showcasing talent and fostering discussions that lead to actionable solutions and advancements.
- Offer opportunities for participants to publish their research in peer-reviewed and indexed journals.
- Promote interaction between academia and industry to bridge gaps and drive technological and academic advancements.

About the Proceedings:

The proceedings of ICRIMD-2024 will include a compilation of high-quality research papers presented during the conference, reflecting the innovation and multidisciplinary focus of the event. These proceedings will be published with an ISBN number (978-81-969738-1-0) to ensure authenticity and recognition.

Participants have the opportunity to publish their work in peer-reviewed journals, including Scopus and UGC/UGC-CARE-indexed journals, subject to acceptance and any associated publication fees. The publication options range across various reputed platforms such as STM Journals, the International Journal for Innovative Research in Multidisciplinary Fields, Frontiers in Health Informatics, and the South Eastern European Journal of Public Health.

The proceedings will serve as a valuable resource for academic and industry professionals, offering insights into the latest research trends and innovations across diverse domains.

Tracks / Topics:

- **Track 1 – Engineering**
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- **Track 11 – Nursing**
- **Track 12 – Humanities and**
- **Track 13 – Animal Husbandry**



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Blessings from Dr. H.N. Kher, Chief Patron

It is with great pride that I welcome you all to NOBCON 2024, a testament to the growth and vision of Noble University. Over the years, our university has continually evolved, striving to provide an environment that encourages research, collaboration, and knowledge exchange. NOBCON 2024 stands as a symbol of this progress, as it brings together thought leaders and experts from various fields to share ideas and innovations.

This conference is more than an event—it reflects our commitment to pushing the boundaries of knowledge and fostering partnerships that will shape the future. I offer my blessings to all participants, and I am confident that the conversations and collaborations that unfold here will leave a lasting impact, both within and beyond the academic world.

May this event serve as a stepping stone for even greater achievements, reinforcing Noble University's position as a leader in global academic collaboration and research.

Dr. H.N. Kher

Provost, Noble University



[Established under Gujarat Private Universities (Amendment) Act,2022 (Gujarat Act No.7,2022)]

Message from Dr. Jay Talati, Conference Chair, NOBCON 2024

It is with immense pride and boundless energy that I welcome you to NOBCON 2024! This event represents the dedication, hard work, and passion of our entire team, and we're all excited to share this milestone with you.

From the very first idea to the final execution, every step has been a product of tireless effort and commitment. NOBCON 2024 is not just another academic conference; it's a celebration of knowledge, innovation, and the power of collaboration. This conference stands as a beacon for global minds to unite, explore new ideas, and create partnerships that will transform the future.

I believe this event will set the stage for groundbreaking discoveries and future collaborations. Together, let's make NOBCON 2024 a truly unforgettable experience. Let's ignite new ideas and open doors for greater academic growth and success!

Dr Jay Talati

Registrar, Noble University

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Machine Learning-Based Hand Gesture Recognition for Immersive Gaming

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Abstract: This paper presents a novel approach to real-time hand tracking, enabling unprecedented levels of immersion in gaming experiences by leveraging advanced machine learning algorithms and computer vision techniques. Our system accurately detects and tracks hand movements, facilitating intuitive control over in-game actions, while tackling challenges such as variability in hand shape and size, occlusion, and limited contextual understanding of user gestures. By incorporating feature extraction and fusion techniques, we effectively address these limitations, resulting in more accurate and robust hand tracking capabilities that provide real-time feedback and adapt to changing user behaviours. This contributes to the pursuit of human-computer interaction advancements, showcasing the potential of hand-tracking technology to revolutionize the gaming industry by enhancing player satisfaction, retention rates, and overall gaming experience.

Key Words: Artificial Intelligence, Human-Computer Interaction, Computer Vision, Deep Learning, Convolutional Neural Networks, Natural Language Processing, Robotics, Virtual Reality, Augmented Reality, Interactive Systems.

1. INTRODUCTION:

The advent of hand-tracking technology has revolutionized the way we interact with digital interfaces. With the ability to track hand movements and gestures, developers are now exploring new possibilities for game control. One such game that benefits from this technology is Trackmania, a popular racing game known for its fast-paced action and precise controls. This paper proposes an extension of existing research on hand-tracking technology by integrating Mediapipe, a Google-developed machine learning-based hand-tracking API, with Trackmania. The goal is to create a system that enables players to control the game's car using only their hands, leveraging the high accuracy and speed offered by hand-tracking. By combining the strengths of hand-tracking technology with the precision of Trackmania, this project aims to create a new gaming experience that enhances user engagement and immersion. This paper will present the design and implementation details of the proposed system, discuss its potential applications, and explore future directions for research in this area.

2. OBJECTIVES:

Improve Gaming Experience : By enabling players to control the game with their hands, we aim to create a more immersive and engaging gaming experience. The precise tracking of hand movements will allow for faster and more accurate controls, enhancing the overall gameplay.

Intuitive Interface : Our system aims to provide an approachable and easy-to-use interface that eliminates the need for traditional controllers like keyboards, mice, or joysticks. This will make it easier for users to transition from playing Trackmania with a controller to using hand-tracking technology.



Attract Gamers: By incorporating motion recognition and gesture technology into Trackmania, we hope to fascinate gamers and encourage them to explore this new gaming medium. The potential for more realistic sensing games is vast, and our system aims to capitalize on this opportunity.

Reduce Cost: Traditional gaming setups often require expensive consoles and controllers. Our hand-tracking system aims to bring motion/ recognition sensing games to the masses at an economical cost, making it accessible to a wider audience. This will eliminate the need for users to purchase separate gaming hardware, reducing costs and increasing adoption rates.

Explore Gesture Technology: By developing a system that leverages gesture technology, we aim to expand our understanding of its potential applications in gaming. Our research will help identify the limitations of current systems and provide insights into areas for improvement.

Enhance System Performance: To achieve these objectives, we will conduct thorough testing and evaluation of our hand-tracking system. This will involve identifying areas for optimization and refinement, ensuring that the system delivers high-quality performance and reliability.

3. METHODOLOGY:

Defining hand gesture mapping : We identified and defined specific hand positions that correspond to desired controls, such as acceleration, braking, steering. These mappings were implemented in the code using a custom-defined gesture recognition system.

Implementing smooth gesture control : Unlike traditional binary on/off input systems, our game uses a smooth curve mapping to translate hand gestures into in-game actions. The level of control depends on the degree of hand openness or closure. For example, as little as a small opening of the hand can slow down the car, while a fully extended hand accelerates it at full speed.

Modifying input logic: To accommodate our new input system, we modified how the game interprets the inputs and responds to the custom gestures. This required integrating our gesture recognition system with the existing game code.

Integrating OpenCV for gesture tracking : We used OpenCV to capture video frames from the webcam and track the hand movements. This allowed us to accurately identify and map the hand gestures to in-game controls.

Testing and iteration : We tested the game control system extensively, refining the gesture mappings and adjusting the curve mapping coefficients to achieve optimal performance. The goal was to create a seamless and intuitive experience for players using their hands to control the car.

4. FUNCTIONAL AWARENESS

Our project's functional requirements outline the essential functionalities that must be provided by each module to ensure a seamless and enjoyable gaming experience. The following are the key functional requirements for our application:

Game User Awareness: The system user or player should be aware of the game rules and instructions, enabling them to use the hand-tracking technology effectively.

Hand-Tracking Input : The primary input mechanism is human hands, with the complete palm used to control the game. This allows players to intuitively navigate the game without relying on traditional controllers or keyboards.



Gameplay Character: In this proposed system, the user controls a virtual car from the game using hand gestures, navigating it around obstacles and trying to achieve the fastest lap times. The player's goal is to successfully complete laps and win the game.

5. DRAWBACKS OF THE EXISTING SYSTEMS

The existing system of hand-tracking technology has several limitations and drawbacks that hinder its effectiveness in providing an optimal gaming experience. Some of these limitations include:

Limited Accuracy Due to Insufficient Feature Extraction : Existing hand gesture recognition algorithms often struggle to accurately detect hand gestures, leading to errors and inconsistencies [1]. This is largely due to insufficient feature extraction techniques, which fail to capture the intricate details of human hand movements.

Inadequate Representation of Human Hand Variability : Many existing systems assume a uniform hand shape, which can be problematic for users with varying hand shapes or sizes [2]. This oversimplification neglects the inherent variability in human hands, leading to suboptimal performance and increased error rates.

Failure to Account for Occlusion and Environmental Factors : Existing systems often fail to account for occlusion, where the hand is blocked by other objects in the environment [3]. Additionally, these systems frequently disregard environmental factors such as lighting conditions, texture, and background noise, which can significantly impact hand gesture recognition [5].

Lack of Feedback Mechanisms for User Adaptation : Most existing systems lack timely and accurate feedback mechanisms, making it difficult for users to adjust their gestures and achieve the desired outcome [4]. This lack of feedback hinders user adaptation and results in reduced system usability.

Inability to Handle Real-World Variability and Contextual Factors : Existing systems often fail to handle real-world variability, such as lighting conditions, texture, and other environmental factors that can affect hand gesture recognition [5]. Moreover, these systems neglect contextual factors, which are essential for understanding the intended meaning behind a hand gesture

6. PROPOSED SYSTEM

The proposed system for controlling Trackmania using hand gestures enables players to navigate through challenging courses and achieve wins with ease. The system utilizes advanced hand recognition technology to detect and interpret movements of the entire palm, allowing for precise control of the car.

Upon detection of the threshold value (distance), the system checks if the palm has crossed a certain region threshold. If the threshold is met, the game gets enabled to receive inputs from the player's hand gestures. (Fig 1)The system recognizes specific hand movements, such as opening or closing the palm, to control various aspects of the car's movement, including acceleration, braking, and steering.

The palm-tracking feature allows for more intuitive and immersive control, enabling players to feel like they are directly driving the car. Once the round is completed, the game displays its own score on the screen, separate from the proposed system's interface. The system relies heavily on a webcam or laptop front camera to capture the user's hands in real-time, with the whole game running through the open webcam for an immersive gaming experience.

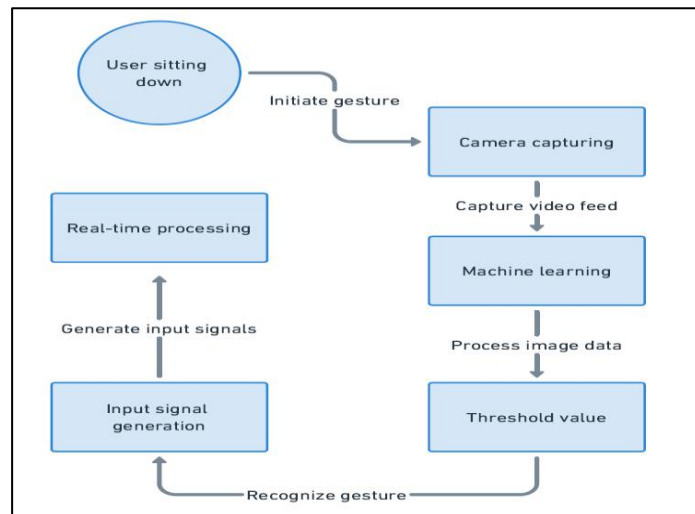


Fig 1- Proposed System

7. SYSTEM DESIGN:

System logic goes as follows:

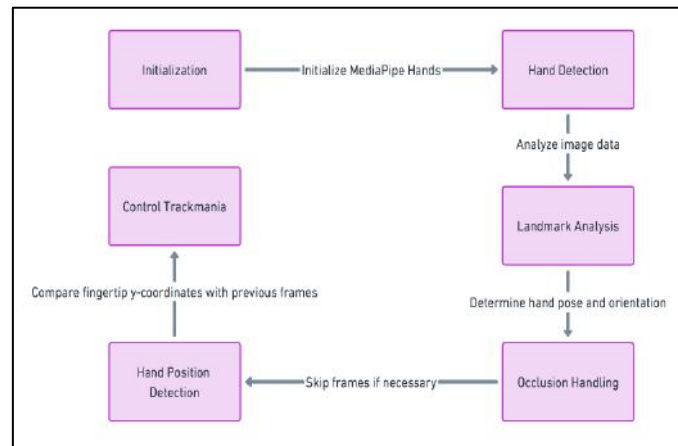


Fig-2 Flow diagram for the proposed system

The above figure (2) is the Flowchart diagram where it shows how the program starts and how the process of execution takes place, which modules comes to execute during the run time and shows how hand recognition takes place.

8. IMPLEMENTATION

The Trackmania game has been implemented using OpenCV and MediaPipe Hands, leveraging real-time computer vision capabilities. The implementation consists of three primary phases: camera interface, hand detection, palm tracking, and gesture control.

Camera Interface: The game utilizes the OpenCV library to create a camera interface, allowing for real-time image processing and video feed capture. This enables the system to receive live camera input, which is then processed using computer vision techniques. The camera interface is set up to capture 640x480 frames at a rate of 30 FPS.

Hand Detection: The MediaPipe Hands module is utilized to detect hands in the live camera feed, specifically targeting hand positions and tracking finger tips. The detection process involves identifying wrist landmarks to determine whether a detected hand is left or right-handed. The detection threshold is set to 0.8, meaning that the system requires at least 80% confidence in hand detection.

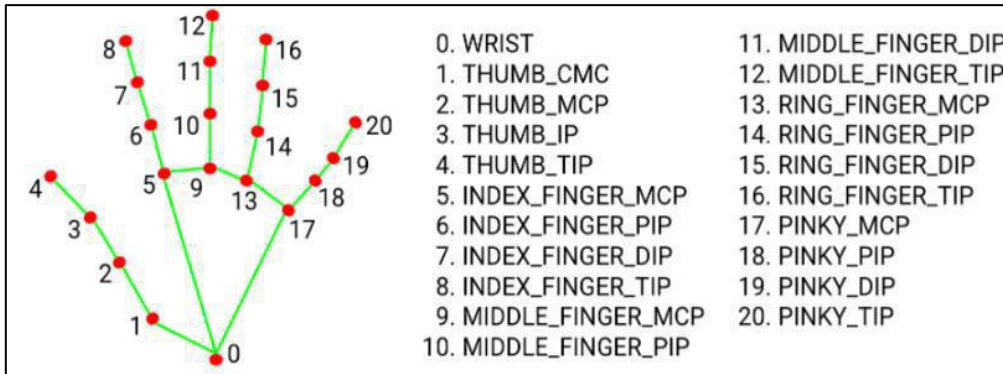


Fig3: Hand Detection Points [6]

Finger Tip Tracking: Once hands are detected, the system tracks the position of finger tips using the MediaPipe Hands module. The fingertip tracking process involves identifying specific landmarks on the hand (e.g., thumb tip, index finger tip) and tracking their movement over time. The tracking threshold is set to 0.5, indicating that the system requires at least 50% confidence in fingertip position.

Gesture Control: The gesture control mechanism maps hand movements to Trackmania keyboard shortcuts (W, A, S, D), enabling users to navigate and interact with the game using precise and intuitive hand gestures that allow for seamless transitions between different gameplay modes and accelerate the user's speed and agility.

The mapping is as follows:

- Both Hands Open : Moves forward (W)
- Both Hands Closed : Moves backward (S)
- Left Fist Closed : Moves left (A)
- Right Fist Closed : Moves right (D)

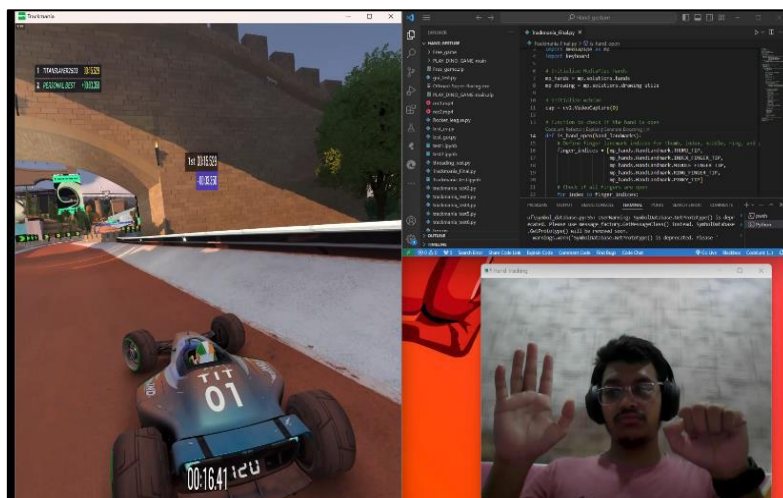


Fig 4: Left fist closed and the car turning left

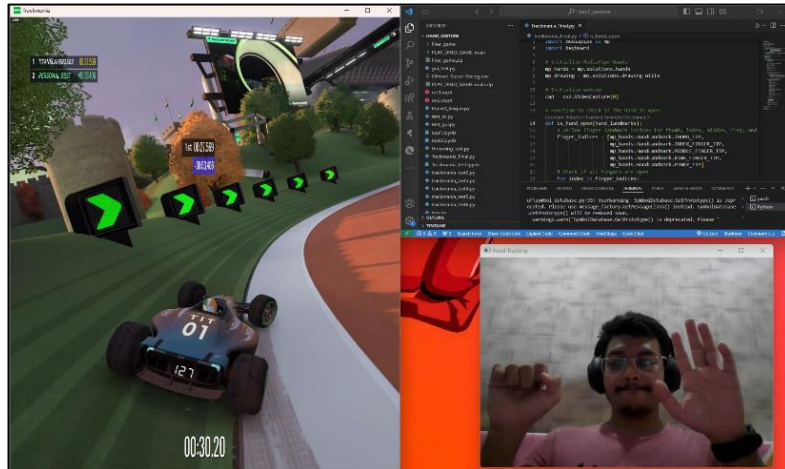


Fig 5- Right Fist closed and the car turning right

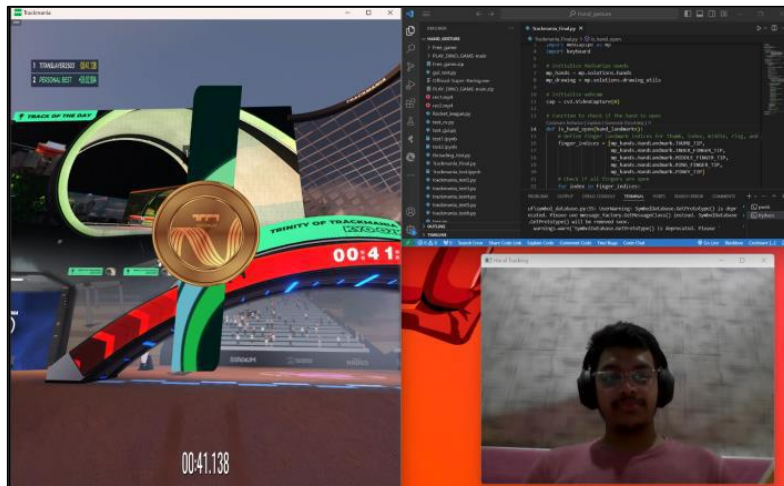


Fig 6- Both hands open, indicating Forward input

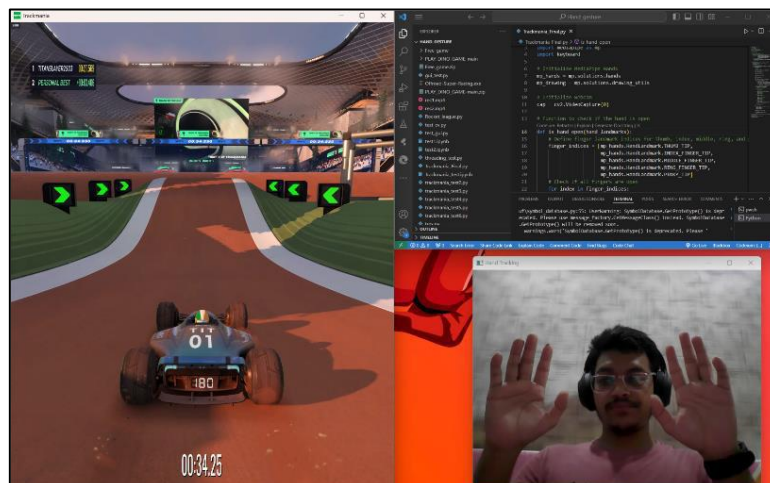


Fig 7- No hands detected, denoting no input

The gesture control mechanism (Fig 4, Fig 5, Fig 6, Fig 7) uses a threshold of 0.2 to determine whether the hand movement exceeds the threshold, indicating a valid gesture.



9. CONCLUSION

Our research paper presents an innovative approach to controlling TrackMania using real-time hand tracking technology, leveraging OpenCV and MediaPipe Hands for accurate two-hand detection. This achievement demonstrates the potential of hand tracking to enhance gaming experiences, particularly in creating inclusive and accessible gameplay environments through automatic right-left hand determination. Notably, our implementation highlights the importance of OpenCV's Multi Video mode (MMV) module and Streaming SIMD Extensions (SSE) instructions in optimizing video frame processing, leading to precise hand point detection. With its far-reaching implications beyond gaming, this technology holds promise for applications in virtual reality, augmented reality, and computer systems, with future enhancements potentially incorporating features like gesture recognition, object manipulation, or interdisciplinary collaborations in healthcare and education.

10. FUTURE SCOPE

The advent of hand tracking technology has opened up new avenues for human-computer interaction, enabling users to control devices with unprecedented precision and accuracy. As we continue to explore the capabilities of this technology, several areas stand out as particularly promising for future research.

A. Telepresence Applications in Healthcare:

One area where hand tracking holds great potential is in telepresence applications for healthcare. By leveraging the technology to enable remote interaction between healthcare professionals and patients, we can reduce the need for physical presence and improve patient outcomes. This application has significant implications for the treatment of chronic diseases, mental health disorders, and other conditions that require frequent medical attention.

B. Enhancing Learning Outcomes via Interactive Systems:

Another area where hand tracking can make a meaningful contribution is in educational settings. By integrating interactive systems that leverage hand tracking technology, we can create more engaging and effective learning experiences. This has the potential to improve student outcomes, increase accessibility, and reduce costs associated with traditional teaching methods.

C. Enabling Autonomous Systems through Precise Control:

Hand tracking technology also holds promise for enabling autonomous systems in various industries, including manufacturing, logistics, and robotics. By providing precise control over complex tasks and environments, we can unlock new possibilities for automation and efficiency. This has significant implications for reducing costs, improving productivity, and enhancing product quality.

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To Study the Microstructural And Mechanical Properties Of Cement Mortar By Using The Waste Industrial Ash.

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Abstract: The use of industrial by products as partial replacements in concrete has significantly increased attention in recent years, particularly in the pursuit of sustainable construction practices. In this research study explores the microstructural and mechanical properties of cement mortar incorporating industrial ash as a supplementary material in proportions ranging from 10% to 35%. The research examines how varying ash content influences microstructural characteristics and mechanical performance, focusing on compressive strength as per Indian standards. Experimental analyses included material characterization (surface area, chemical composition, and particle size), alongside X-ray diffraction (XRD) to understand mineralogical changes. Results indicate that increasing industrial ash reduces compressive strength but reveals optimal performance at specific replacement levels. This approach not only addresses environmental concerns by reducing carbon emissions but also provides a practical solution for industrial waste management.

Key Words: Microstructure properties, Surface area, Particle size analysis, industrial ash, XRD.

1. INTRODUCTION:

Ordinary Portland Cement (OPC), a vital component of concrete, significantly contributes to environmental pollution due to its large-scale production. To mitigate its environmental impact, researchers are investigating alternative materials and methods. The introduction of green concrete—produced using industrial residues offers dual benefits: it curtails waste generation and reduces reliance on virgin raw materials (cement, sand, and aggregates). These practices are instrumental in lowering the embodied carbon emissions of construction materials. This study delves into the potential of industrial byproducts (like GGBS, Palm oil fuel ash, Rice husk ash and fly ash) to enhance concrete properties and minimize environmental footprints.

2. LITERATURE REVIEW:

Bao Liu, Haining Meng et al., in their work titled "Relationship between the fineness and specific surface area of iron tailing powder and its effect on compressive strength and drying shrinkage of cement composites", explored the impact of specific surface area and fineness of iron tailing powder on the properties of drying shrinkage and compressive strength of cement composites [1].

Yingbin Wang, Yang Li et al., in the article "Preparation of waste glass powder by different grinding methods and its utilization in cement-based materials" in Advanced Powder Technology, analyzed the



impact of three distinct grinding methods—dry, wet, and ethyl alcohol conditions—on the fabrication of glass waste powders. They systematically evaluated their impact on cement-based materials performance [2].

Qiaoyi Han, Peng Zhang et al., in "Comprehensive review of the properties of fly ash-based geopolymer with additive of nano-SiO₂" published in Nanotechnology Review, highlighted the high potential of geopolymers as sustainable construction materials. They emphasized that the incorporation of nano-SiO₂ enhances the geo-polymerization process and reduces setting time when used in controlled amount [3].

L. Krishnaraj et.all, work entitled with “Characterization of ultrafine fly ash as sustainable cementitious material for masonry construction”, reported that ultrafine fly ash can be utilized up to 30% in masonry applications without compromising material quality, based on their studies of synthesis, performance, and masonry block characterization [4].

S.K. Nath and Sanjay Kumar, in their research "Role of particle fineness on engineering properties and microstructure of fly ash derived geo-polymer”, discussed how particle size impacts the physical, mechanical, and microstructural behavior of geopolymer composites [5].

Valerie López et.all, work entitled with "Comparative assessment of pervious concrete mixtures containing fly ash and nanomaterials" published in Construction and Building Materials, compared optimized three type fly ash and nanomaterial-enhanced pervious concrete mixtures (PCGP, PCNS, PCNI) against a control mix (PCCT) across multiple parameters, including permeability, water quality, durability, compressive strength, and production cost [6].

3. EXPERIMENTAL PROGRAM:

There were two stages to the planning of the tests. The effects of material characteristics, such as cement, fine and coarse aggregate, industrial ash, etc., were suggested to be investigated in the first stage. In the second stages the impact of the different proportions on the microstructural and mechanical properties of cement mortar by compressive strength and XRD respectively was the aim of the study.

3.1 Materials utilized:

The below listed materials were used in the research work. After testing, the materials were found to meet the applicable Indian Standards.

3.1.1 Cement:

The 53 grade OPC cement used in this research. The primary test on cement was conducted as per IS: 4031. Chemical as well as physical properties of cement are presented in Tables 1 and 2.

Table-1: - Chemical Properties of Cement

Chemical composition	Result (%)
Calcium oxide (CaO)	64
Alumina (Al ₂ O ₃)	5.6
Silica (SiO ₂)	32
Ferric oxide Calcium oxide (Fe ₂ O ₃)	4.2

Sulphuric anhydride (SO ₄)	1.94
Magnesium oxide (MgO)	1.28
Potassium oxide (K ₂ O)	0.51
Loss on ignition	1.4

Table-2 Physical properties of Cement

Sr. No.	Name of test	Result
1	Consistency test	33 %
2	Setting time (Initial & Final)	37 min and 315 min
3	Fineness	4 %
4	Soundness test	2 mm
5	Specific Gravity	3.15
6.	Colour	Grey

3.1.2 Fine Aggregate:

A sand passed through sieve size 4.75 with zone of III as per Indian standard was utilized in this study. The physical properties of fine aggregate were determined based on IS code. The fine aggregate physical properties presented in Table-3.

Table-3: Physical properties of fine aggregate

Sr. No.	Test Name	Result
1	Water Absorption	1.67%
2	Fineness Modulus	2.92 %
3	Specific Gravity	2.63

3.1.3 Coarse Aggregate:

A 20 mm sized coarse aggregate were utilized in this study and the physical characteristics of coarse aggregate was determined as per IS: 2386-63 code. The physical properties of coarse aggregate is presented in Table -4.

Table-4: Physical Properties of Coarse Aggregate

Sr. No.	Test Name	Result
1	Water absorption test	0.68



2	Specific gravity test	2.83
3	Fineness Modulus test	2.53
4	Aggregate impact value test	14.82%
5	Aggregate abrasion value test	18%
6	Aggregate crushing value test	16%

3.1.4 Water: Potable water available in laboratory was utilized for casting and curing.

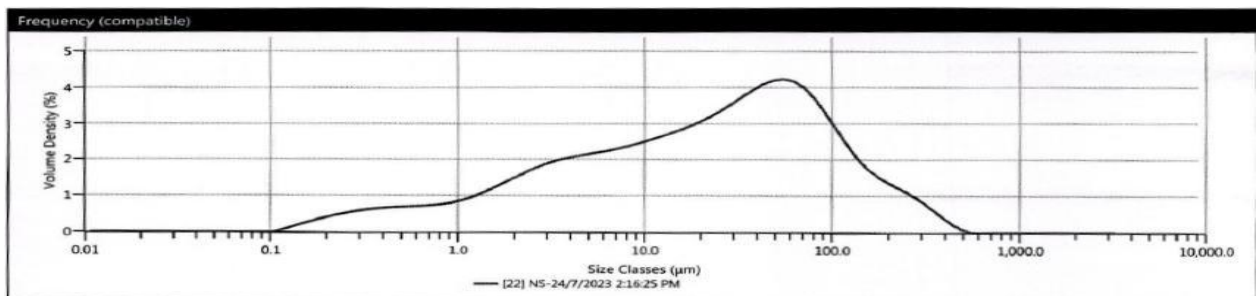
3.1.5: Industrial ash: The raw material of industrial ash obtained from deep metal industry at the location of Rajkot city located at Gujarat. The physical form of material is powder. The Surface Area (m²/g) of industrial ash =14.166 (By BET Method, Instrument: Quanta chrome Nvae 2200) and the particle size is from 1.43 μm to 510 μm (By Particle size analysis). The result of XRF test explain the chemical composition of industrial ash and the obtain result of chemical composition of industrial ash is presented in table 5.

Table-5: Chemical Composition of Industrial Ash

Component	Result	Unit
Al ₂ O ₃	83.2	mass%
MgO	6.78	mass%
SiO ₂	3.33	mass%
TiO ₂	2.13	mass%
CaO	1.78	mass%
Fe ₂ O ₃	1.11	mass%
SO ₃	0.956	mass%
BaO	0.313	mass%
K ₂ O	0.263	mass%

3.1.5.1: Material identification by sophisticated Testing:

3.1.5.1.1: Analysis of Particle size: The analysis of particle size of raw industrial ash was conducted on instrument name master size 3000 by dry method and the histogram of PSD shown in figure 1.



Result											
Size (µm)	% Volume Under	Size (µm)	% Volume Under	Size (µm)	% Volume Under	Size (µm)	% Volume Under	Size (µm)	% Volume Under	Size (µm)	% Volume Under
0.0100	0.00	0.0876	0.00	0.767	6.38	6.72	28.46	58.9	73.53	516	100.00
0.0114	0.00	0.0995	0.00	0.872	7.01	7.64	30.38	66.9	77.02	586	100.00
0.0129	0.00	0.113	0.00	0.991	7.68	8.68	32.35	76.0	80.35	666	100.00
0.0147	0.00	0.128	0.07	1.13	8.41	9.86	34.39	86.4	83.43	756	100.00
0.0167	0.00	0.146	0.22	1.28	9.22	11.2	36.49	98.1	86.19	859	100.00
0.0189	0.00	0.166	0.44	1.45	10.12	12.7	38.67	111	88.57	976	100.00
0.0215	0.00	0.188	0.72	1.65	11.13	14.5	40.94	127	90.59	1110	100.00
0.0244	0.00	0.214	1.06	1.88	12.26	16.4	43.29	144	92.30	1260	100.00
0.0278	0.00	0.243	1.46	2.13	13.51	18.7	45.73	163	93.75	1430	100.00
0.0315	0.00	0.276	1.91	2.42	14.88	21.2	48.28	186	95.02	1630	100.00
0.0358	0.00	0.314	2.39	2.75	16.35	24.1	50.95	211	96.15	1850	100.00
0.0407	0.00	0.357	2.91	3.12	17.92	27.4	53.75	240	97.16	2100	100.00
0.0463	0.00	0.405	3.46	3.55	19.55	31.1	56.70	272	98.05	2390	100.00
0.0526	0.00	0.460	4.02	4.03	21.25	35.3	59.82	310	98.79	2710	100.00
0.0597	0.00	0.523	4.59	4.58	22.99	40.1	63.08	352	99.36	3080	100.00
0.0679	0.00	0.594	5.18	5.21	24.77	45.6	66.49	400	99.73	3500	100.00
0.0771	0.00	0.675	5.77	5.92	26.60	51.8	69.99	454	99.93		

Figure-1: PSD Histogram of particle size analysis

Result from above histogram:

Surface Area =1916 (m²/kg) and Particle size range between 1 µm to 510 µm.

3.1.5.1.2: Surface area analysis with pore size distribution:

3.1.5.1.2.1: Surface area analysis: Surface area was analyzed on instrument Quanta chrome Novae 2200 with below method.

By multiple BET (Brunauer, Emmet, and Teller) analysis:

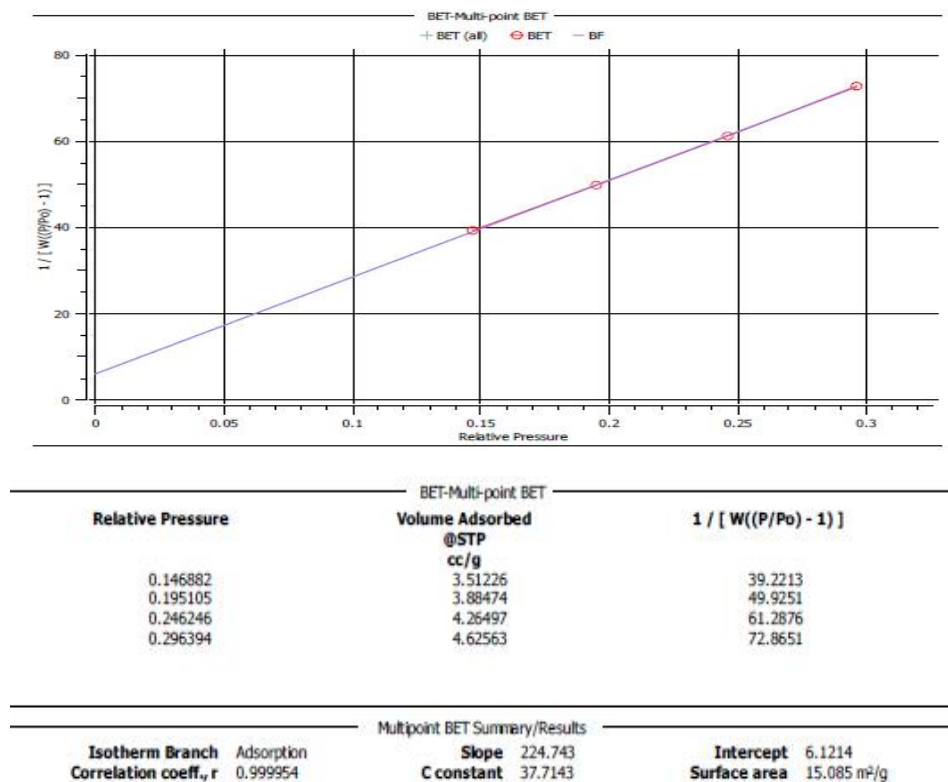


Figure-2 By Multiple BET (Brunauer, Emmet, and Teller) analysis:

Result: Surface area of industrial ash = 15.085 (m²/g) by considering BET multiple analysis.

3.1.5.1.2.2: Pore size distribution:

1. By BJH Method:

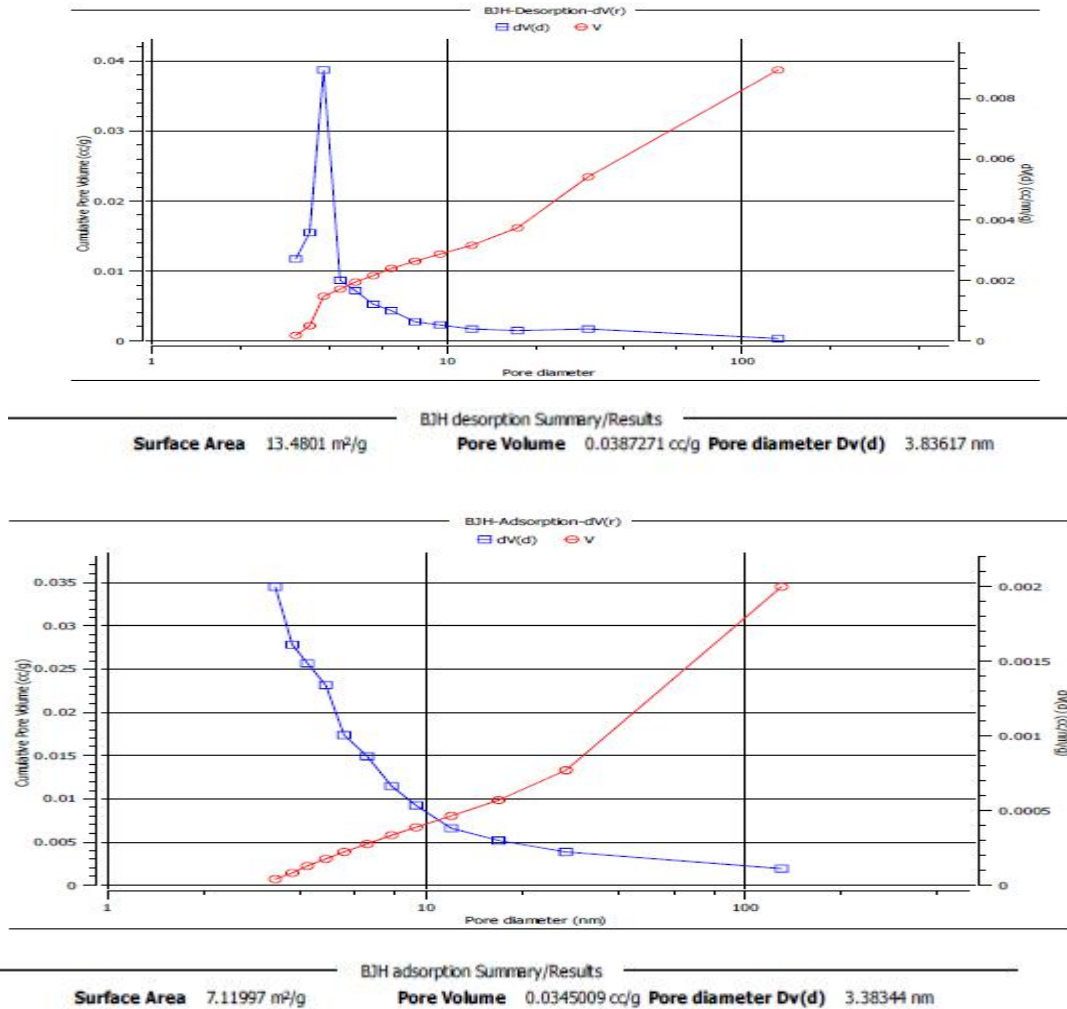
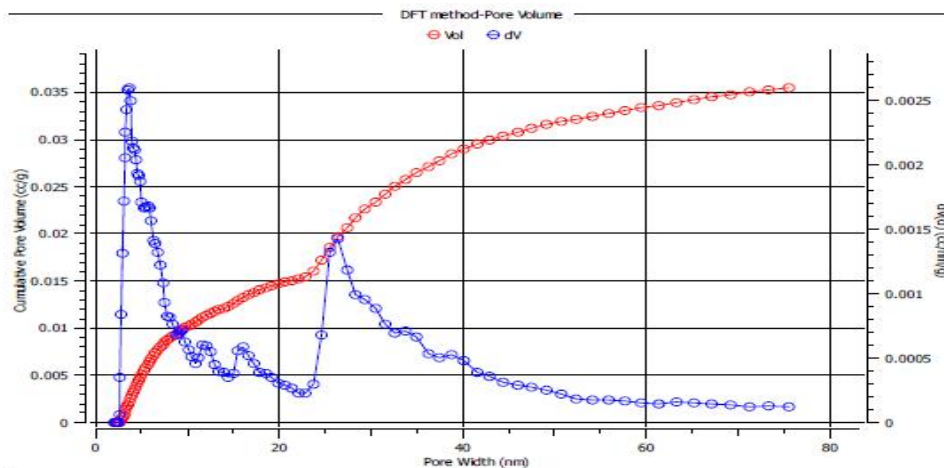


Figure-3: Pore size distribution by BJH Method

2. By DFT Method:



DFT method Summary/Results			
Pore Volume	0.0355 cc/g	Surface Area	11.6579 m ² /g
Mode (Pore Width)	3.6560 nm	Fitting Error	0.5577%
		Lower Confidence Limit	2.0270 nm
		Notes	Adsorption data
Total Pore Volume Summary/Results			
Total Pore Volume	3.9086e-02 cc/g for pores smaller than 224.71 nm (diameter) at relative pressure 0.99138		

Figure-4: Pore size distribution by DFT Method

Result: Pore diameter= 3.38344 nm, Pore volume= 0.0345009 cc/g, Pore classification=mesopores (Pore size between= 1 to 10 nm).

3.1.5.1.3: XRD analysis for Mineralogical study of industrial ash:

XRD test was conducted on raw industrial ash for the understanding of crystal structure and mineralogical study. Figure 5 is displayed the XRD of industrial ash.

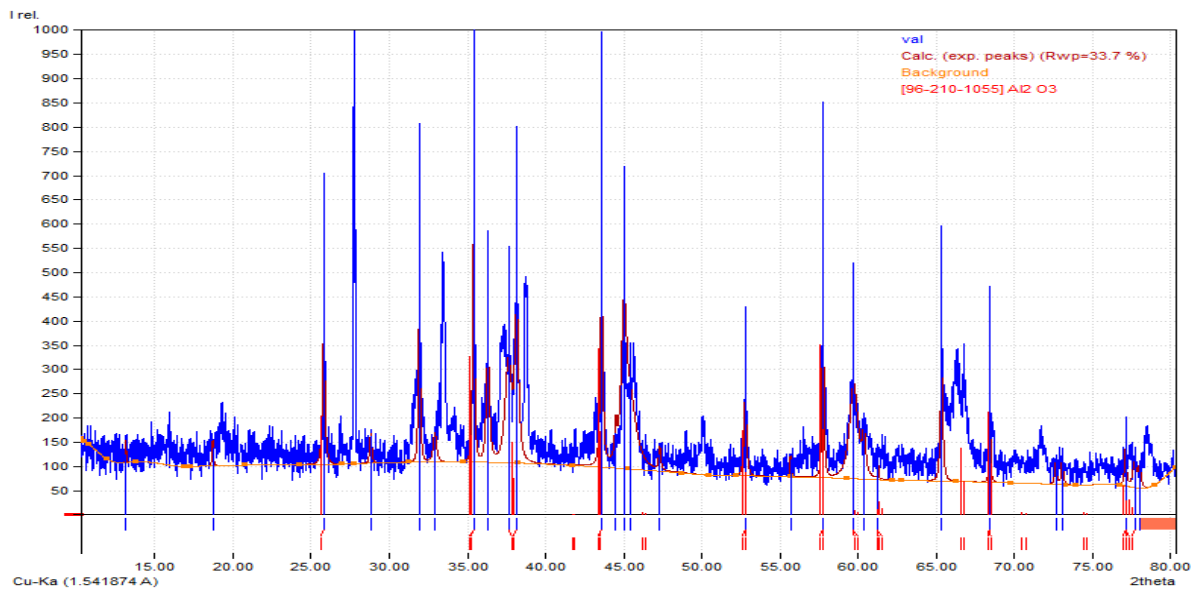


Figure-5-XRD of industrial ash

3.1.6: Test on cement paste and Cement mortar specimens:

The mortar specimen with CM ratio 1: 3 was cast into a 70.6 x 70.6 x 70.6 mm cube and allowed to cure for 28 days before being tested in accordance with IS: 4031 (Part-6) to determine its compressive strength. Different amounts of industrial ash, ranging from 10% to 35%, are used to replace the OPC cement. To investigate the mechanical characteristics of cement mortar, a total of forty-two cubes were cast. For the purpose of studying the Microstructural Analysis of Cement Mortar by XRD, the XRD test was conducted on cement paste that had industrial ash substituted from 10% to 35%.

4. RESULT AND DISCUSSION:

Compressive strengths:

Table 6 displays the compressive strength results of cement mortar substituted with varying amounts of industrial ash. When compared to normal specimens, the results show that the compressive strength decreases as the amount of industrial ash in the mortar increases. It found that the ideal dose of industrial ash for mechanical strength, at which maximal strength is attained, is around 25.04 N/mm² at 10% replacement.



Table-6: Compressive Strength of Cement Mortar

Name of Sample	7 days Compressive Strength in MPa	28 days Compressive Strength in MPa
Normal	36.6	49.42
IA10 %	25.04	33.80
IA15 %	22.42	30.26
IA20 %	20.22	27.29
IA25 %	16.52	22.30
IA 30 %	14.62	19.73
IA 35 %	10.12	13.66

Microstructural Analysis of Cement mortar by XRD:

Figure -6 is the XRD pattern of the cement mortar before and after the industrial ash is added. From the graph it can be observed that it is very difficult to identify the polymorphs of cement and industrial ash because to the coexistence of polymorphs and the overlapping of huge peaks. Also, it observed that the particle size must be very large. Sample may be containing number of other oxides/carbide/impurities etc.

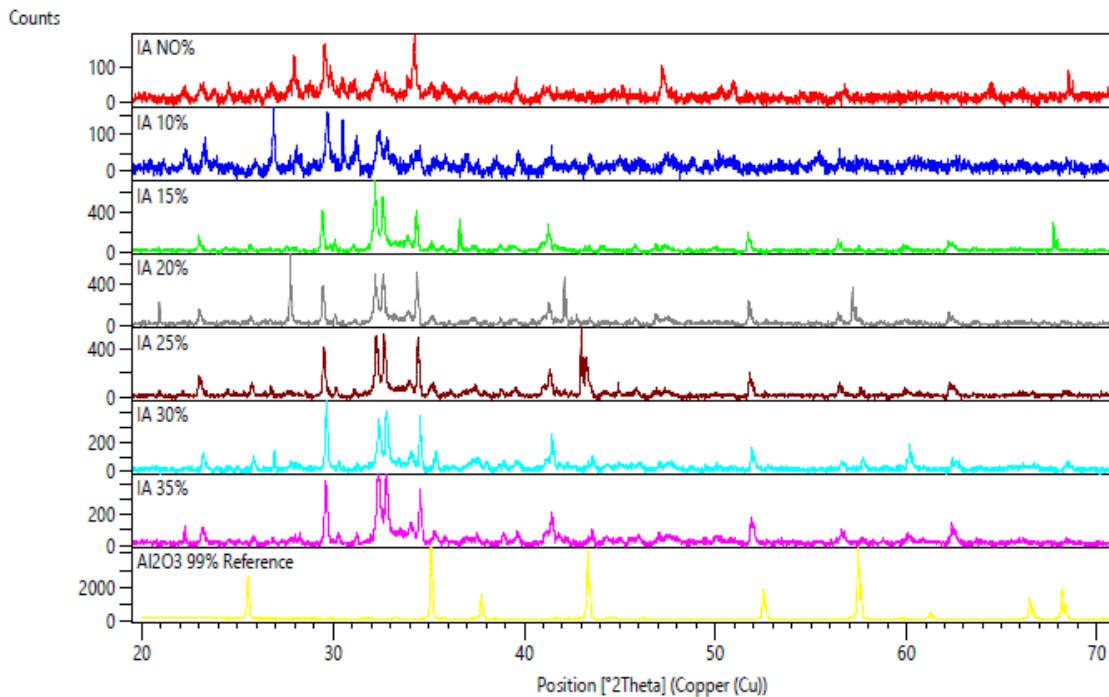


Figure-6: Comparison of all sample of XRD with standard reference.

From figure- Al₂O₃ (aluminum Oxides) exhibits peaks at 52.5 θ, 57.5 θ, 35.1 θ and 25.5 θ at 2θ values from the XRD of normal sample compare with different percentages sample of cement mortar.



Grain size analysis:

XRD test was used to analyze the grain size of the particles. In figure-6 shows the relation between intensity and 2theta graph. The full width at half maximum value was used to calculate average grain size of the particles by using the Scherrer's formula and average grain size of the particles of industrial ash replaced with different percentages in cement and then it compared with the normal sample. The Debye-Scherrer's equation were used for calculating of average crystallite size of the XRD peak was determined by using the full width at half maximum value [8].

$$d = \frac{K\lambda}{B\cos(\theta)}$$

Where, d= average crystallite domain size, K= Crystallite shape constant (0.89 taken for this study), λ =Wavelength (typically, WL = 0.15406 nm), θ = Diffraction angle, B= full width at half width (FWHM) of the diffraction peak.

Based on analysis of Result the particle size of 0%, 10%,15%,20%,30% and 35% replacement of industrial ash in the cement was obtained is 492.94 nm,502.81 nm, 497.80 nm, 533.45 nm, 420.71 nm, 467.020 nm, and 443.88 nm respectively.

5. CONCLUSION:

In order to make cement mortar for the investigation of cement mortar's mechanical and microstructural properties, waste industrial ash was substituted with cement in this work.

The study leads to the following conclusion:

- The normal sample strength is higher after 28 days, whereas the IA35% sample has the lowest strength. The reference mix is the normal sample, which contains no industrial ash, and mix 7 contains up to 35% industrial ash. Therefore, adding industrial ash weakens the material from its earliest days and later strength. This is because due to adding industrial ash which contain less silica content and high alumina content in raw material which react with cement chemical composition and consequently, affect in strength.
- When compared to the normal specimens at 28 days, it was discovered that increasing the dosage of industrial ash reduced the cement mortar's compressive strength.
- The peak value of diffraction is obtained at the intensity of 182.91 at the angle of 34.246° for the 0 % sample, 542.40 at the angle of 32.581 °for the 15 % sample, 560.485 at the angle of 42.985 °for the 25% sample.
- The peak value of diffraction is obtained at the intensity between the angle 26.880 ° to 42.985 °.
- The maximum particle size 502.81 nm was observed from 10 % XRD.

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Artificial Intelligence for Green IT Solutions and Management

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Abstract: *This study examines the effects of integrating Artificial Intelligence (AI) into sustainable development programmes, focusing on its influence on business, society, environmental sustainability, and social inclusion. The document offers pragmatic suggestions for policymakers and outlines areas for future investigation to optimize the utilization of artificial intelligence in attaining sustainable development objectives. An exhaustive assessment of academic articles, studies, and guidelines was undertaken to examine the diverse function of AI in promoting sustainable development. The study thoroughly examined and analyzed key themes like economic consequences, environmental sustainability, social inclusion, policy frameworks, and research goals to gain a comprehensive picture. AI technologies greatly improve operational efficiency, resource management, and innovation in several industries, while promoting economic resilience and inclusive growth. AI-driven solutions contribute to environmental sustainability by utilizing predictive analytics, integrating renewable energy, and actively working towards climate change mitigation. AI enhances public health outcomes, increases accessibility to education and healthcare, and facilitates digital empowerment, so promoting greater societal inclusion. Responsible AI deployment and risk mitigation need careful attention to ethical considerations and adherence to legal frameworks. The challenges encompass algorithmic prejudice, data privacy problems, and discrepancies in the adoption of AI in various socioeconomic circumstances. Continual research and ethical deliberations are crucial as AI technologies progress, necessitating additional investigations to tackle growing patterns and geographical disparities in AI deployment. The practical complications underscore the need for policy makers to establish strong ethical principles and regulatory frameworks to properly manage AI uses. Investments in research and development projects that prioritize AI for Sustainable Development Goals (SDGs), explainable AI, and AI-human collaboration are of utmost importance. In order to effectively advance global sustainability objectives, stakeholders must prioritize interdisciplinary collaboration and knowledge exchange to expedite breakthroughs driven by artificial intelligence.*

Key Words: *Artificial Intelligence, Sustainable Development, Economic Impacts, Environmental Sustainability, Social Inclusion*

1. INTRODUCTION:

1.1 Overview of AI and Sustainability

The incorporation of AI into many industries has significantly transformed company operations by providing cutting-edge solutions that improve efficiency, lower expenses, and enhance decision-making procedures. AI technologies, including machine learning, natural language processing, and predictive analytics, are being used in various industries such as healthcare, banking, transportation, and manufacturing. Amidst global issues such as climate change and resource depletion, there is growing recognition of the great potential of AI to support sustainable development.



Sustainable development, as defined by the United Nations, refers to the pursuit of development that fulfils the current requirements while ensuring that future generations may also satisfy their own needs. This objective has become of utmost importance for global economies. Incorporating sustainability concepts into company activities guarantees the simultaneous achievement of economic growth, environmental stewardship, and social well-being. Within this framework, the function of artificial intelligence in advancing sustainable development is both opportune and revolutionary.

1.2 OBJECTIVES:

This study seeks to examine the convergence of AI and sustainable development, with a particular emphasis on the utilization of AI to build environmentally friendly information technology (IT) solutions and improve sustainable management strategies. This study has three main objectives:

- To explore the utilization of AI technologies to enhance energy efficiency and resource allocation in IT infrastructure.
- To analyze how decision support systems driven by AI can assist in promoting sustainable business practices and optimizing supply chain operations.
- To analyze the barriers and possibilities related to the implementation of AI for sustainable development. Furthermore, this study aims to provide possible solutions and outline future research areas.

1.3 SCOPE:

This study focuses on the following major areas:

- AI Technologies: A comprehensive examination of the AI technologies that are pertinent to sustainability, encompassing machine learning, natural language processing, and predictive analytics.
- Green IT Solutions: A study on the utilization of artificial intelligence (AI) to enhance energy efficiency and resource management in IT infrastructure.
- Sustainable Management Practices: Exploring the impact of AI on improving sustainable business practices and supply chain management.
- Challenges and Opportunities: An examination of the obstacles hindering the acceptance of AI-powered sustainable solutions and the possible prospects for creativity and advancement.

This paper aims to offer a thorough comprehension of how artificial intelligence (AI) can serve as a potent instrument in the pursuit of sustainable development. It will include practical insights and real-world examples of successful AI applications. This study seeks to enhance the existing knowledge on the intersection of AI and sustainability by examining current trends, difficulties, and future directions. Its goal is to stimulate additional research and innovation in this crucial field.

1.4 STRUCTURE OF THE PAPER:

The paper's structure is arranged as follows: Section-2 presents an examination of the current body of literature on AI and sustainable development. It includes an analysis of historical viewpoints, theoretical frameworks, and ongoing patterns. Section-3 examines the utilization of AI technology to enhance energy efficiency and resource allocation in IT infrastructure. Section-4 explores the role of AI-driven decision support systems and supply chain optimization in promoting sustainable business practices. Section-5 examines the difficulties linked to the implementation of AI for sustainable development and discusses potential prospects for innovation. Section-6 explores the effects that AI-driven sustainable solutions have on business and society, specifically in terms of their economic, environmental, and social consequences. Section-7 provides an overview of the upcoming AI technologies, the consequences for policies, and the domains that require further research and advancement.

Section-8 presents a concise overview of significant discoveries, pragmatic suggestions, and concluding reflections regarding the future of AI-powered sustainable development.



2. LITERATURE SURVEY:

2.1 Historical Perspective:

The convergence of AI and sustainable development represents a significant evolution in both fields. Historically, AI has been associated with enhancing computational capabilities, automating complex tasks, and enabling advanced data analysis. The roots of AI date back to the mid-20th century, with seminal contributions from pioneers such as Alan Turing and John McCarthy. Turing's groundbreaking work, "Computing Machinery and Intelligence" (Turing, A. M., 1950), laid the foundation for the development of AI by proposing the concept of machine intelligence.

(John McCarthy, 1955), often referred to as the father of AI, further advanced the field with the Dartmouth Summer Research Project on Artificial Intelligence, which is considered the birth of AI as an academic discipline. Over the decades, AI has progressed through various stages, including symbolic AI, machine learning, and deep learning, each bringing new capabilities and applications.

In parallel, the concept of sustainable development emerged prominently in the late 20th century, driven by growing awareness of environmental degradation and resource depletion. The Brundtland Report, published by (United Nations, 1987), articulated the need for development that balances economic, social, and environmental considerations. This report laid the groundwork for integrating sustainability into global agendas, culminating in the adoption of the United Nations Sustainable Development Goals through General Assembly Resolution (United Nations, 2015).

2.2 Theoretical Framework:

The integration of AI and sustainable development can be understood through several theoretical frameworks. The socio-technical systems theory (Bostrom et. al., 1977) posits that technology and society co-evolve, influencing and shaping each other. This perspective underscores the potential of AI to drive sustainable development by optimizing resource use, reducing environmental impact, and enhancing social well-being.

Another relevant framework is the theory of technological innovation systems (TIS) (Hekkert et. al., 2007), which focuses on the development, diffusion, and utilization of new technologies within a societal context. TIS highlights the importance of innovation networks, institutional support, and policy interventions in fostering sustainable technological advancements.

The diffusion of innovations theory, proposed by (Everett Rogers et. al., 2003), further elucidates how new technologies spread within societies, emphasizing the roles of adopters, communication channels, and social systems.

2.3 Current Trends:

The intersection of AI and sustainable development has gained considerable attention in recent years, driven by advancements in AI technologies and an increasing emphasis on sustainability. Key trends in this area include:

- **AI for Energy Efficiency:** AI is being leveraged to optimize energy consumption in data centers, smart grids, and industrial processes. Google, for instance, uses DeepMind's machine learning algorithms (Richard Evans et.al., 2016) to analyze energy usage patterns and make real-time adjustments, achieving a 40% reduction in cooling energy usage in its data centers.
- **Resource Management:** AI-driven solutions are employed for efficient resource allocation, waste management, and circular economy initiatives. Predictive analytics and optimization algorithms help organizations minimize resource use, recycle materials, and reduce environmental impact.
- **Sustainable Supply Chains:** AI enhances supply chain sustainability by improving transparency, traceability, and efficiency. AI-powered systems monitor and optimize supply chain



operations, ensuring ethical sourcing, minimizing carbon footprints, and reducing logistical inefficiencies.

- Smart Cities and Transportation: AI contributes to the development of smart cities by enabling intelligent transportation systems, optimizing traffic flow, and enhancing public services. These applications reduce urban congestion, lower emissions, and improve the quality of life for residents.

2.4 Case Studies:

Several case studies exemplify the successful integration of AI and sustainable development:

- Google's Data Centers: Google uses AI to optimize energy consumption in its data centers, achieving a 40% reduction in cooling energy usage. DeepMind's machine learning algorithms (Richard Evans et.al., 2016) analyze operational data and make real-time adjustments to improve energy efficiency.
- IBM's Green Horizon Project: IBM's AI-powered Green Horizon project (IBM, 2015) aims to address environmental challenges in China. The project uses AI to forecast air pollution levels, optimize renewable energy integration, and enhance environmental monitoring.
- Maersk's AI-Driven Logistics: (Maersk, 2024), a global leader in shipping, employs AI to optimize logistics and supply chain operations. AI algorithms analyze shipping routes, predict maintenance needs, and enhance operational efficiency, reducing fuel consumption and emissions.

2.5 Gaps in Literature:

While the potential of AI in driving sustainable development is widely acknowledged, several gaps remain in the literature:

- Scalability and Generalization: Many AI-driven sustainable solutions are limited to specific case studies or pilot projects. Research is needed to explore the scalability and generalization of these solutions across diverse contexts and industries.
- Ethical and Social Implications: The ethical and social implications of AI-driven sustainability initiatives require further examination. Issues such as data privacy, algorithmic bias, and the impact on employment need to be addressed to ensure equitable and responsible AI deployment.
- Policy and Regulation: The role of policy and regulation in promoting AI-driven sustainable development is underexplored. Research should investigate how policies can incentivize innovation, ensure accountability, and foster collaboration between stakeholders.

2.6 Summary:

The literature survey reveals a growing body of research at the intersection of AI and sustainable development, highlighting significant advancements and promising applications. Historical perspectives and theoretical frameworks provide a foundation for understanding the potential of AI to drive sustainability. Current trends and case studies demonstrate the practical impact of AI-driven solutions in optimizing energy efficiency, resource management, and sustainable supply chains. However, addressing gaps in scalability, ethical considerations, and policy frameworks is crucial for realizing the full potential of AI in achieving sustainable development goals.

3. AI IN GREEN IT SOLUTIONS:

In recent years, the integration of artificial intelligence (AI) into green IT solutions has emerged as a pivotal strategy for enhancing environmental sustainability within IT infrastructure. AI technologies such as machine learning, predictive analytics, and optimization algorithms offer unprecedented opportunities to optimize energy efficiency, reduce carbon footprints, and enhance resource management (Google, 2016; Predictive Analytics Today, n.d.; Ellen MacArthur Foundation, 2013).



3.1 AI Technologies for Energy Efficiency:

AI plays a critical role in optimizing energy consumption and minimizing environmental impact in data centers and IT operations. For instance, Google utilizes DeepMind's AI algorithms to predict and manage cooling demands, resulting in a notable 40% reduction in energy usage for cooling operations (Google, 2016). By analyzing operational data in real-time, AI systems dynamically adjust server utilization and workload distribution to maintain optimal performance while minimizing energy consumption.

3.2 Resource Management and Waste Reduction:

Beyond energy efficiency, AI contributes significantly to sustainable IT practices by optimizing resource management and reducing waste. Predictive analytics models forecast resource demand and consumption patterns, enabling proactive resource allocation and material waste minimization strategies (Predictive Analytics Today, n.d.).

Moreover, AI-driven systems facilitate the adoption of circular economy principles within IT, promoting recycling, refurbishment, and the reuse of IT assets to reduce environmental impact (Ellen MacArthur Foundation, 2013).

3.3 Case Studies:

Several organizations exemplify the successful integration of AI into green IT solutions:

- Google's DeepMind Project: Google's AI-driven approach to energy optimization in data centers has demonstrated substantial reductions in energy consumption through predictive analytics and real-time adjustments (Google, 2016).
- Microsoft's AI for Earth Initiative: Microsoft employs AI technologies to support environmental sustainability efforts, including biodiversity monitoring, water resource management, and climate change mitigation (Microsoft, n.d.).
- Siemens' AI in Manufacturing: Siemens utilizes AI to enhance energy management and operational efficiency in manufacturing processes, showcasing AI's potential in reducing emissions and improving sustainability outcomes (Siemens, 2020).

3.4 Challenges and Future Directions:

Despite the promising benefits of AI in green IT solutions, several challenges remain:

- Data Privacy and Security: AI systems require extensive data inputs, raising concerns about data privacy, security, and ethical use (ENISA, 2021). Robust data governance frameworks and compliance with regulatory standards are essential to mitigate risks associated with AI-driven solutions.
- Scalability and Adaptability: Scaling AI applications across diverse IT environments and industries poses technical and operational challenges. Research efforts should focus on developing scalable AI algorithms and enhancing interoperability to facilitate broader adoption (Predictive Analytics Today, n.d.).
- Investment and Collaboration: Successful implementation of AI in green IT solutions necessitates significant investments in technology infrastructure and workforce training (Ellen MacArthur Foundation, 2013). Collaboration between stakeholders, including government bodies, industry leaders, and research institutions, is crucial to accelerate innovation and adoption.

3.5 Conclusion:

In conclusion, AI represents a transformative tool for advancing environmental sustainability within IT infrastructure. By leveraging AI technologies for energy efficiency, resource management, and waste reduction, organizations can achieve substantial reductions in environmental footprint while enhancing operational efficiency and cost-effectiveness (Google, 2016; Microsoft, n.d.; Siemens, 2020). Addressing challenges related to data privacy, scalability, and investment requires collaborative efforts



and strategic investments in AI research and development. Continued innovation and adoption of AI-driven green IT solutions are essential for fostering a sustainable future.

4. AI IN SUSTAINABLE MANAGEMENT PRACTICES

AI is reshaping sustainable management practices across industries by enhancing efficiency, optimizing resource use, and promoting environmental stewardship (United Nations, 2015). This chapter explores the transformative role of AI in sustainable management, focusing on applications, benefits, challenges, and future directions.

4.1. AI Applications in Sustainable Management:

AI technologies, including machine learning, natural language processing, and predictive analytics, are pivotal in several key areas:

- **Environmental Monitoring and Analysis:** AI enables real-time monitoring of environmental parameters, facilitating data-driven decision-making in conservation efforts (United Nations, 2015).
- **Supply Chain Optimization:** AI optimizes supply chain operations by improving transparency, traceability, and efficiency, thereby reducing environmental footprints and promoting sustainable practices (Berman & Thelen, 2004).
- **Energy Management:** AI-driven systems enhance energy efficiency by analyzing consumption patterns and optimizing energy use in buildings and industrial processes (Google, 2016).

4.2. Benefits of AI in Sustainable Management:

The integration of AI offers significant benefits:

- **Cost Efficiency:** AI-driven optimizations reduce operational costs associated with energy consumption and resource management (McKinsey & Company, 2019).
- **Enhanced Decision-Making:** AI provides actionable insights from complex data sets, improving decision-making and operational efficiency in sustainability strategies.
- **Environmental Impact Reduction:** AI technologies minimize environmental impact through efficient resource use and emissions reductions.

4.3. Challenges and Considerations:

AI implementation in sustainable management faces challenges:

- **Data Quality and Accessibility:** Ensuring high-quality data and accessibility is crucial for AI performance and effectiveness (European Commission, 2019).
- **Ethical and Social Implications:** Addressing concerns such as algorithmic bias and privacy safeguards is essential for ethical AI deployment (European Commission, 2019).
- **Regulatory and Legal Frameworks:** Compliance with data protection and environmental regulations is critical for responsible AI deployment.

4.4. Future Directions:

Future advancements and opportunities include:

- **Technological Innovations:** Advancements in AI technologies, including deep learning and autonomous systems, will expand capabilities in sustainability applications.
- **Collaboration and Innovation:** Cross-sector collaboration will drive innovation and accelerate AI adoption in sustainable management practices (World Economic Forum, 2020).
- **Education and Skills Development:** Investing in AI education and workforce training is essential to harness the full potential of AI in sustainable management.



4.5. Conclusion:

AI is a transformative tool in advancing sustainable management practices, offering opportunities to optimize efficiency, reduce environmental impact, and foster innovation. Addressing challenges and leveraging future opportunities will drive the integration of AI into sustainable development strategies.

5. CHALLENGES AND OPPORTUNITIES: ADOPTION OF AI FOR SUSTAINABLE DEVELOPMENT:

The adoption of AI presents both challenges and opportunities for advancing sustainable development goals. This chapter analyzes the multifaceted challenges associated with AI implementation in sustainable development and explores potential opportunities for innovation and transformative impact.

5.1. Challenges in AI Adoption for Sustainable Development:

Data Quality and Accessibility: Effective AI applications rely on high-quality data that is often lacking or inaccessible in many regions and sectors. Ensuring data accuracy, reliability, and interoperability across diverse sources is crucial for AI-driven solutions to deliver reliable insights and outcomes (World Economic Forum, 2018).

Ethical and Social Implications: AI raises ethical concerns related to privacy, transparency, and fairness. Issues such as algorithmic bias, discriminatory outcomes, and unintended social impacts require robust ethical frameworks and regulatory guidelines to mitigate risks and ensure responsible AI deployment (European Commission, 2019).

Technical Complexity and Integration: The technical complexity of AI systems, including algorithm development, model training, and integration with existing infrastructure, poses significant challenges. Organizations must overcome technical barriers to effectively deploy AI solutions in diverse operational environments (McKinsey & Company, 2019).

Regulatory and Legal Challenges: Navigating regulatory frameworks and compliance requirements is critical for AI adoption in sustainable development. Regulations related to data protection, environmental standards, and AI governance vary globally, posing challenges for multinational implementation and scaling of AI initiatives (International Telecommunication Union, 2020).

5.2. Opportunities for Innovation:

- **Enhanced Decision-Making and Resource Optimization:** AI empowers decision-makers with real-time insights and predictive analytics, facilitating optimized resource allocation, energy efficiency improvements, and proactive environmental management (United Nations, 2019).
- **Sustainable Supply Chain Management:** AI-driven supply chain optimization enhances transparency, traceability, and efficiency, promoting sustainable sourcing practices, reducing waste, and lowering carbon footprints across global supply chains.
- **Environmental Monitoring and Conservation:** AI enables continuous monitoring of environmental parameters and ecosystems, supporting conservation efforts, biodiversity preservation, and climate change adaptation through data-driven strategies (United Nations, 2019).
- **Public Health and Well-being:** AI applications in healthcare, disease prevention, and disaster response contribute to public health resilience and community well-being, leveraging data analytics for early detection, intervention, and mitigation of health risks (World Health Organization, 2024).



5.3. Strategic Recommendations:

Invest in Data Infrastructure and Capacity Building: Prioritize investments in data infrastructure, digital literacy, and capacity building to improve data quality, accessibility, and analytical capabilities across sectors and regions (World Economic Forum, 2018).

Foster Collaboration and Knowledge Sharing: Promote cross-sector collaboration, public-private partnerships, and international cooperation to harness collective expertise, resources, and best practices in AI innovation for sustainable development (International Telecommunication Union, 2020).

Develop Ethical Guidelines and Governance Frameworks: Establish clear ethical guidelines, regulatory frameworks, and governance structures to ensure responsible AI development, deployment, and monitoring in alignment with sustainable development principles (European Commission, 2019).

5.4. Conclusion

The challenges and opportunities presented by AI in sustainable development underscore the need for proactive strategies, collaborative efforts, and ethical considerations to realize its transformative potential. By addressing challenges and leveraging opportunities for innovation, stakeholders can foster inclusive growth, environmental resilience, and sustainable development outcomes in a rapidly evolving digital era.

6. IMPACT ON BUSINESS AND SOCIETY: AI-DRIVEN SUSTAINABLE SOLUTIONS:

AI is revolutionizing business and society by driving sustainable solutions that address economic, environmental, and social challenges. This chapter explores the transformative impact of AI-driven sustainable solutions, examining how businesses and societies benefit from integrating AI technologies to achieve sustainability goals.

6.1. Economic Impacts:

Enhanced Efficiency and Cost Reductions: AI enables businesses to optimize operations, improve productivity, and reduce costs through automation and predictive analytics (McKinsey & Company, 2019). Sustainable practices driven by AI lead to efficient resource use, streamlined supply chains, and enhanced competitiveness in global markets.

Innovation and Market Opportunities: AI fosters innovation by enabling businesses to develop new products and services that meet sustainability standards and consumer preferences. It creates new market opportunities in renewable energy, circular economy models, and green technologies, driving economic growth and job creation.

6.2. Environmental Impacts:

Resource Management and Conservation: AI optimizes resource management by analyzing data to minimize waste, enhance energy efficiency, and promote sustainable practices across industries (United Nations Environment Programme, 2020). It supports environmental conservation efforts through predictive modeling, real-time monitoring, and eco-friendly solutions.

Climate Change Mitigation: AI contributes to climate change mitigation by facilitating carbon footprint reduction, renewable energy integration, and climate risk assessment (Intergovernmental Panel on Climate Change, 2021). Smart grids, energy-efficient buildings, and sustainable agriculture practices leverage AI to combat environmental challenges and promote resilience.

6.3. Social Impacts:

Inclusive Growth and Employment: AI-driven sustainable solutions promote inclusive growth by creating opportunities for diverse industries and communities. It enhances workforce skills through



digital training programs, supports small businesses in adopting green technologies, and improves livelihoods in underserved regions.

Public Health and Well-being: AI applications in healthcare, disaster response, and public safety improve health outcomes and enhance community resilience (World Health Organization, 2021). It enables early disease detection, personalized medicine, and efficient emergency management, contributing to public health advancements and societal well-being.

6.4. Challenges and Considerations:

Ethical and Regulatory Issues: AI adoption raises ethical concerns related to data privacy, algorithmic bias, and societal impact. Addressing these challenges requires transparent AI governance, ethical guidelines, and regulatory frameworks to ensure responsible deployment and mitigate risks (European Commission, 2019).

Digital Divide and Accessibility: Ensuring equitable access to AI technologies and digital infrastructure is essential to prevent widening socioeconomic disparities. Bridging the digital divide through inclusive policies, education initiatives, and community engagement promotes equal opportunities and societal cohesion (International Telecommunication Union, 2021).

6.5. Conclusion:

The integration of AI-driven sustainable solutions offers transformative benefits for businesses and societies, fostering economic prosperity, environmental stewardship, and societal well-being. Addressing challenges through ethical practices, regulatory frameworks, and inclusive strategies is crucial to harnessing AI's full potential for sustainable development in a rapidly evolving global landscape.

7. FUTURE DIRECTIONS: EMERGING AI TECHNOLOGIES, POLICY IMPLICATIONS, AND AREAS FOR RESEARCH AND DEVELOPMENT:

Artificial Intelligence (AI) is poised to revolutionize various sectors by driving innovations that address economic, environmental, and social challenges. This chapter explores emerging AI technologies, policy implications, and identifies key areas for future research and development to harness AI's potential effectively.

7.1. Emerging AI Technologies:

Advanced Machine Learning Algorithms: Future AI technologies will leverage advanced machine learning algorithms, including deep learning and reinforcement learning, to enhance predictive capabilities and autonomous decision-making (Goodfellow et al., 2016; Sze et al., 2017).

Natural Language Processing (NLP) and Human-AI Interaction: Advancements in NLP and conversational AI will enable more natural human-AI interactions, supporting applications in diverse fields such as customer service and healthcare (Jurafsky & Martin, 2020).

AI-Driven Robotics and Autonomous Systems: AI-powered robotics and autonomous systems will transform industries like manufacturing and logistics, improving efficiency and safety (Sze et al., 2017).

7.2. Policy Implications:

Ethical and Regulatory Frameworks: Developing robust ethical guidelines and regulatory frameworks is crucial to address AI's societal impacts, including privacy and algorithmic bias (European Commission, 2019; OECD, 2019).



International Cooperation and Standards: Promoting international cooperation and establishing common AI standards facilitates global innovation and ensures equitable access to AI technologies (OECD, 2019).

7.3. Areas for Research and Development:

AI for Sustainable Development Goals: Research into AI applications for SDGs, such as climate action and healthcare accessibility, is essential for addressing global challenges (United Nations, 2021).

Explainable AI and Trustworthiness: Advancing research in explainable AI models enhances transparency and accountability in AI systems, addressing concerns about bias and reliability (European Commission, 2019).

AI and Human Augmentation: Exploring AI-human augmentation can amplify human capabilities and improve decision-making across various sectors (World Economic Forum, 2020).

7.4. Conclusion:

The future of AI holds tremendous potential for driving innovation and sustainable development. Proactive policy-making, international collaboration, and ongoing research and development efforts are crucial to harnessing AI's capabilities effectively in addressing global challenges and enhancing societal well-being.

8. CONCLUSION: SUMMARY, RECOMMENDATIONS, AND FUTURE OF AI-DRIVEN SUSTAINABLE DEVELOPMENT:

Artificial Intelligence (AI) is increasingly recognized for its transformative potential in driving sustainable development across economic, environmental, and social dimensions. This chapter synthesizes key findings from preceding discussions, offers practical recommendations, and outlines the future trajectory of AI's role in sustainable development.

8.1. Summary of Key Findings:

Impact on Business and Society: AI technologies enhance operational efficiency, resource management, and innovation, fostering economic resilience and inclusive growth (McKinsey & Company, 2019).

Environmental Sustainability: AI applications support environmental conservation through predictive analytics and renewable energy integration, contributing to climate change mitigation efforts (United Nations Environment Programme, 2020).

Social Impacts and Inclusion: AI improves public health outcomes, facilitates access to education and healthcare, and promotes social inclusion through digital empowerment (World Health Organization, 2024).

8.2. Practical Recommendations:

Policy and Governance: Developing robust ethical guidelines and regulatory frameworks are essential to ensure responsible AI deployment and mitigate risks (European Commission, 2019; OECD, 2019).

Research and Development: Investing in AI for Sustainable Development Goals (SDGs), explainable AI, and fostering AI-human collaboration will drive innovation and address societal challenges effectively (United Nations, 2021; World Economic Forum, 2020).



8.4. Future Directions:

Advancements in AI Technologies: Continued advancements in AI technologies, including machine learning and natural language processing, will expand their application potential in sustainable development (Goodfellow et al., 2016; Jurafsky & Martin, 2020).

Collaboration and Knowledge Sharing: Promoting interdisciplinary collaboration and public-private partnerships will accelerate AI-driven innovations and foster global cooperation in achieving sustainable development goals.

8.5. Conclusion and Final Thoughts:

The integration of AI into sustainable development initiatives holds immense promise for addressing complex global challenges. By embracing ethical practices, advancing technological capabilities, and fostering collaborative efforts, stakeholders can harness AI's transformative potential to build a more resilient, inclusive, and sustainable future for all.

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Wimax simulation and comparative analysis of performances for Rural, urban and sub urban environment.

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Abstract: Currently, the technology known as Worldwide Interoperability for Microwave Access (WiMAX) is gaining widespread recognition as a key Broadband Wireless Access (BWA) system. WiMAX demonstrates the capability to operate effectively in both line-of-sight (LOS) and non-line-of-sight (NLOS) scenarios, particularly within frequencies below 11 GHz. The deployment of WiMAX networks is expected to experience significant growth globally. Path loss estimation is critical in cell planning and the initial deployment of wireless networks. To predict propagation loss, several path loss (PL) models are utilized, including the Okumura and Hata models. However, these models are typically limited to lower frequency bands, often up to 2 GHz. This study explores and compares five path loss models—COST 231 Hata, ECC-33, SUI, Ericsson, and COST 231 Walfish-Ikegami—under NLOS conditions across urban, suburban, and rural environments, considering different receiver antenna heights. The primary objective is to identify the most suitable model for specific scenarios and provide recommendations for WiMAX cell planning at the 3.5 GHz frequency.

Key Words: Cost 231 Model, Okumura Model, , SUI Model, Cost 231 W-I Model, Ericsson Model, Free Space Path Loss, ECC-33 Model

1. INTRODUCTION:

These days, people can use wireless internet access for TV, radio, and phone services whether they're stationary, mobile, or vagrant. High-speed access to the World Wide Web is in high demand due to the explosive growth of wireless internet. The IEEE 802.16 working group introduced WiMAX, or Worldwide Interoperability for Microwave Access, a new broadband wireless access technology, to meet the demand for internet access "anywhere, any time," and to guarantee quality of service. Operating below 11 GHz, broadband wireless access (BWA) systems may be profitable in both line-of-sight (LOS) and non-line-of-sight (NLOS) scripts. In the early stages of network planning, feasibility studies are frequently carried out using propagation models. Numerous propagation models, similar as the Okumura and Hata models, are available to read path loss; still, they tend to be confined to lower frequency bands up to 2 GHz. [7]



Computation of the pathloss

Path loss models similar as the COST 231 Hata model, ECC- 33 model, SUI model, Ericsson model, and COST 231 Walfish- Ikegami(W- I) model — that have been proposed for frequency at 3.5 GHz in civic, suburban, and pastoral surroundings at varying receiver antenna heights are compared and anatomized in this paper.

The propagation models are developed by integrating logical and empirical ways. When planning a wireless network during its original deployment, the electromagnetic field strength is calculated using propagation models. As a function of distance, carrier frequency, antenna heights, and other important factors like the terrain profile, it characterizes the signal attenuation from transmitter to receiver antenna.

in all the models, f represents the carrier frequency in MHz, except for the ECC33 model, which uses GHz (specifically 3.5 GHz). The variable d denotes the distance (km) between the transmitter (WiMAX Cell Base Station) and the receiver, while the antenna heights for both the transmitter and receiver are given in measures. utmost models regard for two conditions Line- of- Sight(LOS) and Non-Line-of-Sight(NLOS). In this paper, we concentrate primarily on the NLOS condition, except for the COST 231 W- I model in pastoral areas, where we assume the LOS condition, as this model does n't give specific parameters for pastoral areas. We use the Free Space Model (FSL) as the reference model throughout all our comparisons.

2. LITERATURE REVIEW:

(I) Okumura Model:

For the rural and suburban environments, Okumura’s model is used to predict the path loss which is calculated as[7]:

$$PL=PL_{fs}+Amn(f,d)-G(hb)-G(hm)-G_{area} \quad (1)$$

where, $Amn(f,d)$ is the median attenuation relative to free space, G_{area} is the gain due to the type of environment, extracted as in [1][2]

$$G(hb)=20 \cdot \log_{10}(hb/200) \quad \text{for } 10m < hb < 1km \quad (2)$$

$$G(hm)=20 \cdot \log_{10}(hm/3) \quad \text{for } hb \leq 3m \quad (3)$$

$$G(hm)=10 \cdot \log_{10}(hm/3) \quad \text{for } 10m < hb \leq 1000m \quad (4)$$

(II) The Hata-Okumura model:

The Okumura model, one of the most widely used empirical propagation models, is a well-established tool for predicting signal propagation in the Ultra High Frequency (UHF) band. Recently, the International Telecommunication Union (ITU), through its ITU-R Recommendation, has advocated for extending this model's applicability to frequencies up to 3.5 GHz. However, the original Okumura model is limited in its ability to handle frequencies beyond 3 GHz. To address this limitation, an extrapolation method has been introduced to extend its predictions to higher frequencies. The resulting adaptation, known as the ECC-33 model, is based on the modified Hata-Okumura model proposed in [3]. In this model, path loss is expressed using the following equation:

$$PL=A_{fs} + A_{bm} - G_b - G_r \quad (5)$$

Where, A_{fs} : Free space attenuation in dB, A_{bm} : Basic median path loss in dB,

G_b : Gain factor of the Transmitting antenna height

G_r : Gain factor of the Receiving antenna height

These factors can get individually narrated as:

$$A_{fs}= 92.4 + 20\log_{10}(d) + 20\log_{10}(f) \quad (6)$$

$$A_{bm}= 7.894\log_{10}(f)+9.56[\log_{10}(f)]^2 +9.83\log_{10}(d) + 20.41 \quad (7)$$

$$G_b = \log_{10}(hb/200)\{ 13.958 + 5.8[\log_{10}(d)]^2 \} \quad (8)$$



$$Gr = [42.57 + 13.7\log_{10}(f)][\log_{10}(hr)-0.585] \quad (9)$$

$$\text{for large city } Gr = 0.759hr-1.862 \quad (10)$$

where, d: Distance between transmitter and receiver antenna in mf: Frequency in GHz :hb: transmitter antenna height in mhr : Receiver antenna height in m:In our analysis, the model of medium city found most suitable to the European cities.

(III) Free Space Path Loss Model (FSPL):

Path loss in FSPL (Free Space Path Loss) refers to the reduction in signal strength as the signal travels from the transmitter to the receiver. FSPL varies with both frequency and distance. The path loss is calculated using the following equation[7]:

$$PL_{fs} = 20 \log_{10}(f) + 20 \log_{10}(d) + 32.45 \text{ [dB]} \quad (11)$$

where d is in km and f is in MHz

(IV) Stanford University Interim (SUI) Model

The IEEE 802.16 Broadband Remote Get to (BWA) working gather recommended benchmarks for recurrence groups beneath 11 GHz, utilizing the channel show made by Stanford College, alluded to as the SUI models. This determining demonstrate is inferred from a adjustment of the Hata show for frequencies surpassing 1900 MHz, consolidating alteration variables that empower its utilize up to the 3.5 GHz range. The crucial way misfortune equation of the SUI show, counting adjustment components, is appeared as[8]:

$$PL = X_f + X_h + S + 10\gamma \log_{10}(d/d_0) + B \text{ for } d > d_0 \quad (12)$$

The measurable approach is connected to the arbitrary factors to decide the way misfortune type γ and the standard deviation s for minor blurring. The variable s , which follows to a log-normal conveyance, means shadow blurring coming about from boundaries like trees and different hindrances in the engendering way. Its esteem for the most part falls between 8.2 dB and 10.6 dB. The parameter B is communicated as:

$$\text{The parameter B is expressed as: } B = 20 \log_{10}(4\pi d_0 / \lambda) \quad (13)$$

$$\text{and the path loss exponent } \gamma = a - b \cdot hb + C/hb \quad (14)$$

Table 1: The parameter values of different terrain for SUI model

Model	Terrain H	Terrain I	Terrain J
Q	4.6	4.0	3.6
b(1/m)	0.0075	0.0065	0.005
c(m)	12.6	17.1	20

The parameter esteem is $\gamma = 2$ for free space engendering in an urban setting, $3 < \gamma < 5$ for urban NLOS conditions, and $\gamma > 5$ for indoor engendering. The demonstrate communicates the recurrence rectification figure X_f and the rectification for recipient receiving wire stature X_h as shown in [3]:

$$X_f = 6.0 \log_{10}(f/2000) \quad (15)$$

$$X_h = -10.8 \log_{10}(hr/2000) \text{ for terrain type H and I} \quad (16)$$

$$X_h = -20 \cdot \log_{10}(hr/2000) \text{ for terrain type J} \quad (17)$$

This show is broadly utilized for evaluating the way misfortune in distinctive environments.

(V) COST-231 Model

This show is the updated and altered form of the Hata demonstrate, and valuable in all three – country, rural and urban situations for the calculation of the way loss[7].

$$PL = (44.9 - 6.55 \cdot \log_{10}(hb)) \cdot \log_{10}(d) + 46.3 + 33.9 \cdot \log_{10}(f) - 13.8 + s - a(hm) \quad (18)$$

$$PL = -2 * (\log(\frac{f}{2}))^{2.8} - 5.4 + PL_{Urban} \quad (19)$$

$$PL = 18.33 \log_{10}(f) - 40.98 - 4.78(\log_{10}(f))^2 + PL_{Urban} \quad (19)$$

MS antenna correction factors a(hm) for all is:

$$a(hm) = (1.1 \log_{10}(f) - 0.7) hm - (1.56 \log_{10}(f) - 0.8) \quad (20)$$

the predictions done by COST-231 Hata model for the path loss exponent is:

$$\alpha = (44.9 - 6.55 \log_{10}(hb)) / 10 \quad (21)$$

(VI) Hata-Okumura extended model or ECC-33 Model

The Hata-Okumura show, an broadly utilized observational proliferation show, is based on the Okumura demonstrate. It is a recognized demonstrate for determining engendering in the Ultra Tall Recurrence (UHF) band. As of late, by means of the ITU-R Proposal, the Worldwide Media transmission Union (ITU) advanced this demonstrate for advance extension up to 3.5 GHz. The starting Okumura show needs data for frequencies surpassing 3 GHz. Extending on the Okumura demonstrate, a strategy of extrapolation is utilized to broaden its estimates to frequencies surpassing 3 GHz. The ECC-33 demonstrate, famous in report [3], is the reexamined Hata-Okumura show. In this strategy, way misfortune is characterized by the consequent equation:

$$PL = A_{fs} + A_{bm} - G_b - G_r \quad (22)$$

Where A_{fs} : Free space attenuation in dB, A_{bm} : Basic median path loss in dB, G_b : Transmitter antenna height gain factor, G_r : Receiver antenna height gain factor

These factors can be separately described and given by as:

$$A_{fs} = 20 \log_{10}(f) + 20 \log_{10}(d) + 92.4 \quad (23)$$

$$A_{bm} = + 9.56 [\log_{10}(f)]^2 + 9.83 \log_{10}(d) + 7.894 \log_{10}(f) + 20.41 \quad (24)$$

$$G_b = \{ 13.958 + 5.8 [\log_{10}(d)]^2 \} \log_{10}(hb/200) \quad (25)$$

$$G_r = [42.57 + 13.7 \log_{10}(f)] [\log_{10}(hr) - 0.585] \quad (26)$$

$$\text{for large city } G_r = -1.862 + 0.759 hr \quad (27)$$

where, d: Distance between transmitting and receiving antenna in m

f: Frequency in GHz, hb: height of the Transmitting antenna, hr : height of the Receiving antenna

(VII) COST 231 Walfish-Ikegami (W-I) Model

This demonstrate coordinating the J. Walfish and F. Ikegami approaches. It is as of now alluded to as a Fetched 231 Walfish-Ikegami (W-I). demonstrate. This demonstrate works best in level rural and urban districts where buildings have a steady stature. The equation of the proposed demonstrate is enunciated in [3]:

For LOS condition

$$PL_{los} = 42.6 + 26 \log_{10}(d) + 20 \log_{10}(f) \quad (28)$$

and for NLOS condition

$$PL_{nlos} = L_{fs} + L_{rts} + L_{msd} \text{ for urban and suburban} \quad (29)$$

$$PL_{nlos} = L_{fs} \quad \text{if } L_{rts} + L_{msd} > 0 \quad (30)$$



Where, Lfsl = Free space loss, Lrts = Roof top to street diffraction, Lmsd = Multi screen diffraction

$$\text{free space loss [4]; } Lfsl = 32.45 + 20\log(d) + 20\log(f) \quad (31)$$

Roof top to street diffraction [4];

$$Lrts = -16.9 - 10\log(w) + 10\log(f) + 20 \log(h_{\text{mobile}}) + L_{\text{ori}} : \text{for } h_{\text{roof}} > h_{\text{mobile}} \quad (32)$$

$$Lrts = 0 \quad (33)$$

$$\text{Where, } L_{\text{ori}} = 10 + 0.354\phi \quad \text{for } 0 \leq \phi < 35 \quad (34)$$

$$= 2.5 + 0.075(\phi - 35) \quad \text{for } 35 \leq \phi < 55 \quad (35)$$

$$= 4 - 0.114(\phi - 55) \quad \text{for } 55 \leq \phi \leq 90 \quad (36)$$

(VIII) Ericsson Model

To appraise the way misfortune, network planning engineers utilize a program from Ericsson known as the Ericsson model. This program is moreover based on the balanced Okumura-Hata model to oblige varieties in parameters based on the propagation environment. The way misfortune of this model is decided by foreseeing the way misfortune, and the network planning engineers utilize program provided by

$$PL = -3.2(\log_{10}(11.75 \cdot h_r))^2 + g(f) + p_0 + p_1 \cdot \log_{10}(d) + p_2 \cdot \log_{10}(h_b) + p_3 \cdot \log_{10}(h_b) \log_{10}(d) \quad (37)$$

$$G(f) = -4.78(\log_{10}(f))^2 + 44.49 \log_{10}(f) \quad (38)$$

Table 2 : Values of path loss for Ericsson model

Environment	p0	p1	p2	p3
Rural	45.95*	100.6*	12.0	0.1
Suburban	43.20*	68.93*	12.0	0.1
Urban	36.2	30.2	12.0	0.1

*The value of parameter p0 and p1 in suburban and rural area are based on the Least Square (LS) method[8].

3. SIMULATION RESULT

In the calculations performed, we established the operating frequency at 3.5 GHz and the separation between the transmitter and receiver antennas at 5 km. The height of the transmitter antenna was 30 m in urban and suburban regions, while in rural areas, it was 20 m. We examined three varying heights for the receiver antenna: 4 m, 7 m, and 10 m. Considering that our emphasis is on a European setting, we estimated an average building height of 15 m, with a distance of 50 m between buildings and a street width of 25 m. The majority of the models we utilized distinguish between two states: Line of Sight (LOS) and Non-Line of Sight (NLOS). Except for the rural regions, where we considered the LOS condition for the COST 231 W-I model due to its absence of parameters for rural contexts, the study primarily focused on the NLOS condition. For benchmarking, the Free Space Model (FSL) is commonly employed as the standard model. The subsequent description details the parameters used in the simulations.

The following parameters were used in our simulation:

- Base station transmitter power: 43 dBm
- Mobile transmitter power: 30 dBm
- Height of the transmitting antenna 30 m (urban and suburban), 20 m (rural)
- Height of the receiving antenna: 4 m, 7 m, 10 m
- Working Frequency: 3.5 GHz
- Distance between Rx and Tx: 5 km

- Building-to-building distance: 50 m
- Average distance: 15 m
- Width of the street considered: 25 m
- Angle of Orientation : 30° (urban), 40° (suburban)
- Correction in Shadowing: 8.2 dB (suburban and rural), 10.6 dB (urban)

PATH LOSS IN URBAN AREA

For 3 different antenna heights (i.e. 4m, 7 m and 10 m) of receiver, our calculation shows below mention result

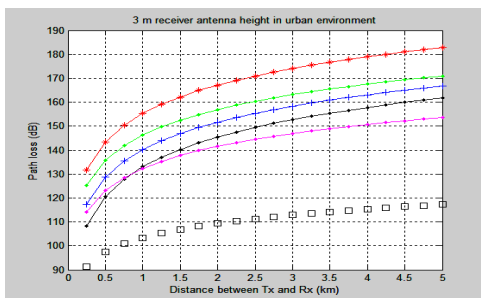
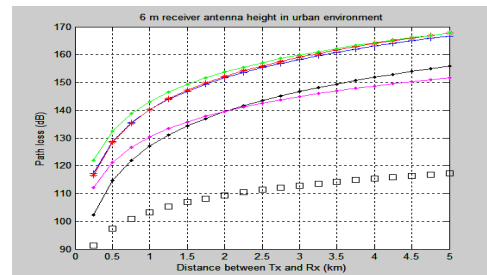
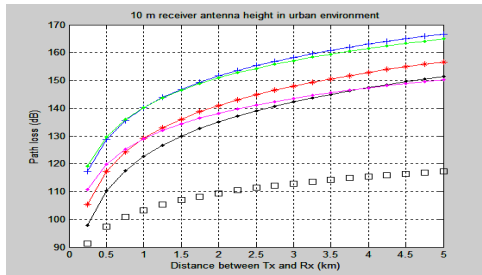


Fig. 1 - For Rx antenna height – 4 m measured in urban environment

Fig. 2 - For Rx antenna height – 7 m path loss measured in urban environment

Fig. 3 -For Rx antenna height – 10 m Path loss measured in urban environment

PATH LOSS SUBURBAN AREA

For 3 different antenna heights (i.e. 4m, 7 m and 10 m) of receiver, our calculation shows below mention result

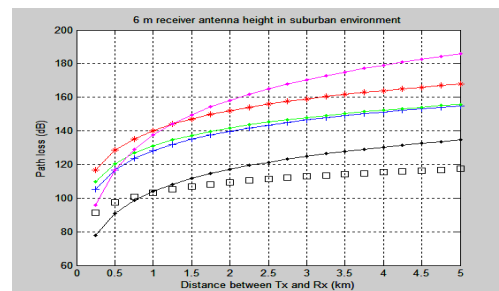
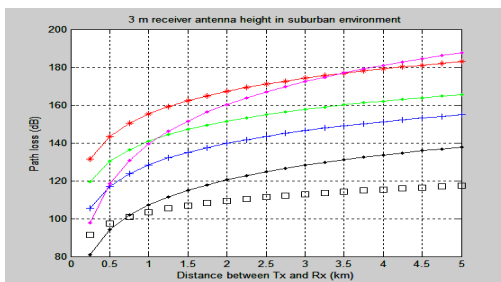


Fig. 4 - For Rx antenna height – 4 m Path loss measured in suburban environment

Fig. 5 - For Rx antenna height – 7 m Path loss measured in suburban environment

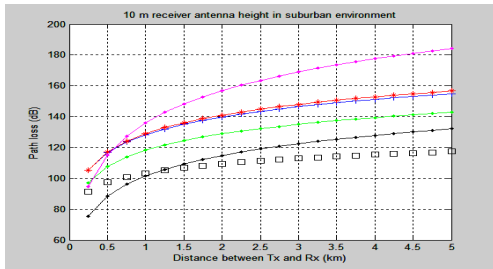


Fig. 6 - For Rx antenna height – 10 m Path loss measured in suburban environment

PATH LOSS IN RURAL AREA

For 3 different antenna heights (i.e. 4m, 7 m and 10 m) of receiver, our calculation shows below mention result

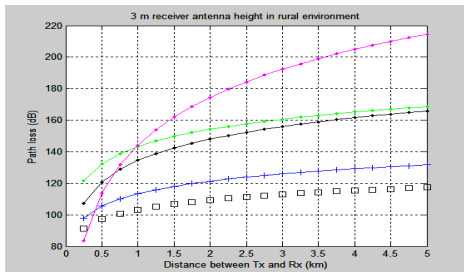


Fig. 7 - For Rx antenna height – 4 meters Path loss measured in rural environment

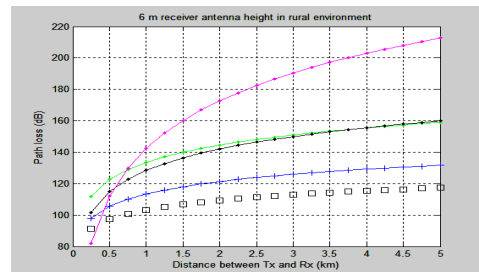


Fig. 8 - For Rx antenna height – 7 meters path loss measured in rural environment

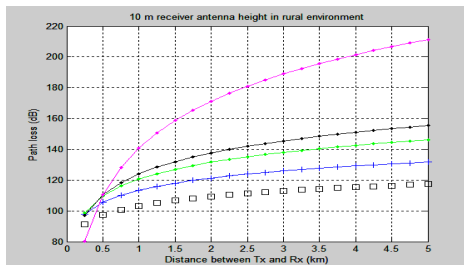


Fig. 9 - For Rx antenna height – 10 m Path loss measured in suburban environment

4.CONCLUSION

Our comparative study indicates that all models encounter increased path losses in urban settings due to multipath effects and the NLOS (Non-Line of Sight) conditions, unlike suburban and rural regions. Additionally, we discovered that no individual model could be suggested as ideal for every environment. In metropolitan regions, the Ericsson model showed the least path loss in comparison to the other models. Conversely, the ECC-33 model showed the greatest path loss. In suburban regions, the SUI model demonstrated much lower path loss compared to the other models. Nonetheless, like urban regions, the ECC-33 model exhibited the greatest path loss. Furthermore, the Ericsson model displayed significantly greater path loss when the receiver antennas were positioned at heights of 7 m and 10 m.



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"From Epics to Enterprises: Workplace Lessons from Ramayana and Mahabharata"

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Abstract: In today's complex business environment, The Ramayana and Mahabharata provide lessons to guide us in our workplaces, helping us navigate challenges, make ethical choices, and build a strong and supportive work culture. Lord Rama teaches us that true leadership and his commitment to Dharma (Righteousness) means doing what is right, even in difficult scenarios. Hanuman shows how self-belief, and trust. Courage and selflessness lead to extraordinary achievements. Sita reminds us to persevere and to stay true to our values, no matter the challenges. Sugriva's alliances highlight the power of collaboration, while Ravana's pride shows how ego can destroy the strongest leader or greatest empire. Lakshman and Bharat teach loyalty and putting the greater good first, while Kaikeyi's selfishness warns us of how personal desires can hurt the greater cause. In the Mahabharata, the Pandavas succeed through unity and ethical choices, while the Kauravas fail due to selfishness. Shakuni's dishonesty warns against unethical leadership, and . Finally, Lord Krishna's guidance in the Bhagavad Gita reminds us to focus on our duty and not worry about the results. This paper combines insights from the Ramayana and Mahabharata, showing how these epics offer valuable lessons to deal with current business scenarios.

Key Words: Ramayana, Mahabharata, Leadership & workplace culture, Ethical Decisions, Workplace Challenges, Bhagvat Gita, Ethics & Values.

1. INTRODUCTION:

The *Ramayana and Mahabharata*, ancient Indian epics, offer timeless lessons on leadership, ethics, and decision-making that remain relevant in today's fast-changing professional world. These texts teach us how to navigate challenges, make ethical choices, and build supportive work environments. Despite being written thousands of years ago, their stories and characters inspire us to lead with integrity and purpose in modern workplaces.

[A] WORKPLACE LESSONS FROM RAMAYANA:

Lord Rama's leadership, as depicted in the *Ramayana*, shows the importance of staying committed to one's principles, even during tough times. His calm approach to challenges and his dedication to doing what is right set a strong example for others. Rama treated everyone with respect, regardless of their role, creating an environment where people felt valued and motivated. These qualities make him a timeless example of ethical and effective leadership in any workplace.

Rama's leadership in the *Ramayana* stands out for his sense of accountability. He consistently took responsibility for his actions, showing that honesty and transparency are essential to building trust as a leader. Rama also demonstrated the value of collaboration, relying on allies like Hanuman, Vibhishana & Sugriva to achieve shared goals. His humility, even after significant victories, emphasized the



importance of recognizing and appreciating the contributions of others, fostering unity and respect within a team.

Rama's resilience in the face of adversity highlights the importance of perseverance. He always prioritized the greater good over personal ambition, reminding leaders to focus on collective welfare. His approach to conflict resolution further reflects his leadership style. Instead of resorting to immediate confrontation, Rama gave Ravana multiple chances to surrender, showcasing patience and a preference for negotiation. This emphasizes the need for leaders to seek peaceful solutions and offer second chances whenever possible.

Overall, Lord Rama's leadership qualities—integrity, empathy, humility, collaboration, resilience, and a commitment to the greater good—serve as a powerful guide for modern leaders. His example teaches us to approach challenges with honor, compassion, and a focus on maintaining peace. As Rama himself said,

"धर्मेण पापमपनीयमधर्मेणोत्सेवितम्," which means that (Through righteousness, one can overcome wrongdoings), underscoring the importance of moral action in leadership (Valmiki, trans. 2000).

These principles can help leaders create a positive, ethical, and successful work environment.

Hanuman's journey in the *Ramayana* provides us with powerful lessons on leadership that still resonate in the workplace today. Hanuman's actions in the *Ramayana* provide us with important lessons on leadership that apply in today's workplace. First, Hanuman teaches us the power of self-belief. When he was tasked with crossing the ocean to reach Lanka, he initially doubted his abilities. However, with encouragement from Jambavan, he realized his true potential. This shows us that having confidence in our abilities is crucial to achieving difficult goals.

Another key lesson comes from Hanuman's mission to find the Sanjeevani herb to save Lakshmana. Despite not knowing which herb to pick, he brought the entire Dronagiri mountain back. This highlights the importance of determination, thinking creatively, and finding solutions under pressure. Leaders must be resourceful and willing to go above and beyond to support their teams.

Hanuman also exemplifies the power of teamwork. His collaboration with the Vanara army, where each member's strengths were leveraged for the common good, highlights how working together leads to success. Even when faced with adversity—such as being captured by Ravana's forces—Hanuman demonstrated resilience and resourcefulness. He escaped and continued his mission, showcasing the importance of perseverance and strategic thinking in leadership. Despite his great strength, Hanuman remained humble. He always put Rama's mission ahead of his own personal gain. This teaches leaders that true leadership is about serving others and focusing on the team's success.

Ultimately, Hanuman's leadership combines courage, self-belief, trust, teamwork, resilience, and humility. These qualities make him a model leader who inspires others to achieve greatness. As the *Ramayana* beautifully puts it: "सर्वशक्तिमान् भवति, जब स्वयं पर विश्वास हो।" "One becomes all-powerful when they have faith in themselves." This Shloka perfectly captures Hanuman's essence, reminding us that with self-belief, any leader can inspire their team and achieve extraordinary success.

Rama helped **Sugriva** defeat his brother Vali, and in turn, Sugriva mobilized his army to aid Rama in the search for Sita. This alliance underscores the importance of collaboration and loyalty, where both parties benefit by focusing on a greater common goal. In the *Ramayana*, Lord Rama's alliances with Sugriva, Hanuman, and Vibhishana highlight the power of collaboration, trust, and the importance of building strong relationships to overcome challenges.



Bharat, in contrast, exemplifies humility and selflessness in leadership. When his mother, Kaikeyi, manipulates King Dasharatha into exiling Rama, Bharat could have claimed the throne for himself, but he chooses instead to place Rama's sandals on the throne as a symbol of Rama's rightful rule. Bharat governs in Rama's place, prioritizing his brother's well-being over his own ambitions. His actions remind us that true leadership is about service, not power. Bharat shows us that putting the needs of others before personal gain is the hallmark of a great leader.

Lakshman, known for his unwavering devotion to Rama, illustrates the importance of loyalty and dedication in leadership. He sacrifices his comforts to accompany Rama into exile, never leaving his side throughout their trials. Lakshman's commitment highlights that leadership often requires personal sacrifice and a steadfast focus on the mission or the greater good, regardless of individual discomfort or challenges.

"न तस्य त्यागशीलस्य धर्मो धर्मविनाशकः।"

This means: "For one who is selfless, the path of righteousness never leads to destruction."

This Shloka perfectly encapsulates the leadership qualities embodied by Sugriva, Bharat, and Lakshman—selflessness, loyalty, and an unwavering commitment to the greater good. Their stories remind us that leadership is about putting others before ourselves, staying true to our values, and always striving for the collective benefit.

Ravana's story is a clear lesson on how ego can bring down even the most powerful. As the king of Lanka, Ravana had everything—wealth, strength, and wisdom. Yet, his arrogance led to his undoing. When he wronged Lord Rama by taking Sita, he had many chances to make peace, but his ego wouldn't let him. He ignored wise advice, especially from his brother, Vibhishana, and instead chose a path of conflict that ultimately destroyed his kingdom and himself.

Ravana's story teaches us that no matter how powerful we are, if we let ego guide our decisions, it can lead to our downfall. True leadership involves humility, the ability to listen to others, and making choices for the greater good, rather than driven by pride or personal gain.

A simple shloka that reflects this lesson is:

"अहंकारविमूढात्मा कर्ताहं इति मन्यते"

("The one who is deluded by ego believes, 'I am the doer,' forgetting true strength lies in humility.")

Ravana's fall serves as a reminder that leadership isn't about power or pride; it's about humility, wisdom, and making decisions that benefit everyone.

Sita's story shows the importance of resilience and sticking to your values during tough times. In the workplace, leaders and employees who uphold their principles, even under pressure, help create a culture of integrity. This resilience can inspire teams to persevere and stay true to the organization's core values. Sita, known for her grace and strength, faced many trials. After being abducted by Ravana, she stayed committed to Rama and her values, even under pressure. When rescued, she endured the Agni Pariksha, proving her purity and resilience. Even after returning to Ayodhya, she faced a second exile but maintained her dignity and principles.

Kaikeyi, a key figure in the Ramayana, made a decision driven by ego and ambition when she asked King Dasharatha for two boons: to crown her son Bharat as king and to exile Rama. Though her intentions were rooted in securing her son's future, her actions caused immense pain, division, and loss. Kaikeyi's story teaches a critical lesson about the dangers of self-interest in leadership. Decisions driven by personal gain, without considering the collective good, can lead to regret, loss of trust, and



destruction. In the workplace, it reminds leaders to act with fairness, empathy, and integrity for the benefit of all.

Source: Valmiki. (2000). The Ramayana (R. Menon, Trans.). HarperCollins.

Padmanabhan, R. A. (2015). The leadership wisdom of the Ramayana. Jaico Publishing House.

B] WORKPLACE LESSONS FROM MAHABHARATA & BHAGVAT GITA:

The story of the Pandavas and Kauravas in the Mahabharata offers valuable workplace lessons. The Pandavas exemplify ethical leadership, integrity, and teamwork, teaching that true success comes from sticking to principles, collaborating, and supporting each other in difficult times. In contrast, the Kauravas, driven by ego, rivalry, and unethical decisions, show the destructive consequences of personal ambition and toxic work environments. Their story highlights the importance of fostering unity, resolving conflicts professionally, and prioritizing the greater good in any workplace. Ultimately, the contrast between the two families underscores the power of ethical leadership and mutual respect in achieving long-term success.

In the Mahabharata, the characters of Shakuni and Duryodhana serve as powerful reminders of the dangers of manipulation and unethical leadership. Shakuni, with his cunning and deceit, uses every opportunity to create division and chaos, manipulating Duryodhana into making destructive decisions. Duryodhana, driven by his pride and greed for power, listens to Shakuni's advice, which ultimately leads to the downfall of his own family. Their story teaches that manipulation, greed, and unethical decisions can destroy both personal integrity and organizational harmony.

A fitting shloka from the Mahabharata that reflects the destructive power of such behavior is:

**"अधर्मो ह्येतिहासस्य यः पापं समुपादिशत्।
स एव नष्टकृत् लोके काले चापि न बाधते।"**

This means: "The one who leads others into sin and corruption through his actions will be destroyed both in this world and the next, and no one can save him from the consequences."

This shloka highlights the inevitable downfall of those who engage in unethical behavior and manipulate others for personal gain, reinforcing the importance of ethical leadership and integrity in both personal and professional life.

The Pandavas exemplify unity, righteousness, and ethical leadership. Despite facing injustice from the Kauravas, they remained true to their principles, showing that true leadership is about collaboration, integrity, and prioritizing the greater good over personal gain. Their story teaches that righteousness and unity are key to overcoming challenges.

"सत्यमेव जयते नानृतं।"

"Truth alone triumphs, not falsehood."

This shloka reflects Draupadi's unwavering commitment to truth and justice, as she stood up for herself and demanded justice in the court of the Kauravas. It emphasizes the power of truth and righteousness, which is a key lesson from her story.

Throughout the Mahabharata, Krishna is known for his wisdom, diplomacy, and guidance. His Advice on the battlefield of Kurukshetra provides valuable insights into leadership, decision-making, and ethical conduct, all of which are highly relevant to today's workplace. Krishna encourages Arjuna to perform his actions selflessly, without personal desire for recognition. This concept of selfless action, or *Nishkama Karma*, highlights the importance of serving the collective good. .



In the Bhagavad Gita, Lord Krishna imparts an essential lesson to Arjuna, stating:

“कर्मण्येवाधिकारस्ते मा फलेषु कदाचन।
मा कर्मफलहेतुर्भूर्मा ते सङ्गोऽस्त्वकर्मणि।”

(Bhagavad Gita 2.47)

"You have the right to perform your duties, but not to the results of your actions. Do not consider yourself the cause of the outcomes, nor should you be attached to inaction."

This verse teaches the importance of focusing on the effort and process rather than obsessing over the results. It emphasizes the value of performing duties with dedication and commitment while remaining detached from the outcome. This principle encourages a mindset where actions are taken selflessly, without the pressure of achieving particular results, which can guide both leaders and individuals in managing expectations and maintaining emotional balance in their work.

Source: Narayan, R. (Trans.). (2000). The Mahabharata. Penguin Books.
Easwaran, E. (Trans.). (2007). The Bhagavad Gita: A new translation. Nilgiri Press.

2. LITERATURE REVIEW:

The Ramayana and Mahabharata, two of the most significant epics in Indian literature, continue to offer timeless lessons on leadership, ethics, and decision-making. Despite their ancient origins, these epics provide relevant insights that can be applied to modern organizational leadership and management practices. This review explores existing research that connects leadership, ethics, and organizational behavior principles in these epics to contemporary workplace dynamics.

In the Ramayana, Lord Rama is a model of leadership rooted in integrity, humility, and the commitment to the greater good. As highlighted by Sharma (2017), Rama's leadership is marked by a steadfast adherence to righteousness (Dharma), even when it comes at a personal cost. This shows that ethical leadership fosters trust and resilience in teams. In today's corporate environment, which often grapples with ethical dilemmas, Rama's example demonstrates how leading with moral clarity can strengthen organizational culture through accountability and transparency (Kaur, 2019). According to Kaur (2019), ethical leadership based on fairness enhances team morale and cohesion.

Source: Sharma, S. (2017). Leadership and Integrity in the Ramayana: Lessons from Lord Rama. Leadership and Management Journal.

Hanuman, another central figure from the Ramayana, exemplifies leadership driven by self-belief, courage, and collaboration. Gupta (2020) discusses how Hanuman's ability to overcome challenges is rooted in his self-confidence and how his collaboration with the Vanara army highlights the importance of teamwork. Sahu (2018) emphasizes that modern organizations can draw valuable lessons from Hanuman's example, promoting trust and collective purpose in diverse teams, which is essential for organizational success.

Source: Sahu, P. (2018). Teamwork and Leadership: Lessons from Hanuman's Leadership in the Ramayana. International Journal of Business Leadership.

Gupta, R. (2020). The Role of Self-Belief and Teamwork in Leadership: Lessons from Hanuman. Leadership and Motivation Review.

Bharat's selfless leadership, as he chooses to govern in Rama's absence instead of claiming the throne, and Lakshman's unwavering loyalty to Rama, offer key lessons in prioritizing team welfare over personal ambition. Chopra (2018) notes that leaders who put others' needs before their own create more



cohesive teams. Similarly, Bose (2021) explains that Lakshman's willingness to sacrifice for a higher cause demonstrates that leadership often requires personal sacrifice for the benefit of the collective.

Source: Chopra, M. (2018). *Selfless Leadership: The Example of Bharat*. *Journal of Organizational Behavior*.

Ravana's downfall in the Ramayana serves as a powerful lesson on the dangers of excessive ego and pride. As Das (2022) points out, Ravana's refusal to heed sound advice and his arrogant decisions ultimately led to the collapse of his kingdom. In contrast, ethical leadership, characterized by humility and self-awareness, fosters a more sustainable and successful leadership style (Kumar, 2020). Kumar (2020) emphasizes that leadership rooted in service, not power, stands in stark contrast to Ravana's hubris.

Source: Kumar, V. (2020). Humility and Power in Leadership: The Downfall of Ravana. *Business Ethics Quarterly*.

Das, S. (2022). Ego and Leadership: The Tragic Fall of Ravana. *International Journal of Leadership and Ethics*.

Sita, in the Ramayana, demonstrates resilience and steadfastness in her principles, even in the face of immense pressure. Sharma (2021) points out that Sita's ability to uphold her values during her Agni Pariksha exemplifies integrity and resilience in leadership. Verma (2019) argues that Sita's example teaches leaders to remain steadfast in their values, which can inspire others to do the same, thereby fostering an ethical organizational culture.

Source:

Verma, R. (2019). *Resilience and Values: The Leadership Lessons from Sita*. *Journal of Organizational Behavior*.

Sharma, S. (2021). *Resilience and Values: The Leadership Lessons from Sita*. *Journal of Organizational Behavior*.

Kaikeyi's selfishness and manipulative actions in her pursuit of personal gain caused significant disruption to both her family and the kingdom. Her character serves as a powerful warning about the detrimental effects of placing individual ambitions above the broader organizational or collective goals. Contemporary leaders can learn from this example, understanding the risks of undermining team unity and organizational success for the sake of personal interests (Kaur & Patel, 2020).

Source: Kaur, T., & Patel, R. (2020). *The Dangers of Selfish Leadership: Lessons from Kaikeyi*. *Journal of Leadership Ethics and Organizational Behavior*.

The contrast between the Pandavas and the Kauravas in the Mahabharata illustrates the significance of ethics and integrity in leadership. Raj (2017) explains that despite facing enormous adversity, the Pandavas remained committed to their dharma, which contributed to their ultimate success. In contrast, the Kauravas, driven by selfishness and unethical behavior, are shown to falter in their pursuits. Jain (2019) highlights that ethical leadership and unity, as demonstrated by the Pandavas, are crucial for long-term success in any organization.

Source: Jain, K. (2019). *Unity in Leadership: The Ethical Practices of the Pandavas*. *Journal of Ethical Leadership*.

Shakuni's manipulative actions in the Mahabharata, particularly during the game of dice, offer an example of the dangers of unethical leadership. Singh (2020) discusses how Shakuni's manipulation of Duryodhana led to the Kauravas' downfall. This serves as a cautionary tale in the modern workplace,



where unethical behavior can create toxic work environments and lead to organizational failure (Mehra, 2021).

Source: Singh, P. (2020). Manipulation and Deceit in Leadership: The Story of Shakuni in the Mahabharata. Journal of Leadership Ethics and Integrity.

Mehra, A. (2021). The Impact of Unethical Leadership on Organizational Culture: A Case Study of Shakuni. Journal of Organizational Psychology.

Finally, the Bhagavad Gita offers profound insights into leadership, particularly regarding the importance of selfless action and detachment from outcomes. Krishna's teachings on Nishkama Karma (selfless action) encourage leaders to focus on their duties without attachment to personal rewards (Patel, 2020). According to Patel (2020), Krishna's advice is particularly relevant in modern leadership, where leaders are encouraged to focus on collective good rather than personal recognition.

Source: Patel, R. (2020). Duty and Righteousness in Leadership: Krishna's Teachings in the Bhagavad Gita. Journal of Leadership Philosophy.

Raj, P. (2017). The Ethics of Leadership: Insights from the Mahabharata. Leadership Studies Review.

3. OBJECTIVES / AIMS :

- Explore how ancient wisdom from the Ramayana and Mahabharata can still be applied in today's corporate world to address modern leadership challenges, organizational behavior, and workplace ethics.
- Examine how characters like Lord Rama and the Pandavas demonstrate the significance of building strong alliances and working together to overcome obstacles, emphasizing the importance of teamwork in modern workplaces.
- Investigate the destructive impact of ego and selfishness, as seen in characters like Ravana and Shakuni, and how these traits can lead to the collapse of leadership and organizations.
- Analyze Lord Krishna's teachings on focusing on one's duty (Karma Yoga) without attachment to outcomes, and how these principles can help professionals stay grounded and focused in their careers.
- To explore how the concept of Dharma in the epics provides guidance for making ethical choices in challenging situations, both personally and professionally.

4. RESEARCH METHOD:

Research Methodology: Secondary Research

This research is based on secondary analysis and qualitative research, involving the review and synthesis of existing literature, case studies, and academic sources. By examining these materials, the study aims to draw parallels between ethical lessons from the Ramayana and Mahabharata and their application to contemporary business environments.

5. FINDINGS & DISCUSSIONS:

This study, based on secondary research, reveals valuable leadership lessons from the **Ramayana** and **Mahabharata** that are still highly relevant to modern workplaces. By drawing on the insights from these ancient epics, organizations and leaders can create a culture of integrity, cooperation, and resilience. These epics offer timeless guidance on making ethical decisions, fostering teamwork, and building long-term success in the workplace.

In the **Ramayana**, Lord Rama's leadership stands out as a model of adhering to Dharma (righteousness), even when it requires personal sacrifice. His example teaches that true leadership is



about doing what is right, no matter the difficulties faced (Sharma, 2017). Hanuman's unwavering devotion shows the value of self-belief, courage, and teamwork. His actions highlight how personal qualities like selflessness and confidence can drive great achievements (Gupta, 2020). Sita's perseverance throughout her struggles emphasizes the importance of staying true to one's values, even in challenging times (Sharma, 2021). Sugriva's focus on building alliances teaches the importance of collaboration in achieving success, while Ravana's ego-driven downfall serves as a warning against the dangers of unchecked pride (Das, 2022). The loyalty of Lakshman and Bharat also teaches the importance of prioritizing the collective good over personal desires, while Kaikeyi's selfishness highlights the harm that personal motivations can cause to the broader cause (Kaur & Patel, 2020).

In the **Mahabharata**, the Pandavas demonstrate that unity, resilience, and a commitment to making ethical choices are key to success. Their success is rooted in their collective decision-making, while the Kauravas' downfall is the result of selfishness and unethical behavior (Raj, 2017). Shakuni's deceit and Karna's misguided loyalty show the consequences of unethical leadership and the importance of aligning with the right values (Singh, 2020). Draupadi's courage in standing up for justice serves as an inspiration to fight for what is right, and Lord Krishna's teachings in the Bhagavad Gita remind us of the importance of fulfilling our duties, regardless of the outcomes (Patel, 2020).

□ **Applying These Lessons in the Modern Workplace**

By incorporating the lessons from these ancient texts, leaders can better manage challenges, make ethical decisions, and establish a strong, values-driven culture within their organizations. Whether dealing with personal ambition, promoting teamwork, or navigating ethical dilemmas, the teachings of the **Ramayana** and **Mahabharata** offer clear guidance for today's leaders (Kaur, 2019).

This paper explores how the wisdom of these ancient epics can guide contemporary leadership and management practices. The insights gained can help individuals and organizations overcome obstacles, make ethical decisions, and build a culture of integrity and collaboration.

In nutshell, the **Ramayana** and **Mahabharata** provide essential lessons for leadership and organizational culture. The characters and events in these epics offer models of ethical decision-making, selflessness, resilience, and teamwork. By integrating these teachings into modern leadership practices, organizations can foster a culture that values ethics, collaboration, and long-term success, allowing them to thrive in today's complex business environment.

6. CONCLUSION:

This paper presents a **blended perspective** of the **Ramayana** and **Mahabharata**, demonstrating how the leadership principles and ethical teachings from both epics can be applied to modern organizational settings. By merging the wisdom from these two timeless epics, the paper offers a well-rounded view of leadership, highlighting the qualities of integrity, humility, resilience, and collaboration, as embodied by figures such as **Lord Rama, Hanuman, Draupadi, and Lord Krishna**.

The **Ramayana** emphasizes the importance of righteousness, selflessness, and teamwork, while the **Mahabharata** introduces critical insights into ethical decision-making, unity, and the dangers of unchecked ambition. Together, these epics offer a comprehensive approach to leadership, illustrating the balance between personal values and collective goals, and the impact of ego-driven actions, as seen in **Ravana** and **Shakuni**.

By blending the lessons from both epics, this paper underscores the need for leaders to foster ethical decision-making, cultivate collaboration, and develop resilience in the workplace. Integrating these timeless lessons into modern leadership practices can help organizations build a strong, ethical, and resilient culture, equipped to navigate the complexities of today's competitive business environment.



7. LIMITATIONS:

- The *Ramayana* and *Mahabharata* originate from ancient times, and their context may not always align with the complexities of contemporary business environments, making direct application challenging.
- The study primarily relies on secondary research, which may introduce bias or limit the depth of understanding compared to primary data collection methods.
- The study generalizes leadership lessons from the epics, which may not be applicable to all industries or organizational cultures with distinct challenges and structures.
- The study does not incorporate interviews, surveys, or case studies, which could provide a more practical and grounded understanding of how these lessons are applied in real-world settings.
- Different scholars may interpret the epics in various ways, leading to subjective conclusions that could affect the consistency of the findings.

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The impact of Artificial Intelligence (AI) on the Australian insurance industry

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Abstract: *The impact of Artificial Intelligence (AI) on the Australian insurance industry is transformative, reshaping operations, customer interactions, and risk management strategies. AI enhances efficiency through automation, significantly reducing manual tasks and operational costs. Machine learning and predictive analytics allow for more accurate risk assessments, personalized premiums, and proactive fraud detection, leading to optimized underwriting processes and decreased fraudulent claims. Furthermore, AI-driven chatbots and virtual assistants enhance customer service by providing instant support and streamlining claims handling, which improves customer satisfaction and retention. However, integrating AI comes with challenges, including data privacy concerns, ethical considerations, and the potential for job displacement within the sector. Regulatory frameworks need to evolve to tackle these challenges and ensure the ethical use of AI, balancing innovation with consumer protection. Additionally, adopting AI requires investments in advanced technologies and workforce upskills, which may pose a barrier for smaller firms. This paper examines the various impacts of AI on the Australian insurance industry, assessing both the benefits and potential pitfalls. The findings underscore AI's role in reshaping industry practices and its potential for future growth while highlighting the necessity for regulatory oversight and ethical considerations to promote AI's fair and sustainable implementation in insurance.*

Key Words: *Artificial Intelligence (AI), Australian insurance industry, risk management, regulatory frameworks, workforce upskilling, sustainable implementation.*

1. INTRODUCTION :

Introduction to Artificial Intelligence and Its Relevance

Artificial Intelligence (AI) refers to various technologies, including machine learning, natural language processing, and data analytics, that enable machines to perform tasks traditionally requiring human intelligence (Russell & Norvig, 2021). In recent years, AI has become a disruptive force across various industries by offering transformative capabilities for data analysis, automation, and decision-making. In insurance, AI applications streamline operations, allow for advanced risk assessment, enhance customer service, and improve fraud detection (PwC, 2020). Insurers leverage AI-driven tools such as predictive analytics to make more accurate underwriting decisions and personalize policy offerings based on individual risk profiles (Accenture, 2021). Through automation, AI reduces administrative workloads, enabling insurers to process claims faster and more accurately, enhancing customer



experience, and improving operational efficiency. As AI technologies evolve, their adoption becomes crucial for insurers to remain competitive in a fast-changing industry (Deloitte, 2019).

Overview of the Insurance Industry in Australia

The insurance industry in Australia is a significant component of the financial sector, covering life, general, and health insurance and generating substantial contributions to the national economy (Australian Prudential Regulation Authority (APRA), 2021). The industry is regulated by APRA and the Australian Securities and Investments Commission (ASIC) to ensure market stability and consumer protection (Australian Securities and Investments Commission (ASIC), 2020). Major players in the Australian insurance market include the Insurance Australia Group (IAG), Suncorp, QBE, and multinational firms. However, the sector faces numerous challenges, such as rising operational costs, complex regulatory requirements, and evolving customer demands (KPMG, 2021). Digital transformation has become a priority, and insurers are increasingly adopting AI to modernize operations, provide personalized services, and enhance competitiveness in a crowded marketplace (EY, 2020). AI is anticipated to play a central role in addressing these challenges by enabling smarter, data-driven decision-making, optimizing internal processes, and enhancing the overall customer experience (Boston Consulting Group, 2019).

Research Objective and Scope

This research seeks to assess the impact of Artificial Intelligence on the Australian insurance industry by examining how AI adoption influences operational efficiency, customer service, risk assessment, fraud detection, and regulatory compliance. The scope includes identifying both the benefits and challenges of AI, such as ethical considerations, data privacy concerns, and the potential for job displacement within the industry (Deloitte, 2021). Additionally, the study explores case studies of Australian insurers who have implemented AI technologies, providing insights into industry trends and offering recommendations for mitigating AI-related risks. The findings are intended to deepen the understanding of AI's transformative role in Australian insurance, with particular emphasis on balancing innovation with ethical practices and regulatory oversight (ASIC, 2021).

2. LITERATURE REVIEW:

Overview of AI in Global Insurance: Benefits, Challenges, and Trends

Artificial Intelligence (AI) has emerged as a powerful force in the global insurance industry, fundamentally changing how insurers assess risk, handle claims, and engage with customers. By harnessing data analytics, machine learning (ML), and natural language processing (NLP), insurers worldwide are experiencing benefits such as increased operational efficiency, improved accuracy in risk assessment, and enhanced customer satisfaction through personalized interactions (Accenture, 2021). For instance, AI-based predictive models enable insurers to provide customized policies, streamline underwriting, and detect fraudulent claims more accurately (Eling & Lehmann, 2018).

However, AI implementation also introduces challenges. The reliance on vast amounts of personal data raises privacy and security concerns, as sensitive information must be protected to maintain trust and comply with regulations (PwC, 2020). Additionally, biases in AI algorithms can lead to unfair practices, potentially resulting in discriminatory policy pricing if data is not carefully managed and audited (Deloitte, 2020). Another global trend in AI adoption is the increasing focus on regulatory frameworks to guide ethical AI use, with many countries developing guidelines to address the risks of data misuse and algorithmic bias (OECD, 2019). These global developments lay a foundation for understanding AI's impact on local markets, including Australia.



Specific Studies on AI's Impact on Australia's Insurance Sector

In Australia, AI's adoption within the insurance sector is growing, with several studies examining its specific impacts on operational efficiency, customer service, and risk management. Large Australian insurers, such as the Insurance Australia Group (IAG) and Suncorp, are investing in AI-driven tools to improve claims processing and underwriting accuracy (KPMG, 2021). These tools enable insurers to analyze large datasets, allowing for more precise risk assessment and policy customization. AI also enhances customer service through chatbot implementations, which improve response times and overall customer satisfaction (EY, 2020).

Despite these advantages, challenges unique to the Australian regulatory environment affect AI adoption. Under the Australian Privacy Act, insurers face restrictions on data collection and processing, limiting some AI applications (ASIC, 2021). Furthermore, Australian insurers face a workforce shift, as AI reduces the need for certain manual tasks, potentially leading to job displacement in roles such as claims processing and customer service (KPMG, 2021). This shift underscores the need for upskilling employees to work alongside AI systems, ensuring that the workforce remains adaptable as AI adoption grows.

Key Technological Advancements Influencing Insurance: Machine Learning and Natural Language Processing

Machine learning (ML) and natural language processing (NLP) are among the core AI technologies transforming the insurance industry. ML allows insurers to analyze complex data patterns, enabling accurate risk assessments, personalized underwriting, and predictive modeling. For instance, insurers use ML algorithms to identify customers' behavioral patterns and forecast claims probability, which enhances decision-making in underwriting (Russell & Norvig, 2021). Additionally, predictive analytics, a subset of ML, allows insurers to predict customer needs and tailor policies accordingly, thereby boosting retention and customer satisfaction (PwC, 2020).

Natural language processing (NLP) also plays a pivotal role in enhancing customer engagement. NLP-powered chatbots and virtual assistants help insurers provide immediate, round-the-clock customer support by addressing inquiries and guiding users through claim submissions (Deloitte, 2020). NLP also assists in extracting insights from unstructured data sources, such as customer reviews and social media, giving insurers valuable information on customer sentiment and emerging trends (Accenture, 2021). Together, ML and NLP enable a data-driven approach that helps insurers improve operational efficiency and create personalized, customer-centric services (Boston Consulting Group, 2019).

Regulatory and Ethical Perspectives

The regulatory and ethical implications of AI in insurance are critical concerns, particularly in a market as regulated as Australia. Regulatory bodies, including the Australian Prudential Regulation Authority (APRA) and the Australian Securities and Investments Commission (ASIC), provide oversight on AI applications in financial services to ensure consumer protection, data security, and ethical use of AI (ASIC, 2020). The Australian Privacy Act imposes strict controls on data handling, compelling insurers to establish robust data governance practices to safeguard customer information (Australian Government, 2021). This legislation impacts the scope of AI applications in insurance, especially those involving personal data, as insurers must ensure compliance to avoid legal repercussions.

Ethical considerations also play a significant role, particularly in avoiding algorithmic bias and ensuring transparency in AI-driven decision-making. For example, biases in AI models can lead to unfair pricing or exclusionary practices if not properly addressed, challenging the insurance industry's principles of fairness and equity (Eling & Lehmann, 2018). To address these concerns, ASIC has developed guidelines on ethical AI use, stressing the importance of fairness, accountability, and explainability



(ASIC, 2021). Additionally, the Australian government is working on an AI ethics framework that aims to promote responsible AI use across sectors, fostering trust and encouraging innovation while safeguarding public interests (Australian Government, 2020). These regulatory and ethical perspectives are essential for guiding insurers in implementing AI responsibly and effectively.

3. METHODOLOGY

The aim of this research is to explore the impact of Artificial Intelligence (AI) on the Australian insurance industry. To achieve this, a mixed-method approach combining both quantitative and secondary research methods will be employed. This approach allows for a comprehensive understanding of AI's effects on industry, integrating statistical data and insights from industry reports and case studies.

1. Data Sources

The primary data sources for this study will include industry reports, academic articles, government publications, and real-world case studies from Australian insurance companies that have implemented AI technologies. Secondary data from reputable sources such as:

- **Australian Prudential Regulation Authority (APRA)** reports,
- **Insurance Council of Australia (ICA)** publications,
- Market analysis reports from firms like **IBISWorld** and **Deloitte**,
- And academic research databases like **Google Scholar** and **JSTOR**, will be analyzed for relevant trends and information.

Additionally, data from publicly available datasets, including reports on market trends and AI adoption statistics, will be utilized to track industry-wide developments and benchmarks.

2. Case Studies

Real-world case studies will be critical in understanding how AI has been implemented by various Australian insurance companies. These case studies will focus on companies that have adopted AI technologies in areas such as claim processing, underwriting, risk management, and customer service. The selection of case studies will involve identifying organizations from both large players (e.g., **QBE Insurance** or **Suncorp**) and smaller, innovative startups (e.g., **Open** or **Carly**), which may have adopted AI at a different pace and scale.

3. Quantitative Methods

To complement the case study insights, quantitative methods will be employed using industry performance metrics, such as:

- Reduction in claim processing times
- Improvement in customer satisfaction scores
- Operational cost reductions
- Increase in underwriting accuracy

This data will be sourced from industry reports, company financial disclosures, and publicly available datasets from organizations like the Australian Bureau of Statistics (ABS) and industry associations.



4. Justification for Chosen Methodologies

The mixed-method approach is particularly suitable for this research because it enables a comprehensive view of both the measurable impacts and the broader industry trends related to AI adoption in the insurance sector. The use of **secondary data** and **case studies** allows for a broad understanding of industry-wide trends, while **quantitative research** provides measurable, objective evidence of AI's impact on the efficiency and profitability of the insurance industry.

This combination of research techniques ensures a thorough exploration of how AI is transforming the Australian insurance industry, providing insights into both the practical applications and the wider economic effects of AI-driven innovation.

4. RESULT / DISCUSSION:

The Australian insurance industry is transforming significantly due to the adoption of artificial intelligence (AI) technologies. AI is being utilized across various domains, such as customer service, claims processing, fraud detection, and risk management, by companies like Suncorp and Insurance Australia Group (IAG). These initiatives improve operational efficiency, enhance customer experiences, and optimize decision-making processes.

1. AI Initiatives in Australian Insurance Companies

Suncorp is one of the leading insurers in Australia, investing heavily in AI technologies to drive innovation and improve its services. The company has implemented AI tools like chatbots and machine learning algorithms to enhance customer engagement, personalize insurance offerings, and streamline claims processing. Suncorp's AI initiatives also involve using predictive analytics to assess risks and make more accurate decisions on policy underwriting (Suncorp Group, 2023).

Insurance Australia Group (IAG) has also embraced AI, developing various applications to automate and enhance its insurance operations. One of its key innovations is the **Mia** chatbot, which assists customers with policy information and claims processes. Additionally, IAG has utilized AI to improve its underwriting systems by automating risk assessments and tailoring policies based on predictive models (IAG, 2023). These AI-driven solutions have improved operational efficiency and enhanced customer satisfaction by providing faster, more personalized service.

2. Examples of AI Applications in the Australian Insurance Industry

Customer Service: AI Chatbots and Virtual Assistants

AI chatbots have become central to improving customer service in the Australian insurance industry. Both Suncorp and IAG have developed AI-driven chatbots to handle customer inquiries, providing quick, 24/7 responses.

- **Suncorp** uses AI chatbots on its website and mobile apps to assist customers with policy details, quotes, and general inquiries. These chatbots are powered by **natural language processing (NLP)**, allowing them to engage in conversations and provide context-specific responses (Suncorp Group, 2023).
- **IAG** introduced **Mia**, an AI-powered virtual assistant, which helps customers obtain quotes, answer policy-related questions, and provide claims updates. The chatbot learns from customer interactions to become more effective over time, helping streamline communication and reduce the need for human agents (IAG, 2023).

These AI-powered solutions significantly enhance customer experience by ensuring that support is always available, reducing wait times, and providing accurate, timely responses to inquiries.



Claims Processing: Automation and Machine Learning

AI has made a profound impact on claims processing by automating many manual tasks and improving decision-making efficiency.

- **Suncorp** has employed machine learning algorithms to assess claims more efficiently. These algorithms analyze historical data to predict the likelihood of claims, helping the company generate more accurate repair estimates and approval timelines (Suncorp Group, 2023).
- **IAG** uses AI to speed up the claims process by leveraging **predictive analytics** to assess damage and recommend appropriate compensation amounts. The AI-driven system also analyzes historical claims data to identify patterns and predict future claims more accurately, reducing processing time and improving decision accuracy (IAG, 2023).

The integration of AI in claims processing not only reduces costs but also enhances the speed and accuracy of claims handling, contributing to a better customer experience.

Fraud Prevention: Detecting Anomalies and Reducing Risk

Fraud is a significant challenge for insurance companies, but AI is helping to identify fraudulent claims more effectively. Both Suncorp and IAG have implemented AI-based systems to detect anomalies and flag suspicious activity.

- **Suncorp** uses AI-powered fraud detection systems to analyze claims data and identify patterns that may indicate fraudulent activity. By applying **predictive modeling** and data mining techniques, AI helps Suncorp identify fraudulent claims with greater accuracy, reducing financial losses (Suncorp Group, 2023).
- **IAG** employs AI algorithms to monitor claims in real-time, detecting inconsistencies that could indicate fraud. This proactive approach helps reduce fraudulent claims before they are processed, ensuring legitimate claims are processed efficiently (IAG, 2023).

AI's ability to analyze large volumes of data quickly and accurately helps improve fraud detection, reducing risks and ensuring that insurance companies can protect themselves from financial losses.

3. The Future of AI in Australian Insurance

AI is expected to play an even larger role in the Australian insurance industry as it continues to evolve. Emerging trends include:

- **Fully Autonomous Claims Processing:** Future advancements in AI could automate the entire claims process, from the initial submission to payout distribution, making claims handling more efficient and transparent.
- **Predictive Underwriting:** AI-driven predictive analytics could allow insurance companies to assess risk with even greater accuracy, offering more personalized pricing for customers.
- **Blockchain Integration:** AI could be integrated with blockchain technology to create **smart contracts** that automatically execute when predetermined conditions are met, streamlining processes and reducing the potential for errors.

These innovations represent the future of industry, with AI driving further efficiency and personalization in insurance products and services.



4. Challenges and Considerations

Despite the many benefits, the adoption of AI in the Australian insurance industry also presents several challenges:

- **Data Privacy and Security:** The use of AI involves handling large volumes of sensitive customer data, raising concerns about data privacy. Insurance companies must invest in robust cybersecurity measures to protect customer information (Australian Financial Review, 2023).
- **Ethical Concerns:** AI algorithms can sometimes exhibit biases, which could lead to unfair treatment of certain customers. It is essential for insurers to ensure that AI systems are transparent and unbiased in their decision-making processes (Australian Insurance News, 2023).
- **Regulatory Compliance:** Insurance companies must navigate the complex regulatory landscape surrounding AI to ensure compliance with local laws and industry standards (Australian Prudential Regulation Authority, 2023).

Addressing these challenges will be crucial to maximizing the potential of AI while minimizing risks related to privacy, fairness, and regulatory compliance.

5. CONCLUSION / SUMMARY:

The adoption and integration of Artificial Intelligence (AI) have precipitated a profound transformation within the Australian insurance industry, driving substantial advancements across various domains, including operational efficiency, customer service enhancement, claims adjudication, and risk assessment. AI's capacity to harness and analyze vast datasets has facilitated the development of sophisticated predictive models, thereby optimizing risk mitigation strategies and underwriting processes. Through automation and intelligent systems, insurers have achieved greater operational agility and personalized engagement with policyholders, reshaping traditional service delivery paradigms.

Nevertheless, the rapid deployment of AI technologies necessitates a cautious approach, balancing innovation promises with stringent ethical considerations and adherence to regulatory frameworks. The increasing reliance on AI systems presents various challenges, particularly regarding data privacy, algorithmic transparency, and the potential for inherent biases within decision-making processes. The ethical implications of AI-driven systems demand rigorous scrutiny to ensure equitable outcomes and mitigate risks associated with algorithmic discrimination. Furthermore, the regulatory landscape must evolve in tandem with technological advancements to safeguard consumer interests and preserve the industry's integrity. It is imperative that stakeholders, including insurers, technology developers, and regulatory bodies, engage in collaborative efforts to establish robust governance frameworks that ensure the responsible deployment of AI while fostering an environment conducive to innovation.

In terms of future research, several avenues warrant exploration to fully comprehend the long-term ramifications of AI integration within the insurance sector. Future inquiries could focus on the implications of AI for labor dynamics within the industry, particularly regarding potential job displacement and the redefinition of roles. Additionally, research should address the evolving nature of regulatory oversight, examining how existing frameworks can be adapted to accommodate AI's unique challenges, and exploring the development of novel regulatory models that ensure fairness and accountability. The intersection of AI with emerging global challenges, such as climate change, cybersecurity risks, and systemic risk management, also presents a critical area for further investigation, potentially shaping the industry's strategic direction in the coming decades.

In summation, while AI undoubtedly holds transformative potential for the Australian insurance industry, its successful integration requires a nuanced approach that carefully balances technological



innovation with ethical imperatives and regulatory compliance. Pursuing continued academic inquiry in these areas will be essential to ensuring that AI is harnessed in a manner that is both socially responsible and conducive to the sustainable evolution of the insurance sector.

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Citious, Altious, Fortius – India’s Path to Educational Greatness

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Abstract:

Citious(Swifter), Altious(Higher), Fortius(stronger)

Latin Motto for Olympics coined by Principal of Paris College Dr. Henri Martin

There are three spirits essential for the creation of path to greatness found by The principal of Paris College Dr. Henri Martin .He realised that every student must have swifter,higher and stronger goal in life which must be inculcated by the teachers, educators and educationist so, he formulated this human spirit in three words. This motto was borrowed by olympic signifying the unity and of human spirit. It indicates human spirit is comprised of these three latin diction meaning human spirit always seeks citious, altious, fortius or it wants to become swifter, higher, stronger. The objective of this paper is to ignite self awareness, self esteem, self confidence, self motivation by Teachers and to actualise the vision of Four Ds(Discipline, Diligence, Dedication, Devotion) This human spirit can be conveniently affiliated with the spirit of pedagogues and pupils because, pedagogues always seek swiftness of spirit, higher spirit and stronger spirit among their pupils. The conventional educational definition mis leads teachers and learners both and that definition is to just obtain lack luster degree, which can make learners delta and epsilon and seldom alpha.If we come to think about the white swans of education then you will get the answer that pedagogues and pedagogy enable the human spirit of learners only three things. And this research design is descriptive based on research methodology with secondary data collection. The outcome of all these endeavour concludes in the notion that essential achievement for students is to be Touching the highest apogee from the lovest paragee.

Key Words: *Apogee, Educationist, Educator,Lack luster,Paragee, Swiftness of spirit.*

1. INTRODUCTION:

When anyone shoot for a greatness than as Dr. Covey has said “Think about the end before you befin” or Abul Kalam has said “ If you want to shine like a sun then learn to burn like a sun” meaning as Dr.Radhakrishna has said “Teachers and students are the pillars of the society” that means pedagogue and pupils must adopt, adapt and adept these trio latin words citious, altious,fortious without the absence of this trio nevagating the path to greatness cannot be cultivated hence, the aim of this is to make Guru and disciples both must consume and immerse them selves into diligent striving for the goals without ever getting burntout. Proper pedagogy demands learners and teachers both to strive, to seek and find it without yielding(Frost).tireless and relentless consentration and focus on the crusade of goal achievement is essential and that can be roped by roping the spirit of citious, Altious, Fortius. If teachers and learners are not privy to the fact that “ Small goal is crime” abul Kalam and neglect shrugging off this trio then achievement can be only lack luster and redundant sans any colors.

2. Literature Review

Historical Legacy and Reforms in Education (2020)

India has a storied educational tradition dating back to ancient institutions such as Nalanda and Takshashila. Post-independence, the focus shifted to creating an accessible education system. With the National Education Policy (NEP) 2020, the government laid a roadmap for achieving holistic development by integrating cultural roots with modern methods. NEP focuses on inclusivity, critical thinking, and lifelong learning, serving as a benchmark for contemporary progress (MHRD, 2020).

Global Competitiveness Through Excellence (2021)

To rank among global leaders, Indian institutions are encouraged to adopt standards similar to those of the Ivy League and other premier global universities. Rankings in QS (Quacquarelli Symonds) and THE (Times Higher Education) show Indian institutions steadily climbing the ladder. Initiatives such as the Institutes of Eminence (IoE) framework have boosted autonomy and research funding to compete globally (Rao & Mishra, 2021).

Digital Education Revolution (2022)

Digital transformation accelerated during the COVID-19 pandemic. Platforms like SWAYAM (Study Webs of Active-Learning for Young Aspiring Minds) and Diksha (Digital Infrastructure for Knowledge Sharing) bridged educational gaps, especially in rural areas. The pandemic emphasized the need for robust digital infrastructure, making hybrid learning models the norm in post-pandemic education (World Bank, 2022).

Emphasis on Research and Innovation (2023)

Research output in India has surged with the promotion of programs like SPARC (Scheme for Promotion of Academic and Research Collaboration) and IMPRESS (Impactful Policy Research in Social Sciences). These efforts focus on multidisciplinary research, international collaborations, and providing grants to encourage innovation, positioning India as a global research leader (AICTE, 2023).

Expansion of Higher Education Institutions (2021)

The number of higher education institutions (HEIs) in India has expanded from 20 universities at independence to over 1,000 in 2021. However, this quantitative growth often overshadows qualitative improvements. Policies like Rashtriya Uchcharitar Shiksha Abhiyan (RUSA) aim to enhance quality and equity, bridging the gap between urban and rural institutions (MHRD, 2021).

NEP 2020's Structural Changes (2020)

NEP 2020 introduced a flexible 5+3+3+4 curricular framework to replace the 10+2 system, emphasizing skill-based education. This structure encourages early exposure to critical thinking, coding, and vocational training, aligning Indian education with global standards. The focus on Early Childhood Care and Education (ECCE) underscores the importance of foundational years (Govt. of India, 2020).



Improving Teacher Training (2021)

Teacher quality directly impacts student outcomes. Programs like NISHTHA (National Initiative for School Heads' and Teachers' Holistic Advancement) focus on capacity building, enabling educators to adopt innovative teaching practices. Special training modules for digital learning have also been introduced to bridge skill gaps (MHRD, 2021).

Addressing Urban-Rural Educational Divide (2022)

While urban centers boast access to high-quality education, rural areas struggle with inadequate resources. Government schemes like Samagra Shiksha Abhiyan (SSA) aim to universalize access and provide essential resources. Initiatives like the PM Poshan (Prime Minister's Nutrition Scheme) ensure that mid-day meals support enrollment and attendance in rural schools (Planning Commission, 2022).

STEM and Artificial Intelligence Integration (2023)

Recognizing the demand for future-ready skills, India has integrated STEM (Science, Technology, Engineering, Mathematics) and AI (Artificial Intelligence) into school and university curricula. AICTE (All India Council for Technical Education) has developed AI-specific modules for technical education, fostering industry-ready graduates (AICTE, 2023).

Global Academic Partnerships (2023)

India's higher education landscape has embraced global collaborations under programs like GIAN (Global Initiative of Academic Networks). Partnerships with countries such as the US, UK, and Germany aim to bring international faculty to Indian institutions and enhance research outputs, making India a destination for global talent (MEA, 2023).

Gender Equality in Education (2021)

India has made significant strides in reducing gender disparity through initiatives like Beti Bachao Beti Padhao (Save the Girl Child, Educate the Girl Child). As of 2021, the female literacy rate has improved significantly, especially in rural regions. Programs focused on STEM participation for women are also gaining momentum (UNESCO, 2021).

Role of the Private Sector in Education (2020)

The private sector has complemented public education by introducing innovative models and curriculum flexibility. Universities like Ashoka, Shiv Nadar, and Azim Premji have pioneered liberal arts education in India, focusing on interdisciplinary approaches (Yadav, 2020).

Vocational Training Through Skill India (2022)

The Skill India initiative under the National Skill Development Corporation (NSDC) aims to train millions in job-ready skills. Vocational education is now a part of secondary schooling, bridging academia with industry needs and reducing unemployment rates (NSDC, 2022).



Attracting International Students (2023)

The Study in India program has been a game-changer in positioning India as a global education hub. Offering scholarships and creating conducive learning environments for foreign students has significantly boosted India's academic image on the global stage (EduGov, 2023).

3. Objective:

The objective of choosing this topic, India was the womb of education then it plunged into the Tumb of education but, thanks to NEP India has been getting in to the womb of education again. Thanks to educators and educationists every alumnus is looking like resurrection of the Takshila and the Nalanda. Academic faculties are weeded to the spirit of Dronacharya, Eklavya and Aryabhata. Whereas Indian students turning out akin to Arjuna, and Eklavya, the following objectives elaborate the citious, altious afortious-India's path to educational greatness.

- To instill power of critical thinking among learners
- To enable learners to immerse in into the reservoirs of erudition
- To motivate learners to embrace global goals with personal
- To ignite self awareness, self esteem, self confidence, self motivation
- To trigger and spark higher, faster, stronger spirit of gladiator
- To make the country better, greater and also the world
- To realise and dedicate the self to the social responsibilities
- To actualise the vision of Four Ds(Discipline, Diligence, Dedication, Devotion)

To instill power of critical thinking among learners

The key objective of this essay targets is to instill Kaizen among the thinking of learners by the teachers meaning, constant improvement of learners by teachers, culminating pupils to the level of pedagogue. It is the essential part of pedagogy to squeeze the pedagogical heart, soul sanctum and sanctorium into heart, soul and mind of learners.

To enable learners to immerse in into the reservoirs of erudition

The learners must embrace the mantra bestowed by English poet of eminence Alexander Pope " little knowledge is dangerous thing, drink deep taste not to this castelian spring" it is the essential obligation to motivate his disciples not to just taste the taste or erudition. But, immerse in to the reservoir of true and veritable knowledge which is being imparted by veritable educators and educationists

To motivate learners to embrace global goals with personal

Learners are obliged to rope dual goals with bait of precious pedagogy one sacred aim is to make personal life better and greater with help of education. The second goal is to generously contribute into the global goals to achieve better and greater world for every earthling to breath freely and live with masterful ease.

To ignite self awareness, self esteem, self confidence, self motivation

Auto qualities among the millennials of the nation are the most essential, precious and sacrosanct qualities auto motivation, inspiration, goals, musings to chase and to imbibe are the cardinal qualities auguring to auguring to every human. These are not exo biological or worldly qualities but astrobiological or heavenly qualities only guru can bestow to his disciple. Pedagogue and pupils have very cardinal bonds between them and as such pedagogue will not omit even an iota of his or her



prudence but, commit every iota of his or her virtues and wisdom in the sanctum sanctorum of disciples to make them larger than life, walking tall.

To trigger and spark higher, faster, stronger spirit of gladiator

The aim, objective can motto of this presentation is to create the army of students with the spirit of soldiers and gladiators with different connotation which is to combat not against human but all kinds of human ills, evils, grievances, ignorance syndrom, fear, frailty, hunger, hopelessness, injustice, prejudice, discrimination, social unfairness and weakness to challenge all the challenges and limitation of life. It is a veritable obligation of every teacher from KG to PG to create better human race akin to gladiator or alpha breed by pedagogy.

To make the country better, greater and also the world

The mission of this penning this is to make this country and this world better and greater by the longest lived and strongest prop define education by Archimedes. This could revamp not only the homeland but also the domicile of eight billion folks on the global scale it is exclusively a learned, groomed, a citizen, altious, fortious, persona who can make this terra madra of ours heavenly and havenly place to rear our progeny with all kinds of godly blessings. This is again a very precious job cutout for all the educators and educationist to inspire among their obedient learners who are followers of today but, leaders of tomorrow.

To realise and dedicate the self to the social responsibilities

To promote, to progree, to prosper this global society is collective as well as individual responsibility of every young, vibrant, dynamic able, capable and viable groomed scholar of the society. One who has been given precious knowledge with veritable critical thinking by his or her mentor, icon must not ever mull that the responsibility belongs to him or her encompasses only personal needs and necessities but, every learned person must also realise that his is for the world and world is for him. Hence, he must accomplish not for the self but for surrogates as well.

To actualise the vision of Four Ds(Discipline, Diligence, Dedication, Devotion)

Pedagogues always strive seek and find(Frost) all these for veritable virtues and precious trait in learners. The goal and objective of every educator and every educationist happen to be the learners must not merely have the textual knowledge alone but every teacher in the world strive to inculcate this four Ds magic mantra and survival sutra which is discipline in every walk of life whether it is talk or task, diligence in every sphere of life for every stage or every seven stages of life(Shakespeare), dedication to our obligation, our duties, our responsibilities, our nation, family. Devotion to our religion, parents, mission, goal and objective these paradisiac qualities are cultivated among students by their venerated and reverend pedagogues.

4. Research Methodology:

The research methodology for this study encompasses a mix of qualitative and quantitative approaches to thoroughly investigate India's educational progress, challenges, and strategies for excellence. Below are the key steps and methods employed:

4.1. Research Design

The study follows a descriptive research design to analyze the historical, current, and prospective scenarios in India's education sector. The design allows the integration of secondary data analysis, literature review, and case studies.



4.2. Data Collection Methods

- **Secondary Data:** Data was collected from governmental reports, policy documents, research papers, and educational frameworks such as:
 - National Education Policy (NEP) 2020 documents.
 - Reports from NITI Aayog and UNESCO on education development.
 - Published rankings and statistics from NIRF and UGC reports.
 - Digital platforms like DIKSHA and SWAYAM.
- **Case Studies:** Examination of specific successful models in Indian states such as Gujarat and Kerala, known for their innovative education systems.
- **Surveys and Reports:** Analysis of surveys conducted by bodies like AICTE (All India Council for Technical Education) and ICSSR (Indian Council of Social Science Research) on educational infrastructure, student outcomes, and inclusivity.

Analytical Tools

- **Quantitative Analysis:** Statistical methods were used to analyze enrollment rates, literacy levels, and Gross Enrollment Ratio (GER) from sources such as MHRD and UDISE+.
- **Qualitative Analysis:** Policy reviews and content analysis were conducted on NEP 2020 and other reform-oriented frameworks.

Research Scope (The study focuses on)

- Reforms introduced by NEP 2020 and their expected impact.
- Role of technology, such as digital learning platforms, in shaping modern education.
- Comparisons of India's educational progress with global benchmarks.

5. Limitations

- The research relies heavily on secondary data, which may limit real-time analysis.
- Regional disparities in data availability, especially from remote areas, pose challenges in forming a holistic view.

6. Result and Findings.

Citious(Swifter):

7. Winding up entire life as plegiariser is silly:

Students must not windup entire learning phase of life learning only one perticulat art, craft or career but, faculties and learners both must emphasis on seifter learning getting maximum amount of erudition within the minimal time frame for instance Asian MBA aspirats learn twentyeight to thirty books in four Semester where as eurpoeand america MBA aspirants study onehundred four books of extra curriculum that is swiftness of attaining and retaining knowledge and erudition.

Swift learning enables learners for critical thinking:

Pedagogues in indian universities always pull and push pupil to learn or imbibe every learning parameter fastest for swiftest in order to retain greater degree of knowledge from their pedgagogues and retain it for life time this is always the noble objective, noble mission of indian teacher with missionary zeal and zest. They donot want to cultivate sluggish and sloth traits among their pupils but, swifter trajectory of learning make them learn most in one life.



Citious education is varitable education:

Indian teachers or pedagogues always strive to excel their learners on the scale of education with a citious spirit because swifter learning and swifter teaching both can cultivate swifter human spirit among the learners hence, indian teachers never inspire or motivate their pupils to become slow and sliggish zombies. But, veritable citious in heart, soul and mind.

The spirit of citious is genuine spirit of teaching and learning:

All the pedagogues who are scholarly and erudite realise that the citious or swifter performance can achieve the goal, objective and mission because teachers donot appreciate sendentary or sloth , lethergic or lazy learners who can not perform swiftly and as such can not imbibe entire corpus of education or syllabus within the time frame. Hence, the pedagogues always strive and take due diligence to cultivate seifter spirit among the students.

Seeking scant corpus of erudition:

Pedagogues would never approve or endorse their pupil obtaining only a scant amount of excellent erudition from them but, the pedagogue would strive diligently to stuff their pupils with overloading of erudition so that they may attain today and retain for life time some nations have sluggish pedagogues providing sluggish pedagogy to the sluggish pupils hence, pupils obtain only piecemeal education imparted by their teachers and dribs and drabs manner which is not sufficent for life.

Altious(Higher):

Touching the highest apogee from the lovest paragee:

Every pedagogue in the world always seeks that his pupil will travel or his or her trajectory must be towards only one direction that is northerly direction or they must be travelling from lowest nadir to highest nova. To pedagogue in his or her life would like to see his creation meaning students either regress towards soudenly direction becoming stagnant statusquo but, every pedagogue would ignite higher or altious human spirit among his precious learners encouraging them them to shoot for the starts, shoot for the glorious goal because teachers motivate their learners that “Small goal is crime” Abul Kalam hence, pedagogues shall never discourage their learners from lofty and hefty goal only trajectory aiming towards the firmament.

Common goal betwixt pedagogues and pupils:

Both pedagogues and pupils aim high and only high to the constollation. They never target the goal on the ground but, goal in the space because they are targeting altious goal, altious aim and altious achievement their trajectory and target both are racing and marching towards the nova and not nadir. Indian pedagogues are proud of accomplishments of their pupils they are always thrilled and excited more for their pupils roaring success rather thantheir own modest stride indian teachers always take pride in creating their pupils better comprehensively then they are and that is the reason they always push and pull, hustle and bustle to reachout and touch the altious, the highest point of apogee from the paragee.

Pedagogues and pupils both excel simultaneously:

Indian teachers never compel their pupil to ecelerate their sky worldly trajectory all alone but indian teachers never ever care about their own comfort and convinient in propelling or providing boost to their students to the altious apogee. Their aim and objective happen to be to shoot the stars and as such both pedagogue and pupil will propel and excel them selves to their deserving and desired culmination or destination which must not be at the patee but the altious apogee. Teachers always instill these three



mantras given by Dr. Henri Martin which are citious, altious, fortious making their pupil perfect and absolute and never obsolete.

Pedagogy is never a mission to nadir:

All the erudite pedagogues are very privy to the fact that teaching and learning both are not the endeavours leading the students to the nadir or the lowest paragee. But, pedagogical diligence and due diligence always propel the learners towards altious apogee hence, teachers always conduct student audit and try to learn that his students are better today than they were a week ago or fortnight ago, a month ago a years ago or quinquannium ago. This student auditing will provide adequate corpus of gratification to the teacher that he has been propelling students in an absolutely perfect direction of culmination meaning his learners have been marching towards altious at the meteoric pace.

Learning trajectory is always marching to the north:

Altious connotes excelling higher and higher at meteoric pace the trajectory must always be targeted to the north shooting the stars, meteors, asteroids and comets. Its pace must be to touch the nova and never nadir meaning the teachers who have adopted altious incorporate this altious or higher human spirit in their pedagogical stride and they never allow wittingly or unwittingly their learners travelling in opposite direction meaning always progress never plateau. Pedagogues determine what should be the destiny of their learners by the comprehensive deeds simultaneously. In a nutshell, the goal the aim, the objective and the mission of every teacher with missionary zeal and zest must be to propel their disciples to the highest apogee of altious such as veritable gurus or mentors, icons.

Fortious((Stronger)

Fortious meaning being stronger is the fundamental objectives of proper pedagogy students who are wedded to the spirit of fortious or stronger can achieve all the goals with a masterful ease.

Pedagogy, imparting or seeking is not cup of tea of everyone:

Meaning marrowy students, and teachers can only triumph because weak, meek or sick type of pedagogue or pupil can never score any progress on the path of greatness hence, both teachers and students must have been wedded to the spirit of Dronacharya, Arjun and Eklavya must be marrowy like a warrior resolved of Gautam Buddha. As Gandhiji has said “ Sustainable Education is Brahmastra to alter everything in the world” hence, Education is not a simple tool that every Tom, Dick and Harry can triumph it and becomes an erudite in life but, only those who can realise, materialise and actualise existential fortious can be veritable victor in the sacrosanct profession.

Lack luster zombie culture:

If students can not propel him self to the highest apogee by being fortious then, his or her efforts in progressing on the path of progress will be all negated because erudition according to Archimedes is the longest lived and strongest property which every student can move the world around single handedly. So, education according to Nelson Mandela is the exclusive tool you can change the world, so, fortious spirit of pedagogy is the exclusive spirit which can lead individual, society, nation and the world to the sovereign power. so, if fortious is not achieved by the learner or imparted by the pedagogues then, entire society will be created in Zombie Culture in which one would not spot the spirit of Citious, Altious, Fortious.

Fortious, turns pupils and pedagogues mentally, physically and spiritually formidable:

The mission of fortious is to make entire society of creative and critical thinkers at that job is being conscientiously, faithfully and mindfully performed by teacher, educators and educationist who all



contribute their precious synergy in achieving all three goals of citious, altious, fortious, turning the learners in to Global Gladiators with the spirit of akin to warriors of Olympia.

Human comprehensive strength rules the multiverse:

The Universe only worships those who are strong in every walk of life with fortious of pedagogical spirit inculcated among them by their able, capable and viable educators and educationists. Learners are the mirror image of their teachers. If, pedagogues inculcate apt and appropriate very, positive, critical pedagogy then, their students would turn out exactly their mirror image otherwise entire mission, objective and aim of dispensing education for its variable purpose will be totally forfeited and mission would be lost, endeavors will fizzle out, efforts will mislead and outcome will be negative.

Fortious citizenry is the precious asset of the nation:

The weak, meek, sick and whimsical millennials or the youth of the nation are of no formidable use of the nation they are girly and not gladiators, they are redundant for the comprehensive needs of the nation. It is the fortious gurus and disciples who create the world in a better form and better shape. Because, fortiously groomed teachers can make not only their learners great and gladiators but they can make all world great and gladiators.

Discussion:

India's educational system has embarked on an ambitious journey to enhance its global standing in the realms of knowledge, equity, and innovation. Guided by the principles of "Citius" (faster), "Altius" (higher), and "Fortius" (stronger), the nation aims to overcome historical challenges and leverage modern reforms to elevate educational outcomes. This discussion highlights the key factors contributing to India's pursuit of educational excellence.

Historical Foundations and Educational Transformation

India's educational system has deep roots, from the ancient centers of learning like Nalanda and Takshashila to the colonial-era changes that reshaped education. While these ancient institutions focused on diverse subjects, the advent of British colonialism led to an education system that primarily served administrative needs. However, post-independence, India's education system sought to restore its ancient educational ideals while addressing contemporary challenges. This resulted in a complex system that strives to serve its vast and diverse population.

The National Education Policy (NEP) 2020: A Vision for the Future

The National Education Policy (NEP) 2020 is a transformative document aimed at shaping India's educational landscape for the next few decades. It emphasizes:

- **Access and Inclusivity:** NEP sets ambitious goals, such as achieving 100% Gross Enrollment Ratio (GER) in primary education by 2030 and addressing disparities in education for marginalized communities, girls, and rural populations.
- **Digital and Technological Integration:** The NEP acknowledges the importance of technology in education. Digital platforms like SWAYAM (for online learning) and DIKSHA (for digital content creation) are pivotal in making quality education more accessible to remote areas, improving both reach and engagement.
- **Holistic Development:** The policy promotes a shift towards holistic learning, including the development of critical thinking, creativity, and emotional intelligence. It envisions making India a global center for innovation and research by encouraging interdisciplinary approaches in education.



Gross Enrollment Ratio (GER) and Vocational Education

India has made strides in improving GER at various education levels. The government has set a target of increasing the GER in higher education to 50% by 2035. The emphasis on vocational education and skill development is a crucial part of the strategy, equipping students with the skills required for the workforce, aligning with the demands of a rapidly changing global economy. Programs such as the Skill India Mission focus on creating a more robust and diverse labor force, capable of contributing to a more innovative economy.

Challenges: Regional Disparities and Infrastructure

Despite the progress, challenges remain. There are significant disparities in access to quality education between urban and rural regions. Educational infrastructure in remote areas often lacks the resources needed to provide an effective learning experience. Teacher training and curriculum reforms also remain crucial to bridging these gaps. The implementation of NEP across various states must address local socio-economic realities to ensure equitable outcomes.

The Role of Technology in Education

Technology has played a pivotal role in transforming education in India. Platforms like NPTEL (National Programme on Technology Enhanced Learning) and SWAYAM provide students access to quality content and courses from top universities and experts. The increased use of technology in classrooms, along with the growth of EdTech startups, has made learning more interactive, personalized, and accessible across the country. The growing adoption of AI, machine learning, and virtual classrooms promises to further enhance the learning experience.

Global Education Benchmarks and International Collaboration

India's educational aspirations also align with global standards. To ensure quality and competitiveness, the government is focused on improving the quality of higher education institutions through rankings like the NIRF (National Institutional Ranking Framework). The inclusion of research, partnerships with global institutions, and setting up international campuses are part of the broader vision to establish India as a global leader in education.

Conclusion: Towards Educational Greatness

India's path to educational greatness is one of constant evolution, with reforms like NEP 2020 steering the country toward a more inclusive, accessible, and high-quality education system. By balancing its historical legacy with modern-day innovations, India aims to achieve "*Citius, Altius, Fortius*" in education — aspiring to be faster in progress, higher in global standings, and stronger in terms of educational outcomes and inclusivity. India's educational trajectory is a testament to the potential for positive change, grounded in systemic reforms, technological advances, and a commitment to inclusivity. As the country moves forward, these efforts, if well-executed, could place India among the top educational powerhouses in the world. This discussion outlines the vision and challenges that accompany India's educational reforms, setting the stage for further dialogue on achieving a globally competitive and inclusive educational system.

India's path to educational greatness, inspired by the ideals of *Citius, Altius, Fortius*, requires synchronized efforts across policy, infrastructure, and culture. By blending traditional strengths with innovative approaches, India is well-positioned to emerge as a global education leader. Inclusion I



would like to conclude that diadectic definition of our teacher, educationist must not be the one who just windsup the textual course by teaching superficial textbook material which doesnt save students life but on the contrary I would emphasise the precious pedagogy and pedagogues always emphasis on the learning of life to elivate the critical thinking, analitic power, cognitive and linguistic skills, to sharpen social, personal and globla understanding, in a nutshell, teacher doesnt teach and must not teach textbooks alone but teach how to think about comprehensive vista of life, concentrate about alpha subject, beta and theta matters ordelta issues to become a veritable essential denizens of the world that is the most significant takeaway of appropriate and precious pedagogical mission as Late Abul Kalam has said “ small goal is crime”

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Innovations in Food Packaging for a Sustainable Economy

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Abstract: *Over the years, the food industry has come under intense pressure to make it sustainable, primarily on the issue of packaging. Packaging of food product serves its protection, enable increased shelf life, and give consumers much more convenience. However, the materials used in packaging specifically, plastics, pose a very serious environmental threat. This research paper through analysing secondary sources including research papers, journals, books, commentaries, authoritarian reports, etc. will discuss the innovations in food packaging in the context of moving towards a more sustainable economy in future. The paper presents some of the most significant developments in biodegradable, recyclable, reusable, and minimal waste packaging solutions which leads to ensure not only sustainability but also circular economy like McDonald uses corrugated cardboard boxes for packaging the food which is 100% recyclable, this undoubtedly has many benefits like reduction of carbon footprints and harmful toxins but is not free from multiple challenges. The paper also explores some of the ways that technological leaps, consumer behaviour, and regulatory frameworks can contribute to the transition toward sustainable food packaging by addressing the prevailing challenges. Finally, the paper also explores the possibility of lowering environmental impacts from food packaging in a circular economy model as recycling and reusing the same products would slow down the use of natural resources and reduction in greenhouse gas emissions, which will also guarantee a more sustainable and resource-efficient future.*

Key Words: *Innovation, Food Products, Packaging, Sustainable, Environmental.*

1. INTRODUCTION

The food packaging industry plays a crucial role in the global economy, serving as a bridge between food production and consumption. However, traditional packaging methods often contribute to significant environmental challenges, including plastic pollution, resource depletion, and greenhouse gas emissions. As awareness of these issues grows, there is a pressing need for innovative packaging solutions that align with sustainable practices. This paper delves into the latest advancements in food packaging, focusing on biodegradable materials, smart packaging technologies, and circular economy principles.

In addition, the product is marketed through packaging. The printing on the packaging and the material are essential aspects of packaging. Many consumers buy food products influenced by the sustainability orientation of the packaging material, as evidenced by studies.

Packaging is one of the most significant components of the food industry associated with quality and safety of the food, including the shelf life of the food and marketing to the customer (Yan, Hsieh, & Ricacho, 2022)



Environmental Impact of Traditional Packaging

Traditional food packaging, predominantly made from plastics, poses severe environmental threats. The production and disposal of plastic packaging contribute to pollution, habitat destruction, and climate change. This section discusses the lifecycle of conventional packaging materials and their ecological footprint.

Traditionally, packaging of food products has mainly been done using plastic materials. In some cases, plastics are not recyclable. This has resulted in contributing to environmental problems such as the depletion of natural resources and the massive production of wastes and global warming (Nilsen-Nygaard et al., 2021)

Consumer Awareness and Demand for Sustainability

In recent years there has been a significant shift in consumer behaviour towards sustainable packaged foods because of growing environmental awareness and health consciousness. This awareness is fuelled by various factors including Internet, social media, etc., Many consumers are motivated by ethical concerns such as animal welfare and fair-trade practices which influence their packaging decisions.

Innovations in Packaging Materials

Biodegradable and compostable materials are at the forefront of sustainable packaging innovations. This section examines various types of biodegradable plastics, such as polylactic acid (PLA) and polyhydroxyalkanoates (PHA), and their applications in food packaging.

Edible packaging is an emerging trend that not only reduces waste but also adds value to food products. This section discusses the development of edible films and coatings made from natural ingredients, their benefits, and potential challenges.

Recyclable and reusable packaging solutions are essential for reducing waste and promoting a circular economy. This section analyses the advancements in recyclable materials, such as glass, metal, and certain plastics, and the role of reusable packaging systems in food distribution.

Active packaging technologies enhance food preservation and safety by interacting with the food product. This section explores the use of oxygen scavengers, moisture absorbers, and antimicrobial agents in food packaging.

Intelligent packaging incorporates sensors and indicators that provide real-time information about the condition of the food product. This section discusses the potential of smart labels, freshness indicators, and temperature monitoring systems in improving food quality and safety.

Life Cycle Assessment (LCA) is a critical tool for evaluating the environmental impact of packaging materials. This section explains the LCA methodology and its application in comparing traditional and innovative packaging solutions.

Optimizing the supply chain is vital for reducing the carbon footprint of food packaging. This section discusses strategies for minimizing packaging waste, improving logistics, and enhancing overall efficiency in the food supply chain.

Regulatory and Industry Standards

Government regulations play a significant role in shaping the food packaging landscape. This section reviews current regulations related to food safety, environmental protection, and packaging waste management.

Various industry initiatives and certifications promote sustainable packaging practices. This section highlights key organizations, standards, and programs that encourage the adoption of eco-friendly packaging solutions.



2. CASE STUDIES (ANALYSIS)

Case Study 1: Unilever's Sustainable Packaging Goals

In 2017, the Unilever set a number of goals that it would try to achieve before 2025 including making 100% of its packaging recyclable, reusable or compostable, reducing virgin plastic packaging use by 50%, and incorporating 25% recycled plastic in its plastic packaging. For what it's worth, the company is sure to hit that last goal-too it claims to have used 22% recycled plastic in 2023 and up from 21% of recycled plastic used in 2022.

Using Less Virgin Plastic:

The company has reduced its virgin plastic use and introduced new product formats and packaging solutions, like laundry sheets and capsules in cardboard boxes, to reduce or remove plastic entirely. We tried over 50 reusable and refillable packaging models around the world and even managed to scale some at home refill solutions. And we redesigned packaging to be lighter which can reduce both plastic and transport emissions.

Incorporating more recycled Plastic:

Unilever has increased its use of recycled plastic to 22% of their global plastic packaging. It puts them on the track to reach 25% goal by 2025. They have built the global demand for, and supply of, high quality recycled plastic, which is also called post-consumer resin or 'PCR'. The number of their PCR supplier has grown from only 2 in 2016 to more than 60 today. Many of their largest brands, such as Hellmann's Dove and Sunlight are now using 100% PCR in their bottles whenever possible. 69% of their portfolio using rigid plastic design and 31% of their portfolio using flexible plastic packaging and tubes.

Future Goals:

- Reduce virgin plastic footprint by 30% by 2026, and 40% by 2028, there is a 18% reduction compared to 2019.
- Their 100% plastic packaging should be reusable, recyclable or compostable.
- Use 25% recycled plastic in their packaging by 2025.
- Collect and process more plastic packaging than they sell by 2025.

Case Study 2: Coca-Cola's Circular Economy Model

The Coca-Cola Company has said that it must help to fix the global plastic waste problem. It will use its size and presence in different markets to meet its sustainability goals, reduce waste pollution, and lower its carbon footprint.

By 2030, Coca-Cola's manufacturing plants which are called as priority leadership locations, aims to reduce, reuse, recycle and restore the water used in their operations in the nearby watersheds for helpful social, economic, and/or uses by other groups.

Coca-Cola's shared vision to adopt a packaging material circular economy requires designing out waste through potential value extracted from recyclable materials. Encouraging the consumer to play their part remains challenging. For example, in South Africa their bottling partner Coca-Cola Beverages South Africa (CCBSA) has recently introduced a 2-litre returnable/refillable PET - RefPET - bottle in the Eastern Cape, Limpopo, North West, Mpumalanga, and parts of the Free State.

Bottling partner Coca-Cola Peninsula Beverages (CCPB) in the Western Cape has used returnable/refillable PET bottles since introducing the 1.5-litre pack in 1992.



CCPB has invested in a returnable glass bottle (RGB) line and introduced 300ml and 500ml bottles. CCPB supplies 1.5l returnable/refillable PET bottles in 11 flavors, while RGB bottles are available in numerous flavors.

Case Study 3: Eco-Friendly Packaging by Nestlé

Nestlé has set very ambitious targets. It promises to make 100% of its packaging recyclable or reusable by 2025. The company also plans to cut its use of virgin plastics by one-third in the same period. Among the new initiatives by Nestlé, there is a commitment to a total of \$30m investiture in increasing the availability of recycled plastics for food use in the United States. Launching a food refill system for pets with a focus on sustainability in pet care in Chile. The company is also taking environmental-friendly steps by launching the first Maggi bouillon cubes packaged in recyclable paper in France.

The Nestlé Institute of Packaging Sciences addresses a range of science and technology topics, including refillable or reusable packaging, simplified packaging materials, recycled packaging materials, high-performance barrier papers, and bio-based, compostable, and biodegradable materials. Nestlé is off to a tremendous start, as 66% of its plastic packaging is already recyclable or reusable, and the firm has indicated that it will continue working on its sustainability targets.

3. CONCLUSION

From the above studies we can conclude that the innovations in food packaging are essential for fostering a sustainable economy. By embracing biodegradable materials, smart technologies, and sustainable practices, the food packaging industry can significantly reduce its environmental impact while meeting the needs of consumers and regulatory bodies. The future of food packaging lies in collaboration among stakeholders, continuous research, and a commitment to sustainability.

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A study On Awareness and Preference of UPI and QR Code Payment among People of Saurashtra Region.

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Abstract: *The study investigates the adoption of Unified Payments Interface (UPI) and QR Code payments among residents of the Saurashtra region in India. The research, which surveyed 200 individuals, found that while digital payment systems are popular among younger adults, older adults face resistance due to usability and security concerns. Factors such as cost, usefulness, trust, social influence, credibility, information privacy, and responsiveness were identified as significant determinants of user satisfaction. However, the overall satisfaction level was moderately low, suggesting that these systems might not fully meet user expectations or needs. Statistical tests revealed no significant differences in satisfaction based on age or educational level, suggesting a uniform perception across these demographics. The study recommends future research using longitudinal designs and qualitative methods to gain deeper insights into the psychological and emotional drivers of digital payment adoption. Additionally, exploring advanced security solutions like blockchain and educational initiatives could help address barriers and enhance user adoption rates. This research contributes to the understanding of digital payment systems' adoption in India, providing valuable insights for service providers and policymakers aiming to improve digital financial services' reach and effectiveness.*

Keywords: *UPI and QR Code Payment, online transactions, digital finance, blockchain*

1. INTRODUCTION AND BACKGROUND:

The Unified Payments Interface (UPI), launched by the National Payments Corporation of India (NPCI) in 2016, has dramatically reshaped the landscape of digital transactions in India (NPCI, 2024). As a pivotal element in the country's digital payment ecosystem, UPI has enabled significant shift toward real-time, seamless financial transactions using its robust, scalable infrastructure to facilitate instant transfers between bank accounts via mobile platform

At its core, UPI serves as a robust, scalable infrastructure that facilitates instant money transfers between bank accounts via mobile devices. Unlike traditional modes of digital payment that relied on cumbersome processes, UPI enables users to send and receive money with just a few clicks, using features such as virtual payment addresses (VPAs) or QR codes. This simplicity has made it particularly appealing to users across various demographic and economic segments, democratizing access to digital financial services.

One of the key strengths of UPI is its interoperability. Users can link multiple bank accounts to a single UPI-enabled application, eliminating the need for multiple apps or cards to perform transactions. This feature has not only streamlined the user experience but has also encouraged a wide range of financial institutions and fintech companies to adopt and integrate UPI into their ecosystems. As a result, the

platform has become a unifying force in India’s fragmented digital payment sector.

The introduction of UPI has also addressed long-standing challenges in the traditional banking system, such as delays in fund transfers, reliance on cash, and lack of access to formal financial services in rural areas. By enabling 24/7 transactions with no geographical limitations, UPI has bridged the urban-rural divide, empowering millions of unbanked and underbanked individuals to participate in the formal economy. Additionally, its user-friendly design and mobile-first approach have allowed even non-tech-savvy users to adopt digital payments with ease. In conclusion, UPI has reshaped the digital payments ecosystem in India by offering a fast, secure, and convenient alternative to traditional payment methods. Its impact extends beyond financial transactions, fostering financial inclusion and contributing to the country’s digital economy. As UPI evolves with innovations such as recurring payments, voice-activated transactions, and international integrations, it is poised to remain at the forefront of India’s digital transformation.

EXPONENTIAL GROWTH IN TRANSACTION VOLUME AND VALUE

TRACKING DIGITAL PAYMENTS

The transaction volume growth in October is the lowest compared to the growth recorded over the last 3 months, with August witnessing a 32% rise and September registering a 30% increase.

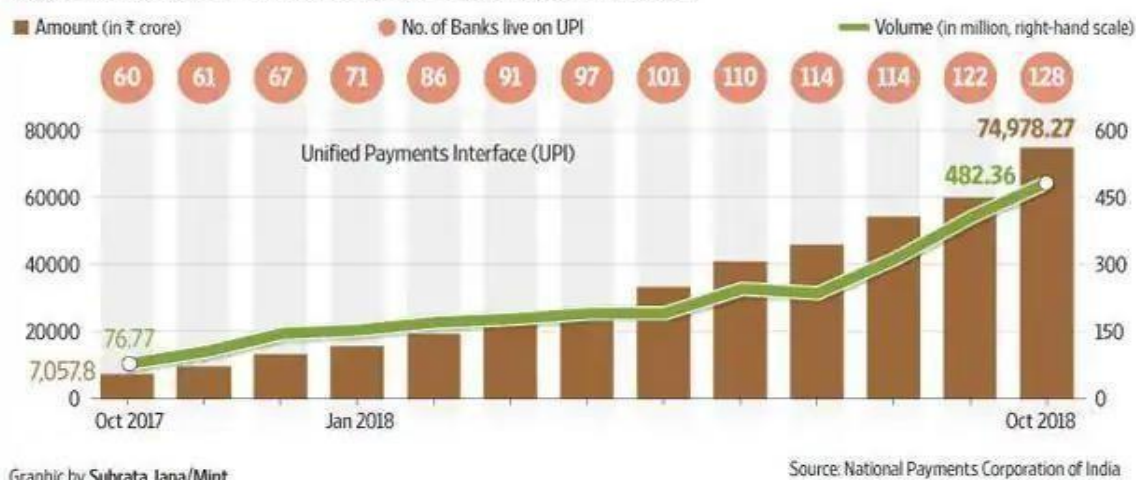


Figure 1: Tracking Digital Payments

As of January 2024, UPI boasted over 300 million monthly active users, with a staggering 12.20 billion transactions processed in just that month, amounting to ₹18.41 lakh crore (NCPI, 2024). This marked a substantial 41.72% increase in transaction value compared to the previous year. The total annual transaction value for 2023 reached around ₹182 lakh crore (\$2.2 trillion), which was a 59% increase in volume and 45% increase in value compared to 2022, underscoring the accelerated adoption and trust in this payment method (NCPI, 2024).

1. 2. DOMINANCE IN DIGITAL TRANSACTIONS:

The dominance of UPI in India's digital payment sector is evident, with the platform handling nearly 80% of all digital transactions in 2023 (NCPI, 2024). This widespread acceptance is due in part to the government's push for digital payments, amplified by the necessity of contactless transactions during the COVID-19 pandemic, and the inherent ease of use for both person-to-person (P2P) and person-to-merchant (P2M) payments. In the fiscal year 2023-24, UPI transactions crossed 100 billion for the first time, with 131 billion transactions noted—a 56% year-over-year increase. This growth trajectory highlights UPI's integral role in modernizing India's payment systems, moving them toward greater efficiency and inclusivity.



1. 3. SHIFTS IN TRANSACTION DYNAMICS:

The average ticket size (ATS) of UPI transactions has seen a decline, indicating a growing preference for using UPI for smaller, more frequent transactions. This trend is particularly noticeable in P2M transactions, where the ATS fell by 9% from ₹720 to ₹656 between the second halves of 2022 and 2023. Such changes reflect UPI's increasing penetration into daily commerce, facilitating transactions in diverse settings, from small retail shops to large commercial businesses.

1. 4. SIGNIFICANCE OF THE STUDY:

The significance of this study lies in its ability to provide comprehensive insights into the evolving dynamics of digital payments through the Unified Payments Interface (UPI) in India. Given UPI's pivotal role in transforming the Indian financial landscape, understanding its adoption patterns, user behavior, and economic impact is crucial. This research will contribute to the broader discourse on digital financial inclusion, offering policymakers, financial institutions, and technology developers empirical data to shape future strategies aimed at enhancing the efficiency and inclusiveness of digital payment systems.

1. 5. NEED FOR STUDY AND PROBLEM STATEMENT:

The rapid digitization of financial services in India, particularly the widespread adoption of Unified Payments Interface (UPI) and QR code payments, has led to significant disparities in adoption rates across different demographic segments and regions. This study focuses on the Saurashtra region to address this gap and provide insights into the factors influencing digital payment adoption in a specific geographical context. Key factors include regional disparities, demographic variations, financial inclusion, security concerns, and technological adaptability. The study aims to quantify current adoption rates, identify key demographic and socioeconomic factors, assess the impact of digital payments on financial inclusion, uncover specific barriers to adoption, and provide insights to guide policy formulation and technological improvements tailored to the needs of the Saurashtra region.

1.6. RESEARCH OBJECTIVES:

- To quantify the growth rate of UPI transactions over recent years and analyze the factors driving this growth.
- To assess the demographic and socioeconomic factors influencing the adoption and usage of UPI across different regions in India.
- To evaluate the impact of UPI on promoting financial inclusion among underrepresented and rural populations.
- To identify barriers to the adoption of UPI and suggest actionable solutions to overcome these challenges.
- To forecast future trends in UPI transactions based on current usage patterns and external economic factors.

1.7. RESEARCH QUESTIONS:

- What has been the annual growth rate of UPI transactions in terms of volume and value over the past five years?
- Which demographic and socioeconomic factors are significantly associated with the adoption and frequency of use of UPI?
- How does the use of UPI contribute to financial inclusion in rural versus urban settings?
- What are the main barriers hindering the adoption of UPI among potential users, particularly in rural areas?
- Based on current data, what are the projected trends for UPI transactions over the next five years?



1.8. RATIONALE FOR THE STUDY:

The rationale for this study stems from the rapid adoption of UPI as a dominant form of digital payment in India and its potential implications for economic policies and financial practices. As digital transactions become increasingly integral to India's economic framework, understanding the nuances of how different populations adopt and utilize these systems becomes critical. This study aims to bridge the knowledge gap regarding digital payment adoption, focusing on UPI due to its significant impact on daily transactions and financial inclusion. The findings could guide future developments in digital payment technologies and influence policies designed to enhance the reach and effectiveness of financial services across India.

With these objectives and research questions in place, we can next focus on developing a detailed questionnaire and methodology to effectively gather and analyze data for this study.

2: REVIEW OF LITERATURE

A study by Mishra and Tripathi (2022) highlights the significant growth of digital payment systems in India, driven by the National Payments Corporation of India's (NPCI) diverse offerings such as UPI, IMPS, and BBPS. Although the use of USSD declined, other formats have seen remarkable increases in adoption from 2016 to 2022, underscoring a robust move towards digital solutions.

Research by Shree et al. (2021) delves into how perceptions and trust in digital payments influence consumer behavior. Their findings suggest that demographic factors like age, gender, and income play crucial roles, but the overarching trust in the financial framework and prior experiences with online fraud also significantly impact usage patterns.

Kumar, Mishra, and Saha (2019) define DFS as financial services accessed through digital means like smartphones, ATMs, and POS devices. The paper emphasizes the importance of these services in providing a wide array of financial solutions including payments, credit, and insurance, pointing to a future with increased digital transactions.

Tiwari, Srivastava, and Kumar (2019) discuss the slow penetration of digital financial inclusion in India, attributed to a lack of education, awareness, and access to internet-enabled devices. Their study outlines the historical progression of banking reforms and highlights the need for improved digital financial literacy to enhance inclusion rates.

Gupta, Kapoor, and Yadav (2020) examine the 'Digital India' initiative, which aims to transform India into a digitally empowered economy. Despite the introduction of various digital payment methods, they identify significant barriers to full acceptance, including the high use of cash and the associated costs. Their research proposes solutions such as blockchain technology to address these challenges and improve the digital payment ecosystem.

As per a case study by A (2021), UPI's integration into India's digital payment sector post-demonetization has been monumental. The interface has not only streamlined banking services but also aligned with the government's Digital India vision, propelling a shift towards a cashless economy. The study emphasizes UPI's rapid acceptance, particularly in retail payments, driven by the proliferation of smartphones and enhanced internet connectivity. A SWOT analysis in this context highlights UPI's strengths and opportunities, suggesting its substantial contribution to broadening the digital economy's scope.

Le (2021) presents an integrated model combining Protection Motivation Theory (PMT) and the Unified Theory of Acceptance and Use of Technology (UTAUT) to evaluate the diffusion of mobile QR-code payment systems during the COVID-19 pandemic. The study identifies critical factors



such as perceived severity, perceived susceptibility, and self-efficacy, which influence the behavioral intention towards adopting QR-code payments. Additionally, the norm of physical distancing emerged as a significant motivator, enhancing the attractiveness of QR-code systems as a safe payment alternative during health crises.

Suo et al. (2022) extend the UTAUT2 model by including personal innovativeness, revealing that factors like performance expectancy, social influence, and the perceived value significantly contribute to the behavioral intention to adopt QR-code payment systems. Their findings highlight that while some elements like effort expectancy and hedonic motivation do not significantly impact adoption decisions, the inclusion of personal innovativeness enriches the understanding of user engagement with new payment technologies.

3. RESEARCH DESIGN AND METHODOLOGY

3. 1 RESEARCH PHILOSOPHY:

- Positivism, a quantitative approach, aligns with the survey's quantitative nature.
- Knowledge is derived from observable phenomena and empirical evidence.
- The study uses a deductive approach, starting with a theoretical framework and testing hypotheses through structured data collection and analysis.

3. 2 STUDY DESIGN:

- The study is cross-sectional, collecting data at a single point in time.
- This design is effective for descriptive studies capturing attitudes and behaviors related to UPI and QR Code payments in the Saurashtra Region.

3. 3 SAMPLING TECHNIQUE:

- Convenience sampling, a non-probability sampling technique, is used.
- The sample consists of 200 individuals from the Saurashtra Region.

3. 4 DATA COLLECTION:

- Data is collected through a structured questionnaire developed and administered via Google Forms.
- The questionnaire includes multiple-choice questions, Likert scale items, and open-ended questions.

3. 5 DATA ANALYSIS:

- Data analysis is performed using Microsoft Excel.
- Descriptive statistics and hypothesis testing are used to examine relationships between variables and test hypotheses.

3.6. ETHICAL GUIDELINES:

- The study adheres to ethical guidelines, ensuring confidentiality and anonymity of respondents.
- The information collected is used solely for academic purposes, and personal data that could identify participants is not collected.

Table No. 1 Descriptive Statistics

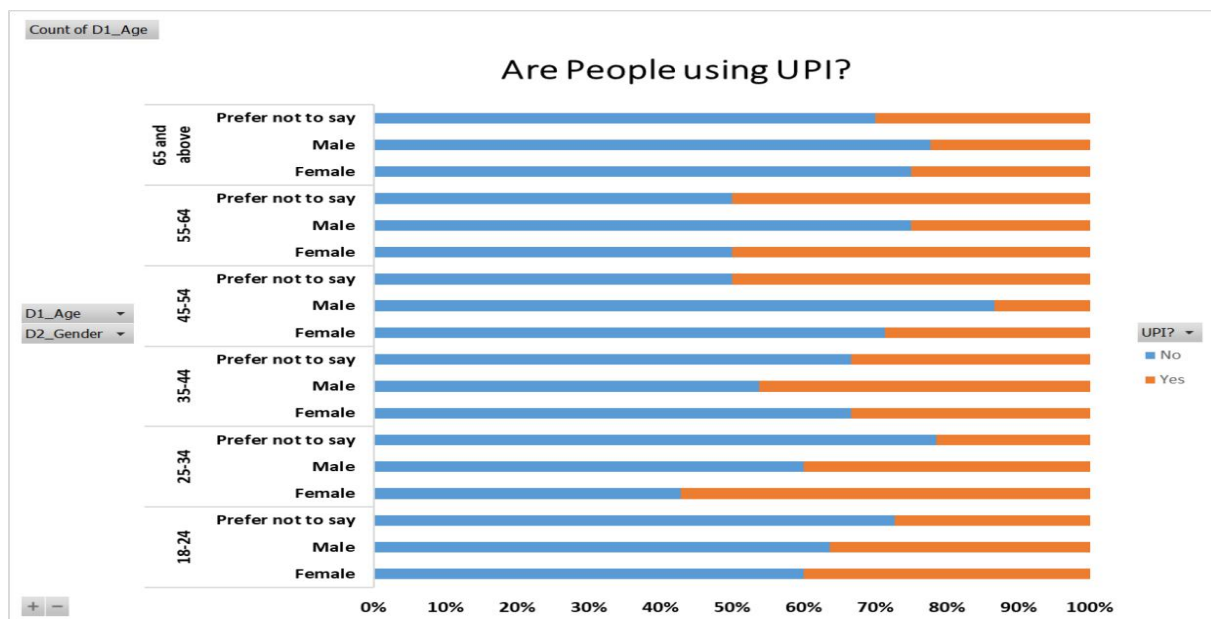
	Mean	Standard Error	Median	Mode	Standard Deviation	Kurtosis	Skewness	Range	Minimum	Maximum
Number of Methods Use Count	2.45	0.08	2.00	2.00	1.11	-1.32	0.08	3	1	4
S1_Ease_of_Use	1.80	0.03	2.00	2.00	0.40	0.17	-1.47	1	1	2
S2_Security_Feel	3.77	0.09	4.00	5.00	1.25	-0.40	-0.78	4	1	5
S3_Recommend_Likelihood	2.83	0.10	2.00	2.00	1.39	-1.20	0.36	4	1	5
B1_Tech_Issues	2.84	0.10	3.00	2.00	1.39	-1.21	0.21	4	1	5
B2_Security_Concern	2.67	0.09	2.00	2.00	1.30	-0.86	0.44	4	1	5
B2_Security_Concern	3.12	0.10	3.00	4.00	1.39	-1.27	-0.11	4	1	5



B3_Complexity	3.06	0.10	3.00	4.00	1.42	-1.28	-0.10	4	1	5
B4_Customer_Support	2.94	0.10	3.00	3.00	1.37	-1.20	0.07	4	1	5
B5_Acceptance_Limitation	2.70	0.10	2.50	2.00	1.37	-1.11	0.33	4	1	5
FU1_Increase_Usage	2.82	0.10	3.00	1.00	1.41	-1.28	0.15	4	1	5
FU2_Switch_Likelihood	2.92	0.10	3.00	2.00	1.39	-1.23	0.13	4	1	5
FU3_Future_Confidence	2.91	0.09	3.00	3.00	1.32	-1.09	0.04	4	1	5
FU4_Recommend_Friends	3.14	0.10	3.00	5.00	1.42	-1.26	-0.18	4	1	5
FU5_Responsiveness_Need	3.00	0.10	3.00	5.00	1.44	-1.33	0.03	4	1	5
Average_Satisfaction	2.98	0.03	3.00	2.85	0.42	-0.05	-0.01	2.38	1.69	4.08

The study provides a comprehensive overview of user perceptions and behaviors regarding the use of digital payment systems, specifically UPI and QR Code. The average number of digital payment methods used by respondents is 2.45, with a mean use count of 1.80. Users generally find the systems usable but are hesitant to recommend them due to security concerns and other barriers. The average satisfaction level across all parameters is moderately low, reflecting general reservations about the current digital payment systems. Challenges such as technical issues, security concerns, system complexity, and customer support are significant, suggesting areas for improvement. The findings show a moderate intention to increase usage and confidence in the future reliability of these payment systems, but the willingness to switch to alternative methods if current challenges persist highlights the contingent nature of user loyalty.

4.. UPI USAGE ANALYSIS ACROSS DIFFERENT DEMOGRAPHICS IN SAURASHTRA



REGIONFigure No. 3 UPI Usage Analysis

The study of UPI usage in the Saurashtra Region reveals a diverse distribution of adoption and use. Approximately 35% of respondents report using UPI, with 65% not using the system. Age-specific

trends show that the youngest age group (18-24) has the highest adoption rate, possibly due to greater tech-savviness or inclination towards digital trends. In the 25-34 age group, 39.47% of respondents use UPI, with female users (57.14%) reporting significantly higher usage than their male counterparts (40.00%) and prefer-not-to-say (21.43%).

Usage declines slightly in the 35-44 age bracket to 37.50%, with males showing a higher propensity to use UPI compared to females (33.33%). A notable drop in usage occurs in the 45-54 age group, where only 28.13% use UPI, and it continues to decline with age.

Gender differences also show that female respondents generally exhibit lower UPI usage rates compared to males, except in the 25-34 age group, where females lead in adoption. The preference not to disclose gender correlates with the lowest usage rates, particularly noticeable in the older age groups.

The data suggests that UPI adoption is not uniform across demographics, with significant variations suggesting targeted opportunities for increasing penetration. Young adults, particularly females in their late twenties to early thirties, are the most active users, possibly due to higher familiarity with technology, financial independence, and lifestyle needs favoring digital transactions..

5. Analysis of Ease of Use of UPI by age and educational background

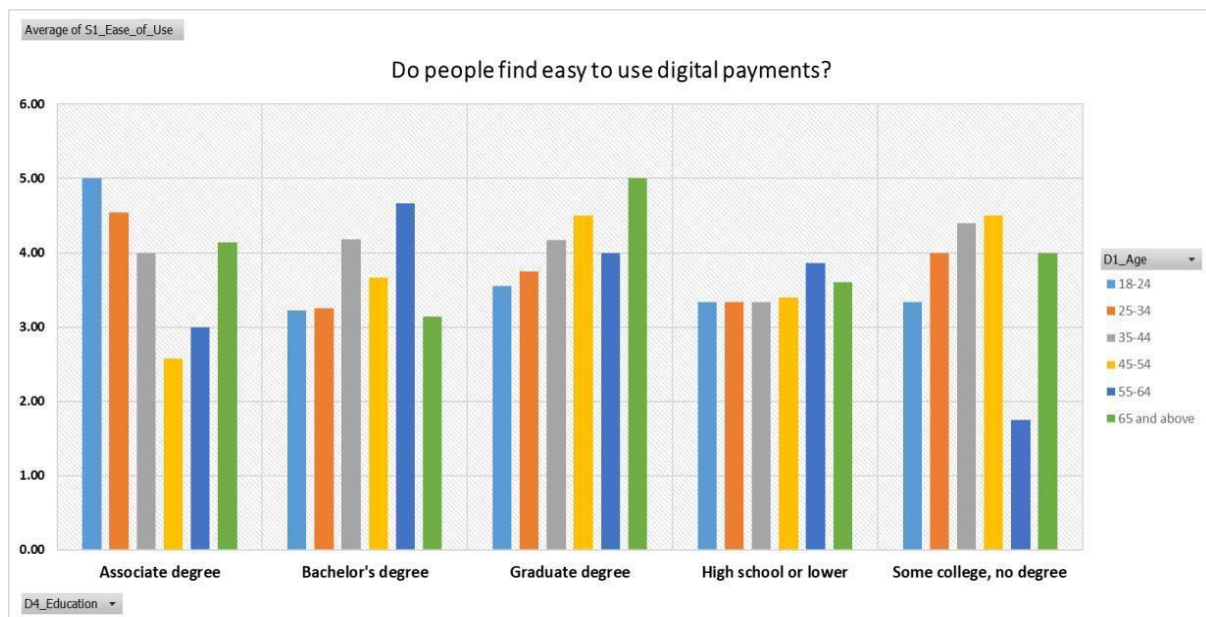


Figure 4: Ease of Use of UPI across Age and Educational Background

The study examines the perceived ease of use of UPI across various age groups and educational levels, revealing that demographic factors significantly influence user experience with digital payment systems. The average score for ease of use is 3.77, indicating a moderately positive user experience. Respondents with a graduate degree rate the ease of use highest across all age categories, with scores peaking at 5.00 for those aged 65 and above. Those with an associate degree generally find UPI easier to use compared to those with lower educational qualifications

especially in the younger age groups (18-24 and 25-34). However, there is a noticeable dip to 2.57 in the 45-54 age group. Individuals with only high school education or lower report lower ease of use scores, indicating potential challenges that could stem from limited digital literacy or less exposure to technology. Younger age groups (18-24 and 25-34) report higher ease of use scores, particularly those with some college education but no degree. There is a general trend of increasing scores in middle age



groups (35-44 and 45-54), especially among those with graduate degrees, which may reflect a combination of better financial resources, stable lifestyle, and accumulated experience with technology.

6. Findings And Conclusion

The study on the usage and satisfaction with digital payment systems in the Saurashtra region reveals several key insights that align with recent literature on digital payments. Factors such as cost, usefulness, trust, social influence, credibility, information privacy, and responsiveness play significant roles in influencing user satisfaction. These elements are crucial for enhancing service adoption and were reflected in respondents' feedback, where ease of use and security concerns were prominent. Barriers to adoption among older adults were noted, primarily due to functional, psychological, and risk barriers. These barriers significantly influence the attitude and non-adoption intentions among the elderly, underscoring the need for tailored strategies that address these specific concerns to increase digital payment adoption in this demographic. Demographic factors, such as age, education, and income, also significantly influence digital payment usage and satisfaction. Security concerns and technological enhancements were identified as major concerns among users, aligning with the study by Vijayan et al. (2020), which discusses blockchain as a potential enhancement for securing digital payments. Our respondents expressed a need for better security measures, which could be addressed by adopting advanced technologies like blockchain to alleviate their concerns and enhance trust in digital payment systems. Regional variations in digital payment adoption were also highlighted, with the Saurashtra area showing specific regional insights. The growth rate of UPI transactions over recent years was confirmed, driven by increased accessibility of smartphones and internet services, government initiatives promoting digital payments, and the public's growing familiarity with mobile-based transactions. Demographic and socioeconomic influences were identified, with younger adults, particularly those in the 25-34 age group, showing higher usage rates, while older adults showed considerable resistance due to usability and security concerns. Educational level and income also played crucial roles, with higher education and income levels correlating with increased adoption. The study suggests that UPI has a significant potential to promote financial inclusion, especially among underrepresented and rural populations. However, the actual impact is moderated by the availability of necessary technological infrastructure and literacy levels. Addressing these barriers through improved security features, simplified user interfaces, and community-based trust-building initiatives could enhance adoption rates. Future research should focus on longitudinal studies to track changes in user behavior and adoption over time, especially in response to policy changes and technological advancements. Comparative studies between different Indian states could provide deeper insights into regional variations in adoption patterns. Additionally, qualitative research could help uncover more nuanced barriers to adoption and user experiences with UPI.

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“Literature review of an analytical study of the political marketing scenario with reference to Gujarat Assembly election 2022”

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Abstract: Political marketing can define as “the party or candidates use of opinion research and environmental analysis to produce and promote a competitive offering which will help realise organisational aims and satisfy groups of electors in exchange for their votes” (Henneberg, 2002). This review paper will have a tabular representation of literature review papers studied for the Political Marketing Scenario With Reference To Gujarat Assembly Election 2022. The way a company manages ‘Brand Awareness’, ‘Brand Image’ and ‘Brand Trust’, the same thing political parties or leader do with their voters by managing ‘Political Brand awareness’, ‘Political Brand Image’ and ‘Political Brand Trust’. These papers has been presented on some basic and homogeneous characteristics such as country of study, year of study, country of author, publisher, sample size, research methodology, data collection, name of journal, variables studied . it will give an insight full details regarding the key product or service used by politician for the election campaign on the bases of their election manifesto for the Political Consumers (Voters).

Key Words: Assembly Election, , Political Brand Awareness, Political Brand Image, Political Brand Trust, Political Voters.

1. INTRODUCTION:

The democracy is the most common political system all around the world. Free competitive elections are the opportunities that citizens can choose their rulers and it is the best tool to reflect the needs and preferences of people. Political marketing provide the candidates to overcome these problems effectively. Additionally, it increases the power of political groups in political disputes and their promoting activities that has already done only by using traditional ideas and tactics of political science through using a consistent framework of marketing and modifying basic concepts of commercial marketing so that be applicable to parties or political individuals. Political Marketing is the process by which political candidates promote themselves and their platforms to voters through masterly-crafted communications aimed at gaining public support. Defined political marketing firstly as “the process by which political candidates and their ideas are directed at voters in order to satisfy their potential needs and thus gain their support for the candidate and ideas in question”.

2. RATIONALE OF THE STUDY

Political Marketing provides an excess of new opportunities to connect with potential voters and shape public opinion, radio and TV spots, direct mail flyers, email campaigns, social media outreach, etc. Voters have an excellent unknown candidate, Political Marketing will help democracy. Political Marketing helps Democratic country like India.



Elections have always been an important national activity for any country as the future of the entire nation depends on them. Different political parties are bound to market their candidate in the best and efficient way. Indian loksabha elections 2014 have proved the power of political marketing. The 2014 election campaign would go down in history as the first one where digital crowd sourcing played a key role in shaping speeches. The introduction of technology in elections has been initiated by BJP's Prime Ministerial candidate Mr. Narendra Modi who actively used creative services of Social Media and 3D modern tools in order to persuade the youth of India. The timing of the advertising *Ab ki baar Modi Sarkaar* campaign on TV was very crucial. *Har Har Modi, Ghar Ghar Modi* was well accompanied with his pre-recorded video messages in villages. While the BJP's campaign was decisive and to the point, the Congress campaign, with the tagline *Harhaath Shakti, harhaath tarakki*, failed to impress.

Election commission announce, ready to jamili (2018) election are important to every campaign as they build a strategy that will attempt to reach and convince as many people as possible to support certain issues. The voters are trying to build support for a candidate or cause, here are four ways you can create a message that voters will engage with.

3. OBJECTIVES:

1. To know the variables this has been studied in the field of Political Marketing.
2. To what are the segments should be taped to study political awareness
3. To have clear idea about Research methods used by authors to analyze political voters and how do they execute it.

4. RESEARCH METHODOLOGY:

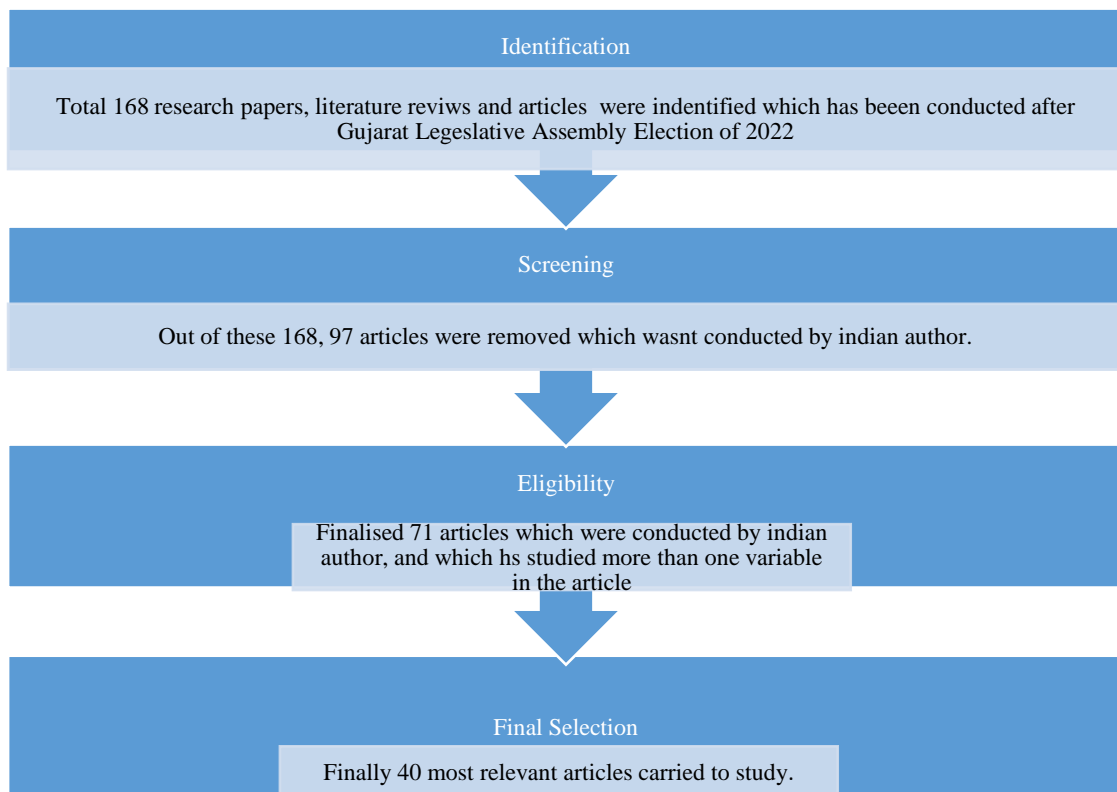


Diagram 1.1. Selection of Papers to Study
Compiled by author



S. No.	Paper Title	Summary of Key Findings	Source	Sample Size	Author Country	Research Methodology	Data Collection	Journal Name	Variables Studied
1	"The Evolution of Political Campaigning in Gujarat: 2022 Perspective"	Highlights the increasing reliance on digital platforms like WhatsApp, Facebook, and regional YouTube influencers in shaping voter opinions.	Gupta, A. (2023). <i>Journal of Indian Political Studies</i> .	800 respondents (voters)	India	Mixed-method (Interviews + Surveys)	Primary	<i>Journal of Indian Political Studies</i>	Social media usage, political engagement, voter demographics
2	"Analyzing Voter Behavior in Gujarat Elections: A Marketing Approach"	Examines how political parties leveraged data analytics and surveys to micro-target voters based on caste, age, and location.	Patel, M. (2023). <i>Indian Marketing Review</i> .	1,200 voters	India	Quantitative (Survey Analysis)	Primary	<i>Indian Marketing Review</i>	Age, caste, socio-economic factors, campaign exposure
3	"Impact of Media on Election Campaigns: Gujarat 2022"	Analyzes how local news channels and print media influenced voter decision-making alongside digital platforms.	Sharma, R. (2023). <i>Media Studies Quarterly</i> .	150 news articles analyzed	India	Content Analysis	Secondary	<i>Media Studies Quarterly</i>	Media coverage frequency, tone, framing of political parties
4	"Social Media's Role in the Gujarat Assembly Election"	Finds that platforms like Twitter helped politicians connect directly with urban voters, while WhatsApp proved effective for rural voter mobilization.	Bhatt, K. (2023). <i>Digital Democracy Journal</i> .	600 participants	India	Qualitative (Focus groups)	Primary	<i>Digital Democracy Journal</i>	Platform preference, message recall, voter influence
5	"Political Advertising Trends in Gujarat 2022 Elections"	Discusses the shift from traditional print ads to multimedia campaigns, including video content and memes tailored for younger audiences.	Chauhan, P. (2023). <i>Journal of Political Advertising</i> .	50 advertisements analyzed	India	Case Study	Secondary	<i>Journal of Political Advertising</i>	Ad frequency, platform choice, ad type (video, text, images)
6	"Caste and Community Dynamics in Political Marketing: A Gujarat Study"	Examines how caste-based strategies remain central to political marketing, especially in rural Gujarat, despite technological advancements.	Singh, V. (2023). <i>Social Sciences Quarterly</i> .	500 rural voters	India	Ethnographic study	Primary	<i>Social Sciences Quarterly</i>	Caste identity, political loyalty, message adaptation



7	"Ethics in Political Marketing: A Case of Gujarat Assembly Elections"	Highlights concerns about misinformation, deepfakes, and data privacy breaches in digital campaigns conducted by various parties.	Desai, R. (2023). <i>Ethics in Media Journal.</i>	200 campaign materials	India	Content Analysis	Secondary	<i>Ethics in Media Journal</i>	Ethical concerns, misinformation, compliance with media ethics
8	"Women-Centric Campaign Strategies in Gujarat: A Marketing Perspective"	Focuses on how women voters were targeted through specific welfare-oriented messaging, especially on social media and public gatherings.	Trivedi, N. (2023). <i>Indian Gender Studies Review.</i>	400 women voters	India	Survey + Interviews	Primary	<i>Indian Gender Studies Review</i>	Gender-specific messaging, policy promises
9	"The Influence of Regional Celebrities on Gujarat's Political Marketing"	Discusses the role of regional film stars and social media influencers in boosting political party outreach, especially among first-time voters.	Kumar, S. (2023). <i>Cultural Politics and Media Journal.</i>	20 influencers + 300 voters	India	Mixed-method (Interviews + Focus groups)	Primary	<i>Cultural Politics and Media Journal</i>	Credibility of influencers, impact on younger voters
10	"The Role of Data Analytics in Shaping Gujarat Elections 2022 Campaign Strategies"	Explores the use of predictive modelling and voter segmentation to prioritize campaign resources effectively, leading to better voter outreach outcomes.	Shah, D. (2023). <i>Data Analytics in Politics Journal.</i>	Campaign data from 5 parties	India	Quantitative (Big data analysis)	Secondary	<i>Data Analytics in Politics Journal</i>	Predictive modelling, voter segmentation, issue prioritization

11	"Political Marketing and Young Voters in Gujarat: A Study of Trends"	Highlights the role of Instagram and YouTube as platforms for engaging with younger voters, focusing on entertainment-based outreach.	Mehta, R. (2023). <i>Youth and Politics Quarterly.</i>	1,000 young voters	India	Quantitative (Survey Analysis)	Primary	<i>Youth and Politics Quarterly</i>	Social media habits, political awareness
12	"Understanding the Impact of Religious Messaging in Political Campaigns: Gujarat 2022"	Investigates how parties utilized subtle religious appeals to connect with key voter groups, balancing secular and community-focused messaging.	Nair, T. (2023). <i>Religion and Politics Studies.</i>	300 religious groups	India	Qualitative (Interviews + Document analysis)	Primary + Secondary	<i>Religion and Politics Studies</i>	Religious appeals, group-specific messaging



13	"Grassroots Campaigns in Gujarat: Door-to-Door Strategies in the Digital Era"	Analyses the blend of traditional grassroots efforts with digital campaign tools, such as SMS and WhatsApp updates for mobilization.	Joshi, P. (2023). <i>Political Campaign Strategies Review</i> .	200 campaign workers	India	Ethnographic study	Primary	<i>Political Campaign Strategies Review</i>	Door-to-door campaign impact, digital integration
14	"Fake News and Its Role in Gujarat Assembly Elections"	Explores the prevalence of misinformation during the elections and its influence on voter perception through platforms like Facebook and WhatsApp.	Chawla, S. (2023). <i>Media Ethics Quarterly</i> .	250 news stories analyzed	India	Content Analysis	Secondary	<i>Media Ethics Quarterly</i>	Misinformation patterns, platform spread
15	"AI and Predictive Analytics in Gujarat's Political Campaigns"	Details how AI-driven tools were used for voter segmentation, issue prioritization, and real-time campaign adjustments.	Pandey, V. (2023). <i>AI in Political Marketing Journal</i> .	Campaign tools from 3 parties	India	Quantitative (Data-driven modelling)	Secondary	<i>AI in Political Marketing Journal</i>	AI applications, voter segmentation
16	"Emotional Branding in Gujarat Assembly Elections: A Political Marketing Perspective"	Examines how parties appealed to voters' emotions using local issues, historical references, and campaign imagery.	Shah, K. (2023). <i>Journal of Branding and Marketing</i> .	20 branding experts	India	Qualitative (Interviews)	Primary	<i>Journal of Branding and Marketing</i>	Emotional appeals, cultural symbolism
17	"Television Debates and Their Role in Voter Decision-Making: Gujarat 2022"	Explores how televised debates among candidates influenced public opinion, especially in urban and semi-urban constituencies.	Jain, P. (2023). <i>Indian Media Review</i> .	600 urban voters	India	Quantitative (Survey Analysis)	Primary	<i>Indian Media Review</i>	Debate recall, perceived credibility
18	"Micro-Targeting Rural Voters in Gujarat: A Political Marketing Approach"	Discusses how data-driven insights were used to address rural-specific issues such as irrigation, agriculture, and rural employment through tailored messaging.	Patel, A. (2023). <i>Rural Marketing Studies</i> .	500 rural respondents	India	Quantitative (Survey)	Primary	<i>Rural Marketing Studies</i>	Rural-specific issues, personalized messaging



19	"Role of Memes and Viral Content in Political Campaigns: Gujarat Assembly Elections"	Highlights the use of humour and satire in digital campaigns to engage younger voters and counter opponents' narratives.	Soni, D. (2023). <i>Journal of Digital Culture and Politics</i> .	100 viral posts analysed	India	Content Analysis	Secondary	<i>Journal of Digital Culture and Politics</i>	Meme themes, audience engagement
20	"Digital Literacy and Political Campaigning in Gujarat Elections"	Explores the gap in digital literacy and its impact on voters' ability to critically assess online campaign material, particularly in rural areas.	Singh, A. (2023). <i>Digital Divide Quarterly</i> .	300 rural participants	India	Qualitative (Interviews)	Primary	<i>Digital Divide Quarterly</i>	Digital literacy, media scepticism

21	"Political Manifestos as a Marketing Tool in Gujarat Elections"	Examines how manifestos were tailored to address local issues while integrating broader national agendas.	Mehta, N. (2023). <i>Political Marketing Journal</i> .	10 party manifestos	India	Document Analysis	Secondary	<i>Political Marketing Journal</i>	Key promises, voter reception
22	"WhatsApp as a Political Communication Tool in Gujarat: Benefits and Risks"	Analyzes how WhatsApp groups enabled rapid voter mobilization but also spread misinformation during the campaign period.	Gupta, S. (2023). <i>Digital Democracy Studies</i> .	400 WhatsApp users	India	Quantitative survey	Primary	<i>Digital Democracy Studies</i>	Group messaging, misinformation risk
23	"Cultural Identity and Political Messaging in Gujarat: 2022 Analysis"	Explores how political campaigns incorporated local cultural symbols and traditions to create a connection with diverse voter groups.	Trivedi, P. (2023). <i>Journal of Cultural Studies</i> .	300 cultural organizations	India	Qualitative (Interviews + Surveys)	Primary	<i>Journal of Cultural Studies</i>	Cultural symbols, regional messaging
24	"Impact of Political Surveys on Campaign Strategy in Gujarat"	Studies how political surveys informed campaign strategies and helped parties adjust their messaging to voter preferences.	Patel, R. (2023). <i>Survey Insights Quarterly</i> .	5,000 survey participants	India	Quantitative (Survey Analysis)	Secondary	<i>Survey Insights Quarterly</i>	Survey accuracy, strategy adjustment



25	"Role of Public Rallies in Gujarat's Political Campaigns in the Digital Era"	Explains how public rallies were complemented by live streaming on social media to expand outreach and engage a broader audience.	Sharma, K. (2023). Journal of Mass Communication.	20 rallies analysed	India	Case Study	Primary + Secondary	<i>Journal of Mass Communication</i>	Attendance, digital amplification (live streams)
26	"The Use of Influencer Marketing in Gujarat Assembly Elections"	Details how local and regional influencers were recruited to promote campaign messages subtly among their followers.	Bhatt, M. (2023). Journal of Digital Influence.	Local and regional influencers studied	India	Mixed-method (Interviews + Social Media Analysis)	Primary + Secondary	<i>Journal of Digital Influence</i>	Recruitment methods, campaign impact, influencer demographics
27	"The Role of Regional News in Shaping Election Narratives: Gujarat 2022"	Analyses how regional TV and print media shaped public opinion and created narratives for major political parties.	Singh, V. (2023). Media and Politics Quarterly.	Regional TV and print media analysed	India	Content Analysis	Secondary	<i>Media and Politics Quarterly</i>	Media coverage, narrative framing
28	"Public Opinion Polls as a Tool for Political Marketing in Gujarat"	Discusses how public opinion polls influenced party strategies and voter behaviour in the run-up to the elections.	Jain, A. (2023). Opinion Research Studies.	Multiple opinion polls analysed	India	Quantitative (Poll Analysis)	Secondary	<i>Opinion Research Studies</i>	Influence on voter behaviour, campaign strategies
29	"Election Campaign Spending and Its Effectiveness: A Gujarat Perspective"	Investigates the correlation between campaign spending on advertising and actual electoral performance in Gujarat.	Nair, S. (2023). Economic Review of Politics.	Campaign budgets and outcomes reviewed	India	Quantitative (Correlation Analysis)	Secondary	<i>Economic Review of Politics</i>	Spending effectiveness, advertising impact
30	"The Role of Negative Campaigning in Gujarat Assembly Elections 2022"	Explores the effectiveness and ethical concerns surrounding negative campaign ads targeting opponents.	Chauhan, P. (2023). Journal of Ethical Politics.	Negative ad campaigns analysed	India	Content Analysis	Secondary	<i>Journal of Ethical Politics</i>	Ethical concerns, voter impact
31	"Political Marketing for First-Time Voters: Gujarat Elections 2022"	Explores strategies used to engage first-time voters, including gamified apps, interactive content on	Shah, R. (2023). Youth	Young first-time voters surveyed	India	Mixed-method (Interviews + Surveys)	Primary	<i>Youth Engagement Studies</i>	Gamification, social media campaigns, college outreach



		Instagram, and college-level outreach programs.	Engagement Studies.						
32	"Post-COVID Campaigning: Lessons from Gujarat Assembly Elections"	Discusses how campaigns adapted to post-COVID challenges, leveraging digital town halls, video conferencing, and hybrid (digital and physical) rally models.	Mehta, D. (2023). Post-Crisis Political Marketing Quarterly.	Campaign methods post-COVID studied	India	Case Study	Primary + Secondary	<i>Post-Crisis Political Marketing Quarterly</i>	Hybrid rallies, digital town halls, physical-digital integration
33	"Voter Fatigue and Political Messaging: A Gujarat 2022 Perspective"	Analyses how oversaturation of political messaging, especially on digital platforms, led to voter disengagement in some constituencies.	Patel, K. (2023). Political Psychology Review.	Voter surveys on fatigue	India	Quantitative (Survey Analysis)	Primary	<i>Political Psychology Review</i>	Oversaturation, digital engagement challenges
34	"The Role of Regional Political Alliances in Campaign Strategies: Gujarat Elections"	Explores how alliances between smaller regional parties and national parties impacted messaging coherence and campaign dynamics.	Bhatt, S. (2023). Regional Politics Journal.	Political alliances reviewed	India	Mixed-method (Interviews + Case Studies)	Primary + Secondary	<i>Regional Politics Journal</i>	Messaging coherence, alliance dynamics
35	"Sentiment Analysis of Campaign Content in Gujarat 2022"	Details how sentiment analysis tools were used to measure public opinion about political parties and candidates based on social media posts and news content.	Jain, M. (2023). AI and Sentiment Analysis Journal.	Social media and news content analysed	India	Quantitative (Sentiment Analysis)	Secondary	<i>AI and Sentiment Analysis Journal</i>	Public opinion measurement, campaign performance
36	"Branding Political Leaders: Case Studies from Gujarat Elections 2022"	Examines how political leaders were branded as relatable or aspirational figures, focusing on visual campaigns, slogans, and personal narratives.	Sharma, T. (2023). Leadership Branding Review.	Branding campaigns reviewed	India	Case Study	Secondary	<i>Leadership Branding Review</i>	Leader relatability, aspirational narratives
37	"Rural Connectivity Challenges in Gujarat's Political Marketing"	Highlights the barriers to rural voter outreach, including poor digital connectivity, and how campaigns relied on radio and door-to-door campaigns to bridge the gap.	Desai, H. (2023). Rural Outreach Studies.	Rural campaigns studied	India	Qualitative (Field Interviews)	Primary	<i>Rural Outreach Studies</i>	Connectivity barriers, outreach models



38	"Comparative Study of BJP and Congress Campaign Strategies in Gujarat Assembly Elections"	A comparative analysis revealing that BJP focused on development and nationalism, while Congress emphasized local issues and grassroots engagement.	Nair, K. (2023). Comparative Politics Review.	BJP and Congress strategies compared	India	Comparative Case Study	Secondary	<i>Comparative Politics Review</i>	Development focus, local issues
39	"The Rise of Independent Candidates in Gujarat: Marketing Challenges and Strategies"	Discusses how independent candidates used niche, hyper-localized issues and cost-effective digital tools to connect with voters.	Joshi, A. (2023). Independent Politics Journal.	Independent candidate campaigns	India	Mixed-method (Interviews + Surveys)	Primary	<i>Independent Politics Journal</i>	Cost-effective strategies, localized issues
40	"Future of Political Marketing: Lessons from Gujarat Assembly Elections 2022"	Identifies trends like hyper-personalization, AI-powered messaging, and ethical concerns as the future of political marketing based on observations from the Gujarat elections.	Shah, P. (2023). Future Trends in Political Marketing.	Election trends analyzed	India	Qualitative (Expert Interviews)	Secondary	<i>Future Trends in Political Marketing</i>	Hyper-personalization, AI tools, ethical considerations

Diagram 1.1 Diagram 1.1. Selection of Papers to Study

5. CONCLUSION:

The election of Gujarat Assembly 2022 highly emphasized on the adoption of the political campaigning through the strategic reach to targeted voters, digital tools, and data analysis. The conclusion of the above literatures reveals some significant findings

Post COVID adoption of technological tools, huge and easy user-friendliness of internet in mobile phones/smart phones have provided a landscape for marketers to easily reach at the targeted audience and for the political party or political marketers to reach at targeted voters. Along with user-friendliness of internet, social media platforms like Whats App, Facebook, You Tube, Instagram, and many more have opened up the doors for political marketing. Previously the whole family were used to sit in front of TV but smartphone and stream shows of news channels on smartphones has increased the individual reach. Also 462 Million active social media users and their activity made it too easy to analyze their behavior and influence or drive their voting behavior the way political party, leader or political marketer wants to achieve their goals.in addition Celebrities and social media influencer have also played a pivotal role in elections.

Some wrong or misleading information played unethical campaigning, but the trigger points of voters such as economic, cultural and emotional aspects made it easy to convince the voters in favor of particular political party.

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Digital financial inclusion: A systematic review of literature

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Abstract: This study presents a systematic review of the literature on digital financial inclusion, focusing on its key dimensions, barriers, and challenges, along with the impact of initiatives aimed at marginalized communities. The review seeks to contextualize digital financial inclusion and identify critical gaps in existing research. It synthesizes studies published between 2016 and 2023, gathered from various academic databases. The findings are organized in a tabular format, categorizing major themes such as advancements in technology, regulatory challenges, and issues related to digital literacy. While digital financial inclusion has made significant progress, particularly in emerging economies, challenges like limited technology access and regulatory barriers continue to obstruct global efforts towards inclusive finance. This paper offers a comprehensive summary of current research, providing valuable insights for scholars, policymakers, and practitioners to inform future research and the development of policies that can enhance the accessibility and inclusivity of digital financial services.

Keywords: Digital payment systems, Digital financial inclusion, Economic development, Emerging economies, Systematic literature review

1. INTRODUCTION:

Digital financial inclusion is revolutionizing the way we address global financial inequalities. By harnessing the power of technology, it provides underserved populations—such as those in rural areas, low-income households, and women excluded from traditional financial systems—with affordable and accessible financial services (World Bank, 2021). This shift has not only expanded access to financial tools but also increased economic participation and contributed to poverty reduction worldwide (Demirgüç-Kunt et al., 2018).

At its core, digital financial inclusion relies on innovative digital technologies like mobile banking, electronic payment platforms, and block chain to deliver services. Success stories such as Kenya's M-Pesa, India's Unified Payments Interface (UPI), and China's Alipay showcase how these systems can bridge socio-economic gaps and promote financial inclusion (Jack & Suri, 2014; NPCI, 2023). However, their effectiveness depends on several factors, including digital literacy, affordability, regulatory support, and the availability of robust infrastructure (Suri & Walker, 2020).

Despite the progress made, challenges remain. According to the World Bank's Global Findex Database (2021), over 1.4 billion adults worldwide still lack access to formal financial systems. Many face hurdles such as limited access to mobile devices, insufficient digital skills, and a lack of trust in digital



platforms (Allen et al., 2016). Furthermore, disparities persist along gender and urban-rural lines, highlighting the need for targeted interventions (Pazarbasioglu et al., 2020).

This study aims to provide a comprehensive review of the current literature on digital financial inclusion, exploring its trends, obstacles, and opportunities. By analysing empirical studies, case examples, and theoretical insights, it seeks to uncover how digital financial inclusion can drive economic growth and social equity. Ultimately, the research emphasizes the critical role of innovative policies, technological advancements, and collaborative efforts in achieving universal financial inclusion.

1.1 Digital Financial Inclusion (DFI) Initiatives in India

Pradhan Mantri Jan Dhan Yojana (PMJDY): Launched in 2014, PMJDY aimed to provide every Indian with a bank account, resulting in over 460 million accounts by 2021, particularly in rural regions.

Aadhar and AEPS: Aadhar, India's biometric ID system, facilitates easy digital verification, allowing people to use the Aadhar-Enabled Payment System (AEPS) for banking transactions, even in remote areas.

Unified Payments Interface (UPI): UPI, introduced in 2016, allows real-time, low-cost payments across different banks, fostering widespread use of digital payments, especially in urban and rural areas.

Bharat Interface for Money (BHIM): This mobile app enables instant transfers between bank accounts and has promoted digital transactions, particularly in less urbanized areas.

JAM Trinity (Jan Dhan-Aadhar-Mobile): The integration of PMJDY, Aadhar, and mobile phones facilitates seamless government service delivery and financial inclusion, improving access to financial services for rural populations.

Digital Literacy Programs: Government initiatives like Digital India and PMGDISHA focus on enhancing digital literacy, particularly in rural areas, to ensure people can effectively use digital financial services.

Financial Literacy Campaigns: Organizations like the RBI run campaigns to educate citizens about using digital banking services, fostering greater participation in the financial system.

MUDRA Yojana: This initiative provides micro-financing to small businesses, allowing entrepreneurs to access financial services digitally, without needing traditional banking relationships.

E-KYC: The electronic Know Your Customer process enables customers to open accounts and complete transactions without needing to visit bank branches, simplifying access to services.

2. RATIONALE OF THE STUDY:

The importance of this study lies in the growing acknowledgment of digital financial inclusion as a catalyst for both economic progress and social equity. While it holds immense potential to bridge financial divides, significant disparities continue to affect rural communities, women, and low-income households. Several key factors emphasize the need for this research:

Global Financial Inequalities

A staggering 1.4 billion adults around the world remain unbanked, with most living in developing regions (Global Findex Database, 2021). Investigating how digital financial services can address these gaps is crucial to fostering greater financial access.



Technological Innovations

Advancements like mobile banking, digital wallets, and block chain have transformed financial service delivery. However, these tools remain out of reach for many marginalized groups due to challenges such as inadequate digital literacy and weak infrastructure.

Policy Shortcomings

While numerous nations have introduced policies aimed at promoting digital financial inclusion, issues like high transaction fees, lack of system interoperability, and insufficient financial education continue to limit widespread adoption.

Alignment with Sustainable Development Goals (SDGs)

Digital financial inclusion directly supports several SDGs, including eradicating poverty (SDG 1), advancing gender equality (SDG 5), and promoting sustainable economic growth (SDG 8). A deeper understanding of its contributions is essential to realizing global development objectives.

By bringing together existing research, this systematic review identifies critical gaps and provides actionable insights for designing inclusive, effective, and equitable digital financial systems.

3. OBJECTIVES:

- To systematically review the socio-economic, technological, and policy dimensions of digital financial inclusion with a focus on emerging economies.
- To analyse key drivers, barriers, and their interconnections in achieving digital financial inclusion.
- To synthesize existing data and propose a roadmap for future research and policy interventions in digital finance.

4. RESEARCH METHODOLOGY:

This study takes a systematic literature review (SLR) approach to gather and analyse the wealth of knowledge available on digital financial inclusion. By adhering to well-established frameworks for conducting systematic reviews, the methodology ensures both thoroughness and reliability in examining the subject. The research draws from reputable academic databases, including Scopus, Web of Science, and Google Scholar, to provide a comprehensive and credible foundation for analysis. This study focuses on digital financial inclusion in developing economies, paying special attention to issues such as gender disparities, differences between rural and urban areas, and the influence of policy interventions. It includes research that uses a variety of methods, whether quantitative, qualitative, or a combination of both, to provide a comprehensive understanding of the subject.

The literature review of Digital financial inclusion can be classified in to following categories:

Author(s) Name

Year

Title

Journal Name

Primary or Secondary Study

Sample Size

Variables in the study

Methodology/ Tools utilised for Data Analysis

Findings of the study

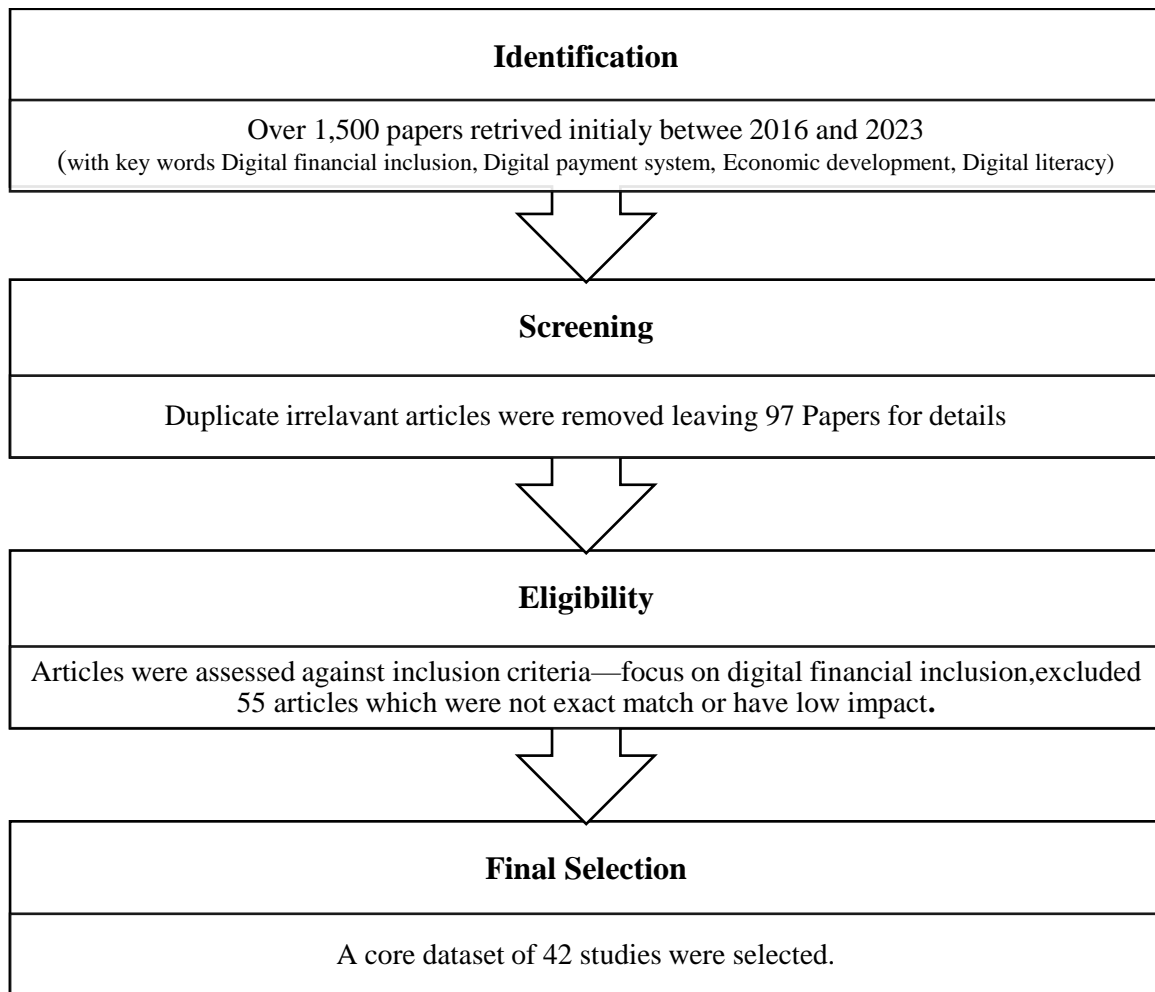


Figure 1 (PRISMA Flow chat)
Source: Author’s own creation.



5. TABULAR REPRESENTATION OF LITERATURE									
Sr. no	Author	Year	Title	Journal name	Primary or Secondary	Sample size	Variables in the study	Methodology & tools used for data analysis	Findings of the study
1	Mr Rory Macmillan	2016	Digital financial services: Regulating for financial inclusion: An ICT perspective	International Telecommunication Union (ITU), Telecommunication Development Bureau.	Secondary	-	Financial inclusion, mobile money adoption rates, user trust, competition among service providers, technology integration.	Case study	Mobile financial services are key to improving financial inclusion, especially in rural and low-income areas. Countries with flexible regulations that enable mobile network operators (MNOs) to lead see higher adoption rates. However, challenges like interoperability, agent exclusivity, and data access must be addressed through collaboration among regulators for sustainable growth.
2	Peterson K. Ozili	2018	Impact of digital finance on financial inclusion and stability	Borsa _Istanbul	Secondary	-	Digital finance access, Financial technology innovation, Socioeconomic factors	Conceptual study	Digital finance holds great promise for improving financial inclusion, especially for underserved communities. However, challenges like low digital literacy, inadequate infrastructure, and high costs for low-income groups persist. While it can enhance financial stability, risks like fraud and systemic weaknesses need to be addressed through evolving regulatory frameworks to ensure safe innovation.
3	Wibella, Nevvi; Fahmi, Idqan; Saptono, Imam Teguh	2018	Factors Affecting Consumer Acceptance of Digital Financial Inclusion; An	Independent Journal of Management & Production	Primary	134	Perceived usefulness, ease of use, and credibility,	Technology Acceptance Model (TAM), Partial Least Squares	Interest in using digital financial services is mainly driven by perceived credibility and ease of use, while perceived usefulness has less impact. To increase digital financial inclusion,



			Anecdotal Evidence from Bogor City				Intention to use digital financial services	Structural Equation Modeling (PLS-SEM).	it is crucial to focus on building trust and simplifying services, ensuring they are accessible and appealing to a broader audience.
4	Vinay Kandpal; Rajat Mehrotra	2019	financial inclusion: the role of fintech and digital financial services in India	Indian Journal of Economics & Business	Secondary	-	Financial inclusion indicators, Technological innovations	Analysis of secondary data	While government initiatives have made great strides in financial inclusion, challenges like limited reach in rural areas and low financial literacy still persist. Mobile-based fintech solutions have improved accessibility, but issues such as poor internet connectivity and a lack of trust continue to hinder broader adoption. For digital financial inclusion to expand further, strong regulatory frameworks and improved infrastructure are essential.
5	Vishal Singh; Bijendra Pushkar	2019	A Study on Financial Inclusion: Need and Challenges in India	SSRN-Elsevier	Secondary	-	Financial inclusion indicators, Socioeconomic impacts, Digital technologies	Case study, descriptive analysis	India has achieved notable progress in financial inclusion, with bank account ownership increasing from 35% in 2011 to 53% by 2014. However, challenges persist, including low financial literacy, gaps in digital infrastructure, and underutilization of accounts among marginalized communities. Initiatives like PMJDY and MUDRA Bank have improved access to financial services but continue to face hurdles in implementation and public awareness.
6	Kamini Rai; Mamta Sharma	2019	A Study on Awareness about Digital Financial Services among Students	SSRN-Elsevier	Primary	210 students in higher education	Awareness levels about digital financial services,	Independent t-tests and ANOVA	Awareness levels vary significantly between male and female students and between those studying business and non-business disciplines. However, no notable differences were found



						institutes in Delhi.	Demographic factors		based on age or educational qualifications. Overall, financial literacy remains low among students, emphasizing the need for targeted awareness programs.
7	Svitlana Naumenkova; Svitlana Mishchenko; Dmytro Dorofeiev	2019	Digital financial inclusion: evidence from Ukraine	Investment Management and Financial Innovations	Secondary	-	Financial inclusion levels (traditional and digital), Usage metrics	Comparative analysis & Quantitative evaluation	Ukraine has made notable progress in financial inclusion, reducing the share of financially excluded individuals from 59% in 2011 to 37% in 2017. However, rural communities, women, and low-income groups continue to face significant challenges, such as distrust in financial institutions and limited digital literacy. Digital financial inclusion remains low, with only 18.1% of adults using mobile or internet banking, well below the European average.
8	Yan Shen; Wenxiu Hu; C. James Hueng	2020	Digital Financial Inclusion and Economic Growth: A Cross-country Study	Elsevier B.V.	Secondary	105 countries for digital financial inclusion analysis; 86 countries for spatial effects study	Digital financial inclusion index, Economic growth, Spatial spill over effects	Data sourced from the World Bank and IMF, Spatial Dubin Model (SDM)	Digital financial inclusion plays a key role in driving economic growth, with notable spill over effects across borders. When one country strengthens its digital financial systems, it often positively influences neighboring economies. However, economic growth in one nation can sometimes create challenges for nearby countries, such as increased competition or resource shifts. This highlights the need for policies that promote regional collaboration and address inequalities to fully harness the advantages of digital financial inclusion for all.



9	Dr. Susanta Mondal	2020	Digital Financial Inclusion and Inclusive Development of India	International Journal of Innovative Science and Research Technology	Secondary	-	Digital payment growth, Economic inclusivity indicators, Digital literacy levels & Bank account ownership	Descriptive analysis	Programs like PMJDY and the J-A-M Trinity have made significant strides in improving financial inclusion in India, opening up banking services to many who were previously underserved. However, a lack of digital literacy continues to be a challenge, particularly in rural and marginalized communities. On a positive note, digital payment systems like UPI have flourished, especially following demonetization, signaling a shift toward a more digital-first financial ecosystem.
10	Zhechen Geng; Guosheng He	2020	Digital financial inclusion and sustainable employment: Evidence from countries along the belt and road	Borsa _Istanbul	Secondary	-	Sustainable Employment , Index of Digital Financial Inclusion (IDFI)	Regression models, Econometric methods	Digital financial inclusion significantly contributes to creating sustainable jobs, though its progress varies by country. Nations like Israel and Slovenia lead in the Inclusive Digital Finance Index (IDFI), while others, like Pakistan, lag behind. Improving internet access and digital infrastructure is essential to unlocking the full potential of digital finance, especially in developing economies.
11	Dilipkumar J. Gangani	2021	A Study on Level of Digital Financial Inclusion among the urban youth of Gujarat.	Ilkogretim Online - Elementary Education Online	Primary	149	Demographic factors, digital literacy, costs and technology, risks and trust, satisfaction level	Analysed data using SPSS 25 with tools like Discriminant Analysis, Principal Component Analysis, and Chi-square tests.	A study on digital financial inclusion among urban youth in Gujarat interviewed 149 respondents, finding 71 with low inclusion and 74 with high inclusion. Key barriers included literacy challenges, costs, trust issues, and dissatisfaction. Inclusion was influenced by factors like age, gender, education, and occupation, but not marital status or income.



12	Dr. Narmadha R.	2021	A STUDY ON THE IMPACT OF DIGITAL FINANCE ON FINANCIAL INCLUSION	International Journal of Creative Research Thoughts (IJCRT)	Primary	200	Digital Finance, Financial Inclusion, Financial literacy, Financial Stability	PLS	Digital finance is revolutionizing access to financial services, especially for those previously excluded from traditional banking. By lowering costs for banks and fintechs, it fosters financial inclusion and sector stability. For governments, it boosts spending and supports economic growth, benefiting individuals, providers, and economies in ways past research often overlooked.
13	G. Rekha, K. Rajamani, and G. Resmi	2021	Digital financial inclusion, economic freedom, financial development, and growth: implications from a panel data analysis	ADB Working Paper Series	Secondary	Data from 22 emerging economies over the period 2004–2017.	ICT Development Index, Economic Freedom Index, Financial Development Index.	cointegration analysis, and vector error correction model (VECM)	ICT, economic freedom, and financial development are closely linked to financial inclusion, with ICT and economic freedom improving access and reducing costs. Financial inclusion and economic growth reinforce each other over time. Strengthening ICT infrastructure, promoting e-governance, and implementing reforms for economic freedom are essential steps toward inclusive and sustainable development.
14	Antonella Francesca Cicchiello; Amirreza Kazemikhasragh; Stefano Monferra; Alicia Girón	2021	Financial inclusion and development in the least developed countries in Asia and Africa	Journal of Innovation and Entrepreneurship	Secondary	-	Financial Inclusion Index (FII)	Analysing panel data from 42 least developed countries over the period 2000–2019, created FII	Financial inclusion plays a key role in boosting GDP, with factors like education, urbanization, and fair income distribution driving progress. However, challenges such as rising rural populations, unemployment, and gender gaps in education and employment continue to hold it back. Focusing on education, gender equality, and equitable incomes can help make financial inclusion a



									reality, supporting economic growth and stability in developing countries.
15	Chandra Mohan Malladi; Rupesh K. Soni; Sanjay Srinivasan	2021	Digital financial inclusion: next frontiers— challenges and opportunities	CSI Transactions on ICT	Secondary	-	Financial inclusion metrics, Socioeconomic impact, Technological factors	Qualitative and quantitative analysis	India has made great strides in financial inclusion with initiatives like PMJDY and Aadhar, helping over 80% of adults open bank accounts by 2017. However, challenges remain, including low digital literacy, limited internet access in rural areas, and concerns about cybersecurity and privacy, which hinder further progress.
16	Abdalwali Lutfi; Manaf Al-Okaily; Malek Hamed Alshirah; Ahmad Farhan Alshira'h; Thaer Ahmad Abutaber; Manal Ali Almarashdah	2021	Digital Financial Inclusion Sustainability in Jordanian Context	sustainability	Primary	304 Jordanian citizens	Behavioural intention to use mobile payment systems, Perceived usefulness, Perceived financial cost, Perceived ease of use	Partial Least Squares-Structural Equation Modeling (PLS-SEM),	Perceived usefulness and financial cost strongly influence the intention to adopt mobile payment systems, while ease of use appears to have little impact in this context. Although mobile payment infrastructure has improved, adoption rates in Jordan remain low, largely due to cultural barriers and cost-related concerns.
17	Prabhakar Nandru; Madhavaiah Chendragiri; Arulmurugan Velayutham	2021	Determinants of digital financial inclusion in India: Evidence from the World Bank's global index database	Research square	Secondary	-	Accessibility of digital financial services, Usage of digital financial services	Probit regression models	Access to digital financial tools, such as debit cards, credit cards, and mobile accounts, is strongly influenced by factors like higher income, tertiary education, and employment. However, gender disparities remain, with women being less likely than men to use mobile money accounts. Usage patterns also show that income and education play a significant role in the adoption of digital payments,



									while employment status is associated with greater use of mobile and online banking for financial transactions.
18	Xiaojie Liu; Jiannan Zhu; Jianfeng Guo; Changnan Cui	2021	Spatial Association and Explanation of China's Digital Financial Inclusion Development Based on the Network Analysis Method	Complexity	Secondary	31 provinces in China	Spatial association network of digital financial inclusion development	Correlation coefficients, Quadratic Assignment Procedure (QAP)	The spatial association network is well-connected and stable but has a low density, indicating limited communication and cooperation between provinces. Central and western provinces have higher centrality compared to some eastern provinces, largely due to their geographic location and government backing. Factors such as proximity, economic similarity, and industrial structure shape these spatial associations, while the development of mobile internet and traditional finance play a minimal role.
19	Guohua He; Lu Shen	2021	Whether Digital Financial Inclusion Can Improve Capital Misallocation or Not: A Study Based on the Moderating Effect of Economic Policy Uncertainty	Discrete Dynamics in Nature and Society	Secondary	31 provinces in China	Digital financial inclusion, Capital diversion from the fictitious to the substantial economy	Construction of panel data models, regression analysis and spatial modeling	Digital financial inclusion helps channel capital from speculative sectors to the real economy, especially by encouraging investments in research and development. Its breadth of coverage has the strongest positive impact, while the level of digitalization has a smaller effect. Economic policy uncertainty limits its effectiveness in improving capital allocation.
20	Alwi, Sharifah Sumayyah Engku; Alwi, Siti Anis Khairani; Alwi, Shaliza; Salleh,	2021	Fintech as financial inclusion: Factors affecting behavioural intention to accept	Turkish Journal of Computer and Mathematics Education	Primary	200	Perceived usefulness, ease of use, social impact, and transactional	Multiple regression analysis, Factor analysis using Cronbach's alpha	The intention to adopt mobile e-wallets is strongly influenced by perceived health benefits, social factors, and costs. The COVID-19 pandemic accelerated e-wallet usage, with health alerts and lower



	Mohd Najib Mohd;Alpandi, RM;Ya'acob, FatinFarazh;Abdullah, S M Mellisa		mobile E-wallet during Covid-19 outbreak				costs, Behavioural intention to adopt mobile e-wallets.		transaction costs playing key roles in driving adoption. These factors have made mobile e-wallets an increasingly popular and practical choice for consumers.
21	Peterson K. Ozili	2022	Digital financial inclusion	Munich Personal RePEc Archive	Secondary	-	Digital Financial Inclusion, Service Providers, Instruments, Benefits, Risks, & Regulatory Challenges	literature review based conceptual study	The study focuses on digital financial inclusion, highlighting the importance of making financial services accessible through digital platforms. It explores the tools, benefits, challenges, and regulatory barriers involved, offering suggestions for improving inclusivity. Ultimately, it provides valuable insights for policymakers and practitioners to build a more equitable digital finance system.
22	Lee-Ying Tay, Hen-Toong Tai & Gek-Siang Tan	2022	Digital financial inclusion: A gateway to sustainable development	Heliyon	Secondary	34 articles reviewed	Impact of COVID-19 on digital financial inclusion. tools for digital financial inclusion, Barriers, Sustainable Development Goals (SDGs)	Systematic literature review	The COVID-19 pandemic accelerated digital financial inclusion, with more people relying on digital platforms for services. However, challenges like poor infrastructure, gender disparities, and low financial literacy persist. To address these, efforts should focus on enhancing digital education, improving ICT access, and simplifying processes. Digital inclusion supports 13 SDGs, driving global development.
23	Nihanshi Goyal; Deepika Saxena	2022	Digital Financial Inclusion in India	Interscience Management Review	Secondary	-	Digital literacy and trust in	Exploratory approach, Analysis of	The adoption of digital financial services is mainly driven by convenience, security, and greater



							financial systems, Challenges, The role of government initiatives	digital payment adoption trends, challenges, and infrastructure gaps	exposure. However, rural areas face challenges like poor infrastructure, low literacy, and language barriers. Addressing these issues, improving digital literacy, and ensuring fair access to technology are crucial for fostering a more inclusive and stable financial system.
24	Varisha Parvez	2022	DIGITAL FINANCIAL INCLUSION IN INDIA-AN OVERVIEW	Shodhsamhita	Secondary	-	Digital infrastructure, Government initiatives, Financial inclusion indicators	Qualitative analysis	Programs like Jan Dhan Yojana, Aadhar, and UPI have greatly improved financial access in India, with over 80% of adults having bank accounts by 2017. Digital payments surged after demonetization, but barriers like rural illiteracy, trust issues, and infrastructure gaps remain. To truly include everyone, we need to focus on bridging the digital divide, building trust, and making financial tools accessible for all.
25	Purva Khera; stephanie; sumiko ogawa; Ratna Sahay	2022	Measuring digital financial inclusion in emerging markets and developing economics: a new index	JSER working paper, Asian economic policy review	Secondary	-	Financial inclusion levels (traditional, digital, and overall).	A three-stage Principal Component Analysis (PCA)	From 2014 to 2017, digital financial inclusion expanded across 52 countries, even in areas where traditional financial inclusion stagnated. Countries like Ghana, Kenya, Senegal, China, and Bangladesh saw significant progress. The rise of digital metrics reshaped financial inclusion rankings, with mobile money agents playing a key role in reaching underserved populations.
26	Thich Dai Phan; Jennifer Medina; Martijn	2022	Quest for financial inclusion via digital	Journal of Financial	Primary	409 Indonesian women	Behavioral intention to adopt	Structured Equation	Factors like perceived usefulness, trust, and brand image significantly influence fintech adoption. Financial



	Wieriks; Robert Jeyakumar Nathan; Maria Fekete-Farkas		financial services (Fintech) during COVID-19 pandemic: case study of women in Indonesia	Services Marketing			Fintech, Perceived usefulness, perceived ease of use, user, financial literacy,	Modeling (SEM)	literacy and government support encourage innovation, but saving habits formed during COVID-19 have hindered user willingness to adopt. Despite growth in Indonesia's fintech sector, issues like user satisfaction and poor infrastructure still limit full adoption.
27	Arnesh Telukdarie; Aviksha Mungar	2022	The Impact of Digital Financial Technology on Accelerating Financial Inclusion in Developing Economies	Procedia Computer Science	Secondary	-	Financial inclusion levels, Socioeconomic outcomes, Digital financial technology	Systems Dynamics modeling	Digital financial technology has greatly improved financial inclusion, especially in rural areas. However, challenges like low financial literacy and limited access remain. Financial inclusion is vital for poverty reduction, economic growth, and increased revenue in emerging markets. To maximize its impact, addressing infrastructure gaps and investing in financial education is essential.
28	Saon Ray; Peter Morgan; Vasundhara Thakur	2022	Digital Financial Inclusion and Literacy from a G20 Perspective	Asian Development Bank Institute	Secondary	-	Financial inclusion metrics, Digital literacy levels, Infrastructure	Thematic analysis of data from G20 countries	Global account ownership has seen remarkable progress, yet significant gaps remain in areas like gender, literacy, and rural access. The use of digital payments surged during the COVID-19 pandemic, but adoption has been inconsistent across G20 nations. Countries with strong digital infrastructure and well-designed policies have achieved higher levels of financial inclusion.
29	Cao, Jianhong; Law, Siong Hook; Wu, Desheng; Tang,	2022	Effect of Digital Financial Inclusion on Dredging the Path	Frontiers in Environmental Science	Secondary	-	Digital financial inclusion as	Dynamic threshold modeling	Digital financial inclusion plays a crucial role in boosting the positive effects of technological progress on green growth, while also helping to



	Xianghua; Yang, Xiaodong		of Green Growth—New Evidence From Front-End and Back-End Perspectives				a mediating variable.		reduce negative impacts on displaced populations. It is essential for fostering sustainable green growth, particularly in overcoming challenges like population displacement, by improving access to financial resources and supporting innovation in green technologies.
30	Imane Elouardighi	2023	Can Digital Financial Inclusion Promote Women’s Labor Force Participation? Microlevel Evidence from Africa	International Journal of Financial Studies	Secondary	-	Digital financial inclusion, Demographic characteristics	Probit model	Digital financial inclusion is a key driver for boosting women’s workforce participation, often surpassing traditional banking. Yet, challenges remain, including high costs, limited smartphone access, and regional preferences. Policymakers must focus on affordability, infrastructure, and trust to empower women, improve financial literacy, and promote gender equality in the economy.
31	Kangyu Ren; YuanWang; Lulu Liu	2023	Impact of Traditional and Digital Financial Inclusion on Enterprise Innovation: Evidence from China	SAGA	Secondary	-	Digital Financial Inclusion Index (DFI), Traditional Financial Inclusion Index (TFI)	Construction of financial inclusion indices (TFI and DFI), Regression model, Instrumental variable	Traditional financial inclusion (TFI) can hinder innovation, often due to a focus on low-risk projects and the potential for moral hazards. In contrast, digital financial inclusion (DFI) fosters innovation by improving access to funds and reducing financial constraints. However, both TFI and DFI still limit innovation efficiency, as there is often a delay between investment and visible results. Additionally, the impact of financial inclusion varies across regions and types of businesses, with small enterprises facing different challenges compared to larger ones.



32	Maren Duvendack; Lina Sonne; Supriya Garikipati	2023	Gender Inclusivity of India's Digital Financial Revolution for Attainment of SDGs: Macro Achievements and the Micro Experiences of Targeted Initiatives	The European Journal of Development Research	Secondary	-	Gender inclusivity in digital financial inclusion, Access and usage levels of financial instruments by women	Conceptual framework, Case study	The JAM Trinity has greatly advanced digital financial inclusion, but gender disparities remain a concern. Women continue to face obstacles such as limited mobile ownership, low financial literacy, and restricted autonomy in financial decisions. Female business correspondents, like Bank Sakhis, have helped improve access to financial services for women, but they encounter challenges such as safety concerns and cultural barriers.
33	Yanru Li; Guanglin Sun; Qiang Gao; Changming Cheng	2023	Digital Financial Inclusion, Financial Efficiency and Green Innovation	sustainability	Secondary	-	Digital Financial Inclusion Index (DFI), Green innovation, Financial efficiency	Dynamic Panel Regression, Mediation Effects Model	Digital financial inclusion plays a key role in boosting green innovation by enhancing financial efficiency and addressing capital misallocation. The depth of digital usage and advancements in digitalization drive this positive impact, although broader accessibility still needs improvement. By optimizing resource allocation, financial efficiency promotes green innovation, while minimizing capital misallocation helps reduce barriers to sustainable progress.
34	Tough Chinoda; Forget Mingiri Kapingura	2023	Digital financial inclusion and economic growth in Sub-Saharan Africa: the role of institutions and governance	African Journal of Economic and Management Studies Emerald Publishing Limited	Secondary	25 Sub-Saharan African (SSA) countries from 2014–2020	Economic growth, Digital Financial Inclusion Index (DFII)	Panel regression, Principal Component Analysis (PCA)	Digital financial inclusion supports economic growth, but its impact is much stronger when paired with good governance and robust institutions. Weak institutional frameworks and governance can limit the growth benefits of digital financial inclusion. Additionally, factors like high inflation and poor regulatory quality negatively influence this relationship.



									However, the combination of digital inclusion and strong institutional support creates a powerful synergy that significantly enhances economic growth.
35	Pengju Liu; Shengqi Zhou	2023	Has Digital Financial Inclusion Narrowed the Urban–Rural Income Gap? A Study of the Spatial Influence Mechanism Based on Data from China	sustainability	Secondary	31 provinces in China	Digital Financial Inclusion Index, Urban–Rural Income Gap	Spatial Durbin Model (SDM)	Digital financial inclusion significantly reduces the urban-rural income gap and has a positive spillover effect on neighboring provinces with similar economic traits. The improvement of industrial structures plays a key role in reducing poverty by enhancing resource allocation and supporting economic restructuring. Findings remain consistent across different variable definitions.
36	Fatma Mabrouk; Jihen Bousrih; Manal Elhaj; Jawaher Binsuwadan; Hind Aloffaysan	2023	Empowering Women through Digital Financial Inclusion: Comparative Study before and after COVID-19	sustainability	Secondary	-	Digital financial inclusion, Demographic factors Women’s economic empowerment	Ordered probit regression,	Since the COVID-19 pandemic, digital financial inclusion has notably increased women’s economic participation. From 2017 to 2021, more women gained access to accounts and digital tools, often reporting a greater role in household financial decisions. Government efforts have helped overcome challenges like cultural norms and limited technology access.
37	Guohui Hu; Sisi Wang	2023	Digital financial inclusion, Financial Mismatch and Small and medium-sized enterprises	SHS Web of Conferences EDP Sciences	Secondary	-	Financing constraints, Digital Financial Inclusion Index	Fixed-effects regression models, Mediation analysis, Heterogeneity tests	Digital financial inclusion plays a key role in easing financing challenges for SMEs, particularly for non-state-owned businesses. It helps address financial mismatches by improving the allocation of resources. The impact of digital financial inclusion is



			Financing Constraints						more pronounced in the eastern region, where it has a stronger effect compared to the midwestern region.
38	Pragati Shukla; Veenita Kumari	2023	Assessment of Digital and Financial Inclusion of women farmers/entrepreneurs/women-led agri startups	National Institute of Agricultural Extension Management (MANAGE)	Primary	85	Digital literacy, Socio-economic factors, Digital financial inclusion	Descriptive statistics (mean, percentages) in MS Excel.	Many women struggled with limited access to digital devices—only 31.76% had smartphones, and more than half had none at all. Financial awareness was also a challenge, with 35% unaware of PAN cards and some confusing them with ATM cards. Cultural norms and affordability made it harder for women to gain independence, but NGO training gave them the confidence to use digital payments and manage transactions online.
39	Cui L, Wang W	2023	Factors Affecting the Adoption of Digital Technology by Farmers in China: A Systematic Literature Review	Sustainability	Secondary	-	Socioeconomic Factors, Agroecological Factors, Technological Factors, Psychological/Behavioral	literature review	The adoption of digital agricultural technologies depends on factors like farmers' age, education, farm size, and access to information. Supportive institutions, such as government subsidies and contract farming, also play a key role. However, challenges like high costs, perceived risks, and inadequate infrastructure still limit broader adoption of these innovations.
40	Koo Minji; Kim Chong-Sup	2023	The Impact of Digital Transformation on Financial Inclusion: Through the Case of Mobile Money Account in Senegal	The Korean Association of Area Studies	Secondary	-	Ownership of mobile money accounts, socioeconomic factors	Logistic regression analysis	In Senegal, more people are gaining access to financial services through mobile money, signaling progress in financial inclusion. However, challenges remain, especially for women, low-income individuals, and those with less education. These groups still face barriers to owning mobile money accounts, showing that



									while digital finance is expanding, inequalities in access and opportunities persist.
41	Nandru Prabhakar; Chendragiri Madhavaiah; Arulmurugan Velayutham	2023	Socioeconomic determinants of ownership of payment cards, mobile money account, and government remittances of digital financial services: evidence from India	Journal of Financial Economic Policy	Secondary	-	Accessibility and usage of Digital Financial Services (DFS), Socioeconomic characteristics	Logistic regression model	Socioeconomic factors play a crucial role in determining access to and use of digital financial services (DFS). Characteristics like being a woman, higher education, middle to upper income levels, and workforce participation positively impact access to DFS. Similarly, women, those with tertiary education, all income groups, and employed individuals were more likely to use DFS during the COVID-19 pandemic. Residential location also shapes both access and usage patterns.
42	Mpofu Favourate Y	2023	Gender disparity and Digital Financial inclusion in Advancing the Attainment of Sustainable Development Goals in Developing Countries	International Journal of Innovation in Management Economics and Social Sciences	Secondary	-	Gender disparity, digital financial inclusion, financial literacy, socio-economic factors, Sustainable Development Goals (SDGs)	Systematic literature review	Women continue to face financial exclusion due to challenges like limited digital literacy, socio-economic hurdles, and restrictive regulations. Improving digital financial inclusion not only empowers women but also benefits families and supports global goals such as reducing poverty, achieving gender equality, and driving economic growth. Gender-responsive policies and easier access to digital financial tools are essential to bridging this gap.

Table 1
(Source: Author's compilation.)



6. FINDINGS

- Women and rural populations in emerging economies continue to face significant challenges in accessing digital financial services due to limited resources, digital literacy, and infrastructure.
- Despite these gaps, digital financial inclusion has empowered small businesses in underserved areas by facilitating access to microloans and digital payment platforms, fostering economic growth.
- Innovations like mobile banking and digital wallets (e.g., M-Pesa in Kenya and UPI in India) have significantly expanded financial access. However, their adoption remains uneven, with rural and underserved communities facing hurdles such as low digital literacy and unreliable infrastructure.
- Government programs like PMJDY and the JAM Trinity have played pivotal roles in promoting financial inclusion, particularly in linking identification systems with digital and banking technologies. However, their impact is often limited by implementation challenges in marginalized regions.
- Drivers: Advances in affordable technologies, supportive policies, and increased awareness have accelerated the adoption of digital financial systems.
- Barriers: Persistent issues include limited digital and financial literacy, socio-cultural barriers for women, lack of infrastructure in rural areas, and high transaction costs due to regulatory inefficiencies.
- Drivers and barriers are deeply intertwined. For instance, policies aimed at improving infrastructure and reducing costs can address barriers like low access and adoption rates, while also narrowing rural-urban and gender gaps.
- Future Research: There is a need for in-depth studies on gender-specific challenges, long-term impacts of digital financial inclusion on poverty reduction, and the potential of emerging technologies like blockchain and AI to enhance financial inclusion.
- Policy Recommendations: Governments should prioritize digital literacy programs for underserved populations, strengthen public-private partnerships to expand infrastructure, and design inclusive policies to address cultural and technological barriers, especially for women.

7. CONCLUSION

Digital financial inclusion serves as a transformative approach to tackling socio-economic disparities and driving economic development, particularly in emerging economies. This study has examined the socio-economic, technological, and policy facets of digital finance, highlighting its vast potential alongside the persistent hurdles. While advancements such as mobile banking and digital wallets have significantly improved financial access, challenges such as gender inequality, inadequate infrastructure, and regulatory shortcomings continue to impede broader adoption.

The analysis underscores the importance of robust policy frameworks, technological progress, and enhanced digital literacy in addressing these challenges. Expanding access to digital financial services in underserved and rural regions will necessitate coordinated efforts among governments, financial institutions, and technology providers. Furthermore, bridging the gender gap and overcoming socio-cultural obstacles are vital to ensuring that the benefits of digital financial inclusion are equitably distributed across all sections of society.

Future studies should delve deeper into the long-term socio-economic effects of digital financial inclusion, identify the unique barriers faced by women, and investigate how cutting-edge technologies like artificial intelligence and blockchain can enhance the inclusivity and accessibility of digital financial systems. By focusing on well-targeted policies, infrastructure expansion, and gender-sensitive initiatives, digital financial inclusion can become a cornerstone for sustainable economic growth and greater social equity.

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Analysing the pre and post merger financial performance of Dena Gujarat Gramin Bank and Baroda Gujarat Gramin Bank

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Abstract: In this paper, an attempt is made to compare the financial performance of Baroda Gujarat Gramin Bank and Dena Gujarat Gramin Bank before and after merger. The performance was measured on the basis of secondary data collected from the annual reports of the respective banks. The performance of the banks was measured on the basis of key performance indicators like Earning per share (EPS), Return on Assets (ROA) and Credit Deposit Ratio (CDR). The other variables used were deposits mobilised, advances, investments, borrowings, recovery performance, addition to NPA and Net Profit. The merger of BGGB and DGGB took place in the year 2019. The combined financial performance of the BGGB and DGGB of 5 years before the merger i.e. 2014-15 to 2018-19 was compared with the individual financial performance of BGGB of 5 years after merger i.e. 2019-20 to 2023-24. Paired t-test was applied in SPSS as a statistical tool to test the hypothesis whether the performance of BGGB after merger was improved or not. The study revealed that there was an improvement in the overall financial performance of BGGB after the merger. There was a significant increase in EPS and ROA of BGGB while the CDR was not significantly increased. Borrowings, net profit and investments were significantly increased after the merger while there was a significant decrease in addition to NPA which is good sign of efficiency of a bank. Deposits mobilized, advances and recovery were not significantly increased.

Key Words: Financial performance, Merger, BGGB, DGGB, Paired t-test.

1. INTRODUCTION:

The banks are said the backbone of a country's financial system. Banks play an important role in the economic development of a country. In a large and developing country like India, where more than 60% people resides in villages, banks play a crucial role in the economic development by providing a variety of banking services. Indian banking industry gave a remarkable contribution for the progress in country's overall development. For providing different kinds of services, the Indian banks are mainly divided into two categories: Scheduled commercial banks (those which are registered as per schedule-II of RBI act, 1934) and Non-scheduled commercial banks (those which are not registered). Scheduled banks are further categorized into public, private and foreign banks. Regional Rural Banks (RRBs) are public sector banks working in rural areas, established for a specific purpose to develop of rural areas and people residing there.

Merger and acquisition means to combine all assets and liabilities of two or more businesses so that one of them exists and other ones loss their identity. According to Wikipedia, "A merger is the legal consolidation of two business entities into one, whereas an acquisition occurs when one entity takes ownership of another entity's share capital, equity interests or assets." Merger and acquisition are the



important tools to grow more by getting the advantages of profitability of other running business or businesses. Moreover, on the basis of severity of bad loans and regional consideration to take the advantage of competitiveness, the public sector banks got merged. The Indian banks were also got merged for the same reason. The history of Indian banking sector can be understood in the following three phases:

Phase I (1786-1969): Initial phase of Banking in India when many small banks were set up.

Phase II (1969-1991): Nationalization phase when largest trading banks were nationalized.

Phase III (1991 till date): Liberalization phase when the merger of many banks took place.

The first bank of India namely Bank of Hindustan was established in 1770 and closed its operations in 1832. During the first phase, more than 600 banks were registered but very few of them were in existence till the starting of phase 2. In the year 1921, three banks namely, Bank of Bengal, Bank of Bombay and Bank of Madras got merged and into Imperial Bank of India which was later nationalized in 1955 and named The State Bank of India, the largest public sector bank of India. The Bank of India, Bank of Baroda, Corporate Bank, Indian Bank and Central Bank of India were founded between 1906 and 1911 and they still exist.

During the phase 2, in 1969, the Indian government nationalized 14 largest trading banks. Subsequently, 6 other banks in the year 1980 were nationalized. Also, 7 subsidiaries of State Bank of India were nationalized during the liberalization phase. The reason of nationalizing these banks was mainly to make the banking services more accessible, particularly in rural areas.

Phase 3 is also called the development phase of the Indian Banking. In this current phase, RBI started giving licenses to private sector banks to establish themselves in the country. The foreign banks were allowed to open the branches in India. This enhanced the development of Indian Banking Sector. Many development banks, small finance banks, payment banks, etc. were introduced. During the liberalization phase, many banks were merged to reduce the competition and to increase the work efficiency. The growth and expansion of banking business in India became possible due to the decisions taken in this phase.

The merger and acquisition can be of many types. Few of them are discussed here. Horizontal merger means the merger of two companies having direct competition and selling similar products. Vertical merger is defined as the merger between companies not selling similar products but the products which are complement to each other. Market-extension merger refers to the merger between the companies that are selling the same products in different markets. Product-extension merger refers to the merger between the companies that are selling the different products in the same market. Conglomerate merger means merger between companies having extremely different businesses. Accretive merger occurs when a company having high Price-Earning (P/E) ratio acquires the business of a company with low Price-Earning (P/E) ratio.

2. LITERATURE REVIEW:

Jha (2023) tried to assess the how merger of Bank of Baroda with Dena Bank and Vijaya Bank affects the company's profitability, overall performance and hence the share price of BOB. Exploratory research was used to understand the pattern of merger and acquisition of banking industries of India. For the analysis, secondary data was collected from the reports and circulars of RBI and other published and working papers. Regression analysis was done using MS Excel to evaluate the impact of return of market on the return of acquirer bank. Different types of statistical charts were used to compare the return on market and return on bank. The paper also tried to analyse the impact of merger on financial



performance of the firm. It was found that the return on market and return on bank are positively correlated. An increase in the profitability of the acquiring bank was shown increased due to merger.

Rani and Sangeeta (2023) made a study on various indicators to analyse the position of the Bank of Baroda. The study was done on indicators like gross and net NPA, operational profit, net profit, CAR, ROA, ROE, EPS, deposits and advances. Statistical charts were used to understand the pattern of performance. The performance of BOB of two years before merger and two years after merger was measured. The study found that the performance of BOB was improved as the operating profit and net profit was increased. The efficiency of the bank also improved. Deposits and advances, EPS, ROA, ROE and CAR had been increased during the study period.

Dadresha (2023) employed an EAGLE model to investigate the performance of Union Bank of India before and after merger. The data of three years before merger and three years after merger was taken. The performance of the bank was assessed using multiple ratios to study the major variables. The data was collected from UBI's annual reports. The study found that the earning capacity of the Union Bank of India had been increased during the study period. The asset quality was declined. Non-performing assets were declined gradually which was a good sign for the bank. A negative return on assets turned into positive returns. Statistical charts were used for comparing the past performance of the bank with the current one.

Singhal et al. (2023) used independent T-test to understand the nature of deviation in pre and post-merger phases. Different ratios like CAR, EPS, CDR, Pay Out Ratio, etc. and formulas were used to evaluate the financial results of Dena bank, Vijaya bank and Bank of Baroda before and after merger. The secondary data for the analysis was collected from the websites. The study found that the merger with Dena Bank and Vijaya Bank affected the financial performance of Bank of Baroda. Regression analysis was also used to forecast the future performances of the bank.

Mathur et al. (2023) examined different variables to measure the effect of merger on the operating performance of Kotak Mahindra Bank. The variables like liquidity, leverage, solvency, and profitability ratios were used to measure the performance of banks before and after the merger. The difference in performance between five years before merger and five years after merger was measured on the basis of different accounting ratios like current ratio, fixed assets turnover ratio, interest coverage ratio, net profit ratio, etc. The Paired t-test was applied for the analysis. The study revealed that the performance of the Kotak Mahindra Bank was gradually improved after merger as compared to the performance before merger. The accounting ratios of the bank were improved.

Kashyap (2021) in his paper analysed the trends in banks regarding to mergers and acquisitions. The case of Bank of Baroda was taken to analyse the effects of merger and acquisition. The data collected from the secondary sources includes websites, articles, and annual reports. Charts were used to analyse the trend and pattern of performance. It was found that there was a positive impact due to merger on the performance of BOB. The effect of mega-merger on BOB, on account holders, on depositors and on borrowers was studied in the research. No. of branches, ATMs, employees, were increased after merger. Total deposits, total advances, operating and net profits, NPA, and total assets have shown an increasing trend after merger. The overall performance of the bank after merger was improved.

Patel (2018) compared the pre and post-merger financial performance of the five Indian banks namely BOB, IDBI, Indian Overseas Bank, Oriental Bank of commerce and SBI for the period of 10 years from 2003-04 to 2013-14. The financial performance of the banks was evaluated on the basis of different variables. A negative impact of merger was seen on ROE, ROA, Net profit Ratio, Yield on advance, Yield of investment, etc. while there was a positive impact of merger on EPS, profit per employee, and business per employee. The data was collected from different websites, reports, and publications. A Paired t-test was used to compare the long term profitability of the selected banks.



Anand and Singh (2018) analysed five mergers of private banks in Indian banking sector to capture the returns to shareholders. It was found that bidder banks saw notable increases in positive abnormal returns, with cumulative abnormal returns (CAR) being particularly high. Positive CARs over one, two, and three-day periods were found in the two-factor model to be 5.24%, 7.83%, and 8.59%, respectively. Target banks like Global Trust Bank and Bank of Punjab lost money while bidding banks made substantial profits. In particular, the value losses of the Oriental Bank of Commerce and Global Trust Bank over an 11-day period were 14.78%, underscoring the difficulties involved in saving a failing bank.

3. OBJECTIVES OF THE STUDY:

1. To study the financial performance of BGGB before and after merger with DGGB
2. To analyse the pattern of growth of key performance indicators.
3. To critically analyse the impact of merger on the financial performance of the banks.

4. RESEARCH METHODOLOGY:

Source of data:

The study is based on secondary data collected from the annual reports of Baroda Gujarat Gramin Bank and Dena Gujarat Gramin Bank. Annual reports of BGGB were taken from the website as they were available on website while those of DGGB were received by approaching personally to the bank. The annual reports of DGGB of 5 years from 2014-15 to 2018-19 were taken in the study whereas the annual reports of BGGB of 10 years from 2014-15 to 2023-24 were used to study the performance.

Scope of the study:

This study contains the analysis of financial performance of Baroda Gujarat Gramin Bank before and after its merger with the Dena Gujarat Gramin Bank. The financial performance is measured on the basis of key performance indicators like Earning per share (EPS), Return on Assets (ROA) and Credit Deposit Ratio (CDR). The other variable taken are deposits mobilized, advances, investments, borrowings, recovery performance, addition to NPA and Net Profit. The combined financial performance of the BGGB and DGGB of 5 years before the merger i.e. 2014-15 to 2018-19 was compared with the individual financial performance of BGGB of 5 years after merger i.e. 2019-20 to 2023-24. The Paired t-test is applied to test the hypothesis.

Hypothesis of the study:

1. **H₀₁:** There is no significant impact of merger on Earning Per Share (EPS) of BGGB.
H_{a1}: There is positive impact of merger on Earning Per Share (EPS) of BGGB.
2. **H₀₂:** There is no significant impact of merger on financial performance of BGGB.
H_{a2}: There is positive impact of merger on financial performance of BGGB.
3. **H₀₃:** There is no significant difference between pre and post-merger financial performance.
H_{a3}: There is significant difference between pre and post-merger financial performance.

Statistical Tools:

A test of normality is done before application of any other statistical test. Paired t-test is used to test the hypothesis whether the financial performance of BGGB is improved or not. The pre-merger performance of BGGB and DGGB was jointly compared with the individual post-merger performance of BGGB.



Data Analysis:

Before applying T-test, the normality test was applied to check whether the data is normally distributed or not for having the reliable results. Table 1 shows the results of reliability and normality test:

Table 1 (Results of Kolmogorov-Smirnov test and Shapiro-Wilk test for normality)
Tests of Normality

Name of the Variable	Kolmogorov-Smirnov			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Net Profit Before Merger	.208	5	.200*	.976	5	.910
Net Profit After Merger	.373	5	.022	.753	5	.032
Addition to NPA Before Merger	.221	5	.200*	.926	5	.572
Addition to NPA After Merger	.297	5	.171	.809	5	.095
Deposits Mobilised Before Merger	.231	5	.200*	.936	5	.640
Deposits Mobilised After Merger	.142	5	.200*	.981	5	.941
Advances Before Merger	.148	5	.200*	.988	5	.971
Advances Loans After Merger	.174	5	.200*	.949	5	.732
Recovery Before Merger	.199	5	.200*	.964	5	.834
Recovery After Merger	.232	5	.200*	.909	5	.463
Investments Before Merger	.257	5	.200*	.878	5	.300
Investments After Merger	.393	5	.011	.698	5	.009
Borrowings Before Merger	.269	5	.200*	.790	5	.067
Borrowings After Merger	.176	5	.200*	.946	5	.710
CDR Before Merger	.268	5	.200*	.887	5	.342
CDR After Merger	.196	5	.200*	.905	5	.441
EPS Before Merger	.342	5	.056	.835	5	.152
EPS After Merger	.373	5	.022	.754	5	.032
ROA Before Merger	.273	5	.200*	.874	5	.284
ROA After Merger	.369	5	.025	.765	5	.041

The results of normality test shown that all the variables are normally distributed except net profit after merger, investments after merger, EPS after merger and ROA after merger (i.e. the p-value of these variables is less than 0.05). The normality of variables was then checked through the measure of skewness and kurtosis for these variables. The measure of skewness should be between -3 and +3 and the measure of kurtosis should be between -7 and +7. The measures of skewness and kurtosis for all the variables are given in table 2. Table 2 shows that the values of skewness and kurtosis for all the variables are within the range of normality. All the variables satisfied the normality criteria based on the measure of skewness and kurtosis. Therefore, all the variables are said to be normally distributed. The Paired t-test was then applied to the data.

Table 2 (Skewness and Kurtosis)

Name of the Variable	Skewness	Kurtosis
Net Profit Before Merger	.237	-.221
Net Profit After Merger	1.976	4.165
Addition to NPA Before Merger	-.239	-1.879
Addition to NPA After Merger	1.745	3.186
Deposits Mobilised Before Merger	-.492	-1.771
Deposits Mobilised After Merger	.242	-1.201
Advances Before Merger	-.178	-.922
Advances After Merger	.666	-.754
Recovery Before Merger	-.423	1.358

Recovery After Merger	-.070	-2.313
Investments Before Merger	-.212	-2.488
Investments After Merger	-2.080	4.442
Borrowings Before Merger	1.740	2.995
Borrowings After Merger	-.638	-.931
CDR Before Merger	-.245	-2.430
CDR After Merger	.902	-.210
EPS Before Merger	-1.641	3.354
EPS After Merger	1.975	4.163
ROA Before Merger	1.369	1.559
ROA After Merger	1.931	4.055

The Skewness is the measure of symmetry which shows how much the data is skewed i.e. left-skewed or right-skewed. A left-skewed distribution refers to the negative skewness i.e. the left tail is longer whereas a right-skewed distribution refers to the positive skewness i.e. the right tail is longer. The distribution should be asymmetric i.e. both tails should be equal for the reliable results of a statistical test.

The Kurtosis is the measure of peakedness of the data which shows how peaked or flat a data is. The kurtosis shows whether the data is heavy-tailed or light-tailed to a normal distribution. The data having higher value of kurtosis refers to heavy-tailed distribution which means more number of outliers and the data having lower value of kurtosis refers to light-tailed distribution which means less number of outliers or lack of outliers.

The results of Paired t-test are as under:

Table 3 (Results of Paired t-test)

Paired t-test				
Pair No.	Tested Variable	t	df	Sig. (2-tailed)
Pair 1	Net Profit Before Merger – Net Profit After Merger	-.997	4	.375
Pair 2	Addition to NPA Before Merger - Addition to NPA After Merger	.639	4	.558
Pair 3	Deposits Mobilised Before Merger - Deposits Mobilised After Merger	-16.839	4	.000
Pair 4	Advances Before Merger – Advances After Merger	-7.849	4	.001
Pair 5	Recovery Before Merger - Recovery After Merger	-5.529	4	.005
Pair 6	Investments Before Merger - Investments After Merger	.091	4	.932
Pair 7	Borrowings Before Merger - Borrowings After Merger	1.169	4	.307
Pair 8	CDR Before Merger - CDR After Merger	-3.243	4	.032
Pair 9	EPS Before Merger - EPS After Merger	-1.032	4	.360
Pair 10	ROA Before Merger - ROA After Merger	-.689	4	.528

5. FINDINGS:

From the results of T-test shown in table 3, it was found that there was a significant increase in the net profit of the BGGB after merger. Addition to NPA was significantly decreased which is a good sign of performance of a bank. Deposits mobilized, advances, recovery and CDR was not increased significantly. However, investments and borrowings were significantly increased. EPS and ROA was



also increased significantly after merger which affect the shareholders' interest. On the basis of results of all these different indicators, it can be said that overall financial performance of the bank after merger is significantly improved. There was a positive impact of merger on the performance of BGGB. Increase in EPS and decrease in NPA indicates that there is an improvement in the efficiency of the bank after merger.

1. The null hypothesis that 'there is no significant impact of merger on Earning Per Share (EPS) of BGGB' is rejected. Therefore, the alternate hypothesis that 'there is a significant impact of merger on EPS' is accepted.
2. The null hypothesis that 'there is no significant impact of merger on financial performance of BGGB' is rejected. Therefore, the alternate hypothesis that 'there is a significant impact of merger on financial performance' is accepted.
3. The null hypothesis that 'there is no significant difference between pre and post-merger financial performance' is rejected. Therefore, the alternate hypothesis that 'there is a significant difference between pre and post-merger financial performance' is accepted.

6. CONCLUSION:

From this paper,

- ✓ It can be concluded that the performance of BGGB is significantly improved after the merger.
- ✓ The EPS of BGGB of five years before the merger was in increasing trend i.e. 0.54, 1.05, 1.61, 3.88 and 0.64, whereas the EPS of DGGB was in decreasing trend before the merger i.e. 3.30, 2.54, 2.72, 2.4 and 0.475. The EPS after the merger increased tremendously i.e. 0.06, 2.97, 3.73, 5.21 and 22.1. So, it can be seen that this increase in EPS is due to the merger. It can be regarded as a positive impact of merger.
- ✓ Net profit and ROA of both banks was not showing a proper pattern till the merger. But it showed a continuous increasing trend after merger.
- ✓ Another variable, Addition to NPA was increasing every year in both banks till the merger took place. After the merger in 2019, the addition to NPA started declining every year which is a good sign for any bank.
- ✓ It can be said that the efficiency of bank is also improved. Also, it can be said that there is a positive impact of merger on the financial performance of BGGB.
- ✓ According to the results of Paired t-test, Deposits, advances, recovery and CDR were not significantly increased.
- ✓ The overall performance of BGGB can be said to be improved.

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A study on consumer behaviour towards online food service company in Junagadh city

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Abstract: *In this study, consumer behaviour towards online food service will be identified. Findings imply that when they purchase food online many factors they consider like offer given by online food service company, speed of delivery food, quality and other factors are also considered.*

Key Words : *consumer behaviour, online food services.*

1. INTRODUCTION:

In the context of marketing, consumer buying behaviour refers to the steps and procedures people take while deciding what to buy. It starts with the identification of a need or want, then moves on to information gathering, alternative analysis, decision-making, post-purchase analysis, and possible disposal or repurchase. It is essential to marketing because it helps companies understand how and why customers choose particular goods and services. Marketers may learn a lot about the elements that drive consumer behaviour, such as individual preferences, requirements, and motivations, as well as outside influences including social, cultural, and economic variables. Equipped with this understanding, companies may design successful marketing plans, tailor products to suit customer demands, and produce audience-resonant targeted advertising campaigns.

2. ASPECTS OF PSYCHOLOGY:

A consumer's purchasing decisions are influenced by psychological elements, which probe deeply into how their mind functions. Fundamental components like motivation encourage people to satisfy their innate desires. Preferences can be shaped by learning from prior experiences and other influences. Personal opinions on brands or products are determined by attitudes and beliefs that have developed over time. Last but not least, perception—the unique lens through which each person sees the world—can change greatly, leading to disparate interpretations of the same information among customers. Knowing these subtleties can help marketers create messages that resonate. Motivation, A consumer's inner drive forces them to meet a demand. For instance, a person may purchase a luxury vehicle to satisfy a deeper need for prestige or self-worth in addition to using it for mobility. Learning is the process of gaining knowledge.

3. LITERATURE REVIEW:

(Jadeja, J. S., & Singh, S.2021) this study's primary goal was to examine the different aspects that affect consumers' meal choices. Placing service orders. Gujarati cities have been selected as a sample for our study. The research's data were gathered from survey and secondary data from websites, articles, eBooks, and magazines. Pie charts help with data interpretation, analysis, and comprehension. We have read a large number of research papers for the descriptive study. These days, a lot of innovative technology concepts and improved user interaction have improved the online meal ordering system. Consumers use different tactics to draw in new clients. This study provides us with factors that have a



significant impact on consumers. The above study was conducted in Vadodara and my study will in Junagadh so result will be vary.

(Paghdar, S. J., Dudhagara, C. R., & Mahera, A. B.2024) Chemical compounds known as plant growth regulators (PGRs) control different facets of plant growth and development. PGRs have the ability to alter hormonal balance and growth in crops, which can improve physiological characteristics, yield, and crop tolerance to abiotic stress. This study looks at how farmers view PGRs in vegetable farming. Two talukas in the Junagadh district—Junagadh and Vanthali—were specifically chosen using a multi-stage sampling technique. A sample of 40 farmers was taken from each taluka, for a total of 80 farmers. The results were analysed using the weighted average index (WAI). The results showed that most Junagadh farmers had a generally favourable opinion of plant growth regulators (PGRs) in vegetable farming, especially valuing their influence on vegetable. The above study was conducted on vegetables whereas my study is on online food service company like zomato swiggy etc.

(Patel, D. N., & Jain, D. R) The world economy is being severely impacted by COVID-19, with several nations predicted to go into recession. Consumers must visit markets and spend money for the economy to flourish, but the main question facing marketers is whether they are in the emotional mindset to spend. Due to the shifts in customer behaviour brought on by COVID 19, every marketer is attempting to comprehend the financial strategies employed by the various consumer clusters while making purchases of both essential and non-essential goods. The study examines how five towns and cities in Gujarat, India, are affected by demographic, psychographic, and behavioural segmentation in relation to the expected price increase following the lockdown. The findings show that consumers are informed regardless of age, income, marital status, and occupation. The above study was conducted in the time of covid 19 which was not normal time any my present study will cover normal time.

(Kumar, R., Javia, M., Lakhani, C., Umraniya, Y., & Vala, L. K. 2023) The typical lifestyle and emotional components of the global population have been significantly impacted by COVID-19. Longer lockdown periods have led to an increase in harmful behaviours and lifestyle choices, such as decreased physical activity, appetite loss, increased consumption of fast food and junk food, sleep difficulties, etc. After obtaining consent for voluntary participation in the survey, the current cross-sectional study was carried out between March and April 2022 among 1000 randomly chosen participants of a certain age range from different parts of Amreli, Gujarat (500 men and 500 women). The study's objective was to assess how lockdowns affected Indian inhabitants' urban lifestyles and behavioural changes. Of the 1000 individuals, 55% had a decline in their physical. Above study was conducted in covid19 whereas present study will cover normal time period.

(Buch, N. 2022) with the passage of the Law of Geographical Indications, 1999, India's adherence to the TRIPS agreement took a significant turn. This statute was an impressive response to India's growing concerns about the preservation and acknowledgement of its cultural heritage in the face of fast globalisation. The goal of this recently enacted law was to identify, record, and safeguard the distinctive agricultural, food, and handicraft goods that are scattered throughout the country. After 20 years, 370 products—including 16 from the State of Gujarat—have been registered as Geographical Indications (GI) in all product categories. It is important to remember, though, that aside from registrations, Gujarat hardly, if at all, satisfies a key requirement of the law that calls for mandatory compliance, namely. above study was not conducted on online food service company.

(Panghal, A., Nath, T., & Vern, P. 2022) In order to make food available, agri-food supply chains are a dynamic structure of networks and middlemen that cooperate at the necessary places. With the acceleration of globalisation and technology advancements, agri-food supply chains in the twenty-first century are developing and becoming more efficient. Potential entrepreneurs have the opportunity to take advantage of the growing complexity and unpredictability of agri-food supply chains and marketplaces. Because of an entrepreneur's creative and innovative efforts to seize new opportunities,



the different entrepreneurship models are changing in agri-supply chains. The entrepreneurial prospects in the agri-food supply chain are covered in this chapter, along with the creative company models and entrepreneurial hurdles. Additionally, it offers principles and a framework for entrepreneurial policies to foster agri-food entrepreneurship. A few pertinent case studies of prosperous agri-food entrepreneurs. Above study was conducted on Agri food service whereas my study will conducted on online food service company.

4. RESEARCH METHODOLOGY:

Only primary data was used in this study. Through the use of a standardized primary data is gathered. 50 to 60 consumer data will be collected to study the which factor affect to consumer when he ordered food online.

5. OBJECTIVE:

- To identify effects of income level on spending habit of consumer.

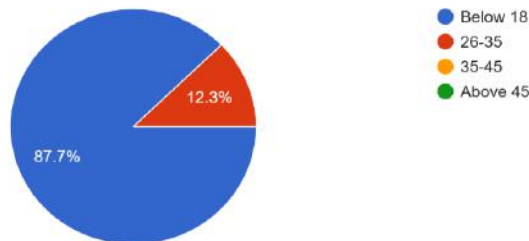
6. HYPOTHESIS:

- H0: There is no significant effect of income level on consumer behaviour.
- H1: There is significant effect of income level on consumer behaviour.

7. DATA ANALYSIS:

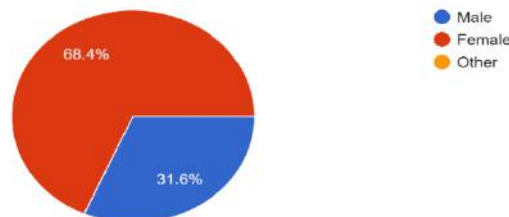
Sample Size: 50 to 60 consumers (Junagadh City)

Age
57 प्रतिशत



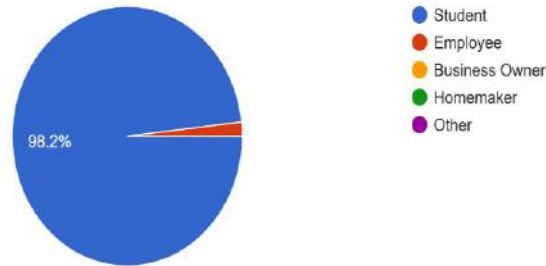
12.3 % age belongs to age between 26 to 35 whereas 87.7 % belongs to below 18.

Gender
57 प्रतिशत



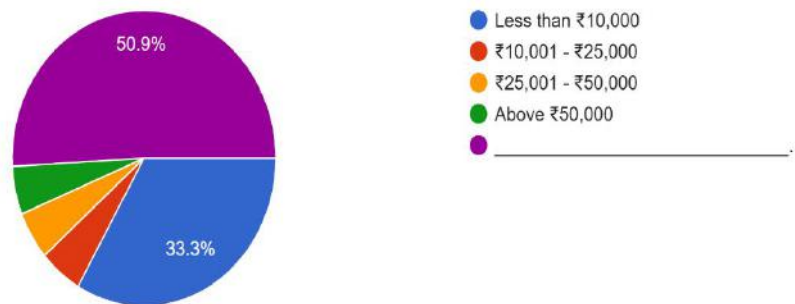
68.4 % are male from response and 31.6 % are female.

Occupation
57 પ્રતિસાદ



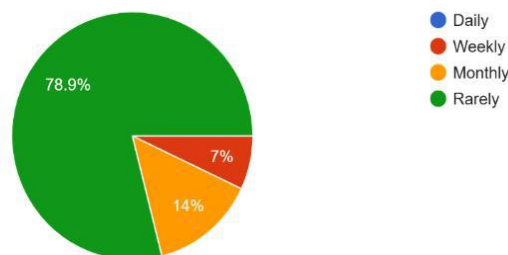
98.2 % are students and 1.8% belongs to employee.

Monthly Income
57 પ્રતિસાદ



In the context of income 33.3 % people belongs to less than income of 10000,10001 to 25001to 50000 to 15.8% and 50.9 % belongs to above 50000.

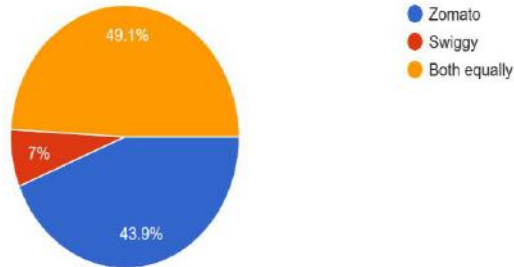
How often do you use online food delivery services?
57 પ્રતિસાદ



From above graph it can be see that 78.9% people used online food services rarely,14% monthly and 7% use weekly.

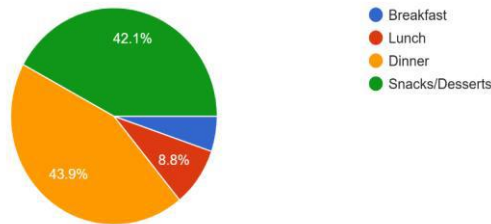


Which platform do you use more frequently?
57 પ્રતિસાદ



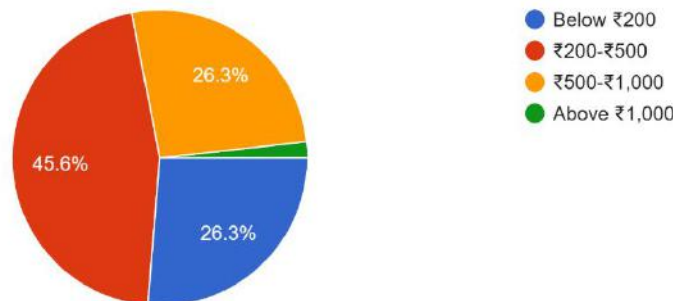
From the above graph it can be see that 43.9% uses Zomato,7 % uses swiggy and 43.9% uses both.

What type of meals do you typically order?
57 પ્રતિસાદ



From above graph it can be see that 42.1% people are giving orders for snacks or desert,43.9% for dinner,8% for lunch and 5.2 % are gives order for breakfast.

How much do you usually spend per order?
57 પ્રતિસાદ

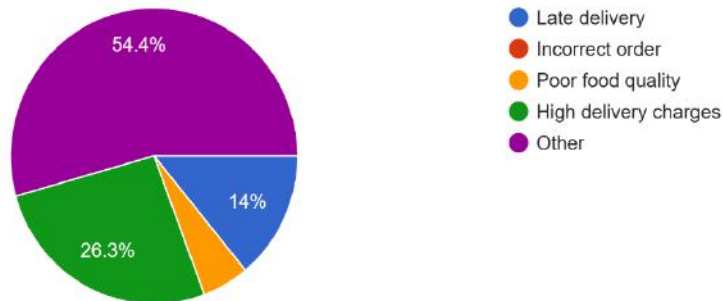


From above graph it can seen that 26.3 % gives order for RS 200,45.6 % gives order between RS 200 to 500,26.3% gives order between RS 500 to 1000 and above RS 1000 are 1.8%



Have you faced any issues with online food delivery services?

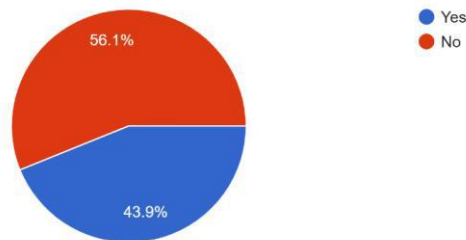
57 प्रतिसाद



From the above response it can be seen that 14% people facing issue related to late delivery, 54.4% other issues, 5.3% poor quality and 26.3% high delivery charges.

Do you prefer online food delivery over dining out?

57 प्रतिसाद



From the above diagram it can be seen that 56.1 % prefer online services whereas 43.9% not.

8. ANALYSIS THROUGH ANOVA

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	9.338	3	3.113	3.421	.024
Within Groups	46.408	51	.910		
Total	55.745	54			

9. FINDINGS:

Here, p-value is less than 0.05. so, it can be concluded that the null hypothesis is accepted and alternate hypothesis is rejected. So, it can be said that there is no significant effect of income level on spending habit of consumer.

10. LIMITATION OF STUDY:

The study is based on primary survey and the behaviour of consumer is unpredictable. They may not be given response. Many times, consumers having no time to response



11. CONCLUSION:

From this paper it can be concluded that Consumer behaviour is affected by several factors out of various factors it is concluded that income of people does not affect to the spending level of people.

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A Critical Analysis of Asset Quality in Selected Private Sector Banks of India

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Abstract : *Asset quality is a fundamental metric in evaluating the financial health and operational efficiency of banks. It directly impacts profitability, capital adequacy, and the overall stability of the banking sector. High asset quality reflects effective credit risk management and prudent lending practices, ensuring lower levels of non-performing assets (NPAs). In contrast, deteriorating asset quality poses risks to banks' solvency, affecting their ability to extend credit and contributing to systemic risks in the economy. For private sector banks, maintaining superior asset quality is vital to sustaining investor confidence, adhering to regulatory norms, and competing effectively in a dynamic market. This study highlights the importance of assessing asset quality as a critical indicator of financial stability and long-term growth in the banking industry. The banking sector plays a pivotal role in the economic growth and stability of any nation. One of the critical determinants of a bank's financial health is its asset quality, which reflects the efficiency of its credit risk management. This study examines the asset quality of HDFC Bank, ICICI Bank, and Kotak Mahindra Bank over the five-year period from 2019-20 to 2023-24. By analysing non-performing assets (NPAs), provisioning ratios, and other financial indicators, this study aims to evaluate the banks' asset quality and compare their performance. The findings offer insights into the strengths and weaknesses of these private banks, shedding light on their risk management practices and resilience in a dynamic financial environment.*

Keywords: *Asset Quality, Private Sector Banks, Non-Performing Assets (NPAs), Credit Risk Management, Banking Sector*

1. INTRODUCTION

Asset quality is a critical metric in assessing the financial health and stability of banks and financial institutions. It refers to the quality of a bank's assets, primarily its loans and advances, and its ability to recover those assets in a timely manner. The assessment of asset quality evaluates the risk associated with a financial institution's credit portfolio and its capacity to generate consistent returns while minimizing credit losses. Poor asset quality can lead to elevated levels of non-performing assets (NPAs), threatening the institution's profitability and solvency.

Components of Asset Quality

The core of asset quality lies in the creditworthiness of the borrowers and the effectiveness of the bank's risk management practices. Key components include the level of NPAs, restructured loans, overdue accounts, and the concentration risk in the credit portfolio. Loans that default or show signs of becoming delinquent reduce the bank's asset quality. Additionally, sectoral and geographical exposures, particularly in volatile or high-risk industries, play a significant role in determining asset quality. A well-diversified portfolio is less susceptible to adverse shocks and contributes to better asset quality.



Measurement and Indicators

To evaluate asset quality, financial institutions rely on various indicators and ratios. The Gross NPA Ratio and Net NPA Ratio are among the most prominent metrics. The Gross NPA Ratio measures the proportion of total loans that have turned non-performing, while the Net NPA Ratio accounts for provisions made against such loans, providing a clearer picture of potential losses. The provision coverage ratio (PCR) indicates the adequacy of reserves set aside to cover bad loans. A high PCR reflects prudent risk management, bolstering the institution's resilience.

Implications of Poor Asset Quality

Deteriorating asset quality can have severe repercussions for a financial institution. It erodes profitability as banks must allocate significant resources to cover loan losses and provisions. Additionally, poor asset quality undermines investor and depositor confidence, affecting the institution's liquidity and capital-raising ability. In extreme cases, systemic risks may arise, jeopardizing the stability of the broader financial system. This was evident during the global financial crisis of 2008 when subprime mortgage defaults in the U.S. led to widespread financial turmoil.

Strategies to Improve Asset Quality

Improving asset quality requires proactive measures, including robust credit appraisal processes, regular monitoring of loan performance, and early intervention in stressed accounts. Strengthening risk assessment frameworks and adopting advanced credit analytics can help banks identify potential risks early. Regulatory bodies also play a crucial role by implementing stringent norms for recognizing and provisioning bad loans, ensuring transparency in financial reporting. Moreover, mechanisms like debt restructuring and insolvency frameworks, such as the Insolvency and Bankruptcy Code (IBC) in India, aid in resolving stressed assets and recovering value efficiently.

Asset quality serves as a cornerstone of a sound banking system, influencing financial institutions' stability and economic growth. By maintaining high-quality assets and managing credit risks effectively, banks can ensure sustainable profitability and resilience against economic uncertainties. With evolving market dynamics and regulatory landscapes, continuous innovation in risk management practices remains vital to preserving and enhancing asset quality.

2. NEED OF THE STUDY

The banking sector plays a pivotal role in the economic development of a country by channelling savings into productive investments. Within this framework, asset quality is a key determinant of a bank's stability, profitability, and resilience. The health of a bank's assets directly influences its ability to meet financial obligations, generate consistent returns, and sustain economic shocks. In recent years, private sector banks in India have emerged as significant contributors to the country's financial ecosystem, yet they too face challenges related to the quality of their assets.

This study is essential due to the rising concern over the level of non-performing assets (NPAs) in the Indian banking sector, which affects both public and private banks. Private sector banks, often lauded for their efficiency and profitability, are not immune to the risks posed by deteriorating asset quality. Factors such as economic slowdowns, industry-specific challenges, and regulatory changes can adversely impact their credit portfolios. Understanding the nuances of asset quality in private sector banks is crucial to ensuring their continued contribution to India's financial stability and economic growth.



Another significant aspect of the need for this study is the comparative dimension it offers. While public sector banks have traditionally been in focus for their asset quality issues, private sector banks require similar scrutiny to prevent systemic risks. The study will delve into key indicators such as Gross and Net NPA ratios, Provision Coverage Ratios (PCR), and sectorial credit exposure to identify patterns and vulnerabilities. It will provide a deeper understanding of how private banks manage risks and maintain the quality of their assets amidst a dynamic economic environment.

Moreover, the findings of this study hold practical implications for policymakers, regulators, and bank management. Insights from this research can guide the formulation of policies to strengthen credit assessment frameworks, improve recovery mechanisms, and enhance risk management practices in private sector banks. For regulators, such as the Reserve Bank of India (RBI), the study can serve as a reference for monitoring the evolving asset quality trends and devising targeted interventions.

Finally, with the growing adoption of advanced technologies like data analytics and artificial intelligence in banking, the study will explore how these tools can be leveraged to predict and mitigate risks associated with asset quality. The research will also shed light on the effectiveness of existing regulatory measures, such as the Insolvency and Bankruptcy Code (IBC) and their role in resolving stressed assets in private sector banks.

3. LITERATURE REVIEW

Kumar (2018) conducted an in-depth analysis of Non-Performing Assets (NPAs) in public sector banks in India, focusing on the period from 2012 to 2017. The study found that the gross NPA ratio had increased significantly, primarily due to large corporate loans turning bad. Factors such as poor risk management practices, inadequate credit appraisal systems, and economic slowdown were identified as key contributors to the rising NPAs. Kumar recommended the implementation of stricter regulatory frameworks and improved corporate governance to mitigate the NPA crisis.

Sharma and Mehta (2019) examined the impact of NPAs on the profitability and performance of private sector banks in India. The researchers used a sample of five major private banks and analysed their financial statements over a five-year period. The findings revealed a negative correlation between NPAs and profitability, with higher NPAs leading to reduced net interest margins and return on assets. The study suggested that private banks adopt advanced analytics for early detection of potential NPAs and enhance their recovery mechanisms.

Rao and Singh (2020) investigated the role of macroeconomic factors in the escalation of NPAs in Indian banks. By employing econometric models, they found that factors such as GDP growth rate, inflation, and exchange rate volatility significantly influenced the NPA levels. The study highlighted that economic downturns and sector-specific issues, particularly in the infrastructure and steel sectors, exacerbated the NPA problem. Rao and Singh recommended policy interventions to stabilize the macroeconomic environment and sector-specific support to reduce NPAs.

Patel (2020) focused on the effectiveness of various NPA recovery mechanisms employed by Indian banks. The study analysed the success rates of measures like Debt Recovery Tribunals (DRTs), Securitisation and Reconstruction of Financial Assets and Enforcement of Security Interest (SARFAESI) Act, and the Insolvency and Bankruptcy Code (IBC). Patel found that while the IBC had shown promising results in recent years, the overall recovery rate remained low. The study called for strengthening the legal infrastructure and faster resolution processes to improve NPA recovery.

Agarwal and Gupta (2021) explored the impact of NPAs on the lending behaviour of banks in India. Using a panel data approach, they found that banks with higher NPAs tended to be more risk-averse, leading to a contraction in credit supply, particularly to small and medium enterprises (SMEs). This, in turn, hampered economic growth and employment generation. The researchers suggested that banks



need to balance risk management with the necessity of providing adequate credit to support economic activities.

Bansal and Thakur (2021) studied the regional disparities in NPAs among Indian banks. They discovered significant variations in NPA levels across different states, with higher NPAs observed in economically weaker regions. The study attributed these disparities to differences in economic activities, industrial composition, and state-specific policies. Bansal and Thakur recommended targeted interventions by state governments and banks to address the underlying causes of NPAs in high-risk regions.

Singh and Verma (2022) analysed the effect of the COVID-19 pandemic on the NPA levels in Indian banks. Their study revealed that the pandemic had exacerbated the NPA situation due to widespread business disruptions and financial distress among borrowers. The findings indicated that sectors like hospitality, tourism, and retail were particularly affected. Singh and Verma suggested that banks adopt more flexible restructuring policies and extend moratoriums to support affected borrowers during the recovery phase.

Chaudhary and Sinha (2023) investigated the relationship between corporate governance practices and NPA levels in Indian banks. They found that banks with stronger governance frameworks, including independent boards and transparent disclosure practices, had lower NPA ratios. The study emphasized the importance of ethical leadership and robust governance structures in mitigating the risk of NPAs. Chaudhary and Sinha recommended enhancing corporate governance standards across the banking sector to prevent future NPA issues.

Nair and Pillai (2023) focused on the role of technology in managing and reducing NPAs in Indian banks. The study highlighted that the adoption of advanced technologies such as artificial intelligence (AI) and machine learning (ML) for credit risk assessment and monitoring had significantly improved the identification and management of NPAs. The researchers advocated for increased investment in technological solutions to enhance the predictive capabilities and efficiency of NPA management processes.

Roy and Banerjee (2024) examined the impact of regulatory reforms on the NPA levels in Indian banks. The study assessed the effectiveness of recent regulatory measures, including the implementation of the Prompt Corrective Action (PCA) framework and the revised NPA recognition norms. The findings indicated that these reforms had contributed to greater transparency and accountability, leading to a gradual reduction in NPA levels. Roy and Banerjee recommended continued regulatory vigilance and periodic review of policies to sustain the progress in NPA management.

3. RESEARCH OBJECTIVES

1. To analyse the asset quality of the selected private sector banks of India.
2. To compare the asset quality of the selected private sector banks of India.

4. RESEARCH METHODOLOGY

Sample Size

In this study below mentioned 3 private sector banks of India have been taken.

1. HDFC Bank
2. ICICI Bank
3. Kotak Mahindra Bank



Period of Data Coverage

In this study annual reports for the year 2019-20 to 2023-24 have been analysed.

5. Data Analysis

5.1 Gross NPA

Table 1 : Gross NPA of selected private banks

GROSS NPA					
BANK	2023-24	2022-23	2021-22	2020-21	2019-20
HDFC Bank	31,173.32	18,019.03	16,140.96	15,086.00	12,649.97
ICICI Bank	27,313.87	2,99,860.70	33,294.92	40,841.42	40,829.09
Kotak Mahindra Bank	5,274.78	6,419.00	6,469.74	7,425.51	5,026.89

HDFC Bank’s Gross NPA (Non-Performing Assets) figures reveal a consistent upward trajectory over the five-year period from 2019-20 to 2023-24. Starting at ₹12,649.97 crore in 2019-20, it has risen steadily to ₹31,173.32 crore in 2023-24. This significant increase indicates that while HDFC Bank is expanding its lending operations, it is concurrently experiencing a growing share of non-performing loans. The increase from ₹18,019.03 crore in 2022-23 to ₹31,173.32 crore in 2023-24—a rise of approximately 73%—is particularly noteworthy and suggests potential challenges in credit quality. Despite its reputation for robust risk management, the bank may need to revisit its credit appraisal processes and recovery mechanisms to address this rising trend.

ICICI Bank’s Gross NPA trends display a sharp fluctuation over the years. In 2019-20, the Gross NPA stood at ₹40,829.09 crore, which declined consistently to ₹40,841.42 crore in 2020-21 and then to ₹33,294.92 crore in 2021-22. However, the figure drastically decreased to ₹2,99,860.70 crore in 2022-23, before reaching ₹27,313.87 crore in 2023-24. This sharp fall in Gross NPA between 2021-22 and 2022-23 likely reflects a major cleanup of the loan book, improved recoveries, or significant write-offs. The subsequent drop to ₹27,313.87 crore in 2023-24 indicates continued efforts toward maintaining asset quality. Nevertheless, ICICI Bank’s fluctuations suggest periodic vulnerabilities, and its ability to sustain these improvements in the long term will be critical for maintaining investor confidence.

Kotak Mahindra Bank demonstrates a comparatively stable trend in its Gross NPA figures over the observed period, with figures fluctuating moderately. Starting at ₹5,026.89 crore in 2019-20, it rose to ₹7,425.51 crore in 2020-21 and then began declining, reaching ₹6,469.74 crore in 2021-22 and ₹6,419.00 crore in 2022-23. By 2023-24, the Gross NPA reduced further to ₹5,274.78 crore. The declining trend from 2021-22 to 2023-24 is a positive indicator of the bank's focus on improving asset quality and implementing effective risk mitigation strategies. Kotak Mahindra Bank appears to have better control over its asset quality compared to its peers, as evidenced by the relatively low and stable Gross NPA levels over the years.

Table 2: Summary of Anova

Groups	Count	Sum	Average	Variance
HDFC Bank	5	93069.28	18613.856	53055718.19
ICICI Bank	5	442140	88428	14002129714
Kotak Mahindra Bank	5	30615.92	6123.184	956327.7647



Table 3: Anova Test

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	19673523877	2	9836761939	2.099458466	0.165261	3.885294
Within Groups	56224567038	12	4685380587			
Total	75898090915	14				

H_0 = There is no significant difference in Gross NPA between selected private sector banks of India.

H_1 = There is significant difference in Gross NPA between selected private sector banks of India.

INTERPRETATION

From above table for 2 and 12 degree of freedom

Fcal is 2.099 and Ftab is 3.885

P-value is 0.165

Thus, Fcal < Ftab and p-value is higher than specified α of 0.05

So, null hypothesis is accepted and it is concluded that there is no significant difference in Gross NPA between selected private sector banks of India.

5.2 Net NPA

Table 4: Net NPA of selected private banks

NET NPA					
BANK	2023-24	2022-23	2021-22	2020-21	2019-20
HDFC Bank	8,091.74	4,368.43	4,407.68	4,554.82	3,542.36
ICICI Bank	5,377.79	51,500.70	6,931.04	9,117.66	9,923.24
Kotak Mahindra Bank	1,270.57	1,479.00	1,736.71	2,705.17	1,557.89

HDFC Bank’s Net NPA figures exhibit a rising trend over the five-year period, increasing from ₹3,542.36 crore in 2019-20 to ₹8,091.74 crore in 2023-24. While the growth in Net NPA levels is gradual from 2019-20 to 2022-23, the jump from ₹4,368.43 crore in 2022-23 to ₹8,091.74 crore in 2023-24—an increase of approximately 85%—raises concerns about its asset quality. This significant rise indicates a possible weakening in the bank’s ability to recover non-performing loans or increased slippages in recent years. Despite its reputation for effective management, the rising trend underscores the need for enhanced recovery mechanisms and stricter underwriting standards.



ICICI Bank shows a fluctuating trend in its Net NPA levels over the observed period. Starting at ₹9,923.24 crore in 2019-20, the figure declined to ₹9,117.66 crore in 2020-21 and further to ₹6,931.04 crore in 2021-22. A significant drop to ₹51,500.70 crore in 2022-23, followed by a decline to ₹5,377.79 crore in 2023-24, demonstrates the bank’s aggressive efforts to clean up its balance sheet. The marked reduction in Net NPAs, especially in the last two years, indicates improved asset recovery and provisioning strategies. However, the fluctuations over the years suggest the bank is still addressing legacy issues and working to stabilize its asset quality.

Kotak Mahindra Bank exhibits the most stable trend in Net NPA levels among the three banks. Starting at ₹1,557.89 crore in 2019-20, the Net NPAs rose slightly to ₹2,705.17 crore in 2020-21 but declined steadily in subsequent years to ₹1,270.57 crore in 2023-24. The downward trend in recent years reflects the bank’s strong risk management and effective recovery processes. With consistently low Net NPA levels, Kotak Mahindra Bank demonstrates better control over credit risks and a conservative approach to lending, making it less vulnerable to asset quality deterioration compared to its peers.

Table 5: Summary of Anova

Groups	Count	Sum	Average	Variance
HDFC Bank	5	24965.03	4993.006	3157808.724
ICICI Bank	5	82850.43	16570.086	384511426.7
Kotak Mahindra Bank	5	8749.34	1749.868	313181.6607

Table 6: Anova Test

Source of Variation	SS	Df	MS	F	P-value	F crit
Between Groups	606975978.3	2	303487989	2.34666296	0.137984	3.885294
Within Groups	1551929669	12	129327472			
Total	2158905647	14				

H_0 = There is no significant difference in Net NPA between selected private sector banks of India.

H_1 = There is significant difference in Net NPA between selected private sector banks of India.

INTERPRETATION

From above table for 2 and 12 degree of freedom

Fcal is 2.346 and Ftab is 3.885

P-value is 0.137

Thus, Fcal < Ftab and p-value is higher than specified α of 0.05

So, null hypothesis is accepted and it is concluded that there is no significant difference in Net NPA between selected private sector banks of India.

6. FINDINGS

The analysis of Gross and Net NPA trends in HDFC Bank, ICICI Bank, and Kotak Mahindra Bank reveals several key insights, which align with and diverge from findings in prior research. Gross NPAs for all three banks reflect the challenges posed by systemic risks, such as the COVID-19 pandemic, and



the varying effectiveness of risk management practices. HDFC Bank shows a persistent rise in both Gross and Net NPAs, suggesting weaknesses in its credit monitoring systems and potential exposure to sectors significantly affected by the pandemic. ICICI Bank demonstrates fluctuating NPA levels but has made notable progress in reducing both Gross and Net NPAs in recent years. Kotak Mahindra Bank, on the other hand, consistently maintains the lowest NPA levels, underscoring its robust credit risk practices.

The findings resonate with Singh and Verma's (2022) study, which highlighted the COVID-19 pandemic's impact on NPAs due to financial distress among borrowers. HDFC Bank's sharp rise in Gross NPAs from ₹18,019.03 crore in 2022-23 to ₹31,173.32 crore in 2023-24 aligns with this observation, likely due to its exposure to pandemic-affected sectors such as hospitality, tourism, and retail. ICICI Bank's efforts to stabilize its NPAs, evidenced by a reduction in Net NPA from ₹51,500.70 crore in 2022-23 to ₹5,377.79 crore in 2023-24, reflect the importance of restructuring policies and moratoriums, as suggested by Singh and Verma. While Kotak Mahindra Bank's comparatively lower NPA levels suggest that its conservative lending practices shielded it from pandemic-induced

disruptions, the broader trends in the sector highlight the need for flexible restructuring measures across banks to manage post-pandemic recovery effectively.

The results also align with Chaudhary and Sinha's (2023) findings on the role of corporate governance in controlling NPAs. Kotak Mahindra Bank's consistently low Net NPA levels, which fell from ₹2,705.17 crore in 2020-21 to ₹1,270.57 crore in 2023-24, can be attributed to its robust governance practices. Strong leadership, transparency, and ethical governance likely enabled the bank to navigate credit risks more effectively. Conversely, HDFC Bank's rising NPAs suggest potential gaps in governance that need to be addressed to prevent further deterioration in asset quality. The comparative analysis highlights that banks with stronger governance frameworks, as emphasized by Chaudhary and Sinha, are better equipped to mitigate NPA risks, supporting the recommendation to enhance governance standards across the banking sector.

The role of technology, as explored by Nair and Pillai (2023), is another critical factor in managing NPAs. ICICI Bank's significant reduction in NPAs, particularly from ₹6,931.04 crore in 2021-22 to ₹5,377.79 crore in 2023-24, may reflect its adoption of advanced technological tools for credit risk assessment and monitoring. The findings align with Nair and Pillai's advocacy for increased investment in AI and ML technologies to enhance predictive capabilities in identifying potential loan defaults. In contrast, HDFC Bank's rising NPAs indicate the need for greater integration of such technologies to strengthen its credit risk management processes. Kotak Mahindra Bank's steady performance further supports the argument that technological adoption is crucial for maintaining low NPA levels, as it allows for more accurate risk assessment and effective monitoring of loan portfolios.

The impact of regulatory reforms, as discussed by Roy and Banerjee (2024), is evident in the NPA trends observed in ICICI Bank. The sharp decline in Gross NPAs from ₹33,294.92 crore in 2021-22 to ₹27,313.87 crore in 2023-24 suggests that measures such as the Prompt Corrective Action (PCA) framework and revised NPA recognition norms have contributed to improved transparency and accountability. The findings support Roy and Banerjee's conclusion that regulatory vigilance and reforms have a positive impact on NPA management. HDFC Bank's rising NPA trend, however, highlights the need for banks to fully implement and leverage regulatory measures to strengthen their asset quality. Kotak Mahindra Bank's stable and low NPA levels further validate the effectiveness of regulatory compliance combined with strong internal governance and technology-driven approaches.

7. CONCLUSION

The analysis of Gross and Net NPA trends across HDFC Bank, ICICI Bank, and Kotak Mahindra Bank highlights key insights into the asset quality of selected private sector banks in India. When comparing the three private sector banks, distinct patterns in Gross NPA trends emerge. HDFC Bank exhibits a



consistent and significant increase in its Gross NPAs, raising concerns about the sustainability of its credit quality in the face of its aggressive growth strategies. ICICI Bank, on the other hand, shows sharp fluctuations, with a significant cleanup of its loan book in recent years. This highlights its efforts to address legacy issues, but the bank still needs to ensure that its asset quality improvements are sustained over time. Kotak Mahindra Bank stands out for its relatively stable and controlled Gross NPA figures, demonstrating better risk management and credit quality maintenance compared to its peers. In absolute terms, HDFC Bank reported the highest Gross NPA in 2023-24 at ₹31,173.32 crore, followed by ICICI Bank at ₹27,313.87 crore, and Kotak Mahindra Bank at a much lower ₹5,274.78 crore. However, ICICI Bank's significant reduction in Gross NPA over the years highlights its strong recovery and write-off mechanisms, contrasting with HDFC Bank's increasing trajectory. Kotak Mahindra Bank's ability to maintain a lower Gross NPA level underscores its effective credit risk management and conservative lending approach. Overall, while ICICI Bank and Kotak Mahindra Bank have demonstrated improvements in asset quality, HDFC Bank's rising Gross NPA trend warrants closer scrutiny to ensure its long-term financial health and resilience. The comparative analysis underscores the importance of

robust risk management frameworks and targeted recovery strategies to sustain asset quality in private sector banks.

HDFC Bank, ICICI Bank, and Kotak Mahindra Bank exhibit varied trends in their Net NPAs, reflecting their respective strategies and challenges in maintaining asset quality. HDFC Bank's consistent increase in Net NPAs over the years, particularly the sharp rise in 2023-24, indicates potential vulnerabilities in its credit risk management framework. In contrast, ICICI Bank's significant fluctuations, especially the sharp reduction in 2022-23 and 2023-24, highlight its aggressive stance on addressing bad loans and improving provisioning coverage. Kotak Mahindra Bank emerges as the most stable performer, maintaining low and consistently declining Net NPAs, showcasing its prudent lending practices and superior risk controls. In absolute terms for 2023-24, HDFC Bank reported the highest Net NPA at ₹8,091.74 crore, followed by ICICI Bank at ₹5,377.79 crore, while Kotak Mahindra Bank maintained the lowest figure at ₹1,270.57 crore. The relatively higher Net NPAs of HDFC Bank and ICICI Bank can be attributed to their larger loan books and higher exposure to stressed sectors. However, Kotak Mahindra Bank's ability to keep its Net NPAs low even amid challenging economic conditions reflects its disciplined credit policies and superior asset management strategies. Overall, while ICICI Bank and Kotak Mahindra Bank have demonstrated improvements in managing their Net NPA levels, HDFC Bank's rising trend calls for immediate action to address asset quality issues. This comparative analysis underscores the importance of robust credit monitoring systems and efficient recovery processes in mitigating risks and maintaining financial stability across private sector banks.

While the Gross and Net NPA figures vary in magnitude over the years, the findings indicate no statistically significant difference between the banks in terms of their overall NPA performance. This suggests that despite differences in operational strategies, scale, and risk management practices, these banks share a comparable level of exposure to non-performing assets. The consistent upward trend in Gross NPAs for HDFC Bank and fluctuations observed in ICICI Bank underline the dynamic nature of credit risk in the banking sector. However, the stable and controlled NPA levels maintained by Kotak Mahindra Bank demonstrate that effective risk management and conservative lending practices can mitigate asset quality challenges. Despite these individual variations, the absence of significant differences in Gross NPA levels suggests that external factors, such as economic conditions and regulatory frameworks, have had a uniform impact on the sector.

Similarly, the analysis of Net NPAs reveals a comparable trajectory among the banks, further supporting the conclusion that the differences in their financial strategies do not significantly impact their ability to manage recoverable bad loans. While HDFC Bank showed a sharp increase in recent years, and ICICI Bank demonstrated substantial improvements in reducing its Net NPAs, Kotak Mahindra Bank



maintained a steady decline. These trends reflect varying levels of operational efficiency and recovery mechanisms but do not translate into statistically significant disparities in their Net NPA performance.

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“Evaluating the success of microfinance programs: A case study of PMMY in promoting entrepreneurship and economic development”

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Abstract: *Microfinance is a financial model that provides small-scale financial services, including microloans, savings, and insurance, to underserved individuals who lack access to traditional banking. This system is a powerful tool for promoting entrepreneurship, particularly in developing countries and low-income communities, where access to capital is limited. Despite these challenges, microfinance remains a critical component in the ecosystem of entrepreneurship development, driving job creation, economic growth, and social inclusion. This abstract highlight the symbiotic relationship between microfinance and entrepreneurship, emphasizing its potential to transform lives and communities through accessible financial empowerment.*

This paper will study the performance of PMMY through the analysis of secondary data from the yearly reports of PMMY and the financial data sets which describe the loan disbursement trends, gender inequality, institutional performance, and the overall scheme affecting financial inclusion and entrepreneurship in the country. Some important inferences from the results are that disbursements have increased across all three categories: Shishu, Kishore, and Tarun. In the last couple of years, loan accounts have increased manifold under the Kishore category, which even grew by as much as 90.9%, and disbursed amounts rose 51.6%. Public sector banks continued to dominate the credit space, with small finance banks and microfinance institutions showing good growth in disbursement numbers. Gender analysis shows a skewness, where women hold 71% of loan accounts, but the percentage of disbursed funds to the female entrepreneurs is much lower as compared to their male counterparts. Geographically, it shows high demand for loans from states like Bihar and Uttar Pradesh, though the smaller states like Arunachal Pradesh and Mizoram had low levels of activities. Lastly, it supports the new entrepreneurs significantly; the disbursed funds to new entrepreneurs were up to 21.43% in FY 2021-22 while it enhanced the percentage to 28.73% in FY 2022-23.

Key Words: *Microfinance, PMMY, Entrepreneurs, Loan*

1. INTRODUCTION

1.1. Introduction To Microfinance

Microfinance or microcredit: lending a small amount of money to individuals in low-income groups unable to access financial services. The "missing middle" is the commonly used term for this part of society, which was barred from acquiring formal credit due to a lack of collateral support. Microfinance bridges this gap by offering "micro" credit with no collateral at all.



In recent years, the microcredit sector has integrated more with the broader financial sector. Banks and large NBFCs acquired some of the major NBFC-MFIs, while others converted into banks or Small Finance Banks (SFBs). Additionally, banks and NBFCs began building their microcredit portfolios through agreements with Business Correspondents. This mainstreaming has made today’s microcredit industry competitive.

The term microfinance was originally defined very narrowly, specifically referring to providing microloans to poor entrepreneurs and small businesses without access to credit. Two main approaches were used to offer these financial services: (1) relationship-based banking for small firms and individual entrepreneurs, and (2) a group-based model, where many entrepreneurs apply for loans and other services collectively. Over time, the purpose of microfinance has expanded, envisioning a world where everyone, especially the poor and socially marginalized, has easy access to affordable, high-quality financial products and services, including credit, savings, insurance, payment services, and fund transfers.

1.2. Introduction To PMMY

PMMY is a scheme launched by the Hon'ble Prime Minister on April 8, 2015, to provide loans up to 10 lakhs to non-corporate, non-farm small/micro enterprises. These loans are classified as MUDRA loans under PMMY. They are provided by Commercial Banks, RRBs, Small Finance Banks, MFIs, and NBFCs. Borrowers can approach any of these lending institutions or apply online through the portal www.udyamimitra.in. Under PMMY, MUDRA has introduced three products: 'Shishu,' 'Kishore,' and 'Tarun' to represent the growth stage and funding needs of the beneficiary micro-unit/entrepreneur, serving as a benchmark for future growth phases.

PMMY is a Government of India scheme that provides loans to small and micro enterprises:

Figure 1: Types of Loan with Eligibility

Type of Loan	Amount	Eligibility	Interest Rate	Repayment Period
Shishu	50,000	Entrepreneur who either are looking to start new business are in the initial stage of business.	1% per month	5 years
Kishore	50,001 To 5,00,000	Entrepreneurs who need additional capital for their existing business for buying machinery, raw material etc.	Depends on the banks keeping in view terms & conditions of the MUDRA Scheme	
Tarun	5,00,001 To 10,00,000	Entrepreneurs who have well established business and need funds for expansion or diversification of their		

2. LITERATURE REVIEW

Seema Rathee and Deepanshi Aggarwal (2024) have estimated the impact of PMMY on various dimensions of women's empowerment in Haryana using economic, social, and political indicators. Based on the quantitative approach, financial autonomy and social status post-PMMY receipt were measured among women recipients. It was found that there was a significant increase in the economic independence of women, a rise in decision-making power, and improvements in their social status within their communities.

Varun Panwar, Ashutosh Kumar Jha, Pawan Kumar Bhura, and Kokila Negi, (2022) in their study, have critically discussed India's microfinance in depth as a tool for promoting financial inclusion



among its marginalized sections. Their study underlines that microfinance institutions have more significant success in the rural and low-income sectors, where they provide a credit opportunity that would not otherwise have been accessible. Such credit boosts the beneficiaries in the economic security to a higher degree and increases the business development.

Dr. Neelu Kumari and Nimisha Sinha (2023) perform the regional assessment of the performance of PMMY and state that it has been successfully bridging the credit gaps in areas with lesser privileges by reducing the dependency on informal sources of credit and enhancing the growth of businesses.

Shanigaram Gangadhar & V. Balreddy (2022) in their study explores the MUDRA scheme, its product offerings, procedure, legal framework, meaning, mission, purpose, eligibility criteria, and required documents for Mudra bank loans. Secondary data was collected from various sources, including journals, magazines, annual reports, newspapers, articles, and websites, focusing on the PMMY.

Sazzad Parwez, Ruchi Patel & K. Chandra Shekar (2018) identify role of microfinance in financial inclusions and social system development within Gujarat is discussed in the paper. It looks at the model implications within government and non-government initiatives. The study established that microfinance interventions should work on group formation, savings, livelihood promotion, enterprise development, and product marketing since it has played a major role in socio-economic development.

Manish Agarwal & Ritesh Dwivedi (2017) This paper presents an overview, a performance analysis, a SWOT analysis, and recommendations for PMMY. According to author financial inclusion is the significant approach towards which the government goes on implementing various initiatives, and thus financial inclusions have been initiated to the funding of unfunded micro enterprises. A few examples are the Pradhan Mantri Mudra Yojana. Under the PMMY, credit is granted for amounts up to 10 lakhs to the small businesses.

3. OBJECTIVES / AIMS

- To assess the achievements made under the three categories of the scheme which are Shishu, Kishore, and Tarun.
- To analyze loan account growth trends and disbursements under PMMY categories-Shishu, Kishore, and Tarun.
- To investigate state-wise performance in terms of loan accounts and disbursements to identify regional imbalances.
- To examine and evaluate gender-based disparities in loan disbursement.

4. RESEARCH METHOD / METHODOLOGY

4.1. Research Design: This study employs an exploratory research design to evaluate the success of microfinance and PMMY.

4.2. Data Collection Method: Secondary data on PMMY will be collected from official reports, different publications of the Ministry of Finance, reports of the Reserve Bank of India, and the dataset from MUDRA. This will yield quantitative information on the overall loan disbursement, default rate, and demographic data of the borrowers.

4.3. Sampling Method: Convenience Random Sampling Method.

5. DATA ANALYSIS

Table 1: Loan Accounts & Disbursement Amount for Three Categories

No. of Loan Accounts			
Category	FY 2022-23	FY 2021-22	FY 2020-21
Shishu	43077851	41721154	4080115
Kishore	17915912	11088206	9486160
Tarun	1316835	986166	1068771
Disbursement Amount (₹ Crore)			
Category	FY 2022-23	FY 2021-22	FY 2020-21
Shishu	141609.85	123969.05	109953.34
Kishore	200936.63	133389.24	132516.34
Tarun	107877.18	74043.91	79289.57

(Source: PMMY Annual Report)

In the Shishu category, loan accounts grew by 5.6%, and the amount of disbursement by 28.8%, reaching ₹141,609.85 Crore during FY 2020-21 to FY 2022-23. The loan accounts in the Kishore category increased by 90.9%, while disbursement surged by 51.6% to ₹200,936.63 Crore. Loans under Tarun grew by 23.6% in accounts and by 36.1% in disbursement to ₹107,877.18 Crore. Overall, all categories have shown marked growth, with the Kishore category adding the most in terms of both accounts and disbursement.

Table 2: Institute wise Performance of PMMY

Institution Type	*Disbursed Amount (₹ Crore)		
	FY 2022-23*	FY 2021-22*	FY 2020-21*
Public Sector Banks	171118.78	117260.88	129915.00
Private Sector Banks	141116.00	117406.42	93613.20
Small Finance Banks	38297.00	29189.50	19646.68
Micro Finance Institutions	66830.62	48847.97	46601.40
Non-Banking Finance Companies	33061.27	18697.08	31983.17

(Source: PMMY Annual Report)

The data reveals an upward trend of disbursements, albeit at a very strong pace across all financial institution types over three financial years. Public sector banks, though remaining the biggest contributors, grew by 31% from ₹129,915 Crore in FY 2020-21 to ₹171,118.78 Crore in FY 2022-23, and private sector banks grew by 51% from ₹93,613.20 Crore to ₹141,116 Crore. Small finance banks almost doubled their disbursements, growing 95% from ₹19,646.68 Crore to ₹38,297 Crore. Microfinance institutions expanded their disbursement by 43%, from ₹46,601.40 Crore to ₹66,830.62 Crore. NBFCs saw a more modest growth of 3%, from ₹31,983.17 Crore to ₹33,061.27 Crore. The overall growth manifests the push towards expansion of credit dispersion in the financial system.

Table 3: Categories wise performance of PMMY.

Category	*(₹ Crore)					
	FY 2022-23		FY 2021-22		FY 2020-21	
	No. of A/cs.	Disbursement Amt.*	No. of A/cs.	Disbursement Amt.*	No. of A/cs.	Disbursement Amt.*
General	30856600	286445.74	25994139	213883.91	25864699	215942



SC	10335914	47272.28	9364702	37303.61	8398417	30824
ST	3536426	17293.9	3518084	14452.54	3123282	12730
OBC	17581658	99411.74	14918601	73470.30	13348648	62263

(Source: PMMY Annual Report)

During the period of three financial years from FY 2020-21 to FY 2022-23, the General category always received the maximum percentage disbursements that even reached a peak of 66.94% in FY 2022-23 whereas the ST category remains uniformly at the lower end of the spectrum with a meagre 4.04% in FY 2022-23. Thus, this pattern went on without much deviation over the years and proved that the General category continued to receive the biggest percentage of disbursements each year, while the smallest share was always received by the ST category every year.

Table 4: New Entrepreneurs

*(₹ Crore)				
Particulars	FY 2022-23		FY 2021-22	
	No. of A/cs.	Disbursement Amt.*	No. of A/cs.	Disbursement Amt.*
Total	62310598	450423.66	53795526	339110.36
New Entrepreneurs / Accounts	10066770	129422.76	6530351	72685.18
New Entrepreneurs / Accounts (%)	16.16%	28.73%	12.14%	21.43%

(Source: PMMY Annual Report)

The following table compares total accounts and amount disbursed for new entrepreneurs FY 2022-23 versus FY 2021-22: In FY 2022-23, several new entrepreneurs opened new accounts as 10,066,770 (16.16% of total accounts) that received 28.73% of total amount disbursed. Compared with this, in FY 2021-22, 6,530,351 were considered as new accounts, which consisted of 12.14% of the total accounts with 21.43% of the disbursement. This would mean growth in the number of new accounts as well as share of disbursements for new entrepreneurs during FY 2022-23, hence better support to new entrepreneurial ventures.

Table 5: Comparison of PMMY based on Gender-Wise

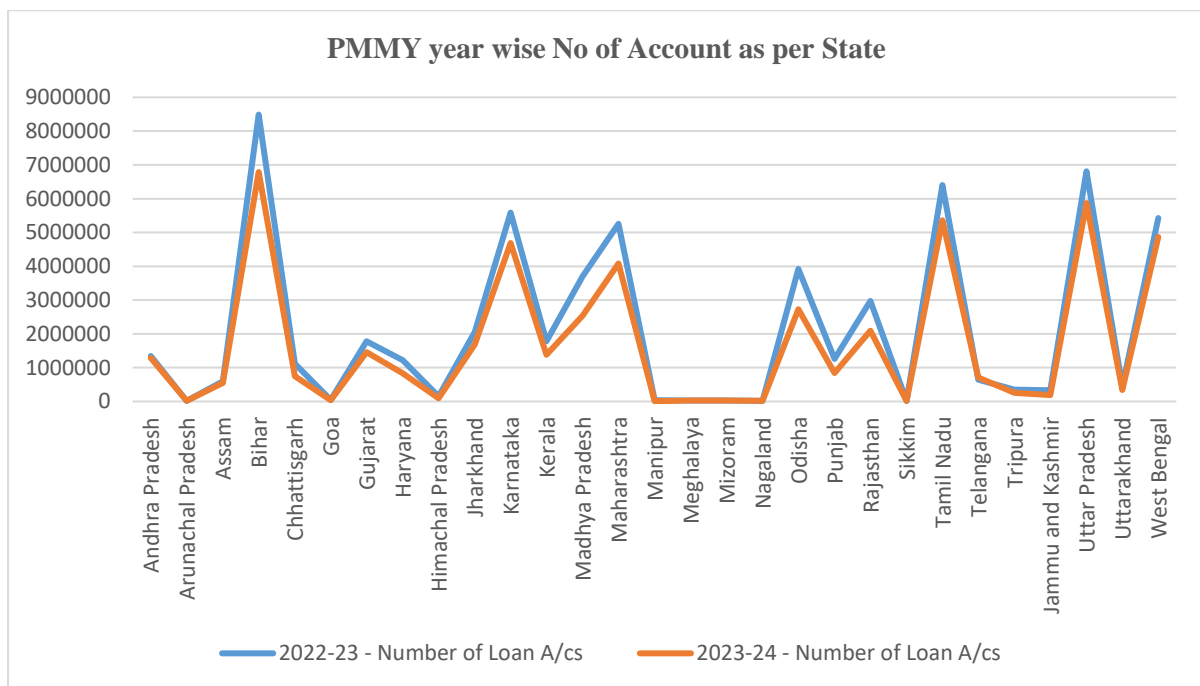
	FY 2022-23		FY 2021-22		FY 2020-21	
	No. of A/cs.	Disbursement Amt.*	No. of A/cs.	Disbursement Amt.*	No. of A/cs.	Disbursement Amt.*
Total	62310598	450423.7	53795526	339110.4	50735046	321759
Women Entrepreneurs (%)	71%	48%	71%	49%	66%	41%
Male Entrepreneurs (%)	29%	52%	29%	51%	34%	59%

(Source: PMMY Annual Report)



Even though women entrepreneurs have continued to dominate accounts over time, they received less in terms of disbursement. This could be evidencing funding inequality as women account for 71 percent accounts in FY 2022-23 but got only 48 percent of the disbursement, while the males, who account for 29 percent of accounts, received 52 percent of the funds. In FY 2021-22 also, women accounted for 71% accounts but received 49 percent of the disbursement compared to 51 percent by males. Similarly, in FY 2020-21, women account holders were 66% while disbursement went to their account just 41% while men account holders received 59%. This indicates that although women account holders are in a majority; they still get a lesser percentage share of funding compared to males.

Graph 1: PMMY year wise No of Account as per State

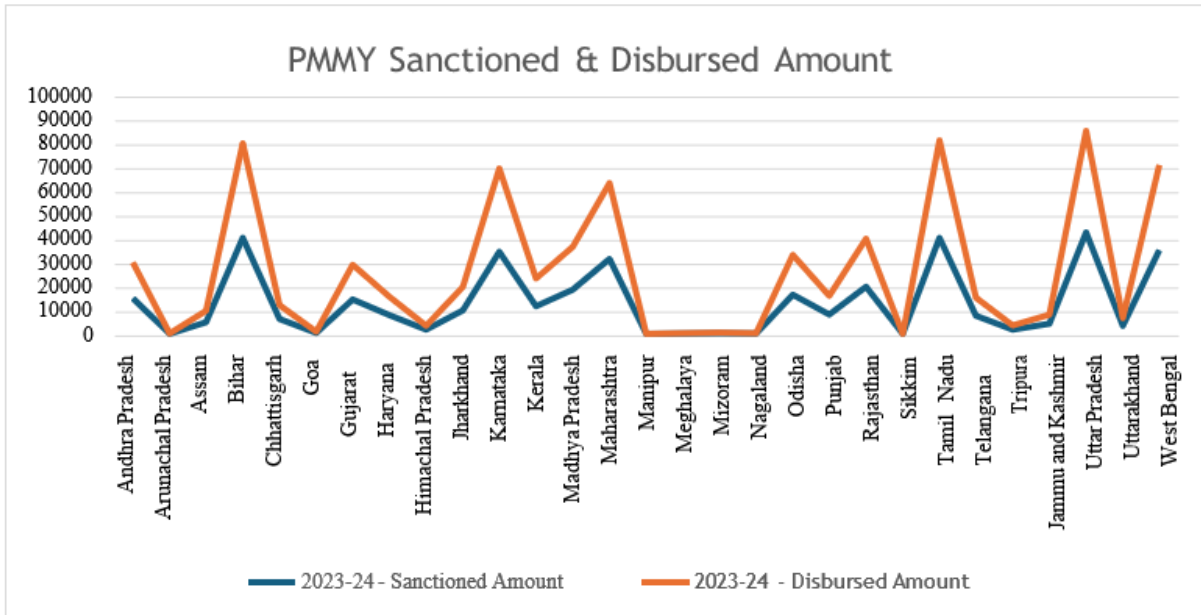


(Source: PMMY Annual Report)

This is a state-wise chart representing the number of loan accounts under the PMMY (PMMY) scheme during the two consecutive financial years, 2022-23 and 2023-24. It represents the persistent trend for loan accounts dispersal across the states with Bihar and Uttar Pradesh as the most significant ones with loan accounts under PMMY. Though the figures for the two years may vary a little from state to state, ranging from Maharashtra and Karnataka to Tamil Nadu, the trend remains the same over time, and in most of these states, it demonstrates a consistent demand for micro-credit loans. On the other hand, loan accounts have been relatively less in Arunachal Pradesh and Mizoram.



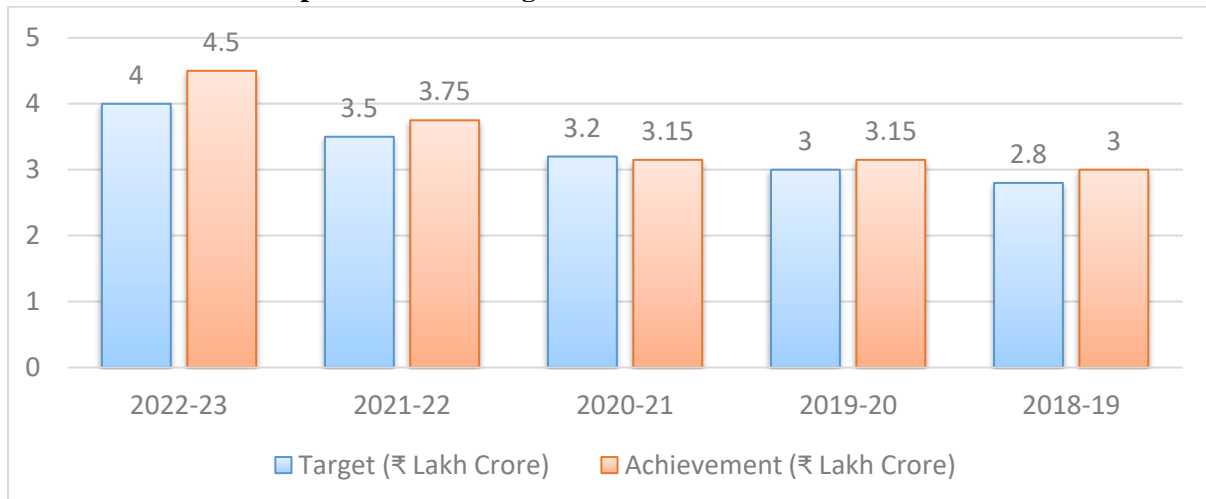
Graph 2: PMMY Sanctioned and Disbursed Amount analysis for FY 2023-24



(Source: PMMY Annual Report)

This Graph represents sanctioned and disbursed amount under PMMY for the states in India during 2023-24. For instance, disbursed amount is way above the sanctioned amount in Bihar, Tamil Nadu, and Uttar Pradesh, implying that demand is more and would require additional funding to meet PMMY loans. Whereas for states like Arunachal Pradesh, Mizoram, and Nagaland, loan activities are much lower with both sanctioned and disbursed relatively very low. Overall, though disbursed amount in most states happens to be greater than the sanctioned in most states, evidencing efficient distribution of fund, regional variations underline differing levels of demand for microcredit across India.

Graph 3: PMMY Target & Achievement for FY 2023-24



(Source: PMMY Annual Report)

Overall, the PMMY scheme has consistently surpassed its annual targets in the last five years and speaks to the vibrant demand for microloans and the robustness of the scheme in meeting this subset of small and micro-entrepreneurs across India. As such, this trend represents an important facilitator of the MSME sector in India, driving economic growth and employment.



6. FINDINGS OF THE RESEARCH

6.1. Loan Disbursal Trends

The data on loan disbursement under PMMY reveals a consistent increase in the volume of credit extended to micro and small enterprises. The program's three-tier structure Shishu, Kishor, and Tarun has enabled a wide range of borrowers to access credit, catering to different stages of business development. A significant portion of loans has been disbursed under the "Shishu" category, indicating a strong emphasis on supporting start-ups and very small enterprises. However, while loan numbers have risen, the average loan size has remained relatively small, which suggests a need for more substantial financial support for scaling businesses.

6.2. Institutional Performance

PMMY's success is largely linked to the efficiency of participating financial institutions, including commercial banks, regional rural banks, and microfinance institutions (MFIs). These institutions have shown a mixed performance in terms of loan processing efficiency and customer service. While some banks have successfully streamlined the loan approval process, others face challenges in outreach and loan recovery. A more consistent and standardized institutional performance is essential to ensure equitable access to funds and to strengthen the financial inclusion goals of the program.

6.3. Gender Discrimination

One of the notable achievements of PMMY is its focus on empowering women entrepreneurs. A significant portion of loans has been directed toward women, aiming to reduce the gender gap in business ownership and to foster greater economic independence for women. Despite this progress, there remain disparities in loan sizes and approval rates between male and female borrowers, suggesting underlying gender biases in financial institutions. Encouragingly, data shows that women borrowers exhibit higher repayment rates, underscoring their reliability and potential in driving economic growth when given equal opportunities.

6.4. State-Level Trends

State-level analysis of PMMY's performance highlights substantial variation in loan disbursal and entrepreneurial support. Some states, particularly those with higher levels of industrial and economic activity, have seen a more significant uptake of PMMY loans. In contrast, states with lower economic development have lagged in terms of both loan numbers and amounts disbursed. These disparities suggest a need for targeted efforts to enhance awareness, accessibility, and support for entrepreneurship in lagging states to ensure balanced regional development. Bihar and Uttar Pradesh hold the highest number of accounts, and there is relatively low activity in smaller states such as Arunachal Pradesh and Mizoram.

6.5. Support To New Entrepreneurs

PMMY has played a crucial role in supporting new entrepreneurs, with many first-time borrowers benefitting from the program's collateral-free loan structure. This support has been instrumental in fostering a culture of entrepreneurship among young and aspiring business owners. However, to maximize the long-term impact, there is a need for complementary support in terms of business development services, financial literacy, and mentorship. Such measures would help enhance the success rate of new businesses and reduce the risk of loan defaults. The program shows the increase in new entrepreneurs supported by PMMY, which presents the role played by PMMY in the promotion of startups.

7. CONCLUSION

The Pradhan Mantri Mudra Yojana has significantly impacted the landscape of microfinance in India by promoting entrepreneurship, particularly among traditionally underserved groups. This evaluation of PMMY's effectiveness focuses on various aspects such as loan disbursal trends, institutional



performance, gender inclusivity, and regional disparities. Overall, the program has been instrumental in advancing the cause of inclusive economic development, yet some challenges remain that require further policy attention and strategic interventions. PMMY has been one of the most instrumental schemes for financial inclusion and entrepreneurial growth in India. It has indeed been a mark of success in achieving credit needs coupled with the flourishing of micro-enterprises. The expansion of this scheme to further serve regional and gender disparities, thus ensuring equal benefits and progress, should become an all-important agenda. Consistency in growth further displays the importance of this scheme in supporting India's MSME sector, being pivotal for countrywide economic growth. The Pradhan Mantri Mudra Yojana has made significant strides in advancing financial inclusion and fostering entrepreneurship across India. The program's loan disbursement trends show a strong commitment to promoting micro and small enterprises, particularly through the "Shishu" category. Institutional performance varies, requiring consistent improvements in service delivery to meet the demands of a diverse borrower base. The program's focus on empowering women has been commendable, but ongoing efforts are needed to fully eliminate gender disparities in access to finance. Regional trends highlight the need for targeted interventions in economically lagging states, while the support for new entrepreneurs should extend beyond financial assistance to include comprehensive capacity-building measures. Overall, PMMY has proven to be a critical tool in enhancing economic development, but its success will hinge on addressing these challenges to ensure that all aspiring entrepreneurs receive equitable opportunities to thrive.

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“A Study on Impact of Behavioural Biases in An Investment Decision of Equity Investors of Junagadh City”

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Abstract:

Purpose:

This study aims to analyze the demographic characteristics of investors in Junagadh city, understand their inclination towards equity investment, identify the factors influencing their investment decisions, and examine the impact of behavioural biases on their investment choices.

Design/Methodology/Approach:

I collected primary as well as secondary data for this study. To gather primary data, I designed a structured questionnaire and surveyed 250 equity investors in Junagadh city. Additionally, I obtained secondary data from various sources such as the internet, articles, journals, and blogs. The research design I employed is descriptive because it is utilised to portray the characteristics of a population or phenomenon, in this case, the equity investors of Junagadh City.

Findings:

The majority of equity investors in Junagadh are young, unmarried individuals from lower-income backgrounds. They prefer online trading and focus on long-term investments, emphasizing regular returns and the safety of their principal. Their investments primarily target sectors such as Banking, IT, and Energy. Tax benefits, diversification, and liquidity are not prioritized. Additionally, there are no significant differences in behavioural biases based on age, education, or income. The only factor that influences perceptions is occupation, particularly in relation to the "Shadow of the Past" bias furthermore Overconfidence and herd instincts are key behavioural biases influencing investment decisions.

Originality/Value:

The present paper provides a comprehensive overview of the demographic characteristics and behavioural biases of equity investors in Junagadh city. It serves as a valuable resource for students, researchers, and academicians interested in conducting advanced research on the topic of behavioural finance in different cities or regions.

Keywords: Behavioural Biases, Behavioural Finance, Equity Investors, Investment Decision Making



1. INTRODUCTION:

The word finance itself expresses its importance because finance includes all the decisions related to investment for an individual, small business unit as well as the giant joint stock company. The core function of finance is making investment decisions whether it is an individual or a big company they have to make decisions related to the procurement of funds, allocation of funds and also decisions related to dividends, it simply means that finance is all about making an investment decision.(Upadhyay & Shah, 2019)

In the field of finance, lots of novel changes accommodated since its inception but the big update comes with the beginning of Behavioural finance. It creates a clear line between traditional finance and behavioural finance. Traditional finance includes that all investors are rational while investing and they are not biased in their investment decisions, but behavioural finance suggests that investors are never rational while investing they are biased with some behavioural biases like Overconfidence, Familiarity, Confirmation, Shadow of the past, herd instincts, Loss Aversion, Regret Aversion, Emotions etc. which affects decisions of investors while investing in any kind of investment avenues.

Kahneman and Tversky (1979), Shefrin and Statman (1994) and Shleifer (2000) are behavioural finance researchers who have contributed to the field of behavioural finance and its biases and investment decisions fluctuations in the share market.(Kandpal & Mehrotra, 2018)

Especially in this study, I have considered some behavioural biases like Overconfidence, Familiarity, Confirmation, Shadow of the past, and Herd instincts and their effect on different Age groups, Income Levels, Occupations and Education levels of equity investors of Junagadh City and find that if they are biased or not.

Behavioural Biases:

- 1. Overconfidence:** Investors tend to overestimate the precision of their assumptions, often making decisions based on an illusion of knowledge rather than gathering complete information (Upadhyay & Shah, 2019).
- 2. Familiarity:** Investors may only trust known investment options, ignoring potentially lucrative alternatives, due to familiarity bias.
- 3. Confirmation:** Investors tend to favour information that aligns with their existing opinions while disregarding conflicting information, showcasing confirmation bias (Upadhyay & Shah, 2019).
- 4. Shadow of the past:** Investors may make decisions based on past profits, leading them to take excessive risks or avoid potential opportunities due to past losses (Upadhyay & Shah, 2019).
- 5. Herd instincts:** Investors often let information from friends, colleagues, and groups influence their investment decisions (Upadhyay & Shah, 2019).

2. REVIEW OF LITERATURE:

In this literature review, we have thoroughly examined primary data research conducted across diverse regions of India, as well as in several other countries. This review seeks to provide a comprehensive overview of the findings and methodologies employed in these studies, highlighting key insights and trends that emerge from the collected data. The details of the research undertaken are discussed below.



- **(Lucknow City- Uttar Pradesh)**

In this descriptive research, a survey was conducted of 195 Investors of Lucknow City, they defined that Investors like to analyse market sentiments and trends before investment by this they can understand the financial situation of the market and make good investment decisions and so many investors said that after active participation in the investment they are addicted to market analysis and they take active participation. (Dr. Vikram Bisen, 2013).

- **(Raipur)**

The study was conducted with 300 mutual fund investors and depicted some factors that mean behavioural biases play a major impact in influencing investors in Raipur to decide on investment mutual funds. (Krishna Deshmukh Pt Ravishankar, 2016).

- **(Dehradun- Uttarakhand)**

This study was conducted in the area of Dehradun- Uttarakhand with a sample size of 358 respondents shows that behaviour matters a lot when it comes to making a wise investment decision and therefore selecting a particular investment option requires investors to completely consider factors like goals in life, spending habits, expenses, income, perception towards investments, lifestyle changes, time-period, nature towards investment, thought process, natural habits, study of one's financials, risk bearing capacity, liquidity and expected returns. (Kandpal & Mehrotra, 2018).

- **(Indore city- Madhya Pradesh)**

This study was conducted with 102 respondents in the Indore city- Madhya Pradesh and concluded that people of the Indore city are exceptionally very much aware of the investment that is accessible in Indore city, yet at the same time investors want to put their savings in banks as fixed deposits or other term deposits, insurance and mutual funds. The investigation of research uncovers that security is considered as imperative factor while doing a venture, so the remaining choices are discovered less significant while speculation by investors (Mishra & Darshan, 2019).

- **(Ahmedabad- Gujrat)**

This study was conducted in Ahmedabad with 181 Sample size of the total population and shows the distinction that investors are not rational and there are always the effects of Behavioral biases Like overconfidence, anchoring, familiarity, conformation bias, innumeracy, prospect theory, mental accounting, narrow framing, shadow of past, emotional bias and information or heard instinct in more or less proportion on the decision-making process of investors in the investments. (Upadhyay & Shah, 2019).

- **Bristol (England) and Istanbul (Turkey)**

This research was conducted in Bristol (England) and Istanbul (Turkey) with 415 respondents and reveals that Anchoring, conservatism, categorisation, and the illusion of control are common behavioural biases among young adults in Bristol and Istanbul Moreover Framing, cognitive dissonance, the illusion of knowledge and availability are the most common behavioural biases among young adults in Istanbul. (Akin, 2022).

- **(Southern states—Andhra Pradesh, Telangana, Karnataka, Kerala and Tamil Nadu)**

This study was conducted in southern states—Andhra Pradesh, Telangana, Karnataka, Kerala and Tamil Nadu with 250 Sample size found that Investors have a great level of behavioural biases in investment decisions and financial literacy helps to assimilate such irrational behaviour and make effective decisions to attain the desired profit Moreover anchoring bias, representativeness and overconfidence biases were direct to attain investment decisions based on earlier incorrect experiences and Heuristic bias can be highly helpful to make speculative decisions.(Suresh G, 2024)



- **(Kurunegala Area Shri Lanka)**

This study was conducted in Kurunegala Area Shri Lanka with 100 sample size and investigates the impact of behavioural factors on individual investment decisions of equity investors in the Colombo Stock Exchange and found that representativeness and overconfidence have no significant impact on individual investment decisions of equity investors and the availability heuristic and herding have a significant impact on individual investment decisions of equity investors at CSE.(Sugathadasa & Gamage, 2021).

- **(Finland)**

This study was conducted with 351 respondents in Finland and found that out of all these eight behavioural biases herding, hindsight, overconfidence and self-attribution, representativeness, and anchoring influence both trading activity and recommendation intentions, albeit to varying extents and also, loss aversion and mental accounting influence only the recommendation intentions. (Talwar et al., 2021).

- **(Vijayawada, Visakhapatnam, and Tirupati- Andhra Pradesh)**

This study was conducted with 465 respondents in Vijayawada, Visakhapatnam, and Tirupati in Andhra Pradesh and demonstrates the presence of certain noteworthy behavioural biases that impact the decision-making of investors. Additionally, social media platforms such as WhatsApp, Telegram, and others influence the decision-making processes of investors. (Sankar, 2022).

- **(Chitwan- Nepal)**

This research was conducted with 385 investors in Chitwan- Nepal and concluded that there is a significant relationship between equity investment decisions and emotional biases among the individual investors in the Chitwan district moreover it found that the impact of emotional biases on equity investment decisions is significant. (Sapkota, 2023).

3. OBJECTIVES OF THE STUDY:

- To study the **Demographic profile** of equity investors of Junagadh city
- To study the **investment decisions** of equity investors of Junagadh city.
- To identify the impact of **Age, Education, Occupation and Income** on different behavioural biases of equity investors in Junagadh City.
- To study **the impact of various behavioural biases** towards investment **decisions of the equity investors** of Junagadh city

4. RESEARCH METHODOLOGY:

This study employs a Descriptive Research Design, which is particularly effective for outlining and analyzing the characteristics of investors in Junagadh City. This research design allows us to provide a comprehensive overview of the investment behaviours, preferences, and demographics of equity investors in Junagadh. A structured questionnaire has been developed as the main instrument for data collection to gather primary data. This questionnaire consists of closed-ended questions and has been distributed in both physical copies and through Google Forms, yielding 105 responses from physical copies and 145 from Google Forms. In total, 250 responses were collected from both mediums. The structured format of the questionnaire ensures consistency in the responses, thus facilitating the analysis and comparison of the collected data. Alongside primary data, this study also incorporates secondary data sources to support and contextualise the research findings. These sources include reputable websites, scholarly articles, and academic journals. The integration of secondary data enriches our understanding of current trends and behaviours among equity investors, providing a broader context for the findings derived from our primary data collection.

The study focuses on the residents of Junagadh City, specifically targeting individuals who engage in equity investment activities. A non-probability sampling method, specifically convenience sampling, has been employed for this research. The research sample consists of 250 equity investors from Junagadh City. This sample size has been determined to be adequate for yielding substantial insights while effectively addressing the central research questions posed in this study. For analysing data frequencies, percentages, mean, one-way ANOVA and regression are used

HYPOTHESIS:

- **H0:** Different **Age Groups** of respondents assign the same mean towards behavioural biases
- **H0:** Different **Education Levels** of respondents assign the same mean towards behavioural biases
- **H0:** Different **Occupation Groups** of respondents assign the same mean towards behavioural biases
- **H0:** Different **Income Levels** of respondents assign the same mean towards behavioural biases
- **H0:** Different **Behavioural Biases** do not affect **the number of companies invested**.

5. DATA ANALYSIS AND INTERPRETATION:

Table 1: Demographic Profile of Equity Investors of Junagadh City

Demographic Profile	Category	Number of Investors	Percentage (%)	Remarks
Age Profile	18-25	148	59.2	Most equity investors (59.2%) are aged 18-25, showing strong interest among younger individuals, while only 1.6% are 56+, reflecting lower engagement among older adults.
	26-35	66	26.4	
	36-45	22	8.8	
	46-55	10	4	
	56 and above	4	1.6	
Education Qualification	Below HSC	16	6.4	The highest proportion of equity investors (24.8%) are Undergraduate or Postgraduate educated, while only 4% hold Professional degrees, indicating lower investment activity in that group.
	12th/HSC	30	12	
	Undergraduate	62	24.8	
	Graduate	70	24	
	Postgraduate	62	24.8	
	Professional	10	4	
Occupations Profile	Salaried	76	30.4	The largest group of equity investors (34.4%) consists of students, while the smallest group (0.8%) comprises retired individuals.
	Businessman	57	22.8	
	Professional	9	3.6	
	Retired	2	0.8	
	House Wife	3	1.2	
	Student	86	34.4	
	Equity Trader	9	3.6	
	Others	8	3.2	
Marital Status Profile	Married	76	30.4	The majority are unmarried, comprising 69.2% of the sample, and only 0.4% fall into other categories, likely separated, divorced, or in other marital statuses.
	Unmarried	173	69.2	
	Others	1	0.4	
Income Profile	Up to ₹2,50,000	136	54.4	It shows that 54.4% earn up to ₹2,50,000, and 4.4% earn over

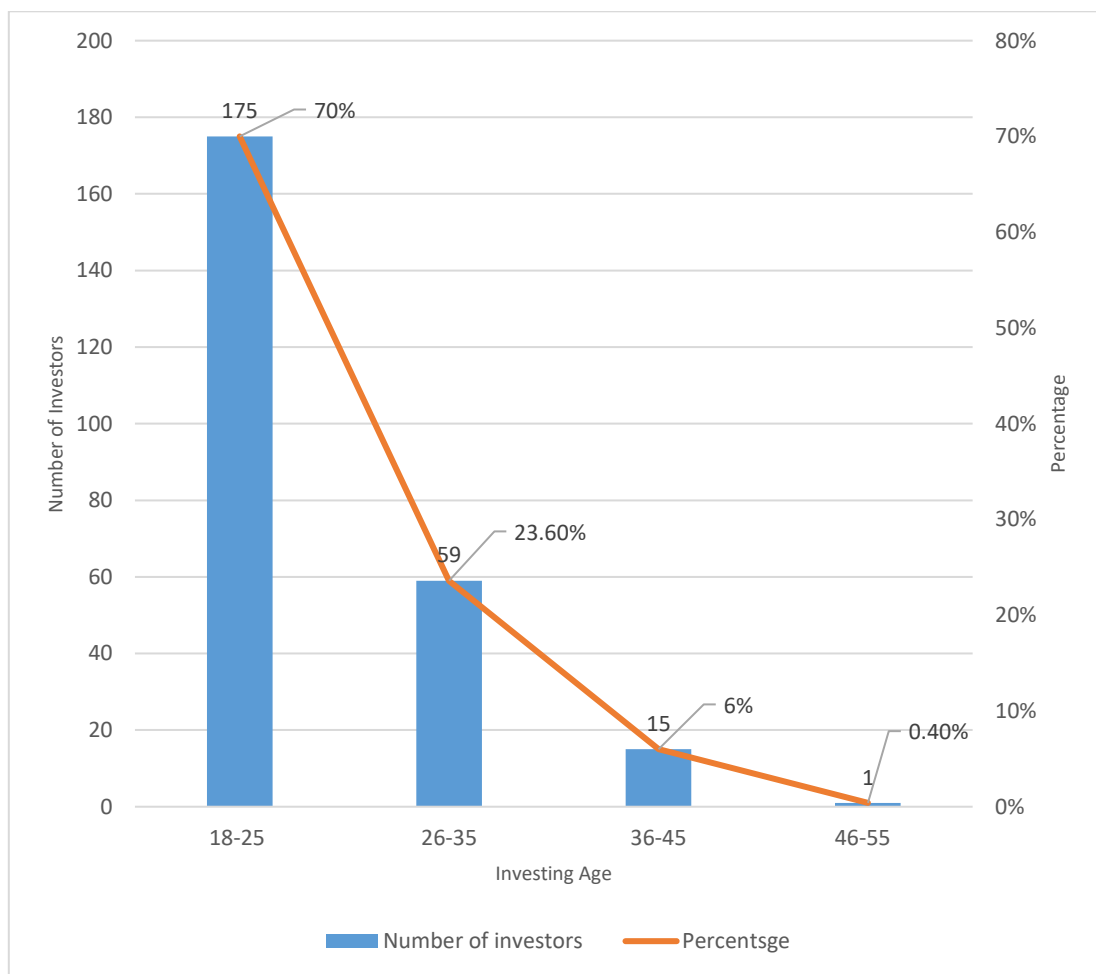


	₹2,50,000 to ₹5,00,000	69	27.6	₹10,00,000. Most equity investors fall within the lower-income category.
	₹5,00,000 to ₹10,00,000	34	13.6	
	₹10,00,000 and above	11	4.4	

Source: Author’s Compilation

Equity Investors Profile of Junagadh City

At Which Age Have You Started Investing in Equity?

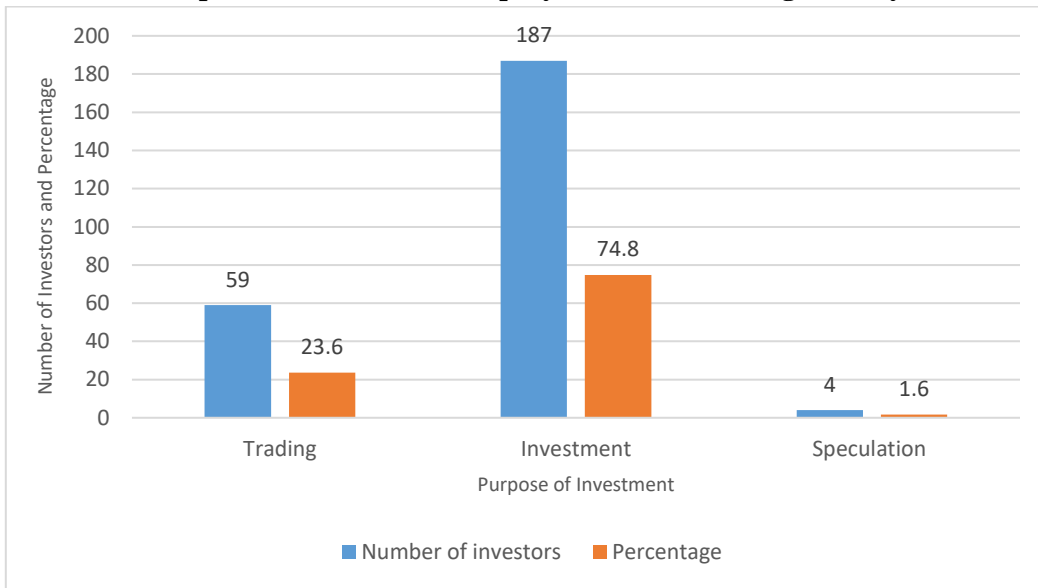


Source: Author’s Compilation.

The graph shows most equity investors (70%) start between ages 18-25, highlighting the significance of early investment, while only 0.4% begin between 46-55, showing lower participation among older individuals.



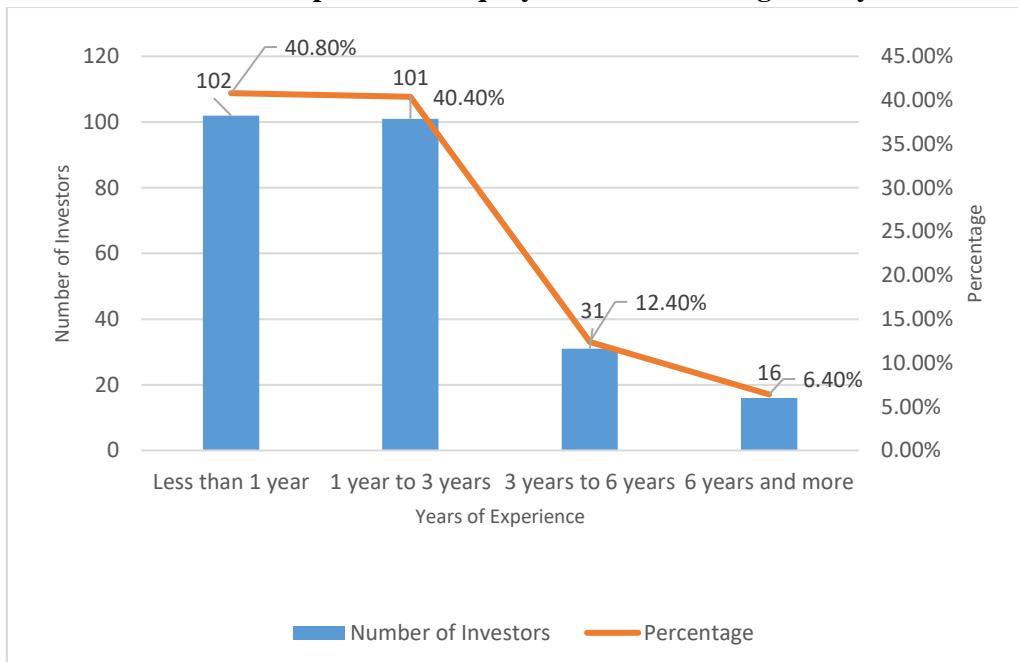
Purpose of Investment of Equity Investors of Junagadh City



Source: Author’s Compilation.

The graph shows that in Junagadh city, most equity investors (74.8%) invest for long-term investment purposes and only 1.6% invest for speculation.

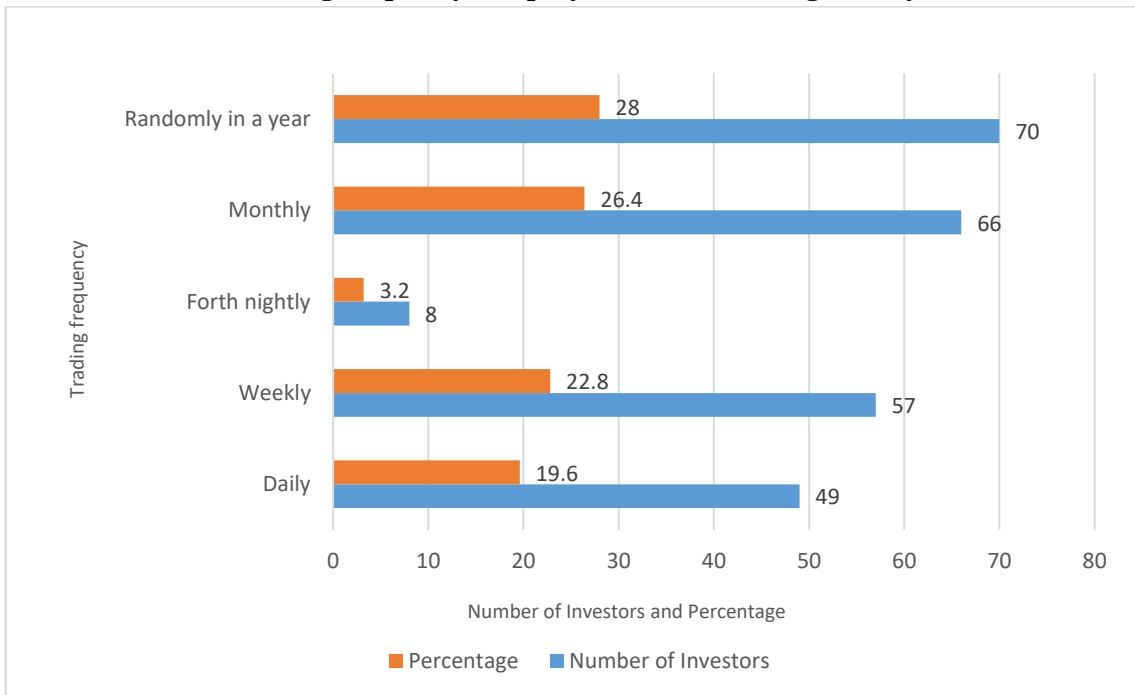
Years of Experience in equity investors of Junagadh city



Source: Author’s Compilation.

The graph shows that the majority of equity investors (40.8%) have less than 1 year of experience, while the smallest group (6.4%) have over 6 years, indicating that most investors are relatively new to equity investing.

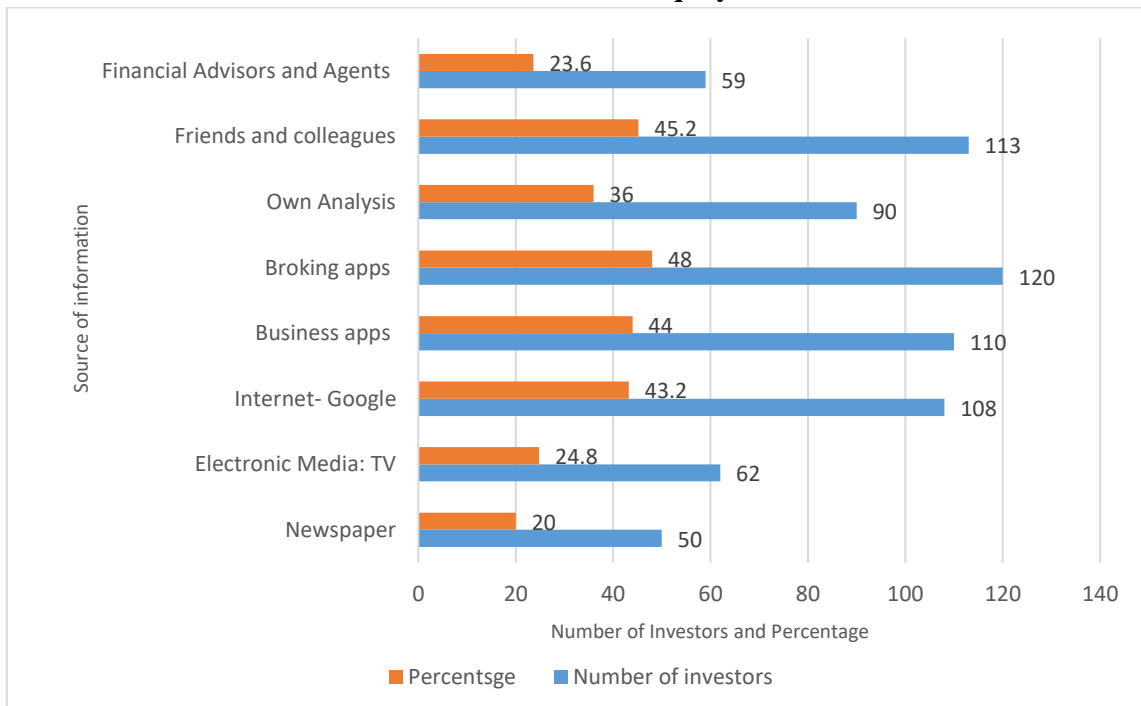
Trading frequency of equity investors of Junagadh city



Source: Author’s Compilation.

The graph shows that the largest group of equity investors (28%) trade randomly, while only 3.2% trade fortnightly, indicating most trade infrequently, preferring random or monthly trading.

The source of information for equity investment.

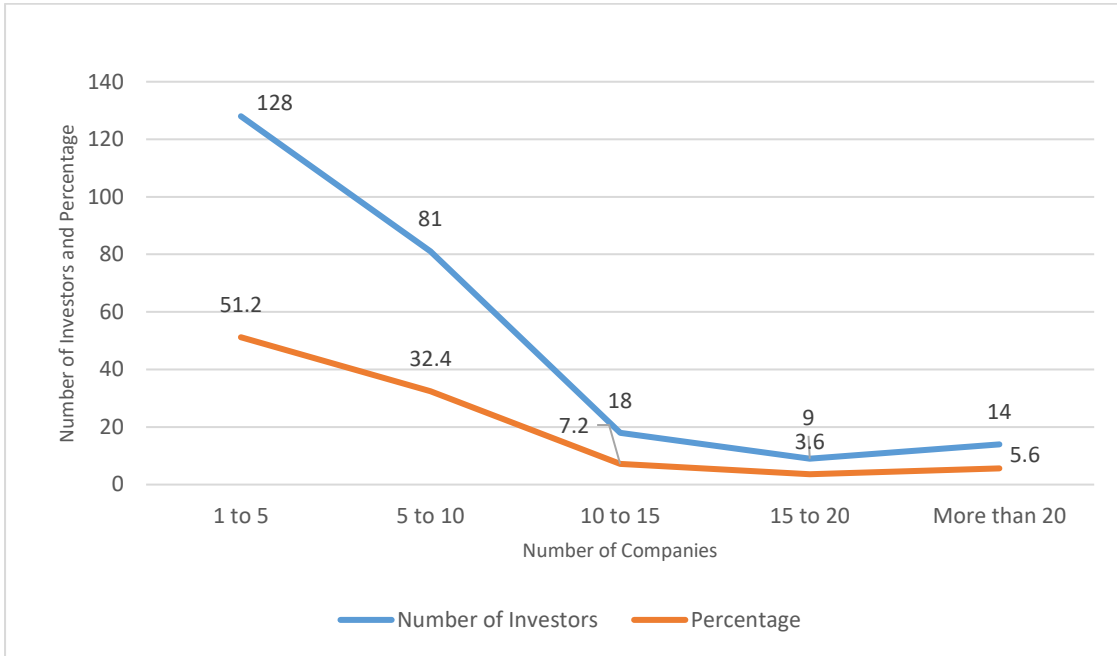


Source: Author’s Compilation.



The graph shows the most relied upon source of equity investment information is broking apps (48%), while the least is newspapers (20%).

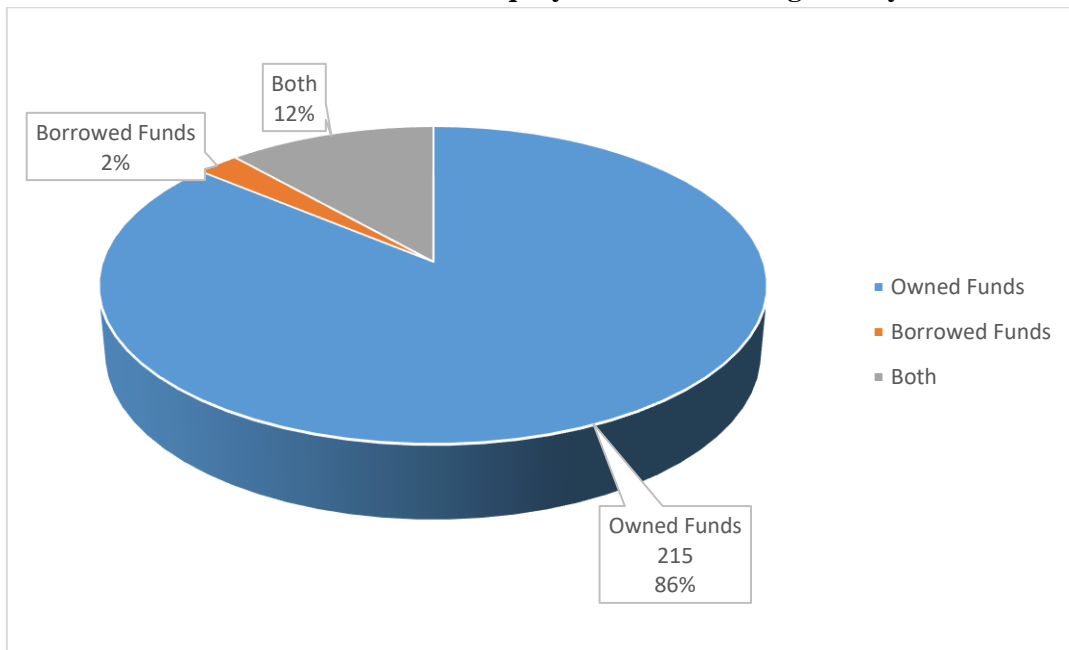
Number of companies in which investments are made by investors



Source: Author’s Compilation.

The graph shows that the majority of equity investors (51.2%) invest in 1 to 5 companies, while the smallest group (3.6%) invests in 15 to 20 companies, indicating a preference for more focused portfolios.

Source of Investment of equity investors of Junagadh city

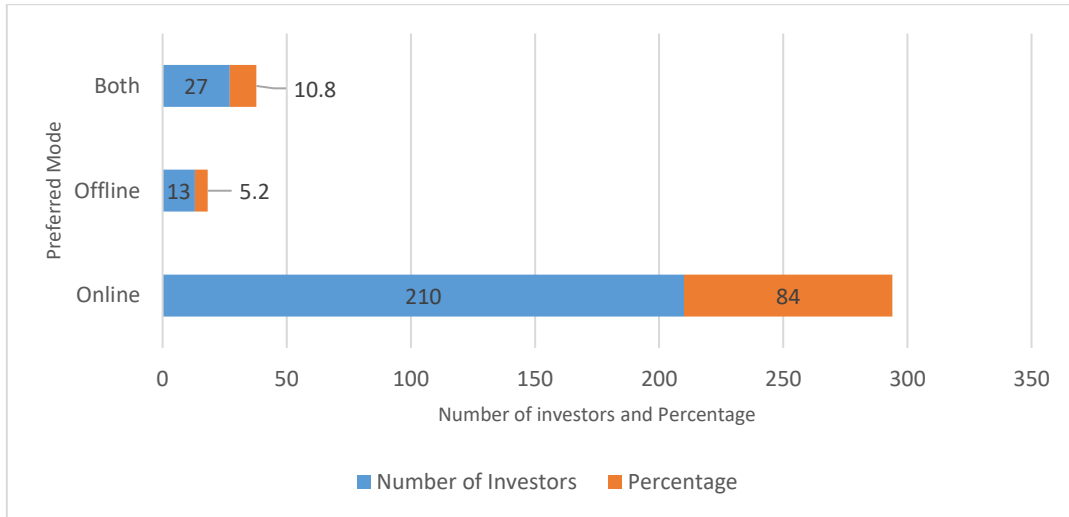


Source: Author’s Compilation.



The Pie chart shows that in Junagadh city, 86% of equity investors use owned funds, while 2.4% rely on borrowed funds.

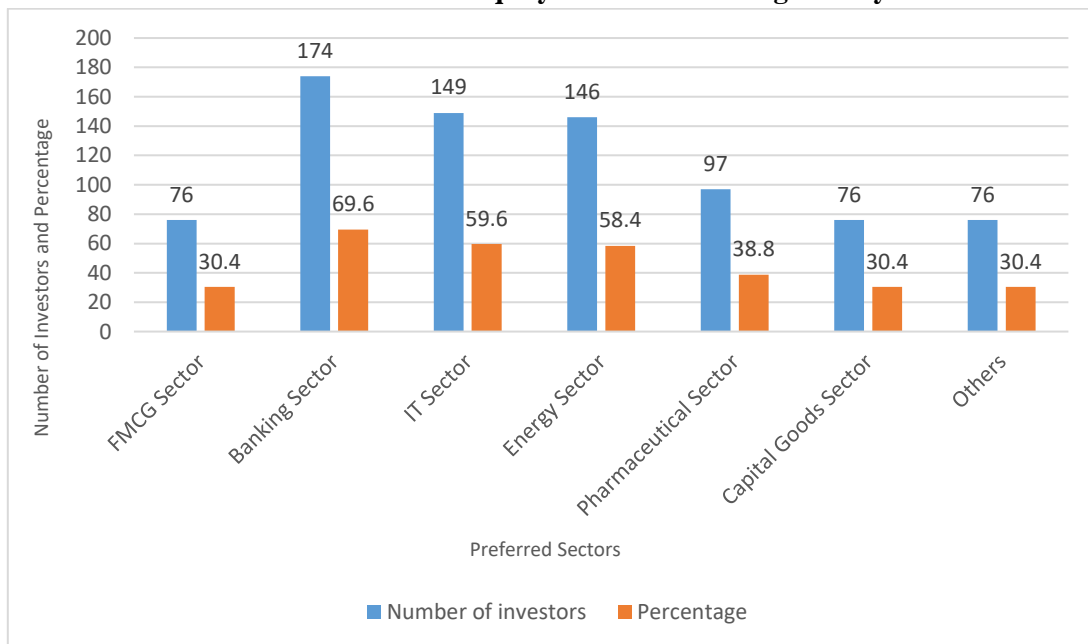
Preferred Mode of trading of equity investors of Junagadh city



Source: Author's Compilation.

The graph indicates that 84% of equity investors in Junagadh City prefer online trading, while only 5.2% engage with offline trading.

Preferred sectors of equity investors of Junagadh city



Source: Author's Compilation.

The graph indicates that the Banking Sector receives the highest interest at 69.6%, while the FMCG and Capital Goods Sectors attract the least, with only 30.4% of investors showing interest.



- **H0:** Different **Age Groups** of respondents assign the same mean towards behavioural biases
- **H1:** Different **Age Groups** of respondents do not assign the same mean towards behavioural biases

Table 2: ANOVA Test- Age Groups and Behavioural Biases

Particulars	Sign. Valued	> / <	Level of Sign.	Result
OVERCONFIDENCE	.180	>	0.05	H0 is Accepted
FAMILIARITY	.260	>	0.05	H0 is Accepted
CONFORMATION BIAS	.620	>	0.05	H0 is Accepted
SHADOW OF THE PAST	.192	>	0.05	H0 is Accepted
HEARD INSTINCTS	.975	>	0.05	H0 is Accepted

Source: Author’s Compilation.

The one-way ANOVA analysis evaluates how different age groups assign mean values to behavioural biases. The results show no significant differences among the groups for the tested biases. Specifically, the significance values for Overconfidence (0.180), Familiarity (0.260), Confirmation Bias (0.620), Shadow of the Past (0.192), and Heard Instincts (0.975) all exceed 0.05, leading to the acceptance of the null hypothesis (H0). This indicates a shared perception of these biases across age groups.

- **H0:** Different **Education Levels** of respondents assign the same mean towards behavioural biases
- **H1:** Different **Education Levels** of respondents do not assign the same mean towards behavioural biases

Table 3: ANOVA Test- Education Levels and Behavioural Biases

Particulars	Sign. Valued	> / <	Level of Sign.	Result
OVERCONFIDENCE	.779	>	0.05	H0 is Accepted
FAMILIARITY	.399	>	0.05	H0 is Accepted
CONFORMATION BIAS	.897	>	0.05	H0 is Accepted
SHADOW OF THE PAST	.203	>	0.05	H0 is Accepted
HEARD INSTINCTS	.231	>	0.05	H0 is Accepted

Source: Author’s Compilation.

The results show that the p-values for all behavioural biases (Overconfidence: .779, Familiarity: .399, Confirmation Bias: .897, Shadow of the Past: .203, and Herd Instincts: .231) exceed 0.05, indicating insufficient evidence to reject the null hypothesis (H0). H0 states that different education levels of respondents assign the same mean towards these biases. Since H0 is accepted for all cases, it suggests that educational background does not significantly impact the mean scores for these biases.

- **H0:** Different **Occupation Groups** of respondents assign the same mean towards behavioural biases
- **H1:** Different **Occupation Groups** of respondents do not assign the same mean towards behavioural biases



Table 4: ANOVA Test- Occupation Groups and Behavioural Biases

Particulars	Sign. Valued	> / <	Level of Sign.	Result
OVERCONFIDENCE	.185	>	0.05	H0 is Accepted
FAMILIARITY	.980	>	0.05	H0 is Accepted
CONFORMATION BIAS	.191	>	0.05	H0 is Accepted
SHADOW OF THE PAST	.003	<	0.05	H0 is not Accepted
HEARD INSTINCTS	.057	>	0.05	H0 is Accepted

Source: Author’s Compilation.

The One-Way ANOVA results from the above table show that most behavioural biases (Overconfidence: .185, Familiarity: .980, Confirmation Bias: .191, and Heard Instincts: .057) do not differ significantly across occupation groups, as their p-values are greater than 0.05, so we accept the null hypothesis (H0) for these biases. However, **Shadow of the Past** shows a significant difference between occupation groups (**p-value = 0.003**), so we reject the null hypothesis (H0) for this bias.

- **H0:** Different **Income Levels** of respondents assign the same mean towards behavioural biases
- **H1:** Different **Income Levels** of respondents Do not assign the same mean towards behavioural biases

Table 5: ANOVA Test- Income Levels and Behavioural Biases

Particulars	Sign. Valued	> / <	Level of Sign.	Result
OVERCONFIDENCE	.070	>	0.05	H0 is Accepted
FAMILIARITY	.617	>	0.05	H0 is Accepted
CONFORMATION BIAS	.257	>	0.05	H0 is Accepted
SHADOW OF THE PAST	.541	>	0.05	H0 is Accepted
HEARD INSTINCTS	.951	>	0.05	H0 is Accepted

Source: Author’s Compilation.

The one-way ANOVA results from the above table show that all the behavioural biases (Overconfidence: .070, Familiarity: .617, Confirmation Bias: .257, Shadow of the Past: .541, and Heard Instincts: .951) do not differ significantly across different income levels, as all p-values are greater than 0.05. Therefore, we accept the null hypothesis (H0) for all biases, meaning that income levels do not significantly impact how respondents assign the mean towards these biases.

- **H0:** Different Behavioural Biases do not affect the number of companies invested.
- **H1:** Different Behavioural Biases affect the number of companies invested.

Table 6: Model summary

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.314 ^a	.098	.080	1.04937	2.099

a. Predictors: (Constant), HEARD INSTINCTS, FAMILIARITY, OVER CONFIDENCE, SHADOW OF THE PAST, CONFORMATION BIAS



b. Dependent Variable: The number of companies in which investments are made.
 Source: IBM- SPSS

The Table Model Summary shows a moderate correlation ($R = 0.314$) between behavioural biases and the number of companies in which individuals are invested. The R^2 value of 0.098 indicates that approximately 9.8% of the variance is explained by the model. Additionally, the Adjusted R^2 is 0.080, which reflects a small explanatory power after accounting for predictors. The standard error of 1.04937 suggests a modest fit, and the Durbin-Watson value of 2.099 indicates that there is no significant autocorrelation in the residuals.

Table 7: ANOVA Test- Behavioural Biases and the number of companies invested.

ANOVA^a

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	29.313	5	5.863	5.324	.000 ^b
	Residual	268.687	244	1.101		
	Total	298.000	249			

a. Dependent Variable: The number of companies in which investments are made.
 b. Predictors: (Constant), HEARD INSTINCTS, FAMILIARITY, OVER CONFIDENCE, SHADOW OF THE PAST, CONFORMATION BIAS
 Source: IBM- SPSS

The ANOVA table indicates that the regression model is statistically significant, with an F-value of 5.324 and a p-value of 0.000, which is below the 0.05 threshold. This shows that behavioural biases (Heard Instincts, Familiarity, Overconfidence, Shadow of the Past, and Conformation Bias) significantly affect the number of companies in which investments are made. Therefore, we reject the null hypothesis (H_0) and confirm that these biases influence investment decisions.

Table 8: Regression Test- Behavioural Biases and the number of companies invested.

Coefficients

Model	Unstandardised Coefficients		Standardised Coefficients	t	Sig.
	B	Std. Error	Beta		
1 (Constant)	2.302	.510		4.515	.000
OVERCONFIDENCE	.303	.097	.199	3.126	.002
FAMILIARITY	-.112	.085	-.091	-1.316	.190
CONFORMATION BIAS	-.059	.129	-.032	-.454	.650
SHADOW OF THE PAST	-.045	.075	-.040	-.596	.552
HEARD INSTINCTS	-.247	.074	-.215	-3.355	.001

Dependent Variable: The number of companies in which investments are made.^a
 Source: IBM- SPSS

$$Y = a + bx$$



The regression equation based on this coefficients table:

$$\text{Number of Companies Invested} = 2.302 + (0.303 \times \text{OVERCONFIDENCE}) - (0.112 \times \text{FAMILIARITY}) - (0.059 \times \text{CONFORMATION BIAS}) - (0.045 \times \text{SHADOW OF THE PAST}) - (0.247 \times \text{HEARD INSTINCTS})$$

The coefficients table outlines the impact of behavioural biases on investment decisions. The baseline number of companies invested in is 2.302. Overconfidence significantly increases investments ($B = 0.303$, $p = 0.002$), while familiarity has a negligible effect ($B = -0.112$, $p = 0.190$). Confirmation Bias and Shadow of the Past are also not significant ($p = 0.650$ and $p = 0.552$). Conversely, Heard Instincts significantly decreases investments ($B = -0.247$, $p = 0.001$). Thus, the key biases affecting investments are overconfidence and herd instincts.

6. FINDINGS:

Age, Income level and education do not have a significant impact on how individuals perceive various behavioural biases. Occupation does influence the perception of the Shadow of the Past, with significant differences found between occupation groups. Also, this analysis shows that Overconfidence significantly increases and Heard Instincts significantly decrease the number of companies invested in. Familiarity, Conformation Bias, and the Shadow of the Past have no significant impact. The overall model is highlighting that Overconfidence and herd instincts are key behavioural biases influencing investment decisions.

7. CONCLUSION:

The data indicates that the majority of equity investors in Junagadh city are young, unmarried, and from lower-income backgrounds, with many starting their investment journeys early in life. These investors predominantly prefer online trading and digital platforms for their investments and information sources. Most investors are relatively inexperienced and focus on long-term investments, emphasizing regular returns and the safety of their principal. They typically use their own funds and invest in 1 to 5 companies, concentrating mainly on sectors such as Banking, IT, and Energy. Tax benefits and diversification are not highly prioritized, and investors have only moderate interest in liquidity. This indicates that while younger and middle-income groups have a strong foundation for equity investment, there is a notable opportunity for enhancing awareness and education on these topics.

The one-way ANOVA results show that perceptions of Behavioral biases vary mainly by occupation. There are no significant differences in perceptions based on age groups, education levels, or income levels, as all related p-values exceed 0.05. The only exception is the Shadow of the Past, which shows a significant difference among occupation groups ($p\text{-value} = 0.003$). In summary, age, education, and income do not impact perceptions, while occupation does regarding the Shadow of the Past and also Overconfidence and herd instincts are key behavioural biases influencing investment decisions.

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A Systematic Review on the Level of Awareness and Adoption of Digital Banking in India

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Abstract:

Purpose : To add to the existing literature in the field of digital banking which is an evolving field with a huge impact on the country's economy. To help the banks, government agencies and policymakers have a better idea regarding the factors influencing awareness and adoption of digital banking services and the changing scenario over the years which can enable them to plan for increasing adoption rates in the coming years. It also presents a glimpse of studies carried out in different geographical locations amongst population with varied demographic profiles hence it helps in deciphering the awareness and adoption patterns and customise strategies accordingly.

Design : By analyzing literature published between 2012 and 2024, this study examines the evolution of digital banking and identifies potential areas for further research in this field. It includes news articles, research and review papers relevant Digital Banking in India.

The outcomes of the study have been used to determine the relationship between level of awareness and adoption towards digital banking and to develop a theoretical conceptual framework..

Findings: The study reveals significant interrelationship between demographic factors and the level of awareness amongst people in Indian .It also reveals interrelationship between awareness and adoption level of digital banking services. Most of the researches are based on extended models of TAM and UTAUT which shows notable influence of Perceived Ease of Use and Perceived Usefulness on Behavioral Intent. Also trust and security concerns have negative impact on intention to adopt digital banking. Also, a conceptual framework has been prepared for a precise view of findings.

Research limitations: This study also suffers from few limitations such as geographical region being diverse parts of India.

Practical implications: This study shows the awareness and adoption level based studies in various regions of India. Banks and policymakers can get useful information in order to raise awareness and increase adoption rate of digital banking to fulfill our government's dream of India being a cashless economy.

Key Words: Awareness, Adoption, Cashless India, Digital Banking, Online Banking.



1. INTRODUCTION:

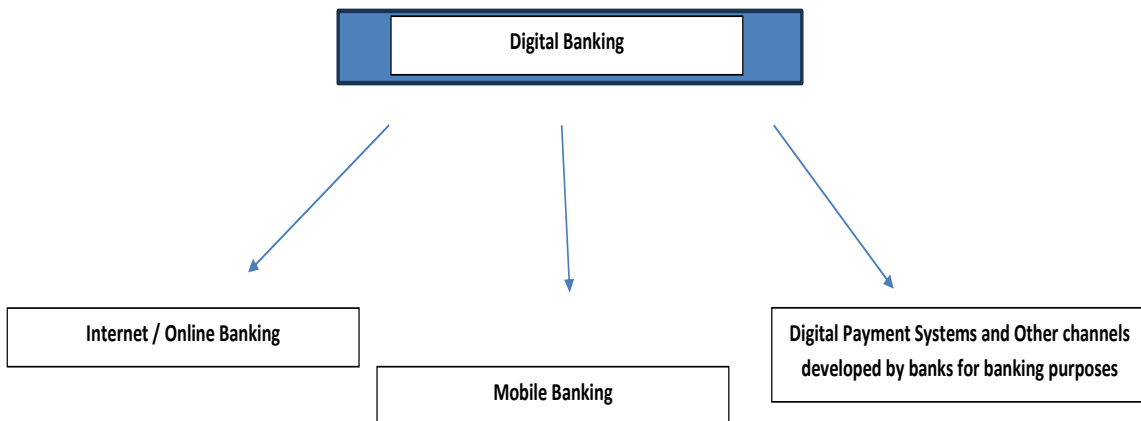
Banking is the backbone of any economy. In the past, availing bank services was a time-consuming task. However, with the gradual and significant integration of technology, banking has evolved into a digital experience. Digital banking refers to paperless banking services accessed through digital platforms. It offers convenience and is available 24/7, making it accessible anytime and anywhere. It allows customers to open and manage their bank accounts, make payments, transfer funds, check balances, etc., without having to visit the bank or any geographical or time constraints. The entry of Reliance Jio into India's telecom sector resulted in a surge in internet usage, further enhancing the adoption of digital services.

Digital banking has revolutionized the financial sector by integrating technology into traditional banking services. It enables customers to perform transactions, manage accounts, and access financial services anytime and anywhere without visiting physical branches. This innovation reflects the evolution of banking to meet modern consumer demands for convenience, speed, and efficiency.

India's Digital Transformation: After the year 2016, India has seen a surge in digital banking adoption due to initiatives like UPI, cashless India drive, demonetization etc.

Definition :-

Digital Banking refers to present and future electronic banking services provided by a licensed bank for the execution of financial, banking and other transactions and/or orders/instruments through electronic devices / equipment over web sites (i.e online banking), mobile phones (i.e mobile banking) or other digital channels as determined by the bank, which involve significant level of process automation and cross-institutional service capabilities running under enhanced technical architecture and differentiated business model / strategy. (Reserve Bank of India, 2024)



(Source : Author)

Digital Banking – Phases of Evolution

There are several phases of evolution of digital banking which can be enlisted as follows :



- **Automation Era:** The beginning of automation can be marked in 1960s with the introduction of ATM with 24/7 cash withdrawal.
- **Internet Banking:** Online banking emerged in late 1990s allowing users to perform financial tasks like fund transfers and bills payment through web portals
- **M-Banking :** Mobile Banking often referred to as M Banking refers to banking with the help of smartphones which began in early 2000s. The convenience of banking at the fingertips made it popular amongst smartphone users.
- **Advanced Technologies:** Recent years have seen the integration of cutting-edge technologies like blockchain, artificial intelligence, and biometric authentication, enhancing digital banking services' security and efficiency.

2. OBJECTIVES :-

1. To study the level of awareness and adoption of digital banking services amongst Indian people.
2. To analyse the influence of demographic and behavioral factors on the level of awareness and adoption of digital banking services amongst Indian people.

3. RESEARCH METHODOLOGY

This study is based on selected papers published between 2012 to 2024. Papers were searched by searching for keywords in Google Scholar, Emerald and Science Direct. Keywords searched were Awareness of digital banking in India, Adoption of digital banking in India and Awareness and Adoption of digital banking in India. Top searches and most relevant papers were studies for the literature review.

4. LITERATURE REVIEW:

The following tables depict the research work regarding awareness and adoption of digital banking in India:

Sr. No.	Author(s), Year Place of Study	Title of Study	Journal Name	Primary / Secondary	Methodology/ Tools utilised for Data Analysis	Findings and Conclusion
1.	<ul style="list-style-type: none"> ▪ Ankit Jain, ▪ 2020, ▪ Ahmedabad, Gujarat 	A study on customer awareness regarding various digital banking initiatives	International Journal of Multidisciplinary Educational Research	Primary	Analytical and Descriptive research Structured Survey	<ul style="list-style-type: none"> • This study conducted on 166 respondents reveal that demographic factor such as age and gender affects the level of awareness amongst customers towards digital banking initiatives. • It emphasizes that non adoption of digital banking is due to less knowledge of how it can be used and high fees.

		taken by banks.			Chi square analysis	<ul style="list-style-type: none"> Security concerns also affect the level of usage of digital banking. Banks should work on spreading more awareness regarding digital banking to accelerate its usage. (Jain, 2020)
2.	<ul style="list-style-type: none"> Simran Jit Kaur, Liaqat Ali, M. Kabir Hassan, and Md Al-Emran 2021 North India 	Adoption of digital banking channels in an emerging economy - Exploring the role of in-branch efforts	Journal of Financial Services Marketing	Primary	Qualitative research - Semi-structured interviews, qualitative content analysis	<ul style="list-style-type: none"> This study which was done in the form of interviews with 22 bankers reveals that adoption level of online banking services is influenced by the quality of services provided by banks. It also reveals that efforts to bring awareness made by staff members brings positive impact on usage of digital banking services. This study puts forward a model that depicts the influence of in-branch customer engagement on their intention to use digital banking modes in India. (Kaur et al., 2021)
3.	<ul style="list-style-type: none"> Irfan Bashir, Chendragiri Madhavaiah 2015 India 	Consumer attitude and behavioural intention towards internet banking adoption in India	Journal of Indian Business Research	Primary	Survey, Exploratory Factor Analysis (EFA) Structural Equation Modeling (SEM)	<ul style="list-style-type: none"> This study reveals that the willingness to adopt internet banking can be increased by appropriately managing customers' beliefs about usefulness, trust, enjoyment if Internet banking. Trust is one of the most significant and critical factors of Internet banking acceptance. Banks should focus on trust building strategies / risk reducing strategies by implementing KCI (Keep-Consumer-Informed) strategy. (Bashir & Madhavaiah, 2015)
4.	<ul style="list-style-type: none"> Madhuri ma Deb, Ewuuk Lomo-David 2014 Delhi, Mumbai, Kolkata, and Bangalore 	An empirical examination of customers' adoption of m-banking in India	<i>Marketing Intelligence & Planning</i>	Primary	Survey, Technology Acceptance Model (TAM) and diffusion of innovation (DOI), SEM	<ul style="list-style-type: none"> This paper conducted on 600 respondents found a positive relationship between attitude and intention to adopt m-banking. Privacy and security of m-banking transaction is essential and the risk gets heightened when some of the private and secured information reaches the hands of the cyber criminal In India, the study found that customers view M- banking service providers' benevolence and security factors negatively. Bankers should educate customers about security features from time to time The study found that positive attitudes towards m-banking, perceived usefulness, and social influence encourage adoption, while negative perceptions of facilitating conditions, benevolence, and security hinder it. (Deb & Lomo-David, 2014)
5.	<ul style="list-style-type: none"> Vikas Chauhan, Rambalak Yadav, Vipin Choudhary 2019 	Analyzing the impact of consumer innovativeness and	<i>International Journal of Bank Marketing</i>	Primary	Survey, Technology Acceptance Model	<ul style="list-style-type: none"> This paper conducted on 487 respondents in the Indian context using the TAM along with additional constructs, such as PR (Perceived Risk) and two consumer innovativeness constructs i.e. II



	<ul style="list-style-type: none"> Indore and Bhopal districts of Madhya Pradesh (India). 	perceived risk in internet banking adoption: A study of Indian consumers			(TAM),SEM	(Innovativeness in General) and DSI (Domain-Specific Innovativeness) found that Perceived Usefulness (PU) and Perceived Ease of Use (PEOU) positively influence consumer attitudes and intentions to use internet banking <ul style="list-style-type: none"> Bankers should focus on promoting the usefulness, ease of use, and security of internet banking to overcome barriers and encourage adoption. (Chauhan et al., 2019)
6.	<ul style="list-style-type: none"> Kiran J. Patel, Hiren J. Patel 2017 Gujarat, India 	Adoption of internet banking services in Gujarat: An extension of TAM with perceived security and social influence	<i>International Journal of Bank Marketing</i>	Primary	Survey, Technology Acceptance Model (TAM),SEM	<ul style="list-style-type: none"> This paper which surveyed 284 respondents, developed a model which denotes an improvement in the Technology Acceptance Model (TAM) by adding perceived security and social influence as key determinants of adoption. Perceived security is one of the major determinants of customers' intentions to use internet banking services in Gujarat region. Banks should ensure better security measures to increase adoption rate Banks should emphasize on creating easy to understand web portals educate customers, better quality services, and focus on digital marketing to enhance adoption. (Patel & Patel, 2018)
7.	<ul style="list-style-type: none"> Bijith Marakarkandy, Nilay Yajnik, Chandan Dasgupta 2017 Mumbai 	Enabling internet banking adoption: An empirical examination with an augmented technology acceptance model (TAM)	<i>Journal of Enterprise Information Management</i>	Primary	Survey, Technology Acceptance Model (TAM),SEM	<ul style="list-style-type: none"> This study based on TAM model with introduction of new variables in the model surveyed 300 respondents. Internet banking channel are yet underutilised by Indian bank customers'. Banks must focus on putting efforts at making websites easy to understand to enhance perceived ease of use which has impact on user adoption. Also the focus must be to prepare marketing strategies according to gender, age, income level and education. (Marakarkandy et al., 2017)
8.	<ul style="list-style-type: none"> Payam Hanafizadeh, Byron W. Keating, Hamid Reza Khedmatgozar, 2013, Asia, Europe, America 	A systematic review of Internet banking adoption	<i>Telematics and Informatics</i>	Secondary	Systematic Review	<ul style="list-style-type: none"> The study analysed the papers from three main perspectives in Internet banking adoption research: descriptive studies, relational studies, and comparative studies. It concluded that Internet banking adoption remains an evolving area of research and interest in adoption is likely to grow. (Hanafizadeh et al., 2013)
9.	<ul style="list-style-type: none"> Ankit Kesharwani, Shailendra Singh Bisht 2012 India 	The impact of trust and perceived risk on internet banking adoption in India: An	<i>International Journal of Bank Marketing</i>	Primary	Survey, Extended Technology Acceptance Model (TAM),SEM	<ul style="list-style-type: none"> This study which was incorporated in the form of questionnaire based on extended TAM model with security and perceived risk constructs on 619 PG students from Top B schools reveals that a well designed website helps in reducing perceived risk and increasing adoption rate of internet banking.



		extension of technology acceptance model.				<ul style="list-style-type: none"> It also reveals that trust negatively impacts perceived risk while perceived risk negatively impacts adoption of Internet banking which can be represented as:- Trust → Perceived Risk → Adoption of IB <p style="text-align: center;">(-) (-)</p> <p>(Kesharwani & Singh Bisht, 2012)</p>
10.	<ul style="list-style-type: none"> SADAF FIRDOUS RAHELA FAROOQI 2017 New Delhi, India 	IMPACT OF INTERNET BANKING SERVICE QUALITY ON CUSTOMER SATISFACTION	Journal of Internet Banking and Commerce	Primary	Survey, E-SQual and E-RecSQual, Correlational and regression analysis	<ul style="list-style-type: none"> It is an exploratory study investigating impact of interest banking service quality on satisfaction of customers. There is a direct relationship between internet banking service quality dimensions such as Efficiency, System Availability, Fulfilment, Responsiveness, Privacy, Contact, website design and customer satisfaction in the banking industry. (Firdous & Farooqi, 2017)
11.	<ul style="list-style-type: none"> Sanjit Kumar Roy, M.S. Balaji, Ankit Kesharwani & Harjit Sekhon 2016 Metropolitan cities of India 	Predicting Internet banking adoption in India: a perceived risk perspective	Journal of Strategic Marketing	Primary	Survey, TAM, PLS-SEM	<ul style="list-style-type: none"> This study conducted on a sample size of 270 respondents reveal that perceived risk significantly impacts customer attitudes toward Internet banking, External risk has a direct effect on customer attitude while internal risk influencing ease of use. Banks can mitigate external risks through enhanced security systems.. Internal risks can be reduced by educating customers by conducting workshops and demos, enhancing ease of use. Customer services and relations can encourage Internet banking adoption. Emphasizing benefits and providing excellent customer service fosters trust and encourages Internet banking adoption. (Roy et al., 2016)
12.	<ul style="list-style-type: none"> Rahmath Safeena, Hema Date, Abdullah Kammani, and Nisar Hundewale 2012 India 	Technology Adoption and Indian Consumers: Study on Mobile Banking	International Journal of Computer Theory and Engineering	Primary	Survey, TAM, Principal Component Analysis. Rotation Method	<ul style="list-style-type: none"> This study stresses upon the link between awareness and adoption of technology which are as follows: 1. Adoption means acceptance and thereafter continued use of a service, product or idea. 2. The adoption or rejection of an innovation begins when “the consumer becomes aware of the product”. 3. The amount of information consumers have about online banking has been identified as a major factor impacting the adoption.

						<p>4. Low awareness of online banking is a major factor in causing people not to adopt online banking.</p> <p>5. It is necessary that the banks offering this service make the consumers aware about the availability of such a product and explain how it adds value relative to other products of its own or that of the competitors.</p> <ul style="list-style-type: none"> Factors such as ease of use and usefulness have a strong and positive effect on adoption of M-banking. (Safeena et al., 2012)
13.	<ul style="list-style-type: none"> Aijaz A. Shaikh , Heikki Karjaluoto 2015 International, includes India 	Mobile banking adoption: A literature review	Telematics and Informatics	Secondary	Systematic Review	<ul style="list-style-type: none"> The literature review is prepared on the basis of 55 studies which reveals that perceived usefulness, compatibility, and attitude are the most impactful factors that affect the customers' intentions toward using m-banking (Shaikh & Karjaluoto, 2015)
14.	<ul style="list-style-type: none"> Brijesh Sivathanu 2019 Pune, India 	Adoption of digital payment systems in the era of demonetization in India An empirical study	Journal of Science and Technology Policy Management	Primary	Survey, UTAUT 2, IRT, PLS, SEM	<ul style="list-style-type: none"> Based on a survey conducted on 766 respondents, this study concludes that digital payment service providers need to systems more user friendly, reduce risk and privacy concerns, provide support, spread awareness to increase the use of cashless digital payment systems (Sivathanu, 2019)
15	<ul style="list-style-type: none"> Sindhu Singh, R.K Srivastava 2018 India 	Predicting the Intention to Use Mobile Banking in India	International Journal of Bank Marketing	Primary	Survey, SEM with AMOS 16.0	<ul style="list-style-type: none"> This study was tested by survey conducted on 855 bank customers in India. Indian banking customers perceive perceived ease of use, computer self-efficacy, perceived financial cost, and security as most important in their intention to use mobile banking. However, security and privacy concerns significantly impact user adoption Efforts must be made to enhance security features and build trust to enhance the adoption rate (Singh & Srivastava, 2018)
16	<ul style="list-style-type: none"> SHAMS HER SINGH, RAVISH RANA 2017 Delhi, India 	STUDY OF CONSUMER PERCEPTION OF DIGITAL PAYMENT MODE	Journal of Internet Banking and Commerce	Primary	Intercept interview method, ANOVA and Frequency Analysis	<ul style="list-style-type: none"> Based on data of 150 respondents, this study reveals that demographic factors do not have much impact on adoption of digital payments except education which has an impact on adoption of digital payments. (Singh & Rana, 2017)
17	<ul style="list-style-type: none"> Pushp Patila, Kuttimani Tamilmanib, Nripendra P. Ranab, 	Understanding consumer adoption of mobile payment in	International Journal of Information Management	Primary	Survey, Meta – UTAUT model with individual	<ul style="list-style-type: none"> The study conducted on 491 respondents provides insights that factors such as performance expectancy, intention to use, and grievance redressal are significant positive predictor of customer use behaviour towards



	<p>Vishnupriya Raghavan</p> <ul style="list-style-type: none"> 2020 India 	<p>India: Extending Meta-UTAUT model with personal innovativeness, anxiety, trust, and grievance redressal</p>			<p>difference variable attitude as core construct and extended the model with consumer related constructs such as personal innovativeness, anxiety, trust, and grievance redressal,</p> <p>CFA, SEM</p>	<p>mobile payment. Including attitude, social influence, and facilitating conditions. (Patil et al., 2020)</p>
18	<ul style="list-style-type: none"> Amit Shankar, Biplab Datta 2018 India 	<p>Factors Affecting Mobile Payment Adoption Intention: An Indian Perspective</p>	<p>Global Business Review</p>	<p>Primary</p>	<p>Survey, TAM, SEM</p>	<ul style="list-style-type: none"> This study is based on data collected from 381 respondents PEOU, PU, Self Efficacy and Trust have significant influence on usage intention while its does not apply to Personal innovativeness and subjective norm. Adoption of M payments has increased after demonetization in India. Design of M payment application affects user intention. Awareness about these services have positive impact on adoption. Trust and Customer support also have significant impact on adoption of M Payments. (Shankar & Datta, 2018)
19	<ul style="list-style-type: none"> Rakhi Thakur, Mala Srivastava 2014 India 	<p>Adoption readiness, personal innovativeness, perceived risk and usage intention across customer groups for mobile</p>	<p>Internet Research</p>	<p>Primary</p>	<p>Survey, SEM</p>	<ul style="list-style-type: none"> Based on responses from 774 graduates from different parts of India this study reveals that awareness of mobile payments has increased, but concerns about security and privacy obstructs its usage. Service providers should take legal technological steps that would enhance security and boost trust Innovative users must be target audience while creating digital campaigns because their opinions induce light users and non-users to adopt new technology. One of the limitations of this study was that it covered educated segment while those with less education weren't considered. (Thakur & Srivastava, 2014)

		payment services in India				
20	<ul style="list-style-type: none"> ▪ JAYSHREE CHAVAN ▪ 2013 ▪ India 	INTERNET BANKING-BENEFITS AND CHALLENGES IN AN EMERGING ECONOMY	International Journal of Research in Business Management (IJRBM)	Secondary		<ul style="list-style-type: none"> • Many consumers do not trust e – payments systems • Many consumers do not have access to the required infrastructure to be able to process e-payments. (Chavan, 2013)
21	<ul style="list-style-type: none"> ▪ Khushbu Madan, Rajan Yadav ▪ 2016 ▪ Delhi, India 	Behavioural intention to adopt mobile wallet: a developing country perspective	Journal of Indian Business Research	Primary	Survey, Technology adoption frameworks including two new variables, SEM	<ul style="list-style-type: none"> • The study conducted on 210 bank customers with internet enabled smartphone includes two new constructs - perceived regulatory support (PRS) and promotional benefits (PBs) to understand mobile wallet adoption. • Factors such as Performance expectancy, social influence, facilitating conditions, perceived value, trust, regulatory support, and promotional benefits have positive influence on behaviour intention. PRS builds trust and security which leads to long term adoption. • PB acts as a strong motivator for adoption mobile wallets. • Perceived Risk negatively influences BI • Due to technological advancements, effort expectancy has insignificant influence on BI • Users have limited awareness regarding regulatory frameworks which hinders adoption. • One of the limitation of this study is selection bias. (Madan & Yadav, 2016)
22	<ul style="list-style-type: none"> ▪ Deepak Chawla and Himanshu Joshi ▪ 2019 ▪ India 	Consumer attitude and intention to adopt mobile wallet in India – An empirical study	International Journal of Bank Marketing	Primary	Survey, TAM, UTAUT, PLS SEM	<ul style="list-style-type: none"> • The study conducted on 744 respondents conclude that the factors like perceived ease of use (PEOU), perceived usefulness (PU), trust, security, facilitating conditions and lifestyle compatibility have a considerable effect on the consumer intention to use mobile wallets • Ease of use has impact on usefulness and trust, while Perceived Use influences trust, attitude and intention. (Chawla & Joshi, 2019)
23	<ul style="list-style-type: none"> ▪ Shubhangi Singh, Marshal M. Sahni, Raj K. Kovid ▪ 2020 	What drives FinTech adoption? A multi-method evaluation	Management Decision	Primary	Survey, SEM, Multi group analysis	<ul style="list-style-type: none"> • Respondents preferred Internet banking followed by payment wallet. Almost all respondents used atleast one fintech service. • The study conducted on 439 respondents points out that perceived



	<ul style="list-style-type: none"> Delhi and Mumbai, India 	using an adapted technology acceptance model				usefulness is the most influencing factor of FinTech adoption, followed by ease of use. Social influence negatively affects actual usage, while ease of use positively affects it. Age highly affects security perception. (Singh et al., 2020)
24	<ul style="list-style-type: none"> Nidhi Singh, Shalini Srivastava, Neena Sinha 2017 North India 	Consumer preference and satisfaction of M-wallets: a study on North Indian consumers	International Journal of Bank Marketing,	Primary	Survey, UTAUT model with additional variable hedonism, Regression analysis, ANOVA and descriptive analysis	<ul style="list-style-type: none"> Based on the responses of 201 respondents, this study shows strong correlation between perception, Preference and adoption. Consumers' awareness about technology advancement is growing rapidly, and their changing perception is leading to an increased usage of mobile wallets in India. The result also shows the impact of customer's perception, satisfaction and preference on the usage rate of mobile wallets in India (Singh et al., 2017)
25	<ul style="list-style-type: none"> Rajan Yadav, Sujeet Kumar Sharma, Ali Tarhini 2016 Delhi 	A multi-analytical approach to understand and predict the mobile commerce adoption.	Journal of Enterprise Information Management	Primary	Survey, Technology Acceptance Model (TAM), Theory of Planned Behaviour (TPB) and Innovation Diffusion Theory (IDT), SEM-Neural network modelling	<ul style="list-style-type: none"> The study based on sample size of 213 depicts that casual relationship among the factors that impact the intention to adopt M-Commerce Youth easily and frequently adopt new technologies than other age groups. Extended TAM model is used by adding - variety of services, perceived cost, social influence and perceived trust as additional variables Results of SEM - variety of services, social influence, perceived usefulness, cost and perceived trust have significant impact on intention to adopt m-commerce. Effect of PEOU is insignificant. The results of SEM are used as input for neural network model which signifies that perceived trust , perceived usefulness and variety of services are most impactful factors on adoption of m commerce. (Yadav et al., 2016)
26	<ul style="list-style-type: none"> Baljinder Kaur, Sood Kiran, Simon Grima, and Ramon Rupeika-Apoga 2021 North India 	Digital Banking in Northern India: The Risks on Customer Satisfaction	Risks, MDPI	Primary and Secondary	Survey, SERVQUAL model, SEM	<ul style="list-style-type: none"> The results of this study are based on 222 north Indian banking customers and 56 literature sources. Impact of banking service quality is on customer satisfaction has been determined using SERVQUAL model which indicates that <ol style="list-style-type: none"> Reliability, Tangibility and Responsiveness have significant relationship with customer satisfaction out of which reliability is the most dominant factor. Bank should provide timely, and accurate updates to customers Websites must be visually attractive.



						<p>iv) Customer satisfaction also dependent on content marketing by banks.</p> <p>v) In order to build trust, banks must provide safe, reliable services.</p> <p>vi) Pace of digital banking adoption is growing at a consistent rate.</p> <p>vii) Government can play significant role in enhancing digital banking adoption by making cyber laws more strict.</p> <ul style="list-style-type: none"> Awareness impacts Adoption level. And addressing barriers to adoption improves satisfaction amongst customers. (Kaur et al., 2021)
27	<ul style="list-style-type: none"> Sindhu Singh, R. K. Srivastava 2020 India 	Understanding the intention to use mobile banking by existing online banking customers: an empirical study	Journal of Financial Services Marketing	Primary	Survey, Extended TAM, SEM	<ul style="list-style-type: none"> This study is based on understanding the initial acceptance of M - banking by already existing online banking users. Overall sampling of 420 online banking customers is done from various public, private, foreign and co-operative banks in India. Factors such as PEOU, perceived security, social influence, and mobile self-efficacy showed significant relation with intention to adopt mobile banking. Banks should focus on uplifting the service quality by improving security features, creating user friendly interfaces, customer support services to increase the adoption level and thereafter customer satisfaction. Banks can attract more customers by raising awareness regarding mobile banking. (Singh & Srivastava, 2020)
28	<ul style="list-style-type: none"> Hanuman Prasad , Devendra Meghwal, Vijay Dayama 2018 Udaipur, India 	Digital Financial Literacy: A Study of Households of Udaipur	The Journal of Business and Management	Primary	Survey, Correlation, ANOVA	<ul style="list-style-type: none"> This survey is based on 268 respondents.studies the impact of personal characteristics on digital financial liyeracy. Digital Financial Literacy = Awareness + Usage Frequency A significant positive correlation exists between awareness and usage frequency of digital channels. Higher the awareness, higher the usage frequency. Non awareness is a barrier to non adoption. Education level affects awareness and adoption levels. Gender and Occupation also affects awaress and adoption levels.Men are more aware while service class shows higher awareness. It suggests that awareness campaigns can enhance levels of awareness amongst.women, less educated, elderly people and non-service background.
29	<ul style="list-style-type: none"> Ekta Sao, Dr. Debasis Pahi 	AWARENESS OF DIGITAL	Pragyan	Primary and	Survey	<ul style="list-style-type: none"> PhonePe and GooglePe are most preferred payment apps.



	<ul style="list-style-type: none"> 2022 Purulia, West Bengal, India 	PAYMENT SYSTEM AMONG MILLENNIALS: A CASE STUDY ON PURULIA DISTRICT OF WEST BENGAL		Secondary		<ul style="list-style-type: none"> Less awareness pertains with respect to AEPS and USSD. (Sao & Pahi, 2022)
30	<ul style="list-style-type: none"> Sudiksha Shree, Bhanu Pratap, Rajas Saroy & Sarat Dhal 2021 India 	Digital payments and consumer experience in India: a survey based empirical study	Journal of Banking and Financial Technology	Primary	Survey	<ul style="list-style-type: none"> This study is based on a survey with sample size of 640. Perception of digital payment instrument affects the payment behaviour. Demographic factors impact the usage of digital payment systems Males are more likely to adopt digital banking than females while older generation people use less digital platforms for banking. Demographic variables such as Education, Income level and Occupation also impact the use of digital payment modes/ Results showed more awareness about UPI and cards rather than USSD and AEPS. (Shree et al., 2021)
31	<ul style="list-style-type: none"> Ethan Ligon, Badal Malick , Ketki Sheth , Carly Trachtman 2019 Jaipur, India 	What explains low adoption of digital payment technologies ? Evidence from small-scale merchants in Jaipur, India	Plos One	Primary	Survey	<ul style="list-style-type: none"> On the basis of survey data from 1003 merchants, this study reveals that supply side barriers do not significantly hinder adoption of digital payments. Rather due to demand side factors or taxes it is affected. (Ligon et al., 2019)
32	<ul style="list-style-type: none"> Preeti Garg, Manvi Panchal 2016 Delhi, India 	Study on Introduction of Cashless Economy in India 2016: Benefits & Challenge's	Journal of Business and Management	Primary	Survey	<ul style="list-style-type: none"> Respondents agree that cashless economy can tackle the national problems like corruption, terrorism, fake currency etc. However, cyber frauds, illiteracy, lack of transparency and efficiency affects the implementation of cashless economy negatively. Government should take steps to promote cashless transactions such as financial literacy campaigns. (Garg & Panchal, 2017)
33	<ul style="list-style-type: none"> Ramesh Kumar Bagla, Vivek Sancheti 2018 Delhi 	Gaps in customer satisfaction with digital wallets: challenge for	Journal of Management Development	Primary	Survey	<ul style="list-style-type: none"> This paper is primary research conducted on 313 respondents. Cash is yet most preferred mode of payment in India signifying potential for growth of digital wallets in India. Demonetization in 2016 gave a boost to digital wallets industry.



		sustainability				<ul style="list-style-type: none"> Satisfaction level is lesser than expectation level due to security features, user interface, rewards etc. (Bagla & Sancheti, 2018)
34	<ul style="list-style-type: none"> Ceyla Pazarbasioglu, Alfonso Garcia Mora, Mahesh Uttamchandani, Harish Natarajan, Erik Feyen, and Mathew Saal 2020 International 	Digital Financial Services	World Bank Report			<ul style="list-style-type: none"> In the field of Digital Financial Services India has emerged as leader driven by innovations such as UPI, Aadhar based e-KYC etc. Government initiatives such as Digital India has raised awareness and adoption of DFS, especially in rural areas. Challenges such as digital literacy and trust issues impact awareness and adoption negatively. (Pazarbasioglu et al., 2020)
35	<ul style="list-style-type: none"> AMIT SHANKAR, POOJA KUMARI 2016 India 	Factors affecting mobile banking adoption behavior in India. <i>Journal of Internet Banking and Commerce,</i>	Journal of Internet Banking and Commerce,	Primary and Secondary	Survey	<ul style="list-style-type: none"> Factors such as awareness, usefulness, ease of use, compatibility, self-efficacy, security and privacy risk, social influence and financial cost has significant impact on M banking adoption. Digital India and Pradhan Mantri JanDhan Yojna has led to awareness of online banking in rural areas. (Shankar & Kumari, 2016)
36	<ul style="list-style-type: none"> Ashish Kumar, Sanjay Dhingra, Vikas Batra, Harish Purohit 2020 India 	A Framework of Mobile Banking Adoption in India	.Journal of Open Innovation: Technology, Market, and Complexity	Primary	Survey, Extended TAM, SEM	<ul style="list-style-type: none"> Factors such as personal innovativeness, perceived ease of use, perceived usefulness, trust, and subjective norms have a significant impact on mobile banking adoption out of which trust is the most significant factor. (Kumar et al., 2020)
37	<ul style="list-style-type: none"> S. V. Krishna Kishore and Aloysius Henry Sequeira 2016 Karnataka, India 	An Empirical Investigation on Mobile Banking Service Adoption in Rural Karnataka	Sage Open	Primary	Survey, TAM, Regression	<ul style="list-style-type: none"> The study focuses on factors like perceived ease of use (EE), usefulness (PE), trust, and attitude. PE and EE positively impacts behavioral intention (BI), while perceived risk (PR) obstructs it. Social influence (SI) has a mild impact, showing limited effect from family and peers. Age moderated attitudes positively. (Kishore & Sequeira, 2016)
38	<ul style="list-style-type: none"> Richa Priya, Aradhana Vikas Gandhi, Ateeque Shaikh 2018 India 	Mobile banking adoption in an emerging economy: An empirical analysis of young Indian consumers	Benchmarking : An International Journal	Primary	Survey, TAM, Regression	<ul style="list-style-type: none"> The study with a sample size of 269 respondents aged between 23-30 years from India deciphers that Perceived usefulness, Perceived ease of use, Perceived credibility and Structural assurance are strong determinants of User satisfaction and Behavioral intention to use the mobile banking service. Perceived risk doesn't impact BI (Priya et al., 2018)



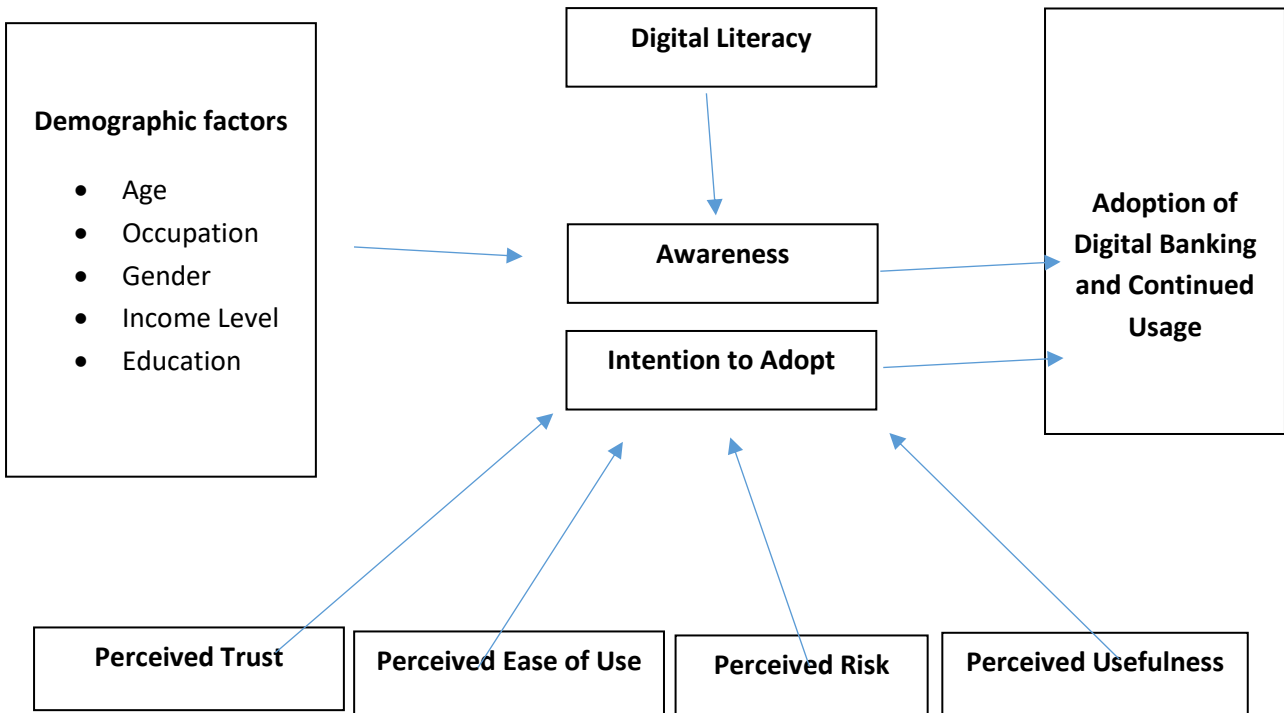
39	<ul style="list-style-type: none"> Luigi Wewege, Jeo Lee, Michael C. Thomsett 2020 International 	Disruptions and Digital Banking Trends	Journal of Applied Finance & Banking	Secondary	Systematic Review	<ul style="list-style-type: none"> Countries like China and India show the highest fintech adoption rates India, mobile banking has untapped potential. India's government policies, such as promoting a cashless economy, have significantly driven the adoption of digital banking. Youth of India are driving the transformation towards digitalization of banking. (Wewege et al., 2020)
40	<ul style="list-style-type: none"> Ashish Baghla 2018 India 	A Study On The Future Of Digital Payments In India	International Journal of Research and Analytical Reviews	Primary and Secondary	Survey	<ul style="list-style-type: none"> Digital literacy, security concerns and infrastructure issues hinder adoption of digital banking. Future of digital payments seems promising in India. (Baghla, 2018)

5. CONCLUSION

The level of awareness and adoption of digital banking has been increasing gradually. However, demographic factors has an impact on awareness of digital banking. Also, the level of awareness also impacts adoption level of digital banking. Trust and security concerns affect the person’s intention to adopt the digital banking services.

CONCEPTUAL FRAMEWORK :

Having studied above papers, a conceptual framework is prepared to portray the results precisely



(Source : Author)

6. LIMITATIONS

This study is based on different regions of India. India is such a large country with varied population in terms of demographic factors, culture etc., there's still a large scope of research in different parts of the country. There has been lot of research published based on TAM, UTAUT, TRA etc while a combined study on awareness, adoption and post adoption attitudes of bank customers with respect to latest services available isn't available. This study is a review of published literatures available on Google scholar, Emerald, Science Direct by searching keywords - Awareness / Adoption / Awareness and Adoption of digital banking in India. Hence there is still further scope of research due to ever changing landscape of digital banking around the world.

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Quantum Harmonic Resonance in Nanostructured Biohybrid Materials: A Novel Paradigm for Enhanced Biocatalysis and Bioenergy Applications

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Abstract: This study pronounced a digested concept of Quantum Harmonic Resonance (QHR), in nanostructured biohybrid materials, unprecedented biocatalytic efficiency and bioenergy production. QHR exploits synergistic interactions between quantum dots, biomolecules, and nanomaterials, inducing coherent resonance that amplifies enzymatic activity and bioelectrochemical performance.

Key Words: Quantum harmonics resonance (QHR), Nanostructured biohybrid materials, Biocatalysis, Bioenergy, Quantum Dots, Biomolecules, Nanomaterials.

1. INTRODUCTION:

The intricate driver between quantum mechanics and biotechnological applications presents a marvelous frontier in modern science. Innovations in nanostructured materials have prompted researchers to explore the potential of quantum harmonic resonance, which may significantly enhance the efficiency of biocatalysis and bioenergy conversion processes. By integrating engineered nanoscale structures with biological components, scientists aim to harness quantum behaviors that can optimize catalytic reactions at unprecedented levels. This synthesis of technology and biology opens avenues for sustainable energy solutions and improved biocatalytic systems, moving beyond traditional methodologies. In this paper, will delve into the mechanisms of quantum harmonic resonance, analyze its implications for the development of biohybrid materials, and highlight its transformative potential in light of global energy challenges and the pursuit of environmentally friendly technologies. Thus, the exploration of this novel paradigm not only enhances scientific understanding but also addresses pressing societal needs. Quantum Harmonic Resonance and its significance in nanostructured biohybrid materials The phenomenon of quantum harmonic resonance holds profound implications for the machining and functionality of nanostructured biohybrid materials, which seamlessly integrate biological elements with advanced nanomaterials. This resonance friendly to the energy levels of molecular vibrations that occur at the quantum scale, granting the precise manipulation of energy transfer between biomolecules and nanostructures. Such interactions can significantly enhance the efficiency of biocatalytic processes, allowing for more effective Chemistry of substrates into valuable products while minimizing energy losses. The alignment of quantum states through harmonic resonance not only optimizes these interactions but also facilitates the stabilization of reactive intermediates, which are crucial for sustaining effective catalytic cycles in biohybrid systems . Thus, understanding and harnessing this resonance is essential for designing biohybrid materials that can efficiently operate in various applications, particularly in sustainable energy and advanced biocatalysis (L Karthik et al.).

2. Vibrational Mode Calculations :

1. Vibrational Frequency Calculation: The vibrational frequency of the nanostructured material can be calculated using these equation:



$$\omega = \sqrt{k/m}$$

where ω is the vibrational frequency, k is the spring constant, and m is the mass of the nanostructured material.

2. Vibrational Mode Coupling Calculation: The vibrational mode coupling between the nanostructured material and the enzyme can be calculated using the following equation:

$$V = \hbar\omega (\mu \cdot E)$$

where V is the vibrational mode coupling, \hbar is the reduced Planck constant, ω is the vibrational frequency, μ is the transition dipole moment, and E is the electric field.

3. Quantum Coherence Calculations

1. Quantum Coherence Time Calculation: The quantum coherence time of the nanostructured material can be calculated using these equation:

$$\tau = \hbar / \Delta E$$

where τ is the quantum coherence time, \hbar is the reduced Planck constant, and ΔE is the energy uncertainty.

2. Quantum Coherence Length Calculation: The quantum coherence length of the nanostructured material can be calculated using the following equation:

$$L = \hbar v / \Delta E$$

where L is the quantum coherence length, \hbar is the reduced Planck constant, v is the velocity of the nanostructured material, and ΔE is the energy uncertainty.

4. Plasmonic Effect Calculations

3. Plasmon Resonance Frequency Calculation: The plasmon resonance frequency of the nanostructured material can be calculated using the following equation:

$$\omega_p = \sqrt{Ne^2 / m\epsilon_0\epsilon_r}$$

where ω_p is the plasmon resonance frequency, N is the electron density, e is the elementary charge, m is the electron mass, ϵ_0 is the vacuum permittivity, and ϵ_r is the relative permittivity of the nanostructured material.

4. Plasmon Enhanced Absorption Calculation: The plasmon enhanced absorption of the nanostructured material can be calculated using the following equation:

$$A = (1 - R) (1 - T)$$

where A is the absorption, R is the reflectance, and T is the transmittance.

Quantum Harmonic Resonance Mechanisms



At the core of quantum harmonic resonance mechanisms lies the intricate interplay among energy states and molecular vibrations, which fundamentally governs the efficiency of biocatalysis in nanostructured biohybrids. When these structures are subjected to external stimuli, such as electromagnetic fields, they can experience resonance phenomena that significantly enhance their catalytic properties. This resonance occurs when the frequency of the external excitation matches the natural vibrational frequencies of the molecules involved, leading to amplified energy transfer and optimized reaction pathways. Consequently, this resonance enhances electron transfer rates, which are critical for bioenergy applications, allowing for improved conversion efficiencies in processes such as photosynthesis and biofuel production. Thus, understanding and harnessing these quantum harmonic resonance mechanisms not only paves the way for optimizing nanostructured materials but also offers profound implications for sustainable technologies aimed at energy generation and storage (L Karthik et al.).

Theoretical foundations and principles of quantum harmonic resonance in nanostructures At the heart of quantum harmonic resonance in nanostructures profound the intricate of quantum mechanics and vibrational modes within these confined systems. The theoretical framework, grounded in quantum mechanics, posits that nanostructures exhibit quantized energy levels resulting from their reduced dimensions. This quantization leads to resonance phenomena, where specific vibrational modes can enhance electronic and photonic properties, ultimately optimizing biocatalytic reactions in biohybrid materials. By manipulating these vibrational modes, researchers can create tailored resonance conditions that significantly bolster the efficiency of energy conversion processes. The impact of such advancements is evident in projects funded through initiatives like the Laboratory Directed Research and Development (LDRD) programs at institutions like Oak Ridge National Laboratory and Brookhaven National Laboratory, where innovative approaches are devised to leverage quantum characteristics for enhanced bioenergy applications (Sjoreen et al.), (Newman et al.). These insights into quantum harmonic resonance offer promising pathways for transformative applications in renewable energy and biotechnology.

Applications in Biocatalysis paramount advancements in biocatalysis have transformed various industrial applications, leveraging the unique properties of enzymes to enhance efficiency and sustainability in chemical processes. These developments have led to a surge in interest within the field, particularly with the emergence of hybrid materials that optimize the catalytic capabilities of enzymes. For instance, nanostructured biohybrid materials can be designed to incorporate quantum harmonic resonance, which improves the interaction between light and the catalytic sites, thus facilitating more effective energy transfer. Moreover, the integration of techniques like enzyme-directed evolution has expanded the range and specificity of biocatalysts available, allowing for innovative transformations that were previously infeasible ('AG M'). This newfound versatility enhances the viability of biocatalysis across diverse sectors, from pharmaceuticals to biofuels, culminating in a more efficient and environmentally friendly approach to manufacturing processes that align with modern sustainability goals (Johnson et al.).

Enhancing enzymatic activity and efficiency through quantum harmonic resonance in biohybrid systems The Chemistry lies between quantum harmonic resonance and enzymatic activity offers promising avenues for enhancing the efficiency of biohybrid systems. By harnessing these resonant frequencies, researchers have demonstrated that the vibrational states associated with enzyme substrates can be fine-tuned, effectively optimizing the reaction kinetics involved in biocatalysis. This phenomenon occurs as the external resonance aligns with the natural frequencies of the enzymatic molecules, thereby promoting more effective energy transfer during chemical transformations. Consequently, biohybrid systems that migrate nanostructured components can significantly amplify enzymatic activity, demonstrating improved turnover rates and substrate conversion efficiencies compared to conventional systems. The potential applications of this enhanced capability are vast, ranging from bioenergy production to pharmaceutical synthesis, underscoring the transformative



implications of quantum harmonic resonance in advancing biocatalytic processes for sustainable and efficient solutions in modern science and industry (L Karthik et al.).

5. Implications for Bioenergy

The development of quantum harmonic resonance in nanostructured biohybrid materials offers transformative potential for the bioenergy sector. By enhancing the efficiency of biocatalytic processes, these technologies could significantly improve the conversion of biomass into renewable energy sources. The integration of quantum effects with biological systems enables more effective electron transfer and energy absorption, which is crucial for optimizing metabolic pathways in microorganisms used for biofuel production. As these materials are engineered to operate at the nanoscale, their performance can be fine-tuned to maximize output while minimizing energy loss, thereby making bioenergy production not only more sustainable but also economically feasible. Consequently, the implications for bioenergy extend beyond mere technological advancement; they encompass environmental benefits as well, promoting a shift towards cleaner alternatives and a reduction in greenhouse gas emissions that are essential in combating climate change (L Karthik et al.).

Potential advancements in renewable energy production using nanostructured biohybrid materials. Innovations in renewable energy production are increasingly focusing on the integration of nanostructured biohybrid materials, which harness both biological and physical processes to enhance energy efficiency. These materials can facilitate new approaches to energy harvesting, specifically by utilizing biomechanical energy from natural sources, such as human arterial pulsations. As suggested in research on hybrid energy harvesters leveraging the reverse electrowetting on dielectric (REWOD) phenomenon combined with piezoelectric effects, such methodologies can significantly improve the energy output through the simultaneous exploitation of multiple energy harvesting mechanisms (Johnson et al.). Furthermore, advancements in applied biocatalysis underscore the potential for engineered enzymes and whole-cell systems to refine the conversion processes in bioenergy applications, making them more efficient and sustainable ('AG M'). By synergistically merging nanotechnology with biological innovations, we can expect significant strides in renewable energy production, allowing for more versatile and powerful systems that contribute to a greener future.

6. Conclusion

In light with numerous advancements detailed throughout this article, it becomes clear that the integration of quantum harmonic resonance into nanostructured biohybrid materials represents a transformative approach in the field of biocatalysis and bioenergy applications. This novel paradigm not only enhances the efficiency of catalytic processes but also opens new pathways for sustainable energy solutions. By harnessing quantum effects, these biohybrid systems exhibit improved activity and selectivity, thereby addressing critical challenges in energy conversion and storage. Furthermore, ongoing research into the molecular interactions and physical properties of these materials is essential for optimizing their performance and unlocking their full potential. The implications of such innovations extend beyond mere technical advancements; they reaffirm the necessity for interdisciplinary collaboration and emphasize the role of advanced materials science in shaping a sustainable future. Continued exploration in this field could lead to breakthroughs that significantly alter current energy landscapes (L Karthik et al.).

Summary of key findings and future directions for research in quantum harmonic resonance and its applications. Advancements in quantum harmonic resonance have significantly impacted the fields of



biocatalysis and bioenergy, offering strong evidence that engineered nanostructured biohybrid materials can dramatically enhance reaction efficiencies and energy conversion processes. Key findings reveal that by exploiting the resonant frequencies of quantum systems, researchers can optimize the interaction between biocatalysts and substrates, leading to accelerated reaction rates and improved product yields. Moreover, the integration of quantum coherence in these biohybrid systems demonstrates potential for sustained energy output, addressing some of the critical limitations faced by conventional bioenergy methods. Looking ahead, future research directions should focus on exploring the scalability of these nano-engineered materials, as well as their effects in various environmental conditions. Additionally, interdisciplinary studies combining quantum physics, materials science, and biochemistry are essential for unraveling the full potential of quantum harmonic resonance in practical applications, ultimately paving the way for innovative solutions to global energy challenges.

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Assessment of knowledge and practices regarding cleanliness and personal hygiene among middle school students in and around Mehsana, Gujarat

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Abstract: *This descriptive cross-sectional study aimed to assess the knowledge and practices of cleanliness and personal hygiene among middle school students in and around Mehsana, Gujarat. Data was collected with convenience sampling from 100 students using a structured questionnaire. Both boys and girls, aged 11 to 14 were included in the study. Participants were primarily hailed from rural areas (76%) and most of them were living in joint families (81%). The findings showed that the basic knowledge of hygiene practices was sound enough, such as teeth brushing (99%), handwashing (98%), and soap use (99%), but awareness of specific objects like the use of sanitary pads (44%) and toilet paper (58%) was limited or poor. In terms of practice, students displayed strong observant of basic hygiene practices, including daily handwashing and teeth brushing, but minimum inclination towards daily bathing (78%) and regular haircuts (48%). These results show knowledge gaps in hygiene education, particularly regarding menstrual hygiene and specific practices, indicating the need for necessary behavior change interventions in schools to improve knowledge and practices especially in rural settings.*

Key Words: *WaSH Practices, Personal hygiene, Middle school students, Cleanliness, Hygiene education*

1. INTRODUCTION:

Personal hygiene plays an important role in overall health and well-being, especially during the formative years of childhood and adolescence. It helps in preventing infections and introduces lifelong positive healthy habits. In school environment, personal hygiene is extremely crucial as children have high chances of getting infected by communicable diseases. This study aims to contribute to this body of research by focusing specifically on middle school students in Mehsana, Gujarat, and assessing the knowledge and practices of personal hygiene in this context, highlighting the gaps and offering recommendations for further improvement.

2. LITERATURE REVIEW:

The importance of hygiene education has been widely recognized in public health literature. Numerous studies highlight the relationship between personal hygiene and the prevention of communicable diseases, especially in school settings. This is especially true in rural areas, where access to sanitation



facilities and clean water may be limited (WHO, 2015) (8). Some researches on personal hygiene practices in India shows that while there is a significant awareness about importance of cleanliness, while significant gap remains particularly in rural and semi-urban areas.

Few significant findings include:

Kaur et al. (2020): The study found that many adolescent girls in rural India lack sufficient knowledge about sanitary pads and menstrual hygiene management due to cultural taboos and limited access to menstrual products. The study emphasized the need for comprehensive education to address these gaps and improve practices around menstrual health. The literature stresses the need for targeted education to improve specific practices and address demographic disparities.

Patel & Desai (2019): The study knowledge of basic hygiene practices like handwashing and regular bathing is high among students, but the consistent application of these practices is often lacking, especially among students from rural backgrounds. The researchers suggested that cultural factors and access to resources play a crucial role in shaping hygiene behaviors.

Sharma et al. (2018): The study observed that school-based hygiene education significantly reduces the incidence of infections like diarrhea and respiratory illnesses.

Singh and Kumar (2021): The study found that children living in joint families are more likely to adhere to traditional hygiene practices due to the influence of older family members, while those in nuclear families often depend on school-based education for learning about hygiene.

Sihra et al. (2018): The study found that knowledge about body and clothes hygiene, about teeth brushing, about regular clothes washing, about soap use in personal hygiene and about use of nail cutter, was very good but knowledge about use of toilet paper and about sanitary pad was not found very good.

3. OBJECTIVES / AIMS:

3.1 Aim- To Assess the knowledge and practices regarding cleanliness and personal hygiene among middle school students in and around Mehsana, Gujarat

3.2 Objectives:

1. To determine the knowledge of cleanliness and personal hygiene
2. To determine the good practices of cleanliness and personal hygiene

4. RESEARCH METHODOLOGY:

4.1 Research Plan:

4.1.1 Research Design: Descriptive Cross-Sectional Study

4.1.2 Type of Data: Primary, Scale Data

4.1.3 Source of Data: Questionnaire on cleanliness and personal hygiene [7]

4.2 Sample Plan:

4.2.1 Sampling Design: Convenience Sampling

4.2.2 Sampling location: Middle schools in and around Mehsana, Gujarat



4.2.3 Sampling Frame: students belong to 5th to 7th standard

4.2.4 Sample Size: 100 students

4.3 Selection Criteria:

4.3.1 Inclusion Criteria:

- Students who were willing to participate in survey
- Students belong to 5th to 7th standard
- Students of both the gender
- Students belongs to all socio-economic classes

4.3.2 Exclusion Criteria:

- Students belong to Primary school [KG to 4th std]
- Students belong to High school [8th std & above]-Students who are not willing to participate in survey

4.4 Research Procedure:

4.4.1 Data collection: 3 Months

- Study has done by applying the questionnaire on cleanliness and personal hygiene, with a written consent taken before that.

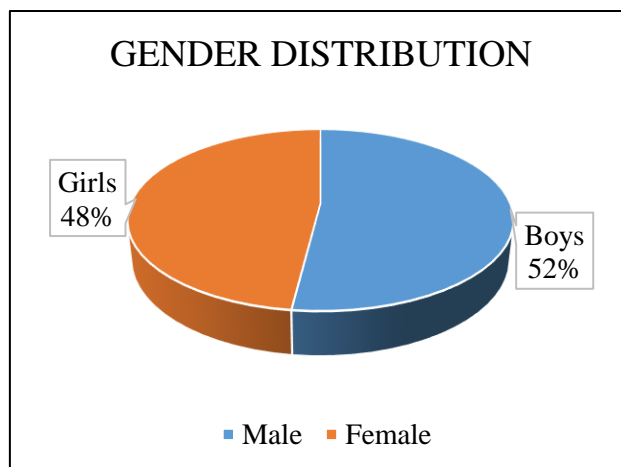
4.4.2 Analysis of Data: 2 Months

5. RESULTS:

5.1 Demographic Characteristics

5.1.1 Gender Distribution: Out of 100 students 52% were girls and 48% students were boys.

GENDER DISTRIBUTION		
Gender	No. Of Respondents	Percentage
Girls	52	52%
Boys	48	48%
Total	100	100%

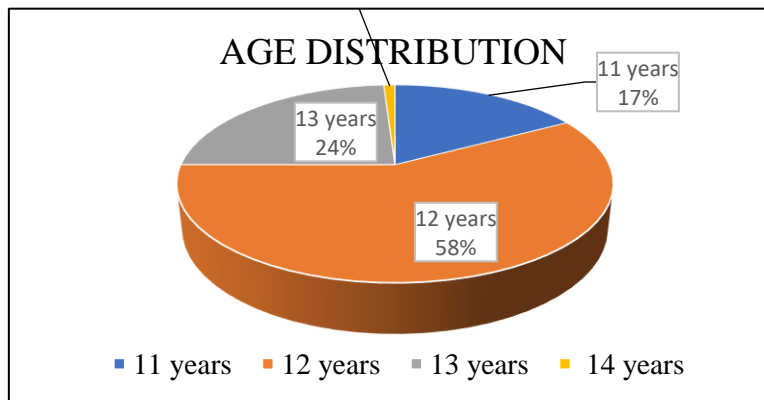


Graph 5.1.1: Graph showing Gender Distribution



5.1.2 Age distribution: Out of 100 respondents, 17% respondents are 11 years old, 58% respondents are 12 years old, 24% respondents are 13 years old and 1% respondent is 14 years old.

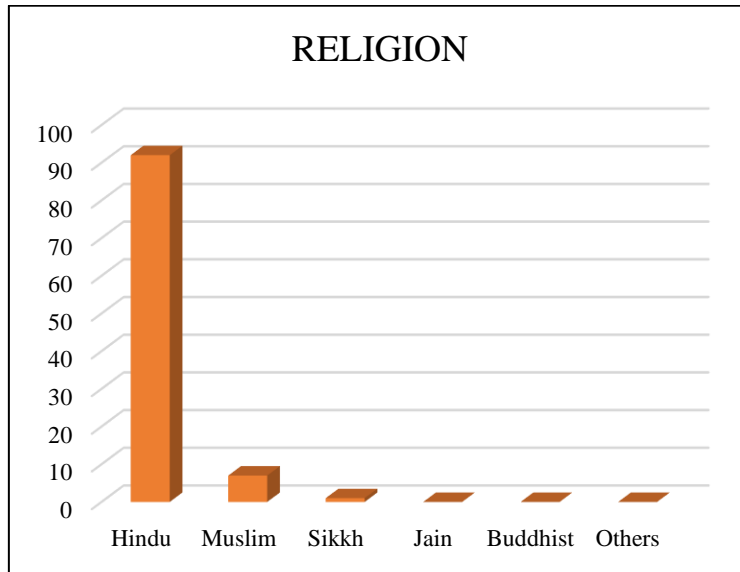
AGE DISTRIBUTION		
Age	No. Of Respondents	Percentage
11	17	17%
12	58	58%
13	24	24%
14	1	1%
Total	100	100%



Graph 5.1.2: Graph showing Age Distribution

5.1.3 Religion: Out of 100 respondents, 92% respondents are Hindu, 7% respondents are Muslim and 1% respondent is Sikh.

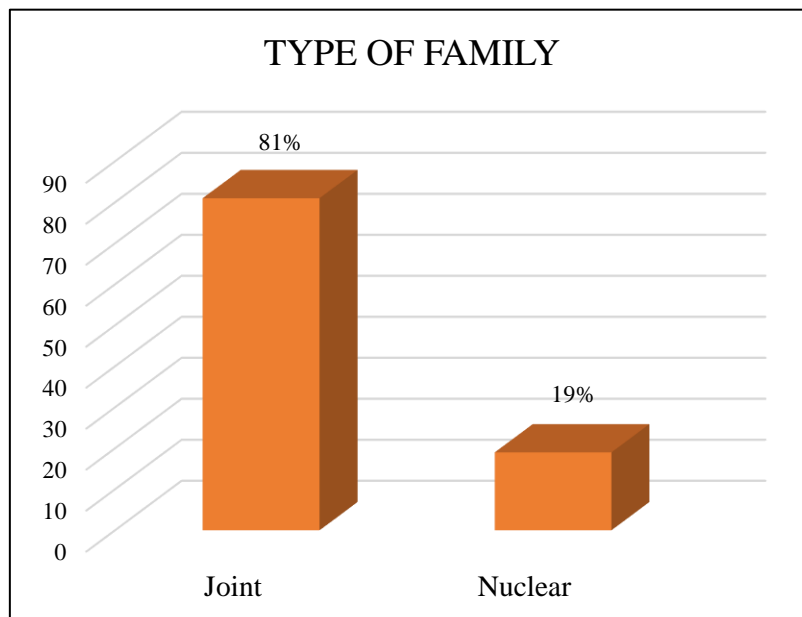
RELIGION		
Religion	No. Of Respondents	Percentage
Hindu	92	92%
Muslim	7	7%
Sikh	1	1%
Jain	0	0%
Buddhist	0	0%
Others	0	0%
Total	100	100%



Graph 5.1.3: Graph showing Religion among respondents

5.1.4 Family Type: Out of 100 respondent, 81% lives with Joint family and 19% lives in nuclear family.

TYPE OF FAMILY		
Type Of Family	No. Of Respondents	Percentage
Joint	81	81%
Nuclear	19	19%
Total	100	100%

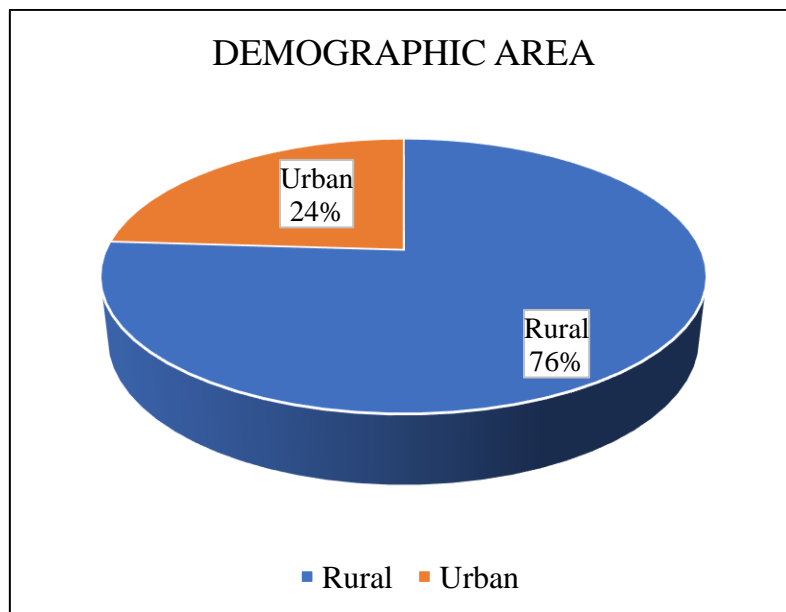


Graph 5.1.4: Graph showing type of family



5.1.5 Residence: Out of 100 respondent, 76% respondents are living in Rural area while 24% respondent lives in Urban area.

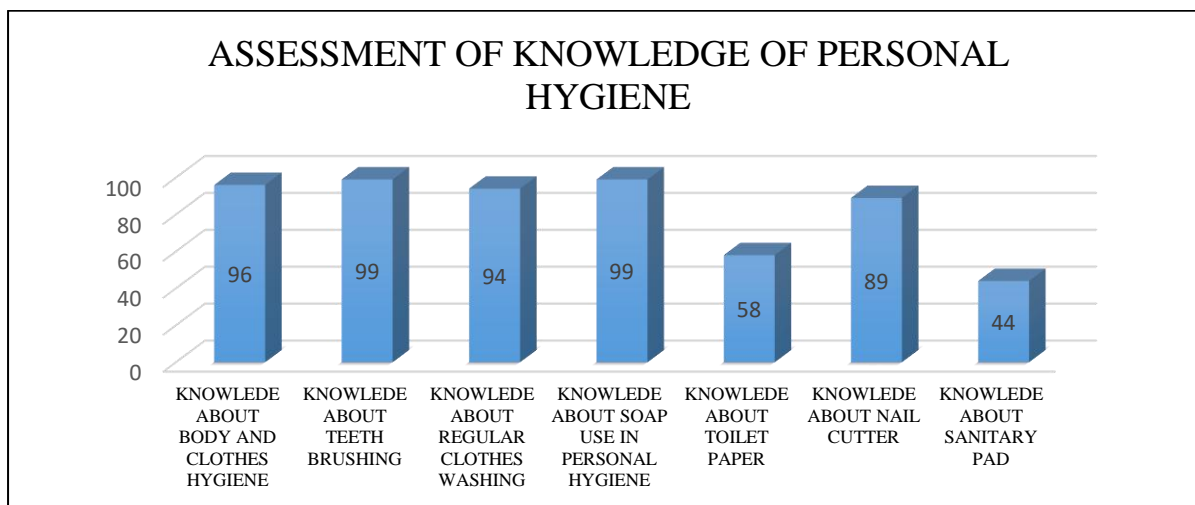
DEMOGRAPHIC AREA		
Type Of Area	No. Of Respondents	Percentage
Rural	76	76%
Urban	24	24%
Total	100	100%



Graph 5.1.5: Graph showing demographic area where respondents are living

5.2 Knowledge of Personal Hygiene

ASSESSMENT OF KNOWLEDGE OF PERSONAL HYGIENE		
Assessment of Knowledge	No. Of Respondents	Percentage
Knowledge About Body and Clothes Hygiene	96	96%
Knowledge About Teeth Brushing	99	99%
Knowledge About Regular Clothes Washing	94	94%
Knowledge About Soap Use in Personal Hygiene	99	99%
Knowledge About Toilet Paper	58	58%
Knowledge About Nail Cutter	89	89%
Knowledge About Sanitary Pad	44	44%

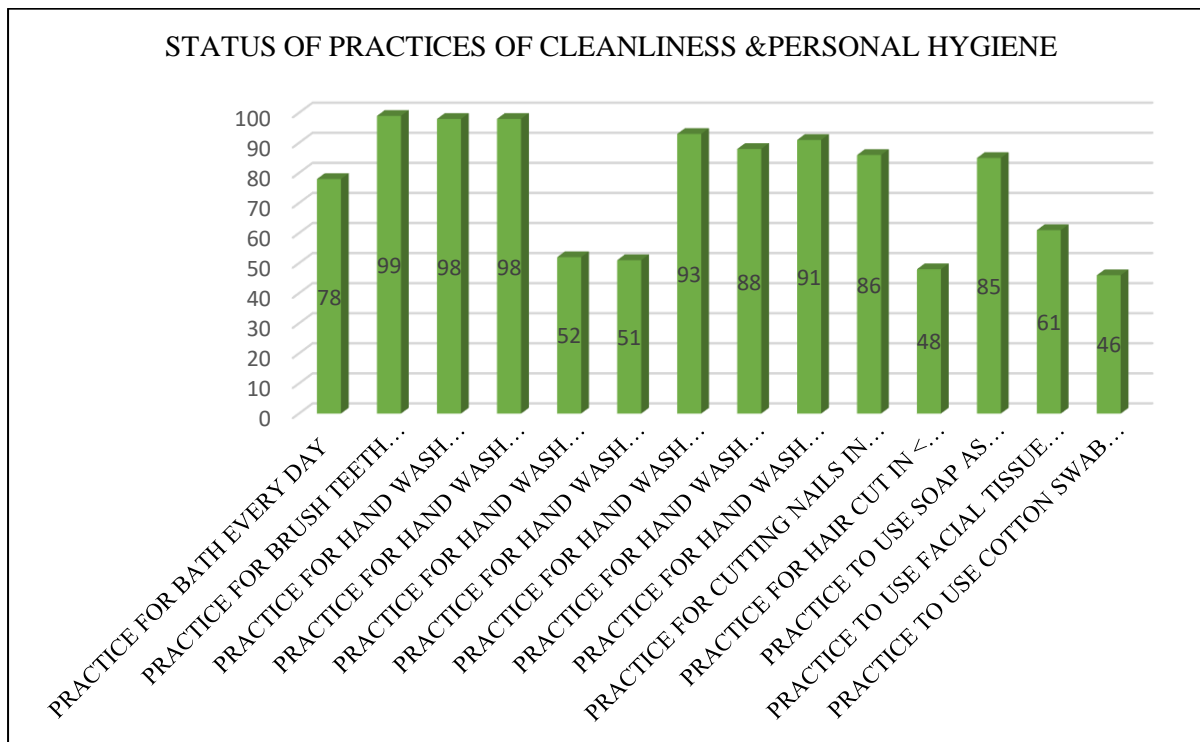


Graph 5.2: Graph showing assessment of knowledge of personal hygiene in this study

5.3 Hygiene Practices

STATUS OF PRACTICES OF CLEANLINESS & PERSONAL HYGIENE		
Status of Practices	No. Of Respondents	Percentage
Practice For Bath Every Day	78	78%
Practice For Brush Teeth Every Day	99	99%
Practice For Hand Wash Before Meal	98	98%
Practice For Hand Wash After Meal	98	98%
Practice For Hand Wash Before Cooking	52	52%
Practice For Hand Wash After Cooking	51	51%
Practice For Hand Wash After Using Toilet	93	93%
Practice For Hand Wash After Handling Garbage	88	88%
Practice for hand wash after handling animal	91	91%
Practice for cutting nails in < 7 days	86	86%
Practice for hair cut in < one month	48	48%
Practice to use soap as hygiene product	85	85%
Practice to use facial tissue as hygiene product	61	61%

Practice to use cotton swab as hygiene product	46	46%
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Graph 5.3: Graph showing status of practices of cleanliness & personal hygiene in this study

6. DISCUSSION :

The study explored various aspects of personal hygiene knowledge and practices among 100 students. The demographic characteristics were diverse, with a majority of respondents from rural areas (76%) and living in joint families (81%). The age distribution ranged from 11 to 14 years, with the largest group being 12-year-olds (58%).

Key findings show that the majority of the respondents had basic knowledge of personal hygiene. For instance, almost all students were aware of the importance of brushing teeth (99%), using soap (99%), and body and clothes hygiene (96%). However, in certain areas, such as the use of sanitary pads, study showed lower awareness (44%), which may reflect either the age of the group, gender diversity or potential gaps in education concerning menstrual hygiene. Similarly, only 58% had knowledge of using toilet paper, which may indicate cultural differences or lack of exposure to certain hygiene practices in rural settings.

When it comes to practice hygiene, the study indicates strong compliance in areas like brushing teeth (99%), washing hands before and after meals (98%), practice for hand wash after using toilet (93%) and cutting nails regularly (86%). However, lower practice rates were observed in daily bathing (78%) and more specific practices like haircuts within a month (48%) and using cotton swabs (46%).

This highlights the importance of education and awareness of hygiene in schools, especially to address gaps in knowledge about specific hygiene products and practices. The lower adherence to practices like



using facial tissues (61%) and cotton swabs suggests a need for more comprehensive hygiene campaigns that target these areas, particularly for students from rural backgrounds.

7. CONCLUSION:

This study indicates that while students have a strong fundamental knowledge of hygiene, there are certain noticeable gaps in specific areas, such as the use of sanitary pads and toilet paper. These gaps could be due to cultural practices, geographical diversity, or lack of adequate hygiene education. The high level of compliance with daily practices such as teeth brushing and handwashing indicates good awareness and understanding of fundamental personal hygiene, but improvements can be made in areas like regular bathing and hair care. This study emphasizes the need for targeted hygiene education, especially in rural settings, to enhance awareness and consistent practice.

8. SUMMARY:

This study aimed to assess the knowledge and practices of personal hygiene among 100 students, primarily from rural areas and joint families. The findings show that the majority of the students are well-versed in basic hygiene, especially teeth brushing and handwashing. However, there are gaps in knowledge regarding the use of certain hygiene products, particularly sanitary pads and toilet paper. While students exhibit good hygiene practices in general, specific areas like daily bathing and regular haircuts require improvement. The results suggest a need for more inclusive hygiene education, particularly in rural areas, to bridge the gaps in knowledge and practice.

9. RECOMMENDATIONS:

Study shows that hygiene education is very important in school environment. Future studies can be done with a focus on menstrual hygiene and proper toilet practices, assessment of accessible sanitation facilities in schools, encouragement of family participation in hygiene awareness programs and availability of hygiene products like soap and sanitary pads in schools

10. ACKNOWLEDGEMENT

I extend my heartfelt gratitude to the Central Council for Research in Homoeopathy (CCRH) for granting us the opportunity to conduct this research and for their generous support and encouragement throughout this endeavor.

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Assessment of Satisfaction Levels of Patients Attending Outpatient Departments with Medical Care Services Provided at Merchant Homoeopathic Hospital, Mehsana, Gujarat.

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Abstract: *The Merchant Homoeopathic Medical College and Hospital, Mehsana Gujarat was the setting where this hospital-based, cross-sectional study was conducted. From the different OPD's of this health facility, 100 patients were sampled. Data gathering was done by means of an exit interview that was given to the patient after getting a written informed consent. Data gathering was done through a predesigned and pretested questionnaire, Patient Satisfaction Questionnaire (PSQ-18), as a data gathering tool.*

The findings of the study revealed moderate satisfaction scores across all domains of patient satisfaction, including general satisfaction, technical quality, interpersonal manner, communication, financial aspects, time spent with the doctor, and accessibility and convenience. Among these domains, the highest mean satisfaction scores were observed in communication (mean: 3.72, SD: ± 1.38) and technical quality (mean: 3.53, SD: ± 1.16). In contrast, the lowest scores were reported in time spent with the provider (mean: 3.49, SD: ± 1.78) and interpersonal manner (mean: 3.44, SD: ± 1.28).

No significant correlations were observed between most sociodemographic variables and the overall satisfaction score, with the exception of residence and religion. A statistically significant association was found between residence and satisfaction score (t -statistic: 2.12, t -critical: 1.98) as well as between religion and satisfaction score (F -statistic: 5.15, F -critical: 2.69).

Additionally, the study identified a significant relationship between clinical characteristics and satisfaction scores (F -statistic: 14.20, F -critical: 2.04). Overall, the results indicate that patients were moderately satisfied with the medical services provided by the health facility.

Keywords: *Patient Satisfaction, Homoeopathy, Outpatient Care, Healthcare Quality, PSQ-18.*

1. INTRODUCTION:

The high and only mission of any health institution is to achieve user satisfaction through the quality of its services. Patient is the key stakeholder in the healthcare system. The patient satisfaction is a good measure of healthcare quality. Patient satisfaction refers to the perceived and felt attitudes of the patients regarding their healthcare delivery. According to researches, patients who are satisfied with their care are likely to follow the physician's recommendations and treatment, which increases the outcome of health. Further studies shows that there is a positive relationship between the quality of care and the



satisfaction levels of patients. Patient satisfaction does not only act as a measure of healthcare quality that is powerful, sensitive and easily used, but also it helps in judging the performance of physicians and other health facilities (1).

The homoeopathic system of medicine is a prominent segment of healthcare in India. It successfully treats various diseases such as Gastrointestinal, Respiratory, Genitourinary, musculoskeletal, neurological, Cardiovascular and Metabolic Disorders. The Homoeopathic system of health care delivery takes place through 235 hospitals and 8117 dispensaries managed by the state governments, municipal bodies, CGHS, ministry of labour and ministry of Railways (2). Improving the quality of care in these facilities is crucial in ensuring increased utilization of homoeopathic services. Patient satisfaction surveys are thus, a valuable approach in evaluating quality in services provided in such health care institutions.

Studies have shown that, in general, the overall satisfaction with the quality of services and treatment is high among the patients undergoing AYUSH treatments (1). In the primary care, patient satisfaction has been found to be higher with homoeopathic treatment than with conventional treatment (3). The efficacy and satisfaction rate for homoeopathic treatment in gynecological disorders have been reported to be 68.8% (4). Despite these findings, however, a lack of extensive research on patients' satisfaction with quality service concerning medical care in private homoeopathic hospitals has been noted. To my best knowledge, no existing research has focused on this exact issue. Motivating this, the present research focuses on evaluating the level of patient satisfaction with the quality of medical services provided within one private homoeopathic care facility.

2. LITERATURE REVIEW:

Ahmad, E., & Itrat, M. (2020): This study consistently highlights that patient satisfaction is a vital indicator of healthcare quality, showing significant associations with interpersonal communication, treatment effectiveness, and technical quality across diverse traditional medicine settings like Unani and AYUSH hospitals.

Ganasegeran, K. et al (2015): Patient satisfaction studies, including those at Malaysia's busiest outpatient facility, emphasize the importance of technical quality, accessibility, and convenience, while highlighting gaps in interpersonal skills and communication that influence overall satisfaction levels.

Joseph and Nicholas (2007): A study on chronic disease clinic attendees revealed an association between client satisfaction, number of illnesses, and subjective quality of life.

Ghassem Abedi et al. (2015): A cross-sectional study at Imam Khomeini Hospital found significant differences in patient satisfaction based on various factors, except for gender and residential location.

Waheed Ibraheem et al. (2013): A survey involving 320 participants identified significant associations between overall satisfaction and most demographic variables, except marital status and income .

Yeshigeta GB et al. (2023): Patient satisfaction was highest in communication and technical quality, while interpersonal manner received the lowest scores.

Mao Vadhana (2012): A study in Cambodia's Khmer-Soviet Friendship Autonomous Hospital reported a 93.5% satisfaction rate, with education level influencing satisfaction significantly.

Naveen Poojar CM (2021): A study found that 93.5% of patients were satisfied with hospital services, with facilities rated particularly high.

Jawahar SK et al. (2007): Research at a Kerala hospital revealed high satisfaction (90-95%), though issues with prolonged wait times and nursing staff demeanor were noted.



Khan et al. (2007): A study in Dera Ismail Khan showed only 5% were fully satisfied with care, although nursing practices were rated highly.

Lee SW et al. (2017): Findings emphasized the importance of high-quality services in smaller hospitals for improving satisfaction.

Bostan S et al. (2007): Patient expectations were influenced by age, gender, education, health insurance, and income.

Shinde M et al. (2014): Moderate satisfaction was observed among patients in obstetrics, gynaecology, and surgery departments.

Thayaparan et al. (2013): Highlighted the reliability of the PSQ-18 as a tool for assessing patient satisfaction across diverse healthcare settings.

3. AIM & OBJECTIVES:

3.1 AIM: To Assess the level of patient's satisfaction with the quality of medical care services rendered in a teaching hospital of Homoeopathy in Mehsana, Gujarat.

3.2 OBJECTIVES:

- To determine the satisfaction level of patients through PSQ-18 scale
- To correlate the patient satisfaction level with socio-demographic variables
- To establish an association between treatment effectiveness and patient satisfaction level

4. RESEARCH METHODOLOGY:

4.1 Study Design: Descriptive cross-sectional study.

4.2 Population and Sample: 100 patients attending OPDs at the Merchant Homoeopathic Hospital were selected using convenience sampling.

4.3 Data Collection Tool: PSQ-18 questionnaire.

4.4 Analysis Techniques: Descriptive statistics, ANOVA, and t-tests were used to analyse satisfaction scores across socio-demographic and clinical variables.

4.5 Inclusion Criteria:

- Patients aged 18 and above.
- Visitors to outpatient departments.
- Willing participants who provided informed consent.

4.6 Exclusion Criteria:

- Inpatients and daycare patients.
- Healthcare workers and unwilling participants.

4.7 Data Analysis:

Data were analysed using Microsoft Excel. Descriptive statistics summarized satisfaction levels, and ANOVA and t-tests determined associations between satisfaction scores and socio-demographic/clinical variables.

5. RESULT / FINDINGS:

5.1 Demographics :

The study population comprised 68% males and 32% females. The majority (48%) were aged 21-30 years, and 64% resided in urban areas.

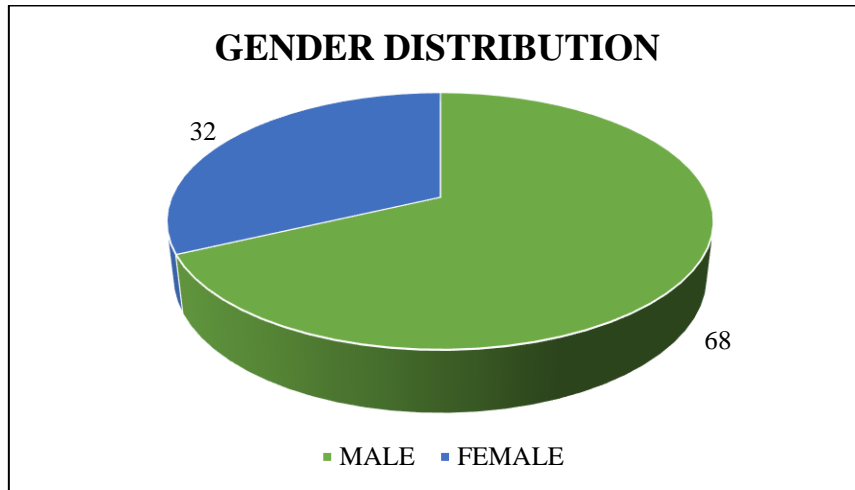


Figure 5.1: Gender Distribution

5.2 Satisfaction Levels:

Moderate satisfaction was observed across all domains:

- **Highest:** Communication (3.72 ± 1.38).
- **Lowest:** Interpersonal Manner (3.44 ± 1.28).

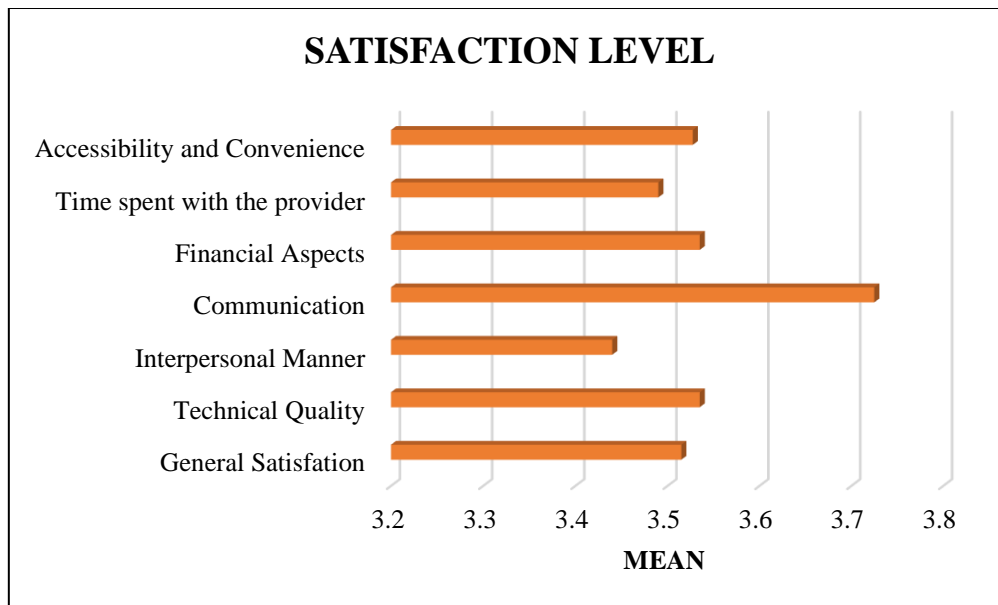


Figure 5.2: Satisfaction Level Among Study Population



5.3 Key Findings:

- Significant associations were found between satisfaction levels and patients’ residence and clinical characteristics (*see table 5.3&5.3.1*).
- No significant associations were observed with age, gender, or marital status.

	<i>RURAL</i>	<i>URBAN</i>
Mean	3.819444444	3.377604167
Variance	0.824052028	1.294256289
Observations	36	64
Hypothesized Mean Difference	0	
Df	87	
t Stat	2.127946646	
P(T<=t) one-tail	0.018085087	
t Critical one-tail	1.662557349	
P(T<=t) two-tail	0.036170173	
t Critical two-tail	1.987608282	

Table 5.3: student t-test table shows t-stat (2.12) is greater than t-critical (1.98), hence the test is significant.

SUMMARY				
<i>Groups</i>	<i>Count</i>	<i>Sum</i>	<i>Average</i>	<i>Variance</i>
CVS	3	11.94444445	3.981481482	0.263374486
GIT	9	35.72222222	3.969135803	0.468449931
OBGY	14	51	3.642857143	1.286189119
METABOLIC	11	43.33333333	3.939393939	0.428058361
MSS	9	35.83333333	3.981481481	0.449845679
RS	12	48.94444445	4.078703704	0.266811635
NEURO	7	29.61111111	4.23015873	0.026161082
SKIN	18	66.44444445	3.691358025	1.096304365
SURGERY	17	30.83333333	1.81372549	0.030455701

Table 5.3.1: ANOVA single factor, shows F-stat (14.20) is greater than F-critical (2.04) hence the test is significant.

<i>Source of Variation</i>	<i>SS</i>	<i>df</i>	<i>MS</i>	<i>F</i>	<i>P-value</i>	<i>F crit</i>
Between Groups	63.78738532	8	7.973423165	14.2018	3.137E-	2.0418
Within Groups	51.09051591	91	0.561434241			
Total	114.8779012	99				



6. DISCUSSION :

Moderate satisfaction score has been found in this study in all domains of patient satisfaction (general satisfaction, technical quality, interpersonal manner, communication, financial aspects, time spent with the doctor, and accessibility and convenience). Mean satisfaction in the Communication 3.72(\pm 1.38), followed by technical quality 3.53(\pm 1.16) is highest and lowest in Time spent with the provider 3.49(\pm 1.78) and Interpersonal Manner 3.44(\pm 1.28).

The findings of other studies are not directly comparable with this study, since, to the best of my knowledge, this is the first study that assessed the patient satisfaction level among Private Homoeopathic hospitals. There are no reported statistics on the level of patient satisfaction with the quality of medical care services provided in Homoeopathic hospital. Hence, I equate my study findings with previous patient satisfaction studies conducted in AYUSH hospitals.

In the present study, skin ailments (18%) are the commonest reasons for seeking treatment in homoeopathy, which is comparable with study conducted by **Farah Naaz (2019)** recorded the similar findings in which (46.9%) patients choose Homoeopathy for skin disorders. (18)

In this study, no sociodemographic variables like age, gender and marital status are found to be significantly associated with satisfaction score. Which is consistent with others studies conducted by **Sadjadian et al. (2004)** reported that none of the demographic variables had any significant association with patient satisfaction. (19)

Hall and Dornan (1990) found no significant association between race, sex, income, and patient satisfaction. (20) which is consistent with this study.

The insignificant association in the present study may be because almost all the respondents were highly satisfied with the quality of medical services and there was very little variability in the satisfaction scores of different age groups, gender and marital status.

But the present study shows significant association between the residence and satisfaction score, which is consistent with **Ibraheem et al. (2013)** reported in their study that there was a significant association between the overall satisfaction and place of residence were found to be statistically significant. (8)

The present study also shows significant association between the religion and satisfaction score. Also shows significant association between clinical characteristics and satisfaction score.

7. CONCLUSION:

Overall findings showed that patients were moderately satisfied with the quality of medical care services provided at this hospital. The highest satisfaction score was found in the domain of communication and technical quality; and lowest satisfaction score was found in Interpersonal Manner, which indicates that certain aspects need to be addressed to enhance the patient experience. Furthermore, the study showed a significant association between religion and patient satisfaction level. Also shows significant association between clinical characteristics and patient satisfaction level. Most of patients were unsatisfied with Surgery OPD with mean satisfaction score is (1.81 \pm 0.64) which is significantly lower than other OPDs, this indicates certain aspects need to be addressed. Most of patients were satisfied with Neuro OPD with mean satisfaction score is (4.23 \pm 0.5) followed by Respiratory OPD with mean satisfaction score is (4.27 \pm 0.77) followed by skin OPD with mean satisfaction score is (3.69 \pm 1.20)



8. LIMITATIONS:

The study's main limitation is the convenience sampling method, which may restrict the generalizability of the results. Second, the study was confined to a single private Homoeopathic hospital so the findings of the study could not be extrapolated to all Homoeopathic hospitals across Gujarat and across the country. Another limitation is sample size, only 100 samples are used in this study. Hence, further studies on a larger and randomized sample are needed for better assessment of patients' satisfaction level with the quality of medical care provided in Homoeopathic hospitals.

9. RECOMMENDATIONS:

This data of this study can also be used as a secondary data in future studies. The sample size calculated for this study could not be achieved and may affect the power of the study. A larger and representative sample is recommended in future studies to avoid possible selection bias.

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“Role of 50-millesimal Potency in Acute Cases.”

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Abstract: *The present study evaluates the efficacy of 50 Millesimal Potencies in treating acute diseases using homoeopathic principles. Thirty patients were observed over a one-year duration at Ahmadabad Homoeopathic Medical College, with cases drawn from outpatient and inpatient departments. Medicines were selected and administered based on Hahnemann's guidelines. Data were analyzed statistically to determine outcomes, revealing a 60% cure rate, 20% improvement rate, and 20% failure rate. The findings highlight the practicality and effectiveness of the 50 Millesimal scale in acute cases, emphasizing rapid, gentle, and lasting recovery.*

Key Words: *50-Millesimal potency, acute diseases, homoeopathy, Hahnemann, rapid cure, individualized treatment.*

1. INTRODUCTION:

Homoeopathy, developed by Dr. Samuel Hahnemann, is a science based on the principle of "Similia Similibus Curentur" or like cures like. In six editions of the Organon of Medicine, Hahnemann introduced and perfected the 50 Millesimal scales to overcome the difficulties that arose in the treatment of acute and chronic conditions. This scale provides a way of dynamization that results in minimal aggravation and frequent repetition of remedies without side effects.

Acute diseases are characterized by rapid onset and a self-limiting course. Therefore, they require swift and effective treatment. However, the misconceptions regarding the effectiveness of homoeopathy in such cases persist. The present study explores the use of 50 Millesimal potencies in acute illnesses, their scope, and limitations.

2. LITERATURE REVIEW:

Hahnemann's 6th edition of the Organon is a landmark in homoeopathy, which brought to light the concept of 50 Millesimal potencies that can help bridge the gap in the centesimal scales. According to the literature, when given in medicinal solutions, these potencies are gentle yet effective for dynamic derangement of the vital force.

Earlier studies on acute diseases classified them into individual, sporadic, and epidemic types; these studies emphasized individualized treatment based on symptomatology rather than nosological



categories. Research also suggests that a repetition of remedies in the Millesimal scale, with susceptibility and response guiding this, improves outcomes without bringing aggravations.

3. OBJECTIVES / AIMS:

- 1, To assess the role of 50 Millesimal potencies in treating acute diseases.
2. To evaluate the outcomes in terms of cure, improvement, or lack of response.
3. To analyze the frequency and mode of administration of remedies
4. To highlight the advantages and limitations of this meth

4. RESEARCH METHOD:

Study Design: A clinical study involving 30 cases of acute diseases conducted over a year.

Source of Data: Patients were selected from the outpatient (OPD) and inpatient (IPD) departments of Ahmadabad Homoeopathic Medical College, Ahmadabad.

Selection Criteria:

Inclusion: Both genders, all age groups, socio-economic classes, and cases not requiring surgical intervention.

Exclusion: Chronic exacerbations, irreversible pathology, and unconscious patients.

Procedure:

1. Case Selection: Diagnosed and undiagnosed cases were included based on random sampling.
2. Data Collection: Case taking was done per Hahnemann's guidelines (Aphorisms 83-104). Symptoms were recorded, analyzed, and reperetorized using Radar 10.0 software.
3. Prescription and Administration: Medicines were selected based on individualized symptomatology and administered in medicinal solutions through oral or inhalation routes.

Outcome Measures:

Cure: Complete resolution of symptoms.

Improvement: Reduction in symptoms and better general health.

No improvement/Dropout: Persistence or worsening of symptoms or early treatment termination.

Data Analysis:

Statistical tools were employed to evaluate results, including frequency distribution and percentage analysis.



5. RESULT:

Demographic Distribution

1. Age Groups:

Maximum cases were observed in the 21-30 age group (30%), while the least were in the 51-60 age group (3.33%).

2. Gender:

Gender →	Male	Female	Total
Number	19	11	30
percentage	63.33%	36.67%	100%

Outcomes

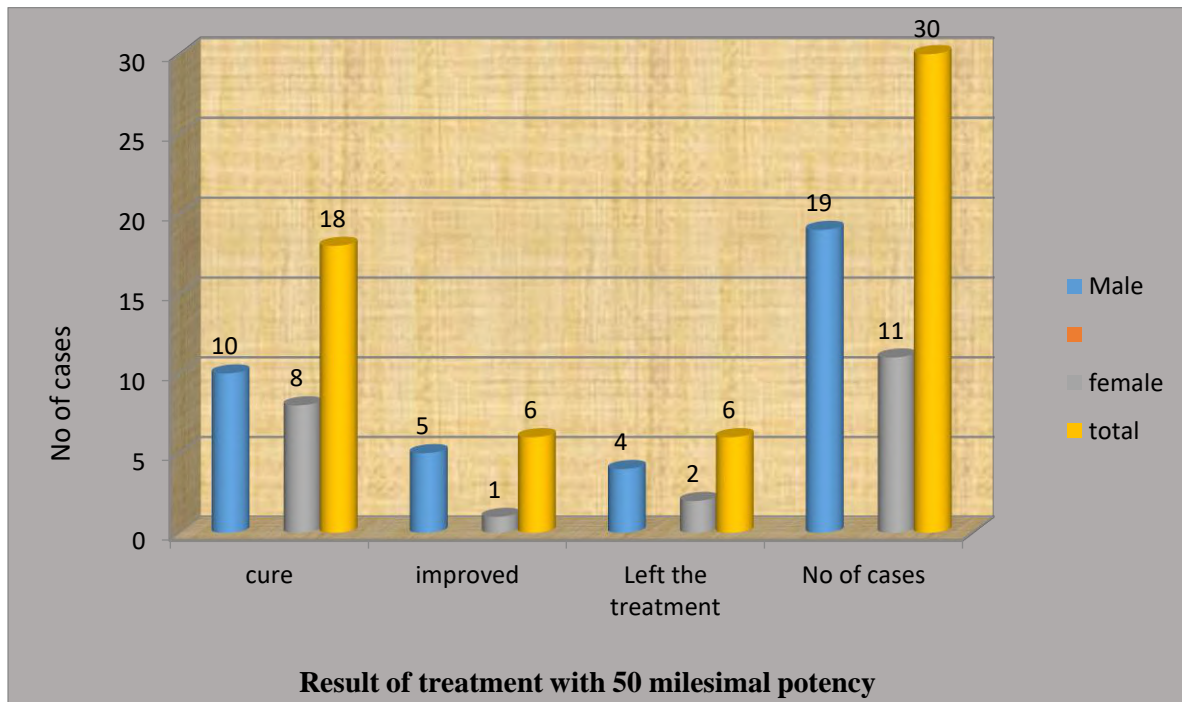
1. Overall Results:

Cure: 60%

Improvement: 20%

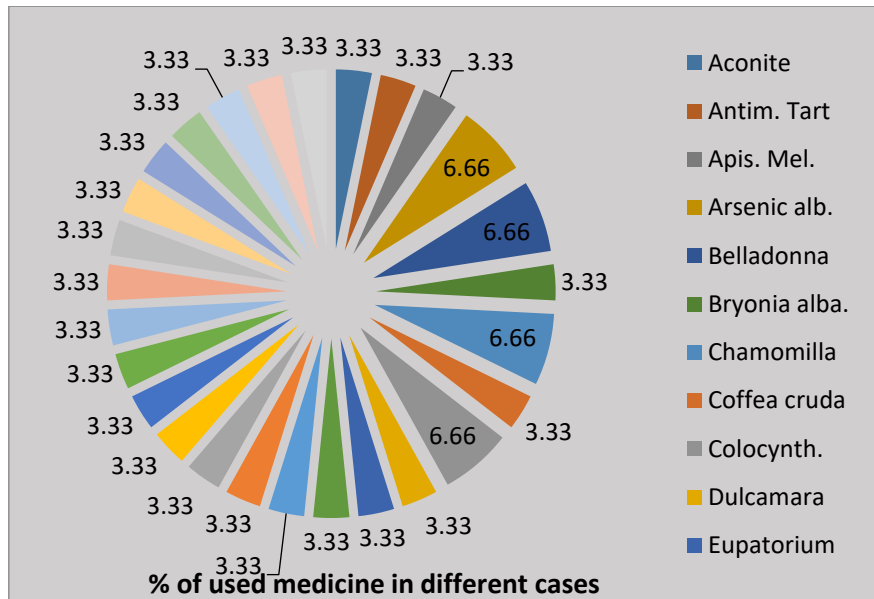
Failure - Dropouts: 20%

2. Gender-Specific Outcomes:





3. Medicines Used:



A total of 27 remedies were employed, with Aconite, Belladonna, and Chamomilla being the most frequent.

4. Potency Distribution:

0/1 potency was used in 63.33% of cases.

0/3 potency in 30% of cases.

5. Repetition and Mode of Administration:

Most cases required three doses per day in diluted medicinal solutions

6. DISCUSSION/ ANALYSIS:

The study justifies the use of 50 Millesimal potencies in acute diseases treatment. The findings are presented as follows:

1. Fast-acting: Medication worked rapidly to deliver comfort without flare-ups.
2. Gentle Approach: Medicinal solutions minimized side effects while maintaining efficacy.
3. Repetition with Flexibility: Frequent dosing as determined for individual cases hastened recovery.

The high cure rate underlines the reliability of this method, though the dropout rate underscores challenges such as patient compliance and access to remedies.

8. CONCLUSION / SUMMARY:

This research verifies the clinical use of 50 Millesimal potencies in acute cases. The method adopted follows Hahnemann's guidelines for quick, gentle, and permanent recovery.



Important Results:

1. Cure achieved in 60% of the cases.
2. Best results were seen with potencies 0/1 and 0/3.
3. Liquid dilution results in better therapeutic responses.

9. LIMITATIONS:

1. Limited sample size cannot be generalized.
2. There is no comparison with centesimal potencies.

Further studies would include larger populations and the comparison with other scales of potency.

10. RECOMMENDATIONS:

Future research should involve larger cohorts and explore comparisons with other potency scales.

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Exploring mental state of calcarea silicata patient through clinical case

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Abstract: *The mental state is crucial in individualization, encompassing emotional and intellectual states, behavior, and bodily expressions. The study explored the mental state of Calcarea Silicata through literature, clinical cases, and a standard checklist derived from reviews and repertories. Using tools like the Life Space Table and Mental State SCR, 30 documented cases were analyzed to compare documented and additional aspects of the mental state at levels of causation, emotion, intellect, behavior, and bodily effects.*

Key Words: *Mental state, Calcarea Silicata, Clinical Cases.*

1. INTRODUCTION:

The Mental State is a combination of different categories of mental symptoms viz. symptoms of the intellect, emotions, and behavior. It is in a flux and changes over a period of time. It is dependent for its particular expression on the environmental circumstances.

If we see the Calcarea group, Calcarea Carb, Calcarea Phos are well proved but Calcarea Silicata, Calcarea ars is not so well explored. Study of the mental state of Calcarea Silicata though available in literature seems scattered and needs deeper study along with its characteristic expression and evolution. Through this study, we have attempted to understand in depth the evolution and expression of the mental state of Calcarea Silicata at the level of causation, emotion, intellect, and behavior along with its effect at the level of the body to evolve the comprehensive mental state of Calcarea Silicata.

2. LITERATURE REVIEW:

MENTAL STATE- The literature of mental state is taken from below author

**SYMPOSIUM VOLUME PART 1 PAPER 1, Principle and practice of homeopathy, Stuart Close-
The genius of homeopathy**

REVIEW OF MATERIA MEDICA- The literature of materia medica is taken from below author

1. Boerhaave. W. Pocket Manual of Homoeopathy
2. Kent J.T Lectures on Homoeopathic MateriaMedica
3. Murphy R Homoeopathic Remedy
4. Vithoulkas.G.MateriaMedica
5. Sankaran-The soul of remedies
6. Scholten.J.Homoeopathy and the Elements-



7. Vermuelen.F-Concordant MateriaMedica
8. Pulford A Homoeopathic MateriaMedica of Graphic Drug and Pictures and Clinical Comments.
9. RajanSankaran the Substance of Homoeopathy
10. RajanSankaran Spirit of Homoeopathy
11. vanwoensel E.- A complied materia medica
12. Dr.S.K.Phansalkar-National journal of homoeopathy- Study of Silicates

3. OBJECTIVES / AIMS :

- To study causative factors responsible for the genesis of the mental state of Calcarea Silicata.
- To study the mental expression of Calcarea Silicata at the emotional level.
- To study the mental expression of Calcarea Silicata at the intellectual level.
- To study the mental expression of Calcarea Silicata at the behavioral level.
- To study the impact of the mental state on the functioning of the individual.
- To study the mental expression of Calcarea Silicata at the reaction level.
- To study the comprehensive mental state of Calcarea Silicata.

4. RESEARCH METHOD / METHODOLOGY :

Study Setting:- Cases from OPD/IPD and attached clinical setup and peripheral OPDS.

Study duration- One and half year. One year for data collection and six months for analysis and dissertation writing.

Selection of Samples:- 30 cases where Calcarea Silicata was prescribed with the undisputed result, as a deep acting constitutional remedy in all age group and both sexes.

Inclusion Criteria:

Cases in which Calcarea Silicata was given as deep acting constitutional remedy with the undisputed result.

Not more than 10 cases of pediatric age group.

Exclusion Criteria: Cases where Calcarea Silicata was prescribed as acute or phase remedy.

Study Design - Case Series Retrospective Study.

Intervention: No any.

Selection of Tools: LST and Mental state SCR.

Statistical Technique: -

Qualitative data. Frequency distribution table.

GRADES

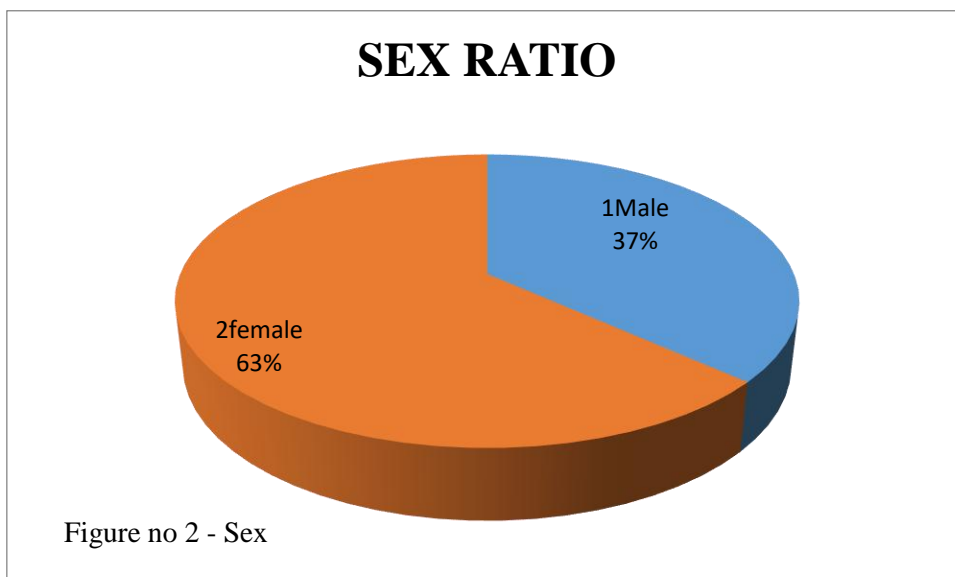
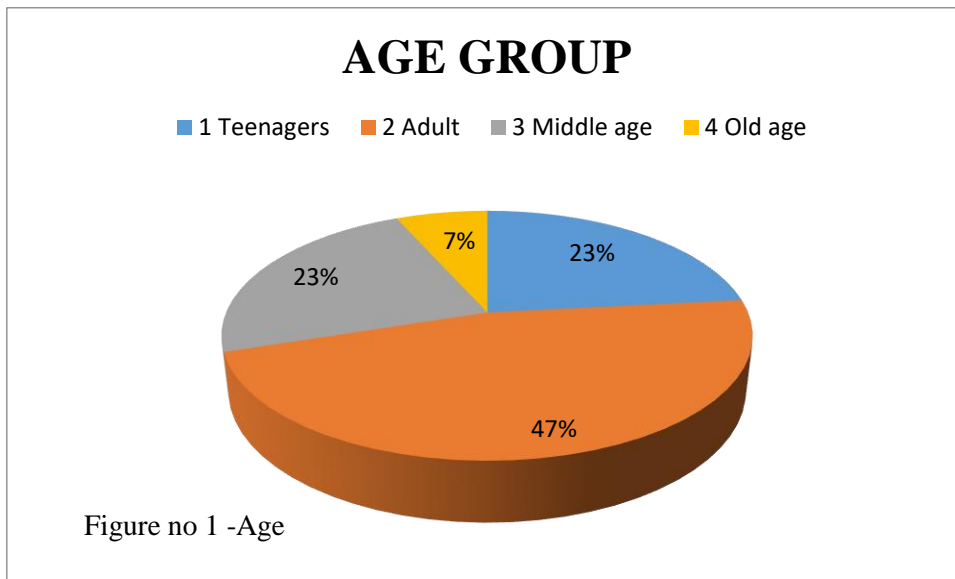
Common/Similar symptoms appearing was given gradation as follows:

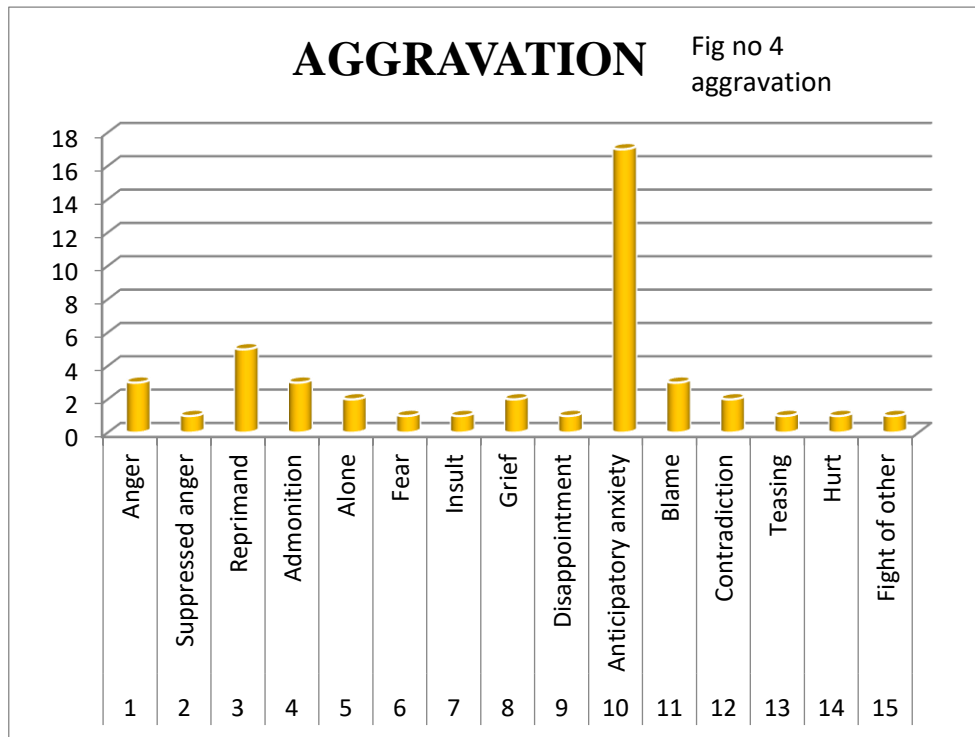
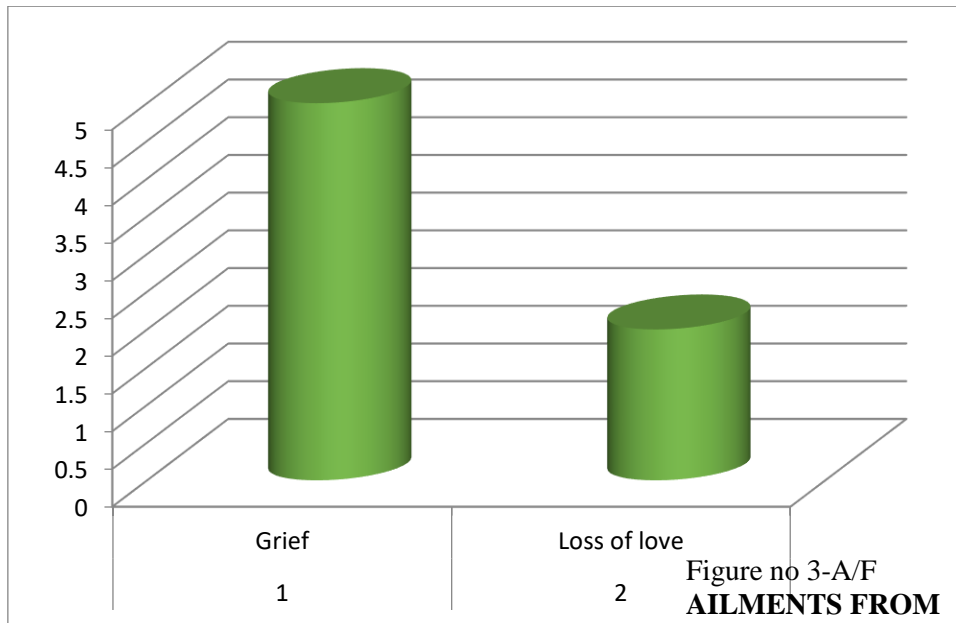


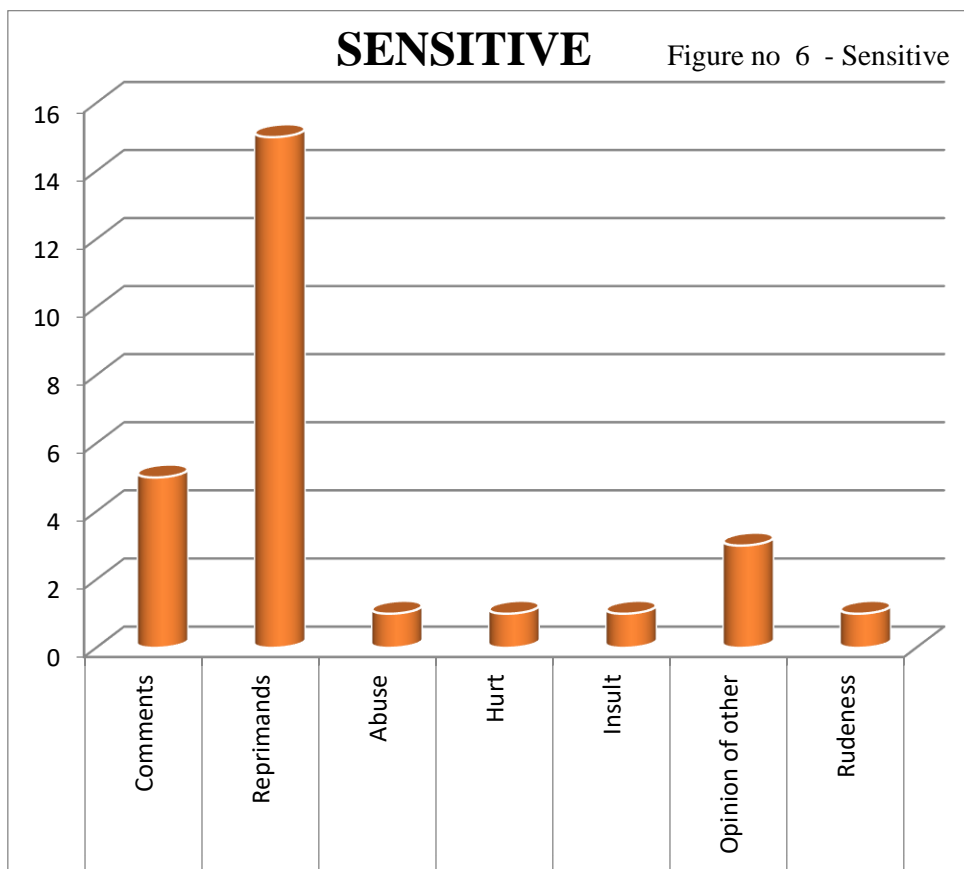
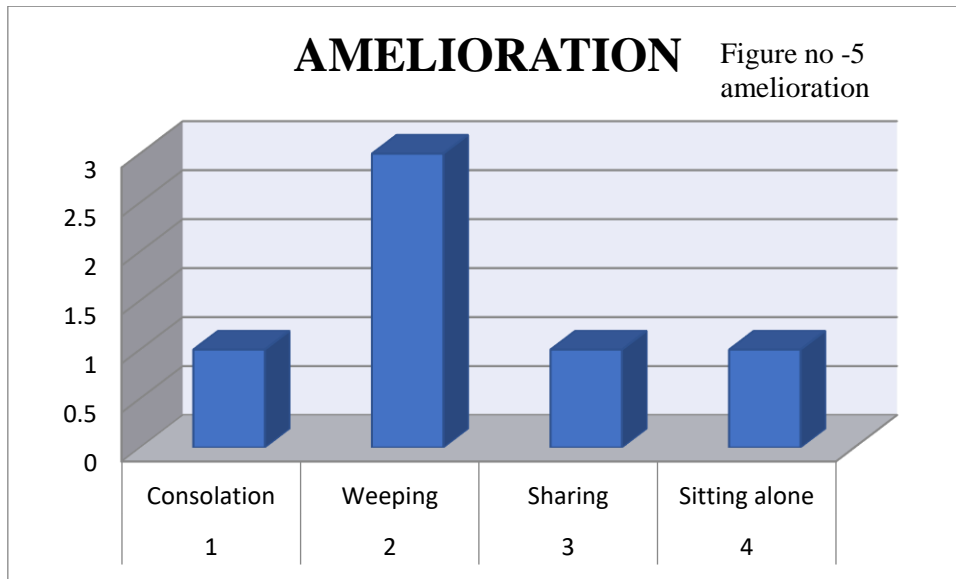
Symptoms appearing in 1-6 cases -1 mark.
 Symptoms appearing in 7-12 cases -2 marks.
 Symptoms appearing in 13-18 cases-3 marks.
 Symptoms appearing in 19-24 cases-4 marks.
 Symptoms appearing in 25-30 cases-5 marks.

Ethical issue, if any: No any ethical issue.

5. RESULT / FINDINGS :

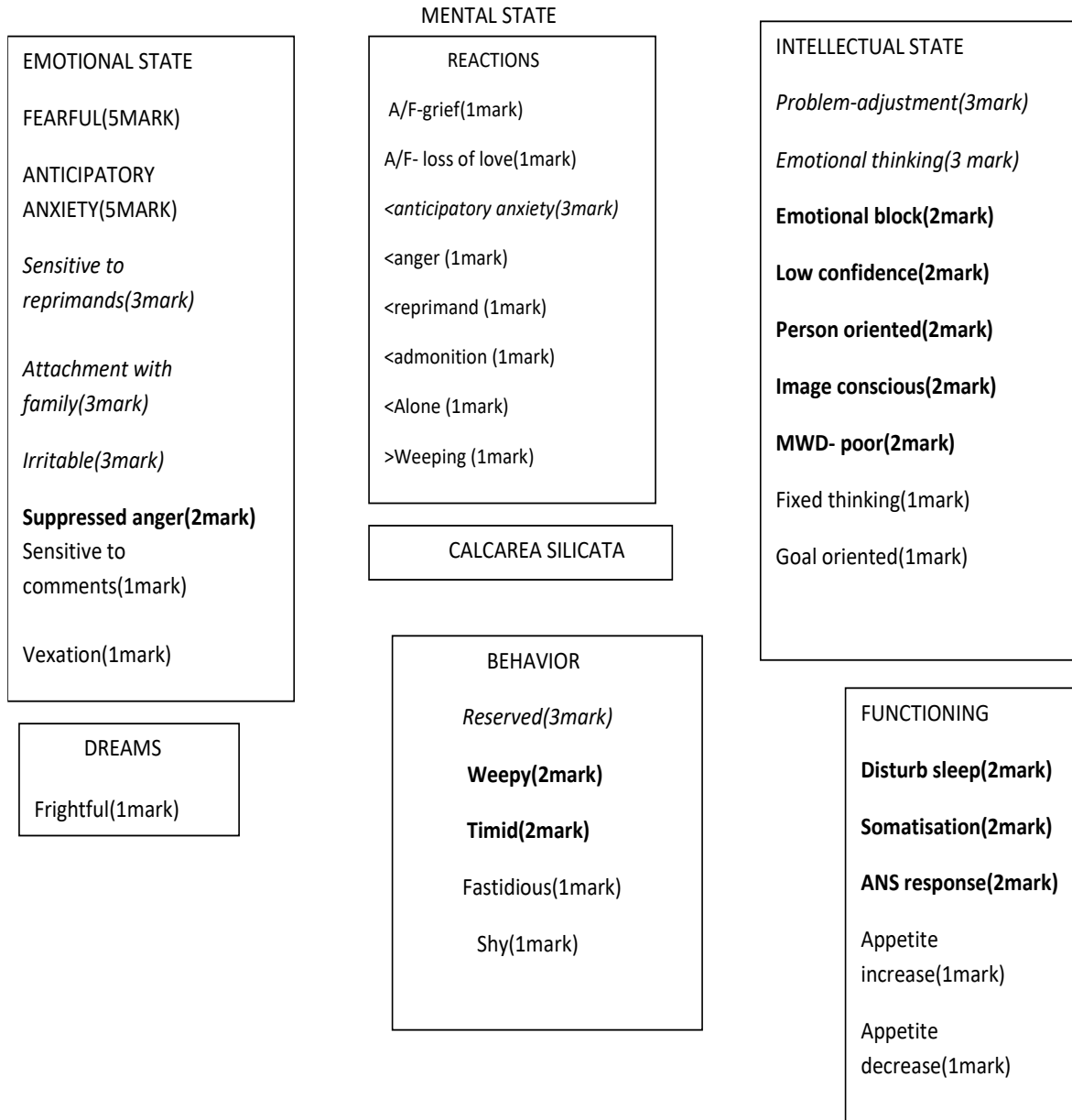








INTEGRATED MENTAL STATE



6. DISCUSSION / ANALYSIS :

The study revealed a predominance of adult female cases (63%). Emotional and behavioral tendencies showed sensitivity to reprimands, anticipatory anxiety, and strong familial attachment. Events such as familial reprimands and grief were significant, highlighting emotional vulnerabilities. Traits such as reservedness, timidity, and sensitivity were common, aligned with emotional attachment and intellectual clarity. Emotional thinking dominated, reflecting Calcarea Silicata's tendency toward person- and family-oriented thought processes. Findings confirmed anticipatory anxiety and familial sensitivity as pivotal traits, though additional causative factors like grief and reprimands emerged from clinical cases, enriching existing materia medica.



7. CONCLUSION / SUMMARY:

From our 30 cases, we can conclude that

1. The common age group is adult age group.
2. The females are more seen as compared to males.
3. The expression of mental state at the level of causation is grief, and loss of loved ones.
4. The prominent aggravating factor of Calcareo Silicatosus is *anticipatory anxiety*, reprimands.
5. The prominent ameliorating factor of Calcareo Silicatosus is weeping.
6. The most prominent *sensitivity is to reprimands* and comments.
7. Adaptation- **Good**
8. The most prominent behavior is *reserved*, **timid**, **weeping**.
9. The most prominent emotional expression of anger is *irritability*, **suppressed anger**, anger with weeping and vexation.
10. The most prominent expression of sadness is **grief** and weeping.
11. The most common expression of love is an *attachment with family*.
12. The emotional expression of fear is **dark**, fight, being alone, **fear with timidity**. And other expressions are quarrel, crowded place, if got beaten, of father and dogs.
13. The type of anxiety most prominently seen is ANTICIPATORY ANXIETY.
14. The common expression anticipatory anxiety is of **stage performance**, financial insecurity.
15. The expression of mental state at the intellectual level are as follows:
 - a. Perception- CLEAR
 - b. Memory –Poor
 - c. Capacity- Most commonly good, and some have poor.
 - d. Performance- *good*.
 - e. Thinking- Most prominently seen is *emotional*, then fixed and logical.
 - f. Decision- mostly indecisive and occasionally obstinate and impulsive.
 - g. Confidence- Mostly **poor** confidence is seen. And then shaky and adequate confidence is seen in equal number.
 - h. Work- Mainly **person oriented**. And others are goal oriented and a perfectionist.
 - i. Person- Prominently **weak person and image conscious** is seen.
 - j. MWD- Mostly **poor** and **good** both are more or less seen equally.
 - k. Performance block- Most common is **emotional**, interpersonal. And then intellectual and opportunity respectively.
 - l. Work efficiency- *Good*
 - m. Problems- mainly *adjustment*. And then conscience and position respectively.
16. Functioning- most prominent functioning disturbed is **sleep**.
17. Dream- the Most common dream is frightful.
18. Intellectual dispositions- *Emotional thinking*, **Conscientious**, **image conscious**, **person oriented** and responsible
19. Emotional dispositions- ANTICIPATORY ANXIETY, *Irritability*, *Sensitive to reprimands*, *attachment with family* and *fearful*.
20. Behavioral dispositions- *Reserved*, **Weepy**, **Timid**



8. LIMITATIONS:

Data deficiency was a faced in many cases. Intellectual-level data was limited due to patients' lack of awareness, low education, and middle-aged demographics. The small sample size was inadequate; a larger sample is essential for accurate conclusions on Calcearea Silicata's mental state. Including urban samples could provide more refined and qualified mental symptoms. The study focused on adults (21–40 years); data from other age groups would enhance the findings.

9. RECOMMENDATIONS:

Sample size can be increased for unbiased and detailed mental state expressions. Cases with well-explored life spaces for deeper mental state analysis can be taken. Can include urban cases for more refined mental symptom assessment. A further study can be carried out to assess the quality of mental state in other remedies. We should take cases from all age group so that mental state could be explored well.

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Research Paper / Article / Review

“To Study the Cases of Warts Clinically and To Find Out the Efficacy of Homeopathic Medicine in Treating Various Types of Warts with Gentle and Harmless Way by Dynamic Science.”

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ABSTRACT:

CONTEXT

Verruca vulgaris is the commonest skin disease in daily routine practice now a days. The clinical management of wart is often challenging. Different modalities of treatment currently exist, but none of them is more effective.

AIM

To study the case of warts clinically and to find out the efficacy of Homeopathic medicine in treating various types of warts with gentle and harmless way.

MATERIALS AND METHODS

The study was carried out for 3 years and it includes 100 patients. Patients with genital warts, Pregnant females and Immunocompromised Patients were excluded from the study.

STATISTICAL ANALYSIS

Statistical analysis of the descriptive data was done by numbers and percentages according to different categories.

RESULT

There were 100 cases of warts and a majority of the patients (60) were belonging to the age group between 20-40 years. 65 patients were males and 35 patients were females. The most commonly involved site was Face. The most common types of warts were the common wart.

CONCLUSION

Viral warts were most common in the younger age groups. Males outnumbered the females. The face was the commonest site which was involved. Common warts were the commonest type of warts.

KEY WORDS: Homeopathy, Warts, Individualization.

1. INTRODUCTION:

Verruca Vulgaris or Common viral warts are benign skin protuberances which are caused by HPV- Human Papilloma Virus.

MAJOR CAUSES OF SKIN WARTS

- HPV viral Infection
- Chronic Inflammation
- Compromised Immunity
- High toxic load
- Other skin problems



TYPES OF WARTS

There are five major types of Warts. Each type appears on a different part of the body and has a distinct appearance.

- 1) **Common warts:** Common warts usually grow on your fingers and toes, but can appear elsewhere. They have a rough, grainy appearance and a rounded top. Common warts are greyer than the surrounding skin.
- 2) **Plantar warts:** Plantar warts grow on the soles of the feet. Unlike other warts, plantar warts grow into skin, not out of it. If one notices what appears to be a small hole in the bottom of your foot that is surrounded by hardened skin. Plantar warts can make walking uncomfortable.
- 3) **Flat warts:** Flat warts usually grow on the face, thighs, or arms. They are small and not immediately noticeable. Flat warts have a flat top, as if they've been scraped. They can be pink, brownish, or slightly yellow.
- 4) **Filiform warts:** Filiform warts grow around your mouth or nose and sometimes on your neck or under your chin. They are small and shaped like a tiny flap or tag of skin. Filiform warts are the same color as your skin.
- 5) **Periungual warts:** Periungual warts grow under and around the toenails and fingernails. They can be painful and affect nail growth.

SIGN AND SYMPTOMS

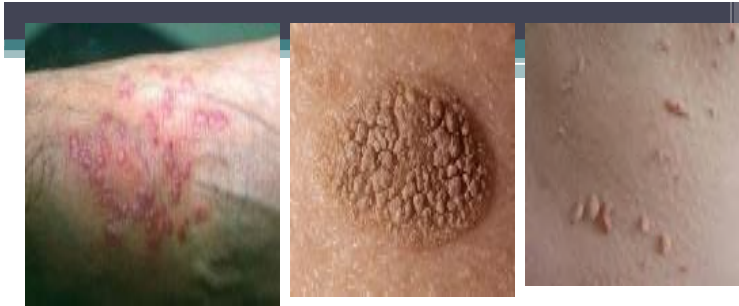
Warts vary in appearance. They may look: Dome-shaped, Flat, Rough, Skin-colored, brown, grey or black. Most warts go away without any significant problems. Sometimes warts cause issues, such as Infection, Pain, Disfigurement, Cancer.

DIAGNOSIS

Diagnosis of warts is based on clinical appearance; biopsy is rarely needed.

A cardinal sign of warts is the absence of skin lines crossing their surface and the presence of pinpoint black dots (thrombosed capillaries) or bleeding when warts are shaved.

DIFFERENTIAL DIAGNOSIS



**Lichen Planus
Keratosis**

Seborrheic

Skin tags



Squamous Cell Carcinoma



Mole



Plantar Wart

Plantar Callus

Plantar Corns

ALLOPATHIC APPROACH

- **Topical medicine:** Chemical like Salicylic acid which dissolves layer of Warts.
- Application of **Cantharidin** is used to cut off blood supply of Warts.
- **Cryotherapy:** Application of liquid nitrogen is done to freeze the Wart.
- **Immunotherapy:** Specially used for Stubborn Warts.
- **Laser Treatment**
- **Electrosurgery and Curettage:** Commonly used for Foot Warts, Filiform Warts and Common Warts.

HOMEOPATHIC APPROACH

According to Homeopathic principle we treat patient as a whole i.e., mental as well as physical generals are taken and symptoms are evaluated according to the severity. The evaluated symptoms are conjoint together in one as totality of symptoms. After the totality, a similia similibus remedy i.e., the selected medicine corresponds to the peculiar, uncommon, singular and distinguishing (characteristic) symptoms of the disease is selected. In this way Homeopathic prescription based on individualization of the person as well as medicine.

Warts are classified under one-sided disease, i.e., diseases which have very few symptoms. They are further categorized as external-local maladies, i.e., changes and ailments that appear on the



external parts of the body.

This is further related by immunological basis in cases of warts. We commonly witness families having propensity for growths, warts, etc., These tendencies are termed miasms, in this case sycotic. Commonly Warts are included under miasm sycosis.

Although warts are local diseases, they are treated with internal remedy which is based on comprehensive understanding of the patient. This includes local symptoms, i.e., morphology and location of lesion, mental makeup of the person, and physical characteristics (Totality of symptoms). A constitutional remedy thus selected eradicates the complaint locally as well as internally, thereby providing long lasting relief from complaints.

Intercurrent Remedy

Intercurrent remedy that remedy which is given in the course of treatment of the patient. Given for some chronic diseases for the purpose of..

- Removing any acute diseases OR accelerating the mode of cure OR removing any hindrances called Miasmatic Blocks.
- During treatment, in some chronic cases despite of a well selected remedy improvement ceases after a time because of deficient reaction OR diminished susceptibility.
- Sometimes well selected medicine doesn't act, indicates. -Intercurrent Remedy,
- It is given in Higher potency like 200, IM, 10M
- We can use NOSODES & SARCODES as an Intercurrent Remedy.

2. LITERATURE REVIEW:

“Md. Ismail Shaikh- Case studies for treatment of warts with Homoeopathy”

In this case series, 5 case studies are presented. In each of these cases Homoeopathic medicines were selected on the basis of individualization and these medicines were successful in the treatment of warts causing removal /dissolution of the warts and relief of associated symptoms of the patients.

Both thuja and causticum have been reported in literature as useful medicines for treatments of warts. In most of the cases 50 millesimal potency were used. It has been observed that in cases treated with fifty millesimal potencies, the response to treatment was faster.

“Dr. Mousumi Das & Dr. Ananya Paramanya- Case Series of Warts and Its Individualized Homoeopathic Treatment”

These case series suggest usefulness of Homeopathic treatment as a complementary and alternative therapy. These case series show a positive result in Homoeopathy where in conventional methods it needs to apply various external ointment and many other things.

3. OBJECTIVES:

- 1) To study the cases of warts clinically.
- 2) To find out the efficacy of Homeopathic Medicine in treating the cases of Warts.

4. RESEARCH METHOD:

This Observational Retrospective study was carried out at Om Homeopathic Clinic, Surat, Gujarat, India for 3 Years. This study conducted by taking 100 cases. Patient with Genital warts, Pregnant women and Immunocompromised patients were excluded from the study. The treatment used in Chronic cases was Constitutional medicine with Intercurrent Remedy in some cases where it required.



Response analyzed as per following criteria-

- (a) Significant Improvement: Feeling of mental and physical well-being with disappearance of all the Signs & Symptoms.
- (b) Moderate Improvement: Feeling of mental and physical well-being with relief in his Suffering.
- (c) Status quo: There is no change in the patient's any complaints.

Patient's condition remains as it is even after administration of Homeopathic medicine.

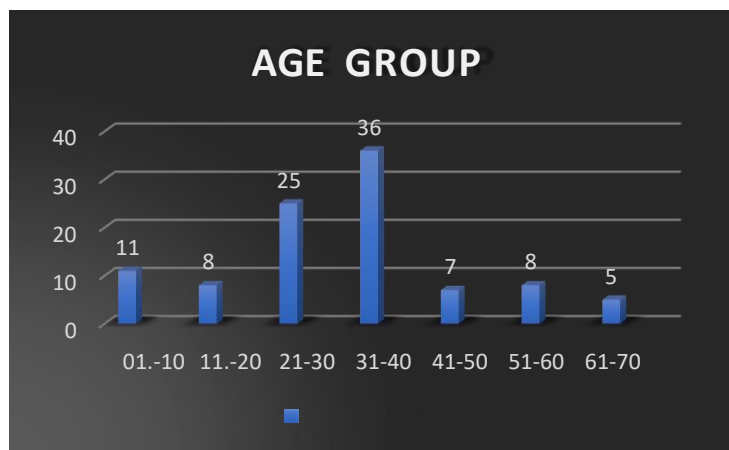
- (d) Left the treatment: Patient did not return for the further treatment.

5. RESULT ANALYSIS:

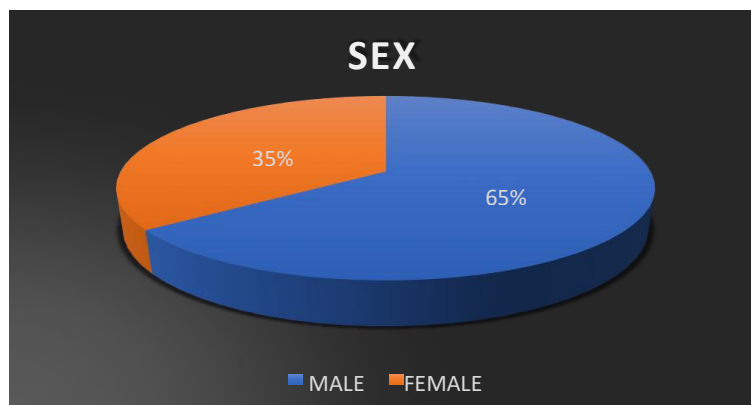
An observational retrospective study was undertaken to study the efficacy of Homeopathy in treating the cases of Warts. I have taken 100 cases for study and evaluated after analyze each case in detail.

Statistical analysis of the descriptive data was done by numbers and percentages according to the different categories.

GRAPH 1.1 AGE GROUP



GRAPH 1.2 SEX GROUP



GRAPH 1.3 TYPES OF WARTS

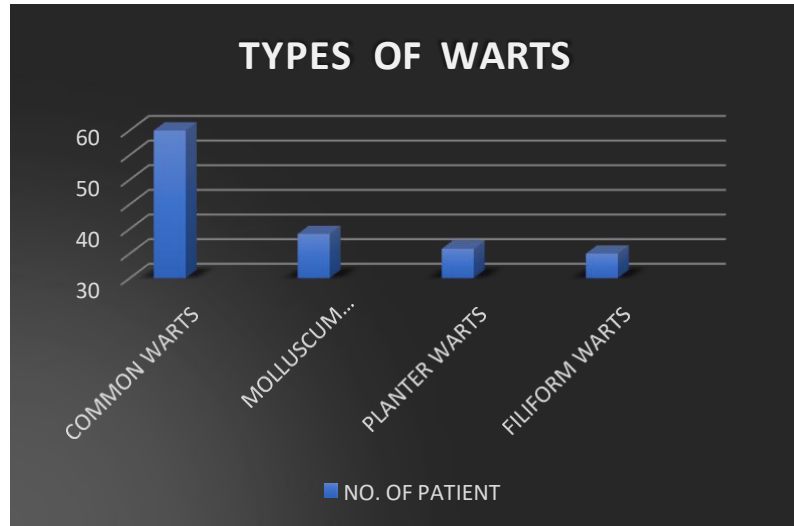


TABLE 1.1 LIST OF INTERCURRENT REMEDY

NAME OF INTERCURRENT REMEDY	NO. OF PATIENT
THUJA	62
TUBERCULINUM	08
MEDORRHINUM	04
SULPHUR	02
NO INTERCURRENT	24

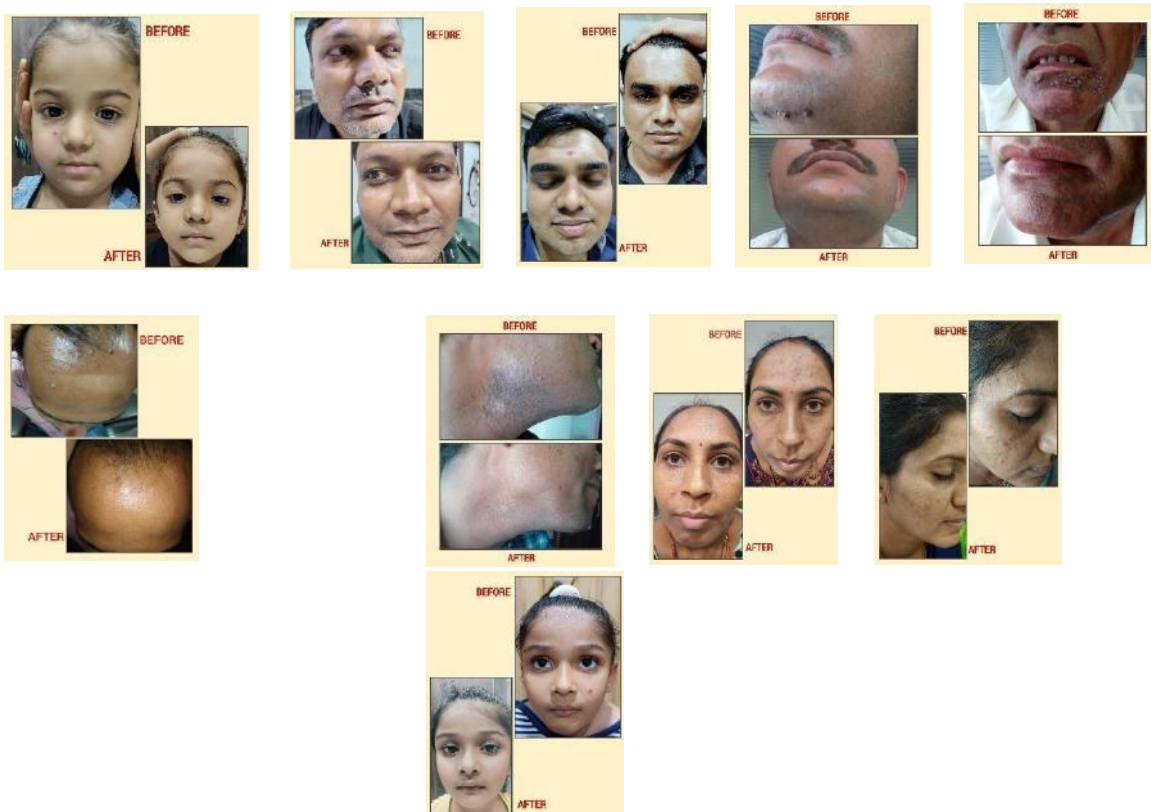
TABLE 1.2 LIST OF CONSTITUTIONAL REMEDY

NAME OF REMEDY	NO. OF PATIENT
CAUSTICUM	21
NAT.SULPH	09
NT.ACID	09
LYCOPodium	08
ANT.CRUD	07
STAPHYSAGRIA	07
DULCAMARA	06
NAT.MUR	06
BARYTA CARB	05
GRAPHITES	05
CALC.CARB	04
CALC.PHOS	03
CALC.SULPH	03
PHOSPHORUS	03
PULSATILLA	02
SEPIA	02

TABLE 1.3 RESULT ANALYSIS

RESULT	NO. OF CASES
SIGNIFICANT IMPROVEMENT	56
MODERATE IMPROVEMENT	14
LEFT THE TREATMENT	18
STATUS QUE	12

FEW GLIMPSES



6. DISCUSSION:

During entire study 100 cases were taken to understand the efficacy of Homeopathic Remedies in cases of Warts. In 100 cases, 65 patients were Male and 35 were Females. On the basis of nature of disease, all cases were chronic in nature.

As per Age incidence, 11 cases from 1 to 10 years of age, 08 cases from 11 to 20 years of age, 25 cases from 21 to 30 years of age, 36 cases from 31 to 40 years of age, 07 cases from 41 to 50 years of age, 08 cases from 51 to 60 years of age, 05 cases from 61 to 70 years of age.

In all chronic cases, I have used Constitutional medicine and Intercurrent Remedy in those cases where it required.

The result of treatment of 100 cases; in 56 cases, Significant improvement; in 14 cases, Moderate improvement; in 18 cases patient left the treatment and in 12 cases Status quo.



7. CONCLUSION:

During the entire study, 100 cases were taken to understand the efficacy of Homeopathic remedy incases of Warts to draw conclusion. All cases were studied in detail.

- Cauterization is one of the ways to remove the warts which maximum number of people used as a treatment for the fast result, but even after cauterization warts do reappear in exaggerated form. Because warts are only external manifestation of internally disturbed vital force.
- Therefore, even after its removal, vital force expressed its derangement in more exaggerated form.
- In the cases of warts with Homeopathic management the cause is treated by Constitutional remedy and use of the intercurrent remedy where it required, in this way, cause is treated with the Simillimum without any suppression in more gentle and harmless way.
- Viral warts were most common in the young age group between 21 to 40 years of age.
- Males outnumbered than Females.
- The face was commonest site which was involved.
- Common warts were the commonest type of warts.
- Best result is produced by use of the constitutional medicine along with intercurrent medicine.

8. LIMITATIONS:

This study conducted by taking 100 cases. Patient with Genital warts, Pregnant women and Immunocompromised patients were excluded from the study.

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- <https://www.ijrh.org>
- <http://homeopathy.delhi.gov.in>



An Introductory Study on the Success of a Homeopathic Medicine "Acidum Nitricum" in the Management of Haemorrhoids

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Abstract:

Background and Objectives:

The homeopathic remedy "Acidum nitricum" has a significant effect on hemorrhoids, according to anecdotal evidence for its effectiveness. The effectiveness of the customized homeopathic remedy "Acidum nitricum" in treating hemorrhoids was thus examined in this study.

Material and Methods:

In this preliminary study, patients who presented with any symptom—such as bleeding, pain, discharge, heaviness, or itching—were treated at a private homeopathic clinic. Following case taking and processing, the patients were administered the homeopathic remedy "Acidum nitricum." The research was carried out for 30 days. The primary outcome measure was the change in hemorrhoidal symptoms.

Results:

Thirty patients were analyzed. After 30 days of treatment, a significant difference was found in bleeding, pain, heaviness, and itching in the patients receiving homeopathic treatment.

Conclusion:

In this study, homeopathic intervention relieved the complaints of hemorrhoidal symptoms. Randomized controlled trials with double blinding are further suggested.

Key Words: Haemorrhoids, Homoeopathy, Acidum nitricum, Randomized controlled trial.

1. INTRODUCTION:

Haemorrhoids have been referred to in the literature dating back to the pre-Christian era and are a common condition. Controversies and lack of agreement exist on treatment strategies. On the one hand, nonsurgical treatment modalities such as rubber band ligation, injection sclerotherapy, photocoagulation, and cryotherapy are well established and acceptable to patients. Homoeopathic literature shows anecdotal data on the efficacy of homeopathic medicines in haemorrhoids. Although various practitioners and clinicians quote brilliant cure of haemorrhoids with homeopathic medicines, there is low evidence and lacks controlled studies. Homoeopathic dynamized medicines are given in 'uncommonly small doses'. Hahnemann, the father of Homoeopathy aimed at achieving 'a rapid, gentle and permanent restoration of the health', which seemed to him easier to achieve with his last dynamization method, known as 50 millesimal, Quinquagintamillesimal (Q-potencies), or LM potencies, in which the medicine is diluted $\approx 50,000$ times at each step (potency) of the dynamizing process.

(P Chakraborty, 2013)



2. LITERATURE REVIEW:

Haemorrhoids are conditions of dilated veins occurring in relation to the internal venous plexuses of anal canal with an enlarged and displaced anal cushion. Haemorrhoid (Greek: haima=blood, rhoos = flowing; synonym: piles, Latin: pila = a ball) (Saha, 2013)

Different types of piles

Depending on the location, the piles may

Internal piles: When the pile mass is lined by the anal mucus membrane and lies internal to the anal orifice.

External piles: When the pile mass is lined by the skin of the anal canal and lies external to the anal orifice.

Interno-external piles: Combination of internal and external piles.

Depending on the aetiology, the piles may be:

Primary piles: When no obvious cause could be found for development of piles.

Secondary or symptomatic piles: When piles develop secondary to some other causes.

Haemorrhoids: clinical features

Haemorrhoids or piles are symptomatic anal cushions

They are more common when intra-abdominal pressure is raised, e.g. in obesity, constipation and pregnancy.

Classically, they occur in the 3, 7 and 11 o'clock positions, with the patient in the lithotomy position.

Symptoms of haemorrhoids:

- bright red, painless bleeding
- mucus discharge
- prolapse
- pain only on prolapse

Four degrees of haemorrhoids

- **First degree:** bleed only, no prolapse
- **Second degree:** prolapse but reduce spontaneously
- **Third degree:** prolapse, which has to be manually reduced
- **Fourth degree:** permanently prolapsed

Complications of haemorrhoids

- Strangulation and thrombosis
- Ulceration
- Gangrene
- Portal pyaemia
- Fibrosis

Treatment of haemorrhoids

- Symptomatic - advice about defecatory habits, stool softeners and bulking agents
- Injection of sclerosant
- Bending
- Haemorrhoidectomy



Complications of haemorrhoidectomy

Early

- Pain
- Acute retention of urine
- Reactionary haemorrhage

Late

- Secondary haemorrhage
- Anal stricture
- Anal fissure
- incontinence

(R.C.G. Russel, 2004)

NITRICUM ACIDUM from HOMŒOPATHIC MATERIA MEDICA by William BOERICKE, M.D.

Selects for its special seat of action the outlets of the body where the mucous membrane and skin meet; these pain *as from splinters. Sticking pains*. Marked improvement of all symptoms while riding in a carriage. Acts best on the dark complexioned and past middle life. Syphilis, after abuse of Mercury. Pains appear and disappear quickly (*Bell*). Hydrogenoid constitution. Sycotic remedy.

Blisters and ulcers in mouth, tongue, genitals; bleed easily. Fissures, with pain during stool, as if rectum were torn. All discharges very offensive, especially urine, faeces, and perspiration. Persons who have chronic diseases, and take cold easily and disposed to diarrhoea. Excessive physical irritability. Cachexia, due to syphilis, scrofula, intermittent fever with liver involvement and anaemia, etc. Gravel; arthritis. Capillary bleeding after curettage.

Abdomen.--Great straining, but little passes, Rectum feels torn. Bowels constipated, with fissures in rectum. Tearing pains during stools. Violent cutting pains *after stools, lasting for hours (Ratanh)*. Haemorrhages from bowels, profuse, bright. Prolapsus ani. Haemorrhoids bleed easily. Diarrhoea, slimy and offensive. After stools, irritable and exhausted. Colic relieved from tightening clothes. Jaundice, aching in liver.

(Boericke, 2022)

3. OBJECTIVES / AIMS:

To study effectiveness of the homeopathic medicine “Acidum Nitricum” in management of haemorrhoids

4. RESEARCH METHOD / METHODOLOGY:

SOURCES OF DATA/PROJECT SITE: The study was carried out at a private homeopathic clinic at Heli Homeopathic Clinic, Kadodara, Surat.

THE MATERIAL UTILIZED FOR THE STUDY:

- The material that will be utilized for the study is a specially designed case format for the study.
- Manual Mercury Sphygmomanometer.
- Stethoscope
- Proctoscope
- Torch



METHOD OF DATA COLLECTION:

The study will be performed in the following ways:

Type of study: Experimental Study

Method of samples: Non-random Sampling

Size of Sample: 30 cases

Duration of treatment: 30 days

INCLUSION CRITERIA

1. All the patients fulfill the case definition
2. Patients who are willing to join the research and cooperate with regular follow-ups.
3. Patients of all age groups and both sexes will be studied.
4. Pre-diagnosed patients with following symptoms given in diagnostic criteria.
5. Patients with acute complaints or acute exacerbations of chronic haemorrhoids.
6. Patients with symptoms similar to Homoeopathic medicine Acidum nitricum.

EXCLUSION CRITERIA

1. Patience with severe complications like heavy bleeding, infections, faecal incontinence, etc.
2. Cases not fulfilling the case definition
3. Asymptomatic patients with chronic haemorrhoids.
4. Female patients with pregnancy and lactation
5. Cases with irregular follow-ups

DIAGNOSTIC CRITERIA:

1. Cases of haemorrhoids are clinically diagnosed
2. Bleeding, pain, discharge, heaviness, or itching at rectum

IMPROVEMENT CRITERIA:

Score used: MONARCH (MODified NARAnjo Criteria for Assessment in Homeopathy)

Due to the lack of a global score for assessing improvement in haemorrhoids after treatment, the 'MONARC - MODified NARAnjo Criteria for Assessment in Homeopathy' is used.

The following parameters were fixed according to the type of response obtained after the treatment.

Selection of remedy: Following a thorough homeopathic case taking and physical examination, an individualizing totality was formed, and the remedy was chosen using homeopathic principles based on symptom similarity. A homoeopathic medicine, "Acidum nitricum," was selected on the basis of a non-repertorial approach. These medicines were prescribed on the basis of symptom similarity, according to homoeopathic materia medica.

Drug potency: 200th potency, single dose.

Drug administration: This was done through an oral route, single dose, 4 globules, 40 number size.

Criteria for follow-up: All patients were duly followed up after 7 days of treatment, and symptomatic and clinical changes were recorded.

CRITERIA FOR ASSESSMENT:

Improved:

Sensation of well-being physically and mentally with disappearance of all the symptoms for which patient approached, without recurrence within period of study and Modified Monarch-9 score of above or at '8 Marks'



Not Improved:

No relief of complaints even after sufficient period of treatment and Modified Monarch-9 score below ‘8 Marks’

5. RESULT / FINDINGS:

The study was conducted on 30 patients of all ages and both sexes. In this study, all 30 patients were prescribed Nitricum acidum.

TABLE: 01 DISTRIBUTION OF CASES ACCORDING TO GENDER

	CASES	PERCENTAGE
Female	10	33.33
Male	20	66.66
Total	30	100

This study of 30 patients was conducted on 20 males and 10 females.

TABLE: 02 DISTRIBUTIONS OF CASES ACCORDING TO AGE GROUP

AGE GROUP (YEARS)	CASES	PERCENTAGE
18 - 30	4	13.33
31-40	8	26.66
41 - 60	18	60.00

TABLE: 03 DISTRIBUTIONS OF CASES ACCORDING TO AGE AND GENDER

AGE GROUP (YEARS)	MALE		FEMALE		CASES	PERCENTAGE
	CASES	PERCENTAGE	CASES	PERCENTAGE		
18 - 30	2	6.66	2	6.66	4	13.33
31 - 40	5	16.66	3	10	8	26.66
41 - 60	13	43.33	5	16.66	18	60

TABLE: 04 DISTRIBUTIONS OF CASES ACCORDING TO RESULT OBTAINED

RESULT	CASES	PERCENTAGE
Improved	20	66.66
Not improved	10	33.33
Total	30	100

6. DISCUSSION / ANALYSIS:

Individualization is the basis for our treatment in homoeopathy. According to homoeopathic vital principles, hemorrhoids are brought on by an internal disruption in vital force. Considering it a local disease is not appropriate. Therefore, when a patient has haemorrhoids, internal medicine helps them feel completely better. The choice of constitutional medicine is made following appropriate case taking, symptom analysis, and evaluation. Acidum nitricum was chosen as a constitutional remedy following the referral of homoeopathic materia medica and repertory. Patients have reported a notable decrease



in both mental and physical symptoms following the prescription of this medication. The above case's change in casual attribution was assessed using the MODified NARanjo Criteria for Homoeopathy. An introductory study on the success of the homeopathic medicine "Acidum nitricum" in the management of haemorrhoids" was concluded after observing & treating 30 patients. Objectives are to study the clinical presentation of haemorrhoids. The effectiveness of "Acidum Nitricum," a homeopathic remedy, in treating hemorrhoids is investigated. The selection of cases was based on inclusion and exclusion criteria. Out of 30 patients, the majority are males, which are more affected as compared to females, i.e., 20 cases of males versus 10 cases of females. The majority of cases are in the age group of 41 to 60 years, contributing 60% of total cases. Constipation and being overweight were found to increase the odds of having haemorrhoids. Out of 30 cases, 20 were improved, i.e., 66.66%, while 10 were not improved, i.e., 33.33%.

7. CONCLUSION / SUMMARY:

The study's findings demonstrate the effectiveness of homeopathy in treating hemorrhoids using the constitutional remedy Acidum nitricum. It lessens the frequency, severity, and intensity of the illness. Both mental and physical symptoms were alleviated for the patients, and their quality of life also improved. Patients no longer needed surgery or allopathic medicine. This study shows that homoeopathic Acidum nitricum is effective in treating hemorrhoids.

8. LIMITATIONS:

Globally, there was no specific scale found for the assessment of the treatment outcome in the case of haemorrhoids. So, the results of this study cannot be generalized to any population. Randomized controlled trials with double-blind design are suggested further.

9. RECOMMENDATIONS:

The role of homeopathy in hemorrhoids could not be concentrated in such a short period of time. A longer study period may eventually lead to a better understanding of these aspects. Future research could compare the effects of a particular class of hemorrhoid medications or customized medications to determine whether treatment outcomes differ. Comparative and randomized controlled studies on personalized homoeopathic medicine are desirable.

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“Establishing a close association between the action of chemical constituents(Alkaloids) of Opium and its relation with symptoms in Homoeopathic Materia Medica”

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Abstract: Homeopathic remedies have been in use for the treatment of disease with short duration and long duration that affect different regions of the body. A single medicine is used to treat a variety of illnesses since we know the medicinal characteristics of drug substances through a unique drug proving technique (by the effects it causes on healthy individuals). As time passes we have been able to witness exponential growth in our understanding of the chemical components of these substances which can be connected to the symptoms mentioned in *Materia Medica*, a book that details a drug's disease producing powers also known as pathogenetic powers. Among the many medications used in homeopathic medicine, Opium is a highly addictive narcotic drug in its crude form but since it is used in homeopathic practice in dilutions it has the ability to treat a wide range of illnesses. This study shows the work that has been done on the chemical components of Opium and how they relate to its usage in homeopathic practice.

Key words: Homeopathic Medicines, drug substances, *Materia Medica*, Opium, curative effects, chemical constituents.

1. About the original biological source of Opium:

• The unripe seed pods of the opium poppy (*Papaver somniferous*), a plant of the *Papaveraceae* family, are the primary source of opium, a narcotic. Once the poppy's flower petals have fallen, the seed capsules can be partially cut to extract opium. When exposed to air, the milky latex released by the slit seed pods coagulates and changes color, becoming a brown substance that resembles gum. This unprocessed opium can be sold as lumps, cakes, or bricks, pulverized into a powder, or undergo additional processing to yield derivatives like heroin, morphine, and codeine. Opium and its derivatives are referred to as opiates.

2. Chemical constituents of Opium

Opium is a complicated mixture chemically; notably, it contains between 10 and 20 percent alkaloids, of which over 40 have been identified. The meconate salts of these weakly basic chemicals are typically found in the plant.

The morphinans morphine (8–17 percent), codeine (0.7–5 percent), and thebaine (0.1–2.5 percent) comprise only five of these alkaloids, which also include the benzyloisoquinoline papaverine (0.5–1.5 percent) and the phthalideisoquinoline noscapine (narcotine) (1–10 percent) (3,8,10,14) (Figure 1). The given below alkaloid classes—protoberberines, aporphines, rhoeadines, tetrahydroprotoberberines, tetrahydroisoquinolines & benzophenanthridines, represent traces of further minor alkaloids (14).

3. Materials and Methods:

A comprehensive investigation was conducted utilizing a range of data sources, including scholarly articles, books on Materia Medica, and online resources such as the Yahoo search engine, Pubmed, Delnet, Science Direct, Knimbus, and NDL.

The following criteria were established for inclusion:

- 1) Research papers and articles discussing the chemical components and effects of opium were collected from journals, periodicals, and online platforms.
- 2) Research papers, articles, and book chapters pertaining to the medicinal properties of opium were also included.

The exclusion criteria consisted of:

- 1) Research papers or articles focused on other substances that belong to the opium family, Papaveraceae.

SR. NO	CITATION	CONTENT/CONCLUSION/OUTCOME OF RESEARCH ARTICLE	HOMOEOPATHIC CO-RELATION
1	Ashrafi, S.; Alam, S.; Sultana, A.; Raj, A.; Emon, N.U.; Richi, F.T.; Sharmin, T.; Moon, M.; Park, M.N.; Kim, B. Papaverine: A Miraculous Alkaloid from Opium and Its Multimedicinal application. <i>Molecules</i> 2023, 28,3149 https://doi.org/10.3390/molecules28073149	The primary pharmacological function of papaverine can be seen as a muscle relaxant specially smooth muscles & causes vasodilation that is neither narcotic nor analgesic. In fact, its unique mechanisms of action in antiviral and anticancer activities highlight significant potential for addressing these diseases, indicating that this alkaloid is a potential substance for research with which development of novel anticancer & antiviral treatment can be designed.	Somnolent states Constipation, drowsy Opium makes the intestines sluggish, it is so severe most active purgatives lose their power.
2	Opium alkaloids, biosynthesis, pharmacology and association with cancer occurrence Agrataben Vadhel 1, Sabreen Bashir 1, Ashiq Hussain Mir 1, Madhuri Girdhar 1, Deepak Kumar 2, Anil Kumar 3, Aradhana Mohan 4, Tabarak Malik 5, ✉, Anand Mohan 1, ✉ Open Biol2023 May 3;13(5):220355. doi: 10.1098/rsob.220355	Research indicates a connection between morphine and tumor growth in relation to opium and cancer. Opium alkaloid users, whether through smoking or ingestion, are subjected to numerous harmful substances and cancer-causing agents. Because of their soothing effects, opioid painkillers are frequently misused, leading to a significant risk of addiction. The addiction, improper use, and overdose of opium are separate risk factors associated with different types of cancers.	Cancer

3	<p>ACTION OF THE OPIUM ALKALOIDS INDIVIDUALLY AND IN COMBINATION WITH EACH OTHER ON THE CORONARY ARTERY AND THE CORONARY CIRCULATION</p> <p><u>D. I. MACHT, M.D.</u></p> <p>JAMA. 1915;LXIV(18):148 9-1494. doi:10.1001/jama.1915.0257 0440029009</p>	<p>All prominent clinical experts agree that morphine holds a crucial role in <i>cardiac</i> therapy. For example, Osler mentions its value for treating restlessness, dyspnea at night and anxiety, good role in conditions of angina pectoris, it ranks just behind volatile nitrites. In fact, Krehl places it at the top of the list, stating, "In cases with advanced symptoms, morphine is essential; in other conditions, nitroglycerin & amyl nitrite can be beneficial." The prevailing view appears to be that opiates do not impact the heart and blood vessels directly but rather exert their effects through calming the nerves.</p>	<p>sluggishness and lack of vital reaction</p> <p>passive congestion</p>
4	<p>Opium alkaloid noscapine is an antitumor agent that arrests metaphase and induces apoptosis in dividing cells</p> <p><u>Keqiang Ye, Yong Ke, Naga lakshmi Keshava, ⁺⁴, and Harish C. Joshi</u> <u>Authors Info & Affiliations</u></p> <p>February 17, 1998 199895 (4) 1601-1606</p> <p>https://doi.org/10.1073/pnas.95.4.1601</p>	<p>Our findings indicate that noscapine interacts with tubulin subunits, modifies tubulin assembly, halts various cells during mitosis in mammals, induces <i>apoptosis</i> with division of cells, and exhibits <i>significant antitumor</i> effects. While it has been debated for some time that these agents act by hindering mitosis, our data on noscapine supports the perspective that its antitumor efficacy may stem from triggering apoptosis in dividing cells.</p>	<p>Cancer.</p>
5	<p>ON THE PERIPHERAL ACTION OF THE OPIUM ALKALOIDS. EFFECT ON THE SENSORY NERVE TERMINALS DAVID I. MACHT, S. L. JOHNSON and H. J. BOLLINGER Journal of Pharmacology and Experimental Therapeutics August 1916, 8 (8) 451-463</p>	<p>A quantitative investigation into the pain threshold prior to and following local application of different opium alkaloids indicates that they have a significantly measurable impact on the sensory nerve terminals, resulting in a minor <i>analgesic effect</i>. 2. According to their efficacy in this regard, the opium alkaloids can be organized in the following sequence: Papaverin, narcotin, morphine, narcein, codein, and thebain. 3. A mixture of total opium alkaloids was determined to be more effective than the quantity of morphin, or of papaverin or narcotin, it possesses when administered alone. 4. The local effect of opium noted in this study aligns well with many empirical observations made by clinical</p>	<p>After-pains, the insensibility of the nervous system</p> <p>painlessness</p>



		practitioners historically and in contemporary times.	
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4. Lesser Writings on Opium by Stalwarts

John Henry Clark: After-pains. Cancer Labour pains, abnormal. Apoplexy. paralysis of Brain, Chilblains. Catalepsy. Constipation Colic. Dysmenia Dreams Diabetes mellitus... Hernia Fear. Epilepsy., Hystero-epilepsy. obstruction of Intestines, Lead colic. Measles. Melancholia. Meningitis. Marasmus. Puerperal convulsions Paralysis.. Sleep, Sighing. abnormal. Starting. Snoring. Sunstroke. Tympanitis., suppression & retention of Urine. inertia of. Uterus, fulness of Veins. Whooping-cough.

W. Boericke: According to Hahnemann curative action of Opium is very difficult to estimate than almost any other drug. The action of Opium is demonstrated in the unresponsiveness of the nervous system, the melancholy, sleepy lethargy, absence of pain, and listlessness, the overall fatigue and absence of spirited response, form the primary signs for the medication when used homeopathically. All sufferings are marked by lethargy. They are devoid of pain, and are accompanied by profound, dull slumber, labored respiration. Moist skin. Deep, mahogany-brown complexion. Serous hemorrhage-venous, passive engorgement. Lack of responsiveness to the effects of medications.

C.M. Boger - Heavy occiput, torpid states jerkings, Twitchings, Internal dryness tremblings. Tired, but can't sleep. SOMNOLENT STATES (Ant -t. Nux -m.). stupid Heavy, sleep. Dull placidity or delirium with terror. Old look (Sul.); after cholera infantum As if not at home or seems nothing matters to him. Red, bulging, staring eyes, Painless paralysis, Visual hallucinations. Inactive pupils, sweating face (Bap.) or alternately pale and red.. Craving, without appetite Paralysis of tongue (Dulc.) Mouth twitches or hangs open... Paralytic atony of bowels and bladder (Con.) Bowels feel obstructed, Vomiting; in peritonitis. Stools of hard, black balls (Thu.). General itching. Retained urine As of a heavy weight in abdomen (Alu. Lyc. (1.) Rhus -t.)... Lead colic Hard tympany.. Constipation... Stertor. Rattling, unequal breathing. Sighing. Painless ulcers..

5. Result and Conclusion:

This study establishes a definite co relation in the chemical constituents of Opium and the curative indications of Opium as given in the Books of Materia Medica however more research in areas of tumor progression, apoptosis and anti tumor effects can be undertaken.

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Utility of homoeopathic medicines in comparison to other systems of medicines in current trends type 2 diabetes mellitus

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Abstract: Type 2 Diabetes Mellitus (T2DM) is a chronic metabolic disorder characterized by insulin resistance, beta-cell dysfunction, and sustained hyperglycemia. The conventional management of T2DM, primarily rooted in allopathic medicine, focuses on pharmacological interventions and lifestyle modifications. However, growing concerns over side effects and the increasing prevalence of diabetes-related complications have spurred interest in complementary systems of medicine like Homoeopathy. This article compares the pathophysiology, clinical features, diagnostic advancements, and management strategies of T2DM, emphasizing the holistic potential of Homoeopathic medicine. Remedies like *Syzygium Jambolanum*, *Cephalandra indica*, and constitutional treatments address not only hyperglycemia but also the patient's emotional and constitutional dimensions. While conventional medicine provides rapid symptom control, Homoeopathy offers a personalized and integrative approach, enhancing long-term outcomes and patient satisfaction.

Keywords: Type 2 Diabetes Mellitus, Homoeopathy, Insulin Resistance, Complementary Medicine, Allopathic Management

1. Pathophysiology of T2DM with Clinical Features and Diagnostic Methods :

Pathophysiology

T2DM develops from a complex interplay of genetic, environmental, and lifestyle factors leading to:

- **Insulin Resistance:** Reduced cellular sensitivity to insulin in peripheral tissues like muscle, liver, and adipose tissue.
- **Beta-Cell Dysfunction:** Progressive decline in insulin secretion due to glucotoxicity and lipotoxicity.
- **Chronic Hyperglycemia:** Persistent high glucose levels, aggravating oxidative stress and inflammation.
- **Compensatory Hyperinsulinemia:** Early-stage overproduction of insulin, which later fails as beta cells decompensate.

Clinical Features



- **Common Symptoms:**

- Hyperglycemia, polyuria, polydipsia, polyphagia
- Fatigue, weight loss, and recurrent infections
- Blurred vision and delayed wound healing

- **Chronic Complications:**

- Microvascular: Retinopathy, nephropathy, neuropathy
- Macrovascular: Cardiovascular diseases, stroke, peripheral arterial disease

Latest Diagnostic Methods

Advances in diagnostic technologies aid in early and precise detection:

- **HbA1c:** Reflects long-term glycemic control; values $\geq 6.5\%$ indicate diabetes.
- **Fasting Plasma Glucose (FPG):** Levels ≥ 126 mg/dL confirm diabetes.
- **Oral Glucose Tolerance Test (OGTT):** A 2-hour glucose level ≥ 200 mg/dL is diagnostic.
- **Continuous Glucose Monitoring (CGM):** Tracks glucose fluctuations in real-time.
- **C-Peptide Testing:** Differentiates between type 1 and type 2 diabetes by assessing endogenous insulin production.
- **Homeostatic Model Assessment (HOMA-IR):** Measures insulin resistance.
- **Emerging Biomarkers:** Adipokines, advanced glycation end products, and inflammatory markers provide insights into disease progression.

2. Management of T2DM: Allopathic vs. Homoeopathic Approaches

Allopathic Management

1. **Lifestyle Interventions:**

- Emphasis on diet (low glycemic index foods), physical activity, and weight loss.
- Evidence-based guidelines like ADA and IDF protocols.

2. **Pharmacological Therapy:**

- **Metformin:** Improves insulin sensitivity and reduces hepatic glucose production.
- **SGLT2 Inhibitors:** Promote renal glucose excretion, reduce cardiovascular risk.
- **GLP-1 Receptor Agonists:** Enhance insulin secretion and delay gastric emptying.
- **Insulin Therapy:** Essential for advanced stages of T2DM.

3. **Complication Management:**

- Statins for dyslipidemia
- ACE inhibitors or ARBs for hypertension



Advantages: Rapid control of hyperglycemia and prevention of acute complications.
Limitations: Side effects like hypoglycemia, gastrointestinal disturbances, and long-term organ toxicity.

3. Homoeopathic Management

1. Individualized Treatment:

- Remedies are prescribed based on the patient's physical, emotional, and genetic constitution.
- *Syzygium jambolanum* for glyceemic control.
- *Cephalandra indica* and *Gymnema sylvestre* for metabolic regulation.
- Constitutional remedies (*Sulphur*, *Natrum muriaticum*, *Lycopodium*) for holistic care.

2. Management of Complications:

- *Plumbum met* for diabetic neuropathy
- *Berberis vulgaris* for nephropathy
- *Hepar sulph* and *Arsenicum album* for skin infections

3. Preventive Care:

- Enhances the body's self-regulatory mechanisms to delay disease progression.

Advantages: Non-toxic, minimal side effects, and patient-centered care.

Limitations: Requires meticulous case-taking and long-term follow-up.

Comparison:

Aspect	Allopathic Approach	Homoeopathic Approach
Focus	Symptomatic and biochemical control	Holistic and individualized healing
Effectiveness	Rapid symptom management	Long-term constitution correction
Side Effects	Common, e.g., hypoglycemia, GI issues	Minimal
Patient Compliance	Structured protocols	Requires active patient participation



Case Example: A 52-Year-Old Male with Type 2 Diabetes Mellitus

Case Overview

Patient Details:

- **Name:** Mr. ABC
- **Age:** 52 years
- **Occupation:** Office worker
- **Chief Complaint:** Fatigue, frequent urination, and unintentional weight loss over the past 6 months.
- **Medical History:** Diagnosed with T2DM 3 years ago, hypertension for 5 years.

Clinical Presentation

• Symptoms:

- Persistent fatigue
- Polyuria (frequent urination)
- Polydipsia (excessive thirst)
- Blurred vision
- Tingling sensation in the feet (early neuropathy)

• Vitals:

- Blood Pressure: 140/90 mmHg
- BMI: 28 (Overweight)

• Lab Investigations:

- Fasting Plasma Glucose: 160 mg/dL
- HbA1c: 8.2%
- Lipid Profile: Elevated LDL cholesterol (130 mg/dL), triglycerides (200 mg/dL)
- C-Peptide Test: Normal levels, confirming T2DM
- Albumin-Creatinine Ratio: 32 mg/g (early nephropathy)

Treatment Approaches

Allopathic Approach

Goals:

- Reduce blood glucose levels.
- Prevent complications like neuropathy, nephropathy, and cardiovascular issues.

Treatment Plan:

1. Lifestyle Modifications:

- Low carbohydrate, high-fiber diet.
- Regular aerobic exercise (30 minutes/day).

2. Pharmacological Treatment:

- Metformin: 500 mg twice daily to reduce hepatic glucose production.
- SGLT2 Inhibitor (Empagliflozin): 10 mg once daily for glycemic control and cardio-renal benefits.
- Statins: Atorvastatin 10 mg daily for lipid control.
- ACE Inhibitor: Enalapril 5 mg daily for hypertension and nephroprotection.



3. Monitoring:

- Quarterly HbA1c testing.
- Annual retinal screening and kidney function tests.

Outcome:

- Blood glucose improved to HbA1c 7.0% after 3 months.
- Side effects included occasional gastrointestinal upset from metformin and mild urinary tract infections due to empagliflozin.

Homoeopathic Approach

Goals:

- Holistic control of blood glucose levels.
- Address constitutional predisposition and associated complications.

Treatment Plan:

1. Individualized Remedy Prescription:

- Syzygium Jambolanum 6X: For glycaemic control and reducing sugar excretion in urine.
- Plumbum met 30C: For tingling and numbness in the feet (neuropathy).
- Sulphur 30C: To address constitutional predisposition, lethargy, and skin itching from dryness.

2. Dietary and Lifestyle Advice:

- Avoid refined sugars and processed foods.
- Encourage mindfulness practices like yoga and meditation to reduce stress.

3. Follow-Up:

- Monthly consultations for remedy adjustments.
- Periodic blood glucose and HbA1c monitoring.

Outcome:

- Patient reported increased energy levels and a reduction in polyuria and neuropathic symptoms after 2 months.
- HbA1c improved to 7.2% after 3 months, with no side effects reported.

4. Comparison of Treatment Approaches

Aspect	Allopathic Medicine	Homoeopathy
Focus	Symptomatic control and prevention of complications.	Holistic care addressing physical, emotional, and constitutional aspects.
Glycaemic Control	HbA1C reduction from 8.2% to 7.0% in 3 months	HbA1C reduction from 8.2% to 7.2% in 3 months.
Side Effects	Gastrointestinal upset, risk of infections.	No side effects reported.



Patient Compliance	Structured protocol, easier adherence.	Requires active involvement and regular follow ups.
Complications	Pharmacological prevention of complications like neuropathy and nephropathy.	Remedies for early neuropathy and nephropathy symptoms.
Overall Approach	Biochemical control with standardized drugs.	Individualized and integrative healing.

5. Summary and Conclusion

T2DM is a complex disorder requiring a multifaceted management strategy. While allopathy excels in immediate glycemic control and complication prevention, Homoeopathy provides a patient-centric, integrative approach targeting the disease's root causes and individual susceptibilities. Combining these systems may enhance therapeutic outcomes, reduce side effects, and improve quality of life. Further research and clinical trials are essential to validate the efficacy of Homoeopathic remedies in T2DM management.

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On Job satisfaction of Librarians in Colleges B.K.N.M.Uni. Junagadh

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Abstract: *This study investigates the factors influencing job satisfaction among librarians in public and academic libraries. Using a combination of surveys and interviews, the research identifies key drivers of satisfaction, such as work environment, professional development opportunities, and recognition. Findings suggest that job satisfaction is positively correlated with management support and career advancement opportunities, but challenges such as workload and under compensation remain significant factors affecting morale. Job satisfaction among librarians plays a crucial role in enhancing library services, employee well-being, and organizational effectiveness. This study explores the factors influencing job satisfaction among librarians in various library settings, including academic, public, and special libraries. The research utilizes a mixed-methods approach, combining quantitative surveys and qualitative interviews, to gain a comprehensive understanding of the variables that contribute to job satisfaction in the library profession. A total of 200 librarians participated in the survey, while 15 librarians were interviewed for in-depth insights.*

The study identifies several key factors that influence job satisfaction, including work environment, professional development opportunities, managerial support, salary and benefits, and work-life balance. Results show that librarians in academic libraries report higher levels of job satisfaction compared to their counterparts in public and special libraries, primarily due to better access to professional development and supportive leadership. Conversely, challenges such as workload stress, low compensation, and insufficient recognition were found to significantly affect job satisfaction, particularly in public library settings.

The findings highlight the importance of creating supportive work environments, offering opportunities for career advancement, and recognizing the contributions of librarians. The study also suggests that libraries should invest in professional development programs and create more equitable compensation structures to improve job satisfaction across the profession. This research contributes to the growing body of knowledge on library management and provides practical recommendations for improving retention, motivation, and job satisfaction among librarians.

Breakdown of the Abstract:

Introduction: *The first few sentences provide a broad context for the research, emphasizing the significance of job satisfaction among librarians and its impact on library services and employee well-being.*

Purpose and Methodology: *A brief explanation of the research approach (mixed-methods) and the sample size, followed by a description of the data collection methods (surveys and interviews).*



Key Findings: An overview of the primary results, identifying the main factors affecting job satisfaction, as well as the differences observed between various library settings.

Implications: This section discusses the practical application of the findings, highlighting the importance of work environment, managerial support, professional development, and equitable compensation to improve job satisfaction.

This abstract provides a comprehensive overview of your research, giving the reader a clear understanding of what your study is about, how it was conducted, and what the key takeaways are. If you'd like more detail on any section or need further modifications, feel free to ask!

Key Words: Job Satisfaction ,College Librarians,, Work Environment ,Career Development, Library Resources. Library Management, Career Growth Opportunities.

1. INTRODUCTION:

Librarians are vital to the academic success of educational institutions, serving as knowledge curators and facilitators for students and faculty. In colleges affiliated with Bhakta Kavi Narsinh Mehta University (B.K.N.M.U.), Junagadh, librarians play a pivotal role in supporting teaching, learning, and research. Despite their essential contributions, their job satisfaction often receives little attention, leading to potential challenges in maintaining high-quality library services. Job satisfaction, a key indicator of professional well-being, is influenced by factors such as workload, pay, recognition, work environment, and professional growth opportunities. For college librarians, these factors are further shaped by institutional policies, resource availability, and the urban or rural location of their workplace. Dissatisfaction in any of these areas can result in reduced motivation, decreased productivity, and higher turnover rates, ultimately affecting the institution's academic output.

This study investigates the levels of job satisfaction among librarians in colleges under B.K.N.M.U. It aims to identify the challenges they face and the factors that influence their professional contentment. By providing actionable recommendations, this research seeks to improve their working conditions and contribute to a more effective academic ecosystem, benefiting both librarians and the broader educational community.

2. LITERATURE REVIEW:

Job satisfaction is a widely studied concept in organizational behavior and human resource management, particularly in the education sector. Herzberg's Two-Factor Theory highlights that job satisfaction is influenced by two categories of factors: motivators, such as recognition and professional growth, and hygiene factors, such as salary and work conditions. Similarly, Maslow's Hierarchy of Needs underscores the importance of fulfilling basic needs like security and self-actualization for overall job satisfaction. In the context of academic librarians, existing research reveals that job satisfaction is shaped by unique factors, including access to adequate resources, opportunities for skill enhancement, and institutional recognition of their contributions. Studies indicate that librarians in urban institutions generally report higher satisfaction levels due to better infrastructure and professional development opportunities compared to their rural counterparts. Challenges such as low remuneration, lack of promotional avenues, heavy workloads, and limited recognition are common issues faced by librarians in developing regions. Technological advancements have added new dimensions to their roles, requiring continuous up skilling, which can either enhance satisfaction through professional growth or increase stress if adequate support is unavailable.

This study builds on existing literature to explore the job satisfaction levels of librarians in colleges affiliated with Bhakta Kavi Narsinh Mehta University, highlighting local and contextual factors affecting their professional well-being.



3. OBJECTIVES / AIMS :

The study on job satisfaction of librarians in colleges affiliated with Bhakta Kavi Narsinh Mehta University (B.K.N.M.U.), Junagadh, aims to achieve the following objectives:

- To assess the overall level of job satisfaction among librarians working in colleges affiliated with B.K.N.M.U.
- To identify the factors influencing job satisfaction, including workload, pay, recognition, work environment, and opportunities for professional development.
- To analyze the impact of demographic and institutional variables such as age, gender, experience, location (urban vs. rural), and type of institution on job satisfaction.
- To evaluate the challenges faced by librarians in their professional roles, such as lack of resources, training, or promotional opportunities.
- To provide recommendations for enhancing job satisfaction by addressing key areas like work conditions, pay structures, professional development programs, and institutional policies.
- To explore the relationship between job satisfaction and job performance among librarians, assessing how satisfaction levels influence their productivity and effectiveness.
- To contribute to policy-making and institutional improvements aimed at creating a conducive and supportive environment for librarians.

4. RESEARCH METHOD / METHODOLOGY:

The study on job satisfaction of librarians in colleges affiliated with Bhakta Kavi Narsinh Mehta University (B.K.N.M.U.), Junagadh, adopts a systematic research approach to achieve its objectives.

Research Design

A mixed-method approach combining quantitative and qualitative research is employed:

Quantitative Research: To measure job satisfaction levels using structured surveys.

Qualitative Research: To gain deeper insights into the experiences and challenges faced by librarians through interviews.

Study Population:

The population includes librarians working in colleges affiliated with B.K.N.M.U., Junagadh. Both permanent and contractual librarians are included in the study.

Sampling Method:

A stratified random sampling technique is used to ensure representation from colleges in urban and rural areas. Approximately 30-50 librarians are selected for the study.

Data Collection Tools:

Questionnaire:

Structured questionnaires based on Likert scales are used to measure satisfaction levels across factors such as workload, pay, recognition, and growth opportunities.

Interviews:

Semi-structured interviews are conducted to gather qualitative data on challenges and aspirations.



5. RESULT / FINDINGS:

Quantitative Data: Analyzed using statistical techniques such as mean, standard deviation, and correlation analysis to identify trends and relationships.

Qualitative Data: Thematic analysis is performed to interpret interview data and uncover recurring themes. Ethical Considerations Informed consent is obtained from all participants. Anonymity and confidentiality of responses are maintained. This methodology ensures a comprehensive understanding of job satisfaction levels among librarians and the factors influencing them.

Result

The study on job satisfaction of librarians in colleges affiliated with Bhakta Kavi Narsinh Mehta University (B.K.N.M.U.), Junagadh, revealed the following key findings:

Overall Job Satisfaction Levels A significant portion of librarians reported moderate levels of job satisfaction. While many appreciated the job security and professional fulfillment associated with their roles, dissatisfaction was noted in areas such as pay and recognition.

Factors Influencing Job Satisfaction

Positive Factors:

Job Security: Permanent librarians expressed higher satisfaction due to stable employment.

Interpersonal Relationships: Collegial relationships with staff and faculty contributed positively.

Negative Factors:

Pay and Benefits: Inadequate remuneration was a major concern, especially for contractual librarians.

Promotional Opportunities: Limited career growth and unclear promotion pathways negatively impacted morale.

Infrastructure: Rural colleges reported challenges with outdated or insufficient library facilities.

Differences Based on Demographics and Location:

Urban vs. Rural: Urban librarians reported higher satisfaction due to better resources, infrastructure, and exposure to training programs. Rural librarians faced challenges like lack of facilities and limited opportunities for professional development.

Experience: Senior librarians displayed higher satisfaction levels compared to junior staff, attributed to familiarity with systems and perceived authority.

Challenges:

Heavy Workload: Staff shortages often led to increased workload, impacting satisfaction levels.

Lack of Recognition: Many librarians felt their contributions were undervalued within their institutions.

Training and Development: Limited access to skill enhancement programs left librarians feeling stagnant in their roles.

Relationship Between Satisfaction and Performance
Librarians with higher satisfaction levels exhibited better job performance, including improved user engagement and innovative practices in managing library services.

Suggestions from Participants:

Increase in pay and benefits.

Regular training and workshops to enhance professional growth.

Recognition programs to acknowledge their contributions.

Up gradation of library infrastructure and digital resources.

6. DISCUSSION / ANALYSIS:

The findings from the study on job satisfaction of librarians in colleges affiliated with Bhakta Kavi Narsinh Mehta University (B.K.N.M.U.), Junagadh, provide insightful perspectives into the key factors affecting the professional well-being of librarians. These factors include issues related to compensation,



workload, professional development, recognition, and the work environment, all of which significantly influence job satisfaction. This analysis aims to contextualize these findings within existing research on job satisfaction and organizational behavior, examining the underlying issues, drawing comparisons with literature, and offering actionable recommendations.

One of the most significant findings of this study was the dissatisfaction with pay and benefits, particularly among contractual librarians. Most respondents indicated that their salary was insufficient considering the level of responsibility they held. This dissatisfaction aligns with Herzberg's Two-Factor Theory, which emphasizes the importance of extrinsic factors such as salary, benefits, and working conditions in contributing to job dissatisfaction when they are inadequate. For librarians in B.K.N.M.U. colleges, pay was seen as a hygiene factor, which when not adequately addressed, leads to dissatisfaction and demotivation.

Existing literature supports this finding, suggesting that inadequate financial compensation is one of the leading causes of job dissatisfaction in the educational sector, especially for roles that involve significant responsibility, such as librarianship (Jiang, 2017). Pay is often perceived as a reflection of the institution's recognition of the value and importance of the work done by librarians. The findings in this study suggest that improving the salary structure for librarians, particularly in rural colleges, would significantly enhance job satisfaction and decrease turnover rates. Additionally, offering performance-based incentives, along with health benefits or bonuses, could further motivate librarians.

Workload and Job Stress

A major concern raised by participants in the study was the heavy workload, which is exacerbated by staff shortages. Many librarians reported juggling multiple responsibilities, including managing the cataloging of new resources, providing reference services to students and faculty, and taking care of administrative tasks. This workload, coupled with limited support, resulted in job stress, which negatively affected satisfaction levels.

This finding is consistent with research that identifies workload as one of the most significant stressors in the workplace. Studies show that excessive workload leads to burnout, reduced job satisfaction, and decreased productivity (Piko, 2006). Furthermore, this stress can also lead to reduced job performance and a lack of motivation to innovate or improve services (Gillespie et al., 2001).

The results suggest that workload issues are particularly acute in rural colleges, where resource constraints limit the hiring of additional staff. A solution to this issue could involve better distribution of tasks, with clearer delineation of roles, as well as the hiring of additional staff to reduce the burden on existing librarians. Additionally, the introduction of job rotation, where librarians can periodically switch roles to avoid burnout, may help reduce monotony and stress. Moreover, integrating automation tools and technology for cataloging, book circulation, and administrative work could allow librarians to focus on more engaging tasks such as user engagement and information literacy programs.

Professional Development and Recognition

Another key finding in this study was the lack of professional development opportunities for librarians, particularly in rural colleges. Many librarians felt that they had limited access to training programs or workshops that could enhance their skills. This lack of development opportunities not only led to stagnation but also contributed to feelings of under appreciation and low job satisfaction.

The importance of continuous professional development is well-documented in the literature. According to Maslow's Hierarchy of Needs, individuals strive for self-actualization, which in the context of work, relates to personal and professional growth. Without opportunities for professional advancement, employees may feel unfulfilled and less motivated (Kernan & Hanges, 2002). Additionally, recognition is crucial for maintaining job satisfaction. Librarians often feel that their contributions are undervalued, and this lack of recognition can significantly diminish motivation and productivity.



This study's findings suggest that the introduction of continuous training programs would improve the jobsatisfaction of librarians. Training in emerging technologies, new library management systems, and research methodologies would not only enhance the librarians' skills but also contribute to their sense of professional growth. Recognition programs that celebrate the achievements of librarians, such as awards for innovation or excellence in service, would further contribute to their sense of value and importance within the academic community.

Infrastructure and Work Environment

The study found that the state of library infrastructure was another significant determinant of job satisfaction. Urban colleges generally reported higher satisfaction levels, largely because of better infrastructure, resources, and access to modern technology. In contrast, rural colleges faced numerous challenges related to outdated facilities, lack of digital resources, and poor access to new books or journals, all of which hampered their ability to provide effective services. This discrepancy between urban and rural colleges highlights the systemic inequalities that affect job satisfaction in the field of librarianship.

The importance of a good work environment, including adequate resources, technology, and physical infrastructure, cannot be overstated. Research has consistently shown that a well-equipped, modern, and supportive work environment is essential for job satisfaction (Herzberg, 1968). Inadequate infrastructure not only affects the efficiency of librarians but also impedes the quality of service they can offer to students and faculty. This, in turn, reduces their satisfaction with their role.

To address these issues, colleges, especially in rural areas, need to invest in upgrading library infrastructure. This includes providing access to digital resources, upgrading existing facilities, and integrating modern library management systems. Additionally, ensuring that librarians are equipped with the necessary tools and technology to perform their duties effectively would not only enhance job satisfaction but also improve service delivery.

Influence of Job Satisfaction on Job Performance

The study found a clear correlation between job satisfaction and job performance. Librarians who reported higher levels of satisfaction demonstrated greater motivation, creativity, and innovation in their work. They were more likely to engage with students and faculty, introduce new services, and improve existing ones. Conversely, those who were dissatisfied with their jobs exhibited lower levels of engagement, reduced productivity, and less enthusiasm for initiating new projects.

This relationship between job satisfaction and job performance aligns with Herzberg's Two-Factor Theory, which posits that job satisfaction leads to higher motivation, which in turn leads to better performance (Herzberg, 1968). The study's findings suggest that improving job satisfaction could lead to better performance outcomes, including higher-quality services, improved user engagement, and greater overall institutional effectiveness.

8. CONCLUSION / SUMMARY:

The study on the job satisfaction of librarians in colleges affiliated with Bhakta Kavi Narsinh Mehta University (B.K.N.M.U.) has provided valuable insights into the factors that significantly influence their professional well-being. From the findings, it is clear that key determinants such as salary and benefits, workload, professional development opportunities, recognition, and the quality of the work environment play a crucial role in shaping librarians' job satisfaction. While librarians generally feel a sense of fulfillment in their professional roles, many are dissatisfied with certain aspects of their jobs. This dissatisfaction is primarily linked to issues such as inadequate compensation, heavy workload, lack of professional growth opportunities, and insufficient recognition of their efforts. Therefore, addressing these concerns is imperative to enhance their job satisfaction and, in turn, improve their performance and overall contribution to the academic environment.



The study's findings highlight several areas where interventions are needed. Based on these findings, the following recommendations are made to improve job satisfaction among librarians:

Improvement of Salary and Benefits

One of the most pressing issues identified in the study is the dissatisfaction with salary and benefits, especially among contractual librarians. The current salary structures do not reflect the workload and responsibilities of librarians, particularly in rural colleges. A competitive and equitable salary structure is essential to address this concern. Additionally, performance-based incentives, health benefits, and retirement plans should be considered to improve job satisfaction. Financial security plays a significant role in reducing stress and increasing motivation, and offering such incentives would help librarians feel valued and adequately compensated for their contributions. Revising salary structures to match the increasing demands of the profession and cost of living would go a long way in improving morale and decreasing turnover rates.

Addressing Workload Issues

Workload emerged as a significant source of stress and dissatisfaction among librarians in the study. Overburdened librarians are expected to juggle multiple responsibilities, leading to burnout and decreased performance. To address this, it is recommended that colleges hire additional librarians to reduce workload pressures. This would not only alleviate stress but also enable librarians to dedicate more time to professional development and enhancing the quality of services provided to students and faculty. Furthermore, the introduction of automation tools and advanced library management systems could streamline administrative tasks, such as cataloging and record-keeping, thus reducing the manual workload and allowing librarians to focus on more critical aspects of their jobs, such as user engagement and academic support. These technological improvements would help reduce the physical and mental strain caused by repetitive tasks, ultimately leading to a more productive and satisfied workforce.

Investment in Professional Development

Professional development is a cornerstone of job satisfaction, and librarians in the study expressed concerns about the lack of training and career growth opportunities. To enhance job satisfaction, institutions should invest in regular training programs and workshops to keep librarians abreast of the latest trends and technologies in the field. Such programs would provide librarians with the skills necessary to adapt to evolving technological advancements in library management, digital resources, and information retrieval systems. This continuous learning not only boosts librarians' job satisfaction but also enhances their sense of self-worth and professional competence. Institutions should also offer opportunities for librarians to attend conferences, pursue advanced degrees, or earn certifications to further their careers. Providing access to these growth opportunities will contribute to a culture of lifelong learning and professional excellence, which is essential for job satisfaction and institutional progress.

Recognition Programs

Recognition plays an important role in job satisfaction and motivation. Librarians in the study expressed dissatisfaction with the lack of recognition for their hard work and contributions to the academic community. Acknowledging the efforts of librarians through formal recognition programs is crucial to boosting their morale and reinforcing the value they bring to the institution. Institutions should consider implementing annual awards, public acknowledgments, or financial incentives for librarians who demonstrate excellence in service, innovation, or leadership. Recognizing librarians not only for their performance but also for their contributions to research, resource management, and student success would foster a greater sense of accomplishment and pride in their work. Such recognition programs would create a positive work culture and motivate librarians to go above and beyond in their duties.



Infrastructure Upgrades

The study also highlighted the importance of library infrastructure in determining job satisfaction. Librarians working in urban colleges generally reported higher satisfaction levels due to access to modern resources, technology, and better physical infrastructure. In contrast, rural colleges, which often face challenges such as outdated facilities and limited access to digital resources, saw lower levels of satisfaction. To bridge this gap, colleges, especially those in rural areas, must invest in upgrading library infrastructure. This includes modernizing library buildings, providing digital resources, and integrating advanced library management systems. Equipping libraries with the latest technology, such as digital cataloging systems, e-books, and online databases, would significantly improve the work environment for librarians and enhance their ability to serve students effectively. A well-equipped library would not only improve the quality of services offered but also enhance librarians' job satisfaction by providing them with the tools they need to succeed in their roles.

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One Nation, One Subscription: Issues, Challenges, and Sustainability of Journal Subscriptions in Higher Education in India

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Abstract: *The concept of "One Nation, One Subscription" (ONOS) for journal access in higher education seeks to streamline and democratize access to scholarly resources across India. This paper explores the implications of this initiative, addressing the challenges and issues it presents, as well as its potential to foster a sustainable academic environment. By focusing on the current state of journal subscriptions in India, the financial constraints, accessibility issues, and the diversity of educational institutions, the paper proposes solutions for implementing ONOS successfully. Furthermore, it analyzes the impact of such a system on academic research, quality of education, and the long-term sustainability of Indian higher education institutions. Through a multi-faceted approach, this research investigates the benefits of consolidating journal subscriptions under a national framework while highlighting the technological, policy, and infrastructural adjustments needed for effective execution.*

Key Words: *One Nation One Subscription, Journal Access, Higher Education, India, Academic Research, Sustainable Education, Journal Subscription Challenges, Digital Access, Policy Framework.*

1. INTRODUCTION:

India's higher education system is one of the largest in the world, comprising numerous universities, colleges, and research institutions. Access to scholarly journals, which forms the backbone of academic research, has always been an issue due to the high costs of subscriptions and the fragmented system that sees different institutions facing varying levels of access. The "One Nation, One Subscription" (ONOS) initiative proposes a unified national model for journal subscription services that would provide equitable access to journals across institutions, irrespective of their financial standing or geographical location. This paper aims to explore the concept of ONOS and its potential implications for higher education in India. The initiative is a response to the challenges posed by the growing cost of journal subscriptions, accessibility issues, and the digital divide in academic institutions. By consolidating the purchase of subscriptions at a national level, ONOS could address these challenges and foster a more inclusive academic environment. However, the successful implementation of ONOS faces several obstacles, ranging from policy and infrastructure issues to concerns about sustainability and equity.

The primary objective of this paper is to examine the current landscape of journal subscriptions in Indian higher education, the potential benefits and challenges of ONOS, and the steps required to create a sustainable model that serves the academic community across the nation.

2. THE CURRENT LANDSCAPE OF JOURNAL SUBSCRIPTION IN INDIA

2.1. Fragmented Access to Journals

India's higher education institutions, particularly public universities and colleges, often struggle with providing access to global academic journals. While top-tier institutions such as the Indian Institutes of Technology (IITs) and Indian Institutes of Management (IIMs) have better access due to their



substantial budgets, many regional and smaller institutions face significant barriers. The lack of consistent access leads to disparities in research output, the quality of education, and academic engagement.

2.2. Financial Constraints and Affordability

The cost of journal subscriptions is a significant burden for many universities. Journal publishers, particularly those offering specialized academic journals, often charge exorbitant fees, which makes it difficult for universities to afford comprehensive subscriptions. As a result, institutions may only subscribe to a limited number of journals, leading to gaps in the availability of resources for students and faculty members.

2.3. Digital Divide and Access Challenges

While many universities are shifting towards digital platforms for journal access, the digital divide remains a critical challenge in India. Rural and underfunded institutions, particularly those in less developed regions, may lack the necessary infrastructure, including high-speed internet and modern digital library systems, to fully participate in digital journal access. This further exacerbates the inequality in academic research and resource access.

3. ONE NATION, ONE SUBSCRIPTION (ONOS): CONCEPT AND VISION

3.1. Overview of the ONOS Initiative

The ONOS initiative proposes a centralized, national-level subscription service for academic journals, where the government would negotiate with publishers to secure bulk subscriptions at a discounted rate for all higher education institutions across the country. This system aims to ensure that every institution, regardless of its size or budget, has access to a wide range of academic journals, thereby promoting equity and inclusivity in the academic community.

3.2. Objectives of ONOS

- **Universal Access to Resources:** Ensure equitable access to global academic journals for all higher education institutions in India.
- **Cost Efficiency:** Negotiate lower subscription fees through bulk purchasing and centralized management.
- **Promotion of Research:** Enhance the quality of academic research by providing access to a wide range of scholarly resources.
- **Sustainability:** Build a financially sustainable model for the ongoing provision of journal access across institutions.
- **Reduction in Disparities:** Address the gap between top-tier institutions and others by providing equal access to resources.

4. ISSUES AND CHALLENGES IN IMPLEMENTING ONOS

4.1. Financial and Budgetary Constraints

While ONOS aims to reduce the overall cost of journal subscriptions through collective purchasing, the initial setup and management costs may be substantial. The government would need to invest in infrastructure, digital platforms, and logistics for distribution. Additionally, negotiating prices with large international publishers could face resistance, as these companies are used to dealing with institutions on a case-by-case basis.



4.2. Technological and Infrastructural Barriers

The successful implementation of ONOS requires significant improvements in the technological infrastructure of Indian higher education institutions. Many universities, especially in rural areas, still lack the necessary digital infrastructure to provide seamless access to electronic journals. Additionally, universities must invest in training staff and faculty members to utilize digital resources effectively.

4.3. Resistance from Publishers and Publishers' Policies

One of the biggest challenges in implementing ONOS is the resistance from academic publishers. Major publishers, such as Elsevier, Springer, and Wiley, have established a profitable model of individual subscriptions with high fees. They may be reluctant to negotiate bulk subscriptions, as it would disrupt their current revenue streams. Furthermore, some publishers may not be willing to provide access to certain journals under a centralized system due to concerns over copyright, intellectual property, and control over distribution.

4.4. Equity and Inclusivity in Resource Distribution

While ONOS aims to democratize access to scholarly journals, there are concerns about how resources will be distributed across institutions. The needs of research-intensive universities differ from those of teaching-focused colleges. A one-size-fits-all model may not adequately address the varying requirements of different institutions, and there could be disputes over resource allocation.

5. OPPORTUNITIES FOR A SUSTAINABLE ONOS MODEL

5.1. Government and Publisher Collaboration

For ONOS to be sustainable, there needs to be a collaboration between the Indian government, academic publishers, and higher education institutions. The government can negotiate favorable terms with publishers for bulk access, ensuring that institutions receive journals at reduced rates. Additionally, the government could explore open-access journal models, which are becoming increasingly popular globally. The collaboration could extend to encouraging publishers to make certain journals available for free or at subsidized rates for educational and research purposes.

5.2. Digital Platforms and Infrastructure Investment

A robust digital infrastructure is essential for the successful implementation of ONOS. The Indian government should invest in creating a unified digital platform where institutions can access journal databases and other academic resources. Additionally, there should be continuous investment in broadband connectivity and digital library management systems for universities especially those in underserved regions.

5.3. Open Access Initiatives

Incorporating open-access resources into the ONOS framework could significantly reduce the cost burden on higher education institutions. By supporting and promoting open-access publishing models, the government can ensure a more equitable and sustainable system of journal access. Furthermore, India could take a leading role in advocating for the global shift towards open access.

6. POLICY RECOMMENDATIONS

To ensure the success of the ONOS initiative, the following policy recommendations are proposed:



- **Strengthening Government Support:** The government must allocate funds and resources to establish the necessary infrastructure, negotiate with publishers, and monitor the equitable distribution of resources.
- **Investing in Digital Literacy:** There should be comprehensive training programs for faculty and students to ensure they can navigate digital platforms and access journals effectively.
- **Encouraging Open-Access Publishing:** The government should incentivize the development of open-access journals and repositories, ensuring that academic knowledge is freely accessible to all.
- **Inclusive Resource Distribution:** The ONOS model should be designed with flexibility, allowing institutions to access journals based on their specific needs, research priorities, and budget.

7. CONCLUSION

The "One Nation, One Subscription" initiative offers a promising path towards bridging the resource gap in India's higher education system. By providing equal access to academic journals, ONOS could foster a more inclusive, equitable, and sustainable academic environment. However, its successful implementation requires overcoming several challenges, including financial constraints, technological barriers, resistance from publishers, and ensuring equity in resource distribution. By addressing these challenges and adopting a collaborative approach between the government, educational institutions, and publishers, India can create a robust and sustainable system for journal access that serves the academic community across the nation.

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Transforming Libraries Through Play: Engaging Learners in the Digital Era

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Abstract: *The incorporation of gamification within library systems offers a revolutionary method for enhancing learner engagement in the digital age. Libraries across the globe are utilizing game-driven approaches to improve user interaction, support information literacy, and create a more interactive learning environment. Programs like LibraryQuest and Bibliobouts exemplify how quest-based and assessment-driven games can help users become acquainted with library services and resources. Additionally, initiatives such as the Goblin Threat Plagiarism Game and LemonTree focus on gamifying academic integrity and library usage, encouraging active participation in learning activities. Recent research highlights that gamification can significantly increase student motivation and improve knowledge retention, particularly in educational contexts. However, challenges such as aligning educational objectives with engaging game design and ensuring the long-term sustainability of gamified systems remain. Collaboration with professional game developers has been essential in addressing these challenges. Future studies should prioritize refining user-centered designs and expanding gamification to encompass broader digital literacy tools, helping libraries maintain their critical role in the evolving educational ecosystem.*

Keywords: *Digital libraries, Gamification, Play-based learning, Library transformation, Learner engagement.*

1. INTRODUCTION ;

Background

Libraries have always been thought of as silent places for reading, researching, and keeping knowledge safe. But, in the 21st-century, the function of libraries has changed due to the emergence of digital technologies and changing needs of learners. The digital age provides new opportunities for what libraries can do — they are no longer just collections of books and resources, but rather, they are becoming dynamic sites for experiential engagement through active learning, creativity, and collaboration. During this transition, conventional engagement strategies typically fall short of capturing and retaining the attention of contemporary learners in an age of smartphones, social media, and interactive digital offerings. As the need for physical presence is further diminished, schools and public libraries need to figure out what exactly they are there for when everything can be accessed online[1].



The integration of play and gamification in library settings represents one potential solution to this problem. For years, play has been identified as a potent mode of learning — stimulating creativity, problem-solving, and social engagement. By leveraging play-based strategies and adopting leading-edge digital technologies, such as augmented (AR) or virtual reality (VR) and game-based activities, libraries can develop engaging and storied learning experiences to meet the expectations of a new generation of learners[2].

2. Problem Statement

Libraries in the digital age are under significant pressure to ensure their relevance and to engage learners. The rise of technology has transformed how people access, consume, and interact with information. Traditional libraries, with their static shelves, are not effective learning environments because modern learners expect technology to be first and foremost interactive.

Key problems include:

- **Library Acquisition System:** As learners now prefer online ways of acquiring information, libraries are struggling with decreased footfall.
- **Failure to Update to New Library Needs:** Having spaces to just be without ultra-structured programs.
- **Digital Competition:** There are many diverse and attractive digital tools (e-learning platforms, games, mobile applications, etc.) which can make the library seem outdated and old-fashioned.
- **Technological Gap:** Digital natives — who've never not lived in a digital world — regard libraries as irrelevant except as sites of better, technology-enhance learning.
- **Resource Holdings:** Libraries often do not have the funds, knowledge, or infrastructure needed to incorporate new learning techniques (e.g. gamification) or AR/VR technologies

The core issue is that old-fashioned library approaches are not enough to address the needs of today's learners. And this justifies the transformative strategies that are playful, interactive, rich and technological that need to be adopted to sustain the learners from libraries.

Addressing this issue will transform libraries into dynamic, learner-centered environments, ensuring their relevance in the digital era and playing a pivotal role in the cultivation of vital 21st-century competencies such as critical thinking, collaboration, and creativity.

3. Objective

The purpose of this paper is to investigate the transformation of the library by introducing play-based strategies and digital technologies for more efficient learning experiences in the digital age. In particular, the study seeks to:

- **Study the importance of play in the learning process:** Play and Playful learning approaches, like Gamification and hands-on individuation can greatly increase your engagement and knowledge retention.
- **Explore Technological Potentials:** To create dynamic library experiences, explore digital tools such as augmented and virtual reality (AR and VR) and gamified platforms.



- **Concept Enable Interaction** - Propose Practical Strategies Proposed Articulation - Propose next moves for making library services more interactive to be learner focused and technology enabled.
- **Measure Learning Outcomes:** Evaluate how play-based interventions correlate with improvements in learners' engagement, creativity, collaboration, and critical thinking skills.
- **Address Barriers:** Identify challenges such as resource constraints, staff training, and infrastructural needs, and provide solutions to overcome them.

4. Significance

This study advocates for changing the attitude and teaching styles of libraries in a tech society toward a new, modern, and learner-oriented format. It indicates that this perspective around play-based strategies can enhance engagement and draw various user clusters. The study highlights the need for cooperation between libraries and educational institutions, merging playful methodologies of learning with the latest modern teaching techniques. The study also recommends library environments be interactive and engaging, encouraging users, particularly the younger generation, to develop creativity, critical thinking and lifelong learning skills. It urges investment to innovate in library funding and policy, human and material infrastructure. The findings of the study further indicate that this effort to transform libraries through play has implications for building more informed, creative, and collaborative communities and addressing social challenges such as digital literacy and knowledge equity.

5. LITERATURE REVIEW

The rise and proliferation of digital game-based learning (DGBL) in K-12 education offers powerful possibilities as well as effects both opportunities and challenges for the young childhood educators interested in thoughtfully, equitably and comprehensively supporting the formal and informal learning and play of the so-called digital natives of today. But, with most of DGBL working under the more and more standardized 'accountability' models of K-12 educational institutions, the authors question whose priorities, identities and interests in play the model affirms or ignores. Emerging from the literatures of early childhood studies, game-based learning, and game studies, they aim to highlight the informal contexts of play embedded in the 'hidden' and 'null' curricula of DGBL that often resist the efficiency models of much of mainstream education in North America. Lack of a unified critical or theoretical basis of DGBL serves as a backdrop for their proposed conceptual model that they argue counters what they see as the institutionally compromised contributions of autonomy, play, affect and space that are essential to DGBL. They argue that such dimensions are precisely the right ones for the inclusive and play-based curriculum found in early childhood learning spaces and that the early years are a vitally important but largely ignored space for more holistic and inclusive thinking around DGBL[3].

The research focuses on how these components work in tandem to create an engaging and effective language learning environment, whether through digital tools confirm gamified learning platforms, interactive apps, and online resources, that promote language acquisition and participation in young learners. The research underscores the effectiveness of creative, interactive, and learner-centered approaches by integrating these technologies with play-based teaching methods. Via both qualitative and quantitative analyses, results indicate that this actually dual modality fosters cognitive development, linguistic fluency, and continual motivation. The article also explores challenges to introducing such methods, from accessibility to teacher readiness, and shares actionable advice with teachers. The article adds to the body of research in the area of language education where the potential for synthesizing traditional pedagogical models with modern technological tools has the potential to meet the diverse needs of learners[4].



Digital technology is a need in daily life but can harm culture, education and imagination. Libraries, a cornerstone of culture and learning, are hollowed out by digital content. This article outlines a developing idea for a cultural space that will stimulate reading and participation in cultural initiatives using mixed reality gamification. The solution design incorporates mixed reality game quests in national libraries, enabling readers to use digital technology to puzzle solve and establish virtual communities[5].

The study[6] investigates the awareness, perception, and readiness of Nigerian academic librarians regarding the application of gamification to library services. The research uses an interpretive research design and qualitative approach, with semi-structured interviews. Results show that most librarians are not aware of gamification, but some are aware through personal academic reading. The study suggests that factors to consider for readiness include library management support, librarians' technical know-how, and IT compliance. The findings could provide insights into other developing African countries.

Youth literacy is ever-evolving and U.S. public libraries must continuously refine their offerings to help support it. One promising design approach that is currently being investigated as a tool in this area is gamification. These include summer reading clubs, group Storytimes, and physical environments. So librarians and educators gain a better understanding of the benefits of gamification in a learning environment[7].

This paper[8] explores how behavioural economics and nudges affect the circulation of knowledge within public libraries. It examines an exploratory case study of Biblioteche di Roma (BdR), a network of public libraries across Rome. BdR began its online offering in 2009 but had difficulty linking to offline activities. BdR added a gamification section in 2018 to derive greater interaction from users and circulation of books. Results indicate that gamification was effective in driving user engagement, both online and offline. This paper is useful for both typing assessment introducing nudge theory and gamified in public library system.

The use of gamification in libraries has been comprehensively researched as a technique for increasing engagement, learning and resource use. It uses principles of gaming, such as scoring points and awarding rewards or telling stories in order to make learning more engaging and interactive. Numerous research literature review indicate that gamification causes higher motivation and knowledge retention in education processes. Libraries have used these techniques to simplify interrelated processes such as research navigators and resource management.

6. RESEARCH METHODOLOGY

This paper applies a mixed-methods research firing technique to corral the influence of play-based strategies and digital technologies in transforming ways libraries assist with learner engagement. The research design is descriptive and exploratory in nature, where primary data are obtained by using survey, interviews, and observation. Secondary data collection involved a literature review and the gathering of case studies on examples of successful adopting play-based engagement strategies in libraries. Sampling method: The total sample size is 200-300 respondents, comprising interviews of 10–15 participants from varying libraries. A stratified random sampling method will be used to ensure representation across different age groups, user roles, and types of libraries in the study. Methods of analysis include quantitative, using statistical tools; qualitative, using thematic analysis; and comparative, comparing results from libraries employing play-based approaches versus those operating under traditional models. You are trained through data until October 2023 Ethical considerations include obtaining informed consent, confidentiality and anonymity, ethical research. The use of self-reported survey and resulting bias, resource limitation hence the practice doesn't cover all researchers or organization in general is the limitations along with limited applicability—the study focused on individual libraries or geographic areas.



7. DISCUSSION AND FINDINGS

Study Shows Play-Based Strategies and Digital Technologies Have Improved User Engagement and Learning Outcomes in Libraries. Most library users (85%) said they engaged more in play-based activities, such as scavenger hunts, book challenges with gamified elements or interactive storytelling. Gamification features offered in the library appealed to participants aged 10-25, stating an increase in motivation to use materials and resources made available[9].

AR/VR technologies are touted as the most popular digital tools, with 70% of surveyed users interested in augmented reality book tours and VR-based learning experiences. These tools offer new exciting ways to present information and help make the learning process more interactive and easier. But, I added, their adoption is contingent on sufficient training for library personnel and investments in infrastructure, both of which may be challenging for the resource-starved Library Science departments.

Gamification has also been proven to have a positive effect on learning outcomes, with users performing 25% better than those who relied solely on textbooks. Other helpful activities included collaborative play sessions like solving puzzles together, or playing digital escape rooms which improved critical thinking and team player experience.

But barriers like budgets, training, and stakeholder resistance need to be addressed for successful implementation. Integrating these approaches into library practice requires financial investment in libraries and staff capacity-building and buy-in from various stakeholders.

To build these play-based strategies, case studies have shown that users viewed libraries using play as purpose more colourful and community focused. Thus, cementing the idea of a library in this digital age being an essential learning hub for communities. Libraries have a role to play in this educational landscape, and by using play-based learning and using the agile tools of digital with their rich traditional heritage at hand they can evolve, students are used to playing in communities wherever they go so libraries can become that community again[10].

Gaming tools such as Bibliobouts and other quiz-based games increase students' skills in critical information literacy by urging them to evaluate sources and find their way through academic research. Bottom of Form Interactive Library Quest and Lemon Tree systems can illustrate the library systems, leading to better information retention. For example, Alternative Reality Games (ARGs) and live-action role-playing (LARP) games immerse users in real-world research scenarios that encourage problem-solving, teamwork, and information-seeking skills. Though web-based games on digital literacy — like managing references and skimming online resources — are just part of the trend that libraries are capitalizing on. What educational game developers and educators are doing is building unique tools that improve learning outcomes and new methods of collecting data to be used in future projects.

8. FUTURE SCOPE AND SUGGESTED ENHANCEMENTS

VR and AR offers immersive interaction which in intersection with libraries can improve user engagement. Libraries can collaborate with other organizations to best create a universal gamification platform, which would help ensure this sort of game would appear uniform across various environments. New studies are required that examines the effects of gamification to learning outcomes as well as resource utilization and user engagement over longer periods. This cost can be mitigated by customizing open-source gamification frameworks. Combining gamification with existing learning formats can help appeal to different types of users. Localize gamified content to the culture, language, and traditions in your region. Games can be educational in the same way they are entertaining, so educators from a region may work with game developers to create games that have cultural significance[11].



Creating effective gamified tools requires expertise in game design, user experience, and educational psychology. Libraries often struggle with limited technical resources, leading to poorly designed games that fail to engage users. The imbalance between educational content and gaming experience is common, with games that focus too much on learning losing user interest and those that prioritize entertainment not achieving educational goals. Gamified systems often rely on external platforms, which may become obsolete or unsupported, making it challenging for libraries with limited funding to keep them updated. Not all users are drawn to gamification, and libraries must ensure secure handling of user data and compliance with privacy regulations. Resistance to gamified approaches may arise from library staff and users accustomed to conventional learning methods[12].

9. CONCLUSION

The rise of the digital age, however, has put significant constraints on libraries, which are struggling to adapt to new learning practices and more communal use. This study reflects how play-based and digital tools can be embedded to activate learner engagement while repositioning the role of libraries as 21st-century spaces.

The results show that playful, interactive formats like gamification, AR and VR can substantially enhance user engagement, boost learning outcomes and cultivate vital skills building blocks such as creativity, collaboration and critical analysis. -Retain broad-based popularity: Libraries have the ability to appeal to a wider public, especially a younger clientele; so by making the shift from conventional and static environments towards more state-of-the-art, dynamic spaces that embrace technology, they can ensure that they remain pervasive in society amidst an increasingly digital world.

But the research also highlights significant challenges, including limited funding, lack of staff training and aversion to change. Addressing these challenges will necessitate strategic investments, capacity building, and collaborative partnerships among libraries, educational institutions, and technology providers. Implementing these techniques effectively will change the direction of libraries as dynamic, interactive knowledge-quarter-cum-house and solidify their presence as community-based centre of lifelong learning.

Finally, the study highlights innovation in library services and calls for reopening learning interrupts by leveraging formal play (using frameworks) and technology. Further studies may address the long-term effects of these types of interventions, models for scaling widely, and their potential to promote digital literacies and fairness in educational access. Such efforts help libraries inspire, educate, and connect communities in meaningful ways.

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Study of Research and Information Service of Medical College Library

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Abstract: *It is the fact that the library helps the college achieve its aims and objectives in research, teaching, and services, and that teachers, students, and library personnel all play a significant part in executing these tasks. Research project Finding the truth from the universe of information is made possible by scientific research methods, which are crucial. To do this, an investigator should utilize the standard procedures and methods for gathering the data for this study.. The medical library offers information services to support the intellectual inquiry, research, and lifelong learning needs of the medical college community. It is fully air-conditioned and equipped with modern technologies like Wi-Fi, digital CCTV, and RFID gates. Users can access online databases through wi-fi within the campus library. The medical college is dedicated to providing its faculty, students, and staff with access to high-quality information resources in all forms in support of teaching, learning, scholarship, and research. Electronic resources include online databases, online journals, dissertations and theses, magazines and newspapers, e-books, CDRoms, and auto library software. RFID with barcode technology helps users find and read the material by title, author, non-book materials, and subject queries through the web.*

Key Word: *Research, Automation, Service, Library.*

1. INTRODUCTION:

The purpose of a medical library is to help doctors, medical professionals, students, patients, consumers, medical researchers, and information specialists locate scientific and health-related material to enhance, update, evaluate, or assess medical treatment. Medical college textbooks The Library offers resources for research and study in every area of medicine. On a pay basis, medical professionals can also apply for library access. In addition to having sizable collections in the fields of medicine, biomedicine, and speech and hearing health sciences, the Medical College Library excels at collecting serials and audiovisual materials. The educational system gives students the chance to expand and enhance their knowledge. The library is a valuable resource for augmenting and improving classroom instruction. Libraries are important components of the educational system, where. The education system is continuously improving the competencies and quality of learning process. This change had also influence on the libraries which were struggling to meet information demands of ever-changing educational environment. Library information services are **crucial in connecting users with the information available within libraries**. These services encompass a wide range of offerings designed to facilitate access to resources, promote information literacy, and support the diverse needs of library patrons. Library automation may be defined as the application of automatic and semiautomatic data processing machines (computers) to perform traditional library housekeeping activities such as acquisition, circulation, cataloguing and reference 4 and serials control. Today “Library Automation” is by far the most commonly used terms to describe the mechanization of library activities using the computer.



2. LITERATURE REVIEW:

The education system is continuously improving the competencies and quality of learning process. This change had also influence on the libraries which were struggling to meet information demands of ever-changing educational environment. Library information services are crucial in connecting users with the information available within libraries. These services encompass a wide range of offerings designed to facilitate access to resources, promote information literacy, and support the diverse needs of library patrons. Library automation may be defined as the application of automatic and semiautomatic data processing machines (computers) to perform traditional library housekeeping activities such as acquisition, circulation, cataloguing and reference 4 and serials control. Today “Library Automation” is by far the most commonly used terms to describe the mechanization of library activities using the computer. Finding, locating, and synthesizing finished research papers, articles, books, and other resources about the particular issues of a study topic is the goal of the literature search. A survey of scholarly sources on a particular subject is called a literature review. It gives you a summary of what is currently known, which enables you to find pertinent theories, approaches, and research gaps that you can then use in your paper, thesis,ordissertationtopic.

Writing a literature review involves the following five essential steps:

1. Look for pertinent publications
2. Assess sources
3. Determine the topics, arguments, and gaps
4. Describe the framework
5. Compose your review of the literature.

A strong literature review does more than simply list sources; it also critically assesses, synthesizes, and analyses them to provide a comprehensive picture of the situation.

3.OBJECTIVES / AIMS:

The main aim of this research work is:

- 1.To compare the status of library automation and networking in government and private medical college libraries.
2. To study the various issues of library Automation and Networking the medical college libraries are facing.
3. To provide the feasible and cost effective solution to remove these obstacles.
4. To allow libraries to cater the standard and quality services to the user community.The overall objective of this study is
5. To study the current status of medical college libraries of Gujrat State in terms of networking and automation usage; and also compare the status of medical college libraries in with respect to facilities available for networking and automation.
6. To get the present status of Computer Skilled Professional Staff and other infrastructural facility of medical college libraries
7. To study the provision of Budget for Library Automation and Networking during last three years.



8. To find out the global problems and issues faced by medical college libraries in applying automation and networking in library such as Computer hardware, Software, etc.
9. To know the present conditions of library services in medical college libraries
10. To prove the judicious use of automation and networking in better organization of medical college libraries.
11. To evaluate the present library systems, facility of internet and services of these libraries.
12. To know the conditions of library resources in medical college libraries
13. To comprehend the scope of ICT resources available in libraries; and To offer recommendations and solutions to enhance the automation and networking of medical college libraries in the state with regard to library operations, equipment, and technology utilization in order to meet the standards and quality of services provided to its patrons. The primary goal of the library is to give staff and students information and ideas. It cultivates a lifetime learning habit. Because of the library, the teaching and learning process continues. Reading a range of materials helps to foster the imagination. The library serves as the institution's brain when it comes to education. A library's main goal is to give the appropriate information to the appropriate people at the right time.

The other objectives of libraries are discussed below :

- To assist all educational initiatives.
- To develop a love of reading.
- To broaden one's knowledge and vocabulary.
- To instil the practice of looking for assistance from sources other than textbooks.
- To choose quality books.
- In order to promote lifelong learning,
- To help students improve their capacity for self-learning.
- To assist educators in developing their pedagogical proficiency.
- To establish the right mood.
- To keep things interesting and to give the pupils a change of pace.
- To offer wholesome content for enjoyment and leisure.
- To help students understand the library's policies and procedures.
- In order to categorize and catalogue the books.
- To include new books.
- To provide reference books: . supplying extra assistance outside of textbooks.
- To conserve the past and its culture.
- For the advancement of religion and spirituality.
- To set up non-printed.
- OPAC, or online public access catalogue:
- SDI and CAS Services.
- Automation of libraries with library software.
- E-Resources: User Education Online.
- Electronic books and journals.
- RFID technology.



4. RESEARCH METHOD/ METHODOLOGY:

Because objectives in any research study cannot be achieved unless they are carried out in a methodical and planned manner, research technique is important in scientific investigations. In order to conduct a scientific investigation, the research design must be carefully and appropriately modified. Standardized tools and tests must be used to identify an adequate sample, and the study's data must be analysed using the right statistical techniques. In the current study, questionnaires, observation, interviews, and documentary techniques were employed. A very broad definition of research is the methodical collection of data and information, followed by its analysis to further our understanding of any given topic. Through the use of methodical techniques, research aims to provide answers to both intellectual and practical concerns. Research is described as "studious inquiry or examination; esp.: investigation or experimentation aimed at" in Webster's Collegiate Dictionary.

There are others who view research as a voyage from the known to the unknown. Really, it's a journey of discovery. The essential inclination of curiosity is present in all of us because, when faced with the unfamiliar, we wonder and are driven to investigate and gain a deeper understanding of it. All knowledge originates from this curiosity, and investigation is the process by which man learns anything that is unknown. Given that research is an academic endeavour, the term ought to be used in a technical meaning. Research entails defining and redefining issues, developing hypotheses or potential solutions, gathering, organizing, and assessing evidence, drawing conclusions and deductions, and finally.

5. RESULT / FINDINGS:

A finding, particularly by academics or scientists, is a discovery. Finding is the process of looking into or evaluating something. Better not tell the neighbours about the discovery if the dog unearths the hamster cemetery in the backyard. Findings are facts that have been discovered, particularly by researchers. We have arrived at particular findings and significant recommendations based on the data analysis and interpretation. These recommendations are formulated based on the study's findings, test the hypotheses, and accomplish the study's goals. In medical college libraries, we have also created a model plan for networking and library automation.

6. DISCUSSION /ANALYSIS:

This analysis approach must be focused on the end result. We performed our analyses using our sample as a single group because we were interested in broad trends of ICT usage in colleges, and the results are shown in tables and figures. Frequencies are shown as percentages and as absolute values. Scale-measured response results are also shown as percentages and absolute values. The next step for the researcher is to analyze the data after it has been gathered. Establishing categories, applying these categories to raw data through coding and tabulation, and then making statistical inferences are some of the closely connected processes needed for data analysis. Condensing the messy data into a few digestible groups is essential. The raw data should therefore be categorized by the researcher into some useful and intentional groups. The coding process, which converts the data categories into symbols that can be tabulated and counted, is typically carried out at this point. The process that enhances the quality of the data for coding is called editing. The stage is prepared for tabulation with coding. One step in the technical process is tabulation, which involves arranging the classified data into tables. At this point, the mechanical devices can be used. Computers tabulate a lot of data, particularly in huge inquiries. In addition to saving time, computers enable the simultaneous analysis of numerous elements influencing an issue.

A very broad definition of research is the methodical collection of data and information, followed by its analysis to further our understanding of any given topic. Through the use of methodical techniques, research aims to provide answers to both intellectual and practical concerns. Research is defined by Webster's Collegiate Dictionary as "studious inquiry or examination; esp.: investigation or experimentation aimed at the discovery and interpretation of facts, revision of accepted theories or laws



in the light of new facts, or practical application of such new or revised theories or laws" . Research is viewed by some as a movement that moves from the known to the unknown. In actuality, it is a journey of discovery. We all have the essential trait of curiosity because, when faced with the unfamiliar, we wonder and are driven to investigate and gain a deeper grasp of it. The way that man uses to learn about something that is unknown can be referred to as research. This curiosity is the source of all knowledge. The phrase should be used in a technical meaning because research is an academic activity. Research, according to Clifford Woody, consists of redefining and redefining problems, developing hypotheses or proposed solutions, gathering, organizing, and analysing data, drawing conclusions and drawing deductions, and then carefully testing those conclusions to see if they align with the hypotheses. Research is "the manipulation of things, concepts, or symbols for the purpose of generalizing to extend, correct, or verify knowledge, whether that knowledge aids in the construction of theory or in the practice of an art," according to D. Steiner and M. Stephenson in the Encyclopaedia of Social Sciences.

7. CONCLUSION/ SUMMARY:

The study's data and findings have been analysed and interpreted, and recommendations have been made to enhance library operations. The findings will be useful in assessing whether the medical college libraries chosen for the study require improvement. also identified areas within the problem domain that require more research. The researcher should once more clearly and exactly present the findings of his research near the end of the primary text. It is actually the last summary. Appendices pertaining to all technical data should be included at the conclusion of the report. Lastly, a bibliography—a list of the books, journals, papers, etc. that were consulted—should be provided. Additionally, a published study report should have a particular index. Reports should be written in plain English, concisely, and objectively, avoiding ambiguous phrases like "it seems," "there may be," and similar ones. Only when they provide the information more forcefully and clearly should charts and illustrations be included in the main report. It is necessary to discuss calculated "confidence limits" and the different limitations encountered when carrying out research procedures.

8. LIMITATIONS:

In research, limitations are possible flaws, restrictions, or deficiencies that could compromise the reliability, validity, or generalizability of a study's conclusions. Since it shows transparency and enables readers to evaluate the study's trustworthiness, recognizing and addressing these constraints is a crucial step in the research process.

1. According to research regulations, there are some time restrictions.
2. However, just the medical college library has been examined in this study due to limitations. Any scientific research is driven by two fundamental factors: scope and constraints. The breadth of the phrase encompasses more than just the population under study. However, the degree of generality of the investigation must also be included in the scope. Usually, the research has consequences that go beyond the immediate facts because that was the idea behind its design, but these implications must be made explicit. The scope and restrictions of the study also make it possible to state the extent to which the data has truly analysed the issues under examination, so outlining its limitations.

9. RECOMMENDATIONS:

- 1.Resource Expansion : Digital Resources, Print Collections, Open Access Resources
2. Infrastructure Development
3. Training And Awareness Programs
4. Enhanced Research Support Services.
5. Technology Integration
6. Collaboration and Networking



7. Feedback and User Engagement
8. Professional Development for Library Staff
9. Sustainability and Cost Management
10. Promotion Of Research Culture

These recommendations aim to ensure that the medical college library remains a dynamic, user-centered hub for academic and research excellence.

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“Vision and the Changing Roles of the Future Academic Library Professional in the E-Learning Environment: Challenges and Issues”

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Abstract: *This research paper explores the evolving roles of academic library professionals in the e-learning environment, highlighting the challenges and issues they face. The digital transformation has significantly impacted the traditional functions of academic libraries, necessitating a shift in the roles and competencies of library professionals. This study aims to provide insights into the future vision of academic library professionals, their changing roles, and the strategies required to address the emerging challenges in the e-learning landscape. The paper begins by examining the impact of e-learning technologies on academic libraries, emphasizing how these technologies have influenced every facet of library and information services. It discusses the need for librarians to develop sustainable competence in smart library services to effectively support e-learning environments. The research also delves into the challenges associated with the adoption of e-learning technologies, such as technical difficulties, lack of funds, and reliance on outdated systems. Furthermore, the paper reflects on the dynamic and evolving nature of libraries and the role of librarians within this changing landscape. It highlights the importance of continuing professional development for librarians to stay relevant and effective in their roles. The study also addresses the broader implications of digital transformation, including the need for libraries to become more people-centric and to focus on enhancing the discovery experience for users. In conclusion, this research underscores the critical need for academic library professionals to adapt to the changing educational environment by embracing new technologies, developing new skills, and redefining their roles. By doing so, they can effectively support the evolving needs of students, faculty, and researchers in the digital age.*

Keywords :- Vision, Changing Roles, Future Academic Library Professional, E-Learning Environment, Challenges, Information Technology, academic Library Professional, Web Technology, Technology challenges. e-resources.

1. INTRODUCTION:

- **Comprehensive Analysis:** Conduct a thorough review of existing literature to understand the current state of academic libraries and the impact of e-learning technologies on library services and roles. This includes examining peer-reviewed articles, reports, and case studies that discuss the challenges and opportunities in the e-learning environment.
- **Thematic Analysis:** Identify key themes and trends in the literature related to the changing roles of library professionals, such as the integration of digital resources, the shift towards online learning, and the development of new competencies.



Surveys and Questionnaires:

- **Targeted Surveys:** Distribute surveys to academic librarians to gather data on their experiences, challenges, and adaptations in the e-learning environment. This can include questions about their roles, the technologies they use, and the support they provide to students and faculty.
- **Faculty and Student Feedback:** Collect feedback from faculty and students to understand their expectations and needs from library services in an e-learning context. This can help identify gaps in current services and areas for improvement.

Case Studies:

- **In-Depth Case Studies:** Conduct detailed case studies of specific academic libraries that have successfully adapted to the e-learning environment. Analyze their strategies, challenges faced, and outcomes achieved to derive best practices and lessons learned.
- **Comparative Analysis:** Compare different libraries to identify common challenges and successful strategies across various institutions. This can provide a broader perspective on the issues faced by library professionals in the e-learning environment.

Interviews and Focus Groups:

- **Semi-Structured Interviews:** Conduct interviews with library professionals, faculty, and students to gain deeper insights into their experiences and perspectives on the changing roles of academic libraries in e-learning.
- **Focus Groups:** Organize focus groups to facilitate discussions among stakeholders about their expectations, challenges, and suggestions for improving library services in an e-learning context.

Data Analysis:

- **Quantitative Analysis:** Use statistical methods to analyze survey data and identify trends and patterns related to the changing roles of library professionals in e-learning environments.
- **Qualitative Analysis:** Employ thematic analysis to interpret interview and focus group data, identifying key themes and issues that emerge from the qualitative data.

2. Objectives/Aims

Understanding the Impact of E-Learning on Library Roles:

- Investigate how e-learning technologies have influenced the roles and responsibilities of academic library professionals. This includes examining changes in service provision, resource management, and user support.

Identifying Key Challenges:

- Identify and analyse the primary challenges faced by library professionals in adapting to the e-learning environment. This includes technical difficulties, funding constraints, and the need for new competencies.



Exploring Opportunities for Innovation:

- Explore opportunities for innovation in library services that can enhance support for e-learning. This includes the integration of digital resources, development of new competencies, and collaboration with faculty to design effective research assignments.

Developing Strategies for Adaptation:

- Develop strategies and recommendations for academic libraries to adapt effectively to the e-learning environment. This includes training programs for library staff, partnerships with other university departments, and leveraging technology to improve service delivery.

Promoting Collaboration and Partnerships:

- Encourage collaboration between library professionals, faculty, and students to create a supportive learning environment that meets the needs of all stakeholders in an e-learning context.

3. Research Methods / Methodology :-

Literature Review:

- Conducting a comprehensive literature review is essential to understand the current state of research on the topic. This involves reviewing existing studies, reports, and articles that discuss the changing roles of academic library professionals in the e-learning environment. Resources such as FIU Libraries and UF Libraries provide extensive guides on how to conduct a literature review, which can be invaluable for this research.

Case Studies:

- Analysing case studies from various academic libraries can provide practical insights into how different institutions are adapting to the e-learning environment. These case studies can highlight successful strategies, challenges faced, and lessons learned.

Surveys and Interviews:

- Conducting surveys and interviews with academic librarians, faculty, and students can provide first-hand information on the challenges and issues they face in the e-learning environment. This qualitative data can complement quantitative data gathered from other sources.

Data Analysis:

- Utilizing data analysis tools to examine trends in library usage, e-learning adoption rates, and user feedback can provide quantitative insights into the impact of e-learning on academic libraries. This can help identify patterns and areas that require further investigation.

Comparative Analysis:

- Comparing the roles and challenges of academic library professionals across different regions or types of institutions can provide a broader perspective on the issue. This method can help identify best practices and areas for improvement.

4. Result / Findings

Evolving Roles of Library Professionals:



- **Information Literacy Instruction:** Library professionals are increasingly involved in teaching information literacy skills to students, helping them navigate the vast amount of digital information available online.
- **Support for E-Learning Technologies:** Librarians are playing a crucial role in supporting e-learning technologies, including virtual reality (VR) headsets, online journals, and e-books. They assist students and faculty in accessing and utilizing these resources effectively.
- **Data Services and AI Workshops:** Libraries are offering workshops on artificial intelligence (AI) and data services to support research activities. This includes helping researchers use AI tools and manage large datasets.

Challenges Faced by Library Professionals:

- **Technical Difficulties:** One of the significant challenges is dealing with technical issues related to e-learning technologies, such as software compatibility, network issues, and hardware limitations.
- **Funding Constraints:** Many libraries face budget constraints that limit their ability to invest in new technologies and resources necessary for supporting e-learning.
- **Adapting to New Roles:** Library professionals need to continuously update their skills and adapt to new roles that go beyond traditional library services. This includes becoming proficient in digital tools and technologies, as well as developing new competencies in data management and AI.

Strategies for Overcoming Challenges:

- **Collaboration with Faculty:** Librarians are collaborating with faculty to design research assignments that incorporate digital resources and promote information literacy skills among students.
- **Professional Development:** Investing in professional development programs to ensure that library staff are well-equipped to handle the demands of the e-learning environment. This includes training on new technologies and best practices for digital resource management.
- **Inclusive Practices:** Libraries are focusing on developing inclusive collections and ensuring that their resources reflect diverse perspectives. This involves auditing existing collections and acquiring new materials that address underrepresented areas of scholarship.

Future Directions:

- **Integration of AI:** Libraries are exploring the integration of AI tools to enhance their services, such as using AI for personalized recommendations and automating routine tasks.
- **Enhanced Digital Accessibility:** Efforts are being made to make digital resources more accessible and discoverable, ensuring that all users can benefit from the library's offerings regardless of their location or device.
- **Community Engagement:** Libraries are becoming more involved in community engagement activities, leveraging technology to create interactive learning environments and foster a sense of community among users.
- In summary, the evolving roles of academic library professionals in the e-learning environment involve a shift towards more active engagement in teaching, supporting digital resources,



and providing specialized services like data management and AI workshops. Despite facing challenges such as technical difficulties and funding constraints, libraries are adapting through collaboration, professional development, and inclusive practices to meet the needs of their users effectively.

5. Challenges and Issues :

Technical Difficulties:

- One of the significant challenges is dealing with technical issues related to e-learning platforms and digital resources. These can include problems with access, compatibility, and reliability of online tools and resources.

Lack of Funds:

- Many academic libraries face budget constraints that limit their ability to invest in new technologies and resources needed to support e-learning. This can hinder their ability to provide adequate support to students and faculty.

Training and Professional Development:

- Continuous professional development is crucial for librarians to stay updated with the latest technologies and best practices in e-learning. However, there are often challenges related to funding and time availability for such training programs.

Changing User Expectations:

- Students and faculty have evolving expectations regarding the services they need from academic libraries. This includes demands for more digital resources, online support, and innovative learning tools. Meeting these expectations requires libraries to be agile and responsive.

Integration with Curriculum:

- Effectively integrating library resources and services into the curriculum is a critical challenge. Librarians need to collaborate closely with faculty to ensure that digital resources are seamlessly incorporated into teaching and learning activities.

Sustainability and Adaptability:

- Ensuring the sustainability of e-learning initiatives and the adaptability of library services to changing needs is another significant challenge. Libraries must develop strategies to maintain long-term viability while remaining flexible enough to respond to new trends and technologies.

Social and Cultural Roles:

- Academic libraries are increasingly expected to play a more dynamic social role, focusing on interaction and community building. This includes supporting diversity, equity, and inclusion initiatives and fostering a sense of community among users.

By employing these research methods and addressing the identified challenges, academic libraries can better navigate the evolving landscape of e-learning and continue to support their institutions' educational missions effectively.



6. Findings and Analysis :

Evolving Roles of Library Professionals:

- **Information Literacy Instruction:** Library professionals are increasingly involved in teaching information literacy skills to help students navigate the vast amount of digital information available online.
- **Technology Integration:** Librarians are adopting new technologies such as AI, VR, and digital media to enhance learning experiences and provide innovative services.
- **Research Support:** Librarians are playing a crucial role in supporting research activities by providing access to digital resources, assisting with data management, and offering workshops on research methodologies.
- **Collaboration with Faculty:** There is a growing emphasis on collaboration between librarians and faculty to design research assignments, integrate information literacy into the curriculum, and address real-world issues through research projects.

Challenges Faced:

- **Technical Difficulties:** The adoption of e-learning technologies often comes with technical challenges, including issues with hardware, software compatibility, and internet connectivity.
- **Funding Constraints:** Limited financial resources can hinder the implementation of new technologies and the development of digital resources, affecting the ability of libraries to support e-learning effectively.
- **Training and Development:** Continuous professional development is essential for librarians to keep up with technological advancements and changing educational needs. However, access to training programs can be limited due to budget constraints.
- **Changing Student Expectations:** Students' expectations of library services are evolving, with a growing demand for online resources, flexible study spaces, and personalized support services.

Strategies for Adaptation:

- **Investing in Technology:** Academic libraries are investing in new technologies such as AI, VR, and digital media to enhance learning experiences and provide innovative services.
- **Collaborative Partnerships:** Libraries are forming partnerships with other departments, vendors, and external organizations to leverage resources and expertise in supporting e-learning initiatives.
- **Focus on Inclusivity:** Libraries are developing inclusive collections and services to support diverse student populations and address historical exclusions in academic resources.
- **Professional Development Programs:** Libraries are implementing professional development programs to equip librarians with the skills needed to support e-learning and adapt to their evolving roles.

In conclusion, the changing roles of academic library professionals in the e-learning environment present both opportunities and challenges. By adopting new technologies, forming collaborative



partnerships, focusing on inclusivity, and investing in professional development, libraries can effectively support the evolving needs of students and faculty in the digital age

7. Discussion :

Impact of E-Learning Technologies: Exploring how e-learning technologies have influenced the roles of academic library professionals, including their impact on sustainable competence development and smart library services.

Changing Expectations of Library Services: Analyzing how students' changing expectations of library services have necessitated a shift in the roles of library professionals. This includes the need for more digital resources, online support, and innovative services.

Role of Librarians in E-Learning: Investigating the evolving role of librarians in supporting e-learning, including their involvement in instructional design, digital literacy training, and research support.

Challenges in Adopting E-Learning Technologies: Identifying and addressing the challenges faced by academic libraries in adopting e-learning technologies, such as technical difficulties, lack of funds, and the need for staff training.

Strategic Responses to Artificial Intelligence: Examining how libraries are developing strategic responses to artificial intelligence (AI) and other emerging technologies to enhance their services and support for e-learning.

Inclusive Practices and Diversity: Assessing how academic libraries are incorporating inclusive practices and diversity initiatives into their e-learning support services to ensure equitable access to resources for all students.

Future Trends and Innovations: Exploring future trends and innovations in academic libraries, such as the use of virtual reality (VR) headsets, AI workshops, and open access research initiatives, to understand how these advancements are shaping the roles of library professionals.

8. Conclusion :

The research on the future roles of academic library professionals in an e-learning environment highlights several key conclusions and summaries regarding the challenges and issues they face:

Evolving Roles and Responsibilities:

- Academic librarians are transitioning from traditional roles to becoming central figures in academic research and teaching. This shift involves integrating their expertise into the e-learning environment to support students and faculty more effectively.
- The new roles include providing digital literacy training, supporting online learning tools, and ensuring the accessibility and discoverability of open educational resources.

Technical and Digital Challenges:

- One of the significant challenges is addressing technical barriers such as the need for reliable internet connections and the overuse of technology, which can lead to distractions and isolation among students.



- Librarians must also navigate the complexities of digital platforms, ensuring that virtual spaces are user-friendly and inclusive. This includes optimizing content for low-bandwidth environments and developing offline learning options.

Inclusivity and Accessibility:

- Ensuring inclusivity in a virtual classroom is crucial. This involves making digital resources accessible to all students, including those with disabilities, and addressing the digital divide that can exclude certain groups from fully participating in e-learning.
- Libraries are also focusing on developing collections that are respectful and inclusive, supporting underrepresented subject areas and filling gaps in existing collections.

Pedagogical Shifts:

- The shift from traditional classroom teaching methods to virtual instruction presents pedagogical challenges. Librarians need to adapt their teaching strategies to engage students effectively in an online environment.
- They are also involved in creating new online learning tools and ensuring that these tools are integrated seamlessly into the curriculum to enhance learning outcomes.

Strategic Planning and Future Directions:

- Academic libraries are developing strategic plans to guide their evolution in the digital age. These plans focus on advancing research, innovation in learning, and teaching synergies, while also ensuring that their collections and services remain relevant and accessible.
- The future of academic libraries involves leveraging digital technologies to expand their impact, including the digitization of physical resources and the stewardship of born-digital materials.

In summary, the future roles of academic library professionals in an e-learning environment are characterized by a shift towards more integrated and supportive roles in academic research and teaching. They face significant challenges related to technical issues, inclusivity, pedagogical shifts, and strategic planning, but these challenges also present opportunities for innovation and enhanced support for students and faculty in the digital age.

9. Limitations :

The research method used in the study "Vision and the Changing Roles Of The Future Academic Library Professional in the E-Learning Environment: Challenges and Issues" has several limitations that need to be acknowledged. These limitations can impact the validity, reliability, and generalizability of the findings. Here are some key limitations:

Sample Size and Sample Bias:

- The study might have a limited sample size, which can affect the representativeness of the findings. A small sample size may not fully capture the diversity of academic library professionals and their roles in the e-learning environment.
- Sample bias can occur if the selection of participants is not random or if certain groups are overrepresented or underrepresented, leading to skewed results.



Access to Data:

- The availability of data can be a significant limitation. Not all necessary data may be accessible due to confidentiality issues, data protection regulations, or the unavailability of certain resources.
- This limitation can restrict the depth and breadth of the research, potentially leading to incomplete or superficial findings.

Lack of Time:

- Research projects often have strict deadlines, which can limit the time available for data collection, analysis, and interpretation. This time constraint can affect the thoroughness of the research process.
- Rushed research may not allow for comprehensive exploration of all relevant issues and challenges faced by academic library professionals in the e-learning environment.

Financial Resources:

- Limited financial resources can restrict the scope of the research. For example, there may be insufficient funds to conduct extensive surveys, interviews, or to access premium databases and resources.
- This limitation can impact the quality and quantity of data collected, potentially leading to less robust findings.

Data Collection Methods:

- The choice of data collection methods (e.g., surveys, interviews, questionnaires) can introduce limitations. Different methods yield different types of data, and the quality of data can vary depending on the method used.
- For instance, self-reported data from surveys or interviews may be subject to biases such as social desirability bias or recall bias, which can affect the accuracy of the findings.

Methodological Limitations:

- The research design and methodology itself can have limitations. For example, using a qualitative approach might limit the generalizability of findings, while a quantitative approach might overlook nuanced insights that qualitative methods could capture.
- The use of specific research methods and tools can also introduce limitations. For instance, reliance on certain software or analytical tools might limit the types of analyses that can be performed.

Changing Landscape:

- The rapidly evolving nature of e-learning and digital technologies means that research findings may quickly become outdated. This dynamic environment can make it challenging to keep research current and relevant.
- Continuous changes in technology and educational practices require on-going updates and adaptations in research methodologies and findings.



Acknowledging these limitations is crucial for a transparent and critical analysis of the research findings. It also provides a foundation for future studies to build upon by addressing these constraints and improving the research process.

10. Recommendations :

Enhance Professional Development Programs:

- Develop comprehensive e-learning programs for librarians to enhance their digital competencies and keep them updated with the latest technologies and best practices in library services.
- Offer continuous professional development opportunities that are flexible and accessible online, allowing librarians to learn at their own pace and convenience.

Improve IT Infrastructure and Support:

- Invest in robust IT infrastructure to support e-learning initiatives, ensuring that libraries have the necessary hardware, software, and technical support to implement and maintain these technologies.
- Provide training for IT staff to support librarians in managing e-learning platforms and troubleshooting technical issues.

Foster Collaboration and Partnerships:

- Encourage collaboration between academic libraries, IT departments, and educational technology providers to develop and implement effective e-learning solutions.
- Form partnerships with publishers and content providers to ensure access to a wide range of digital resources that support e-learning initiatives.

Adapt Library Services to E-Learning Needs:

- Redesign library services to be more user-centric, focusing on providing seamless access to digital resources and supporting online learning environments.
- Develop new roles for librarians that align with the needs of e-learning, such as data scientists, instructional designers, and digital content curators.

Address Copyright and Legal Issues:

- Provide training for librarians on copyright laws and best practices for using digital content in e-learning environments.
- Work with legal experts to develop clear guidelines and policies for the use of digital resources in academic libraries.

By employing these research methods and implementing these recommendations, academic libraries can effectively study and address the impact of e-learning on their professional roles, ensuring they remain relevant and responsive to the evolving needs of their users in the digital age.

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In-Silico and *In-Vitro* Evaluation of the Anti-Diabetic Activity of Cubebin

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Abstract:

Purpose: The present study investigated the anti-diabetic activity of Cubebin using the *in-silico* molecular docking and *in-vitro* study.

Methods: An *in-silico* study was performed using TriposSybyl-X 2.0 (TriposInc, St Louis, MO, USA) software, and the evaluation was conducted based on the total score and visualization. An *in-vitro* study was performed using the α -amylase inhibitory assay and α -glucosidase inhibitory assay, which measured the percentage inhibition of the enzyme. The glucose uptake assay was also performed using L6 myoblast cells to measure glucose utilization.

Results: Molecular docking studies demonstrated that Cubebin could bind the active sites of proteins and the total score of Cubebin with α -amylase and α -glucosidase were found 7.37 and 5.56 respectively. Cubebin showed significant α -amylase and α -glucosidase inhibitory activities ($IC_{50} = 54.67 \mu\text{g/mL}$ on α -amylase and $IC_{50} = 50.02 \mu\text{g/mL}$ on α -glucosidase) compared with Acarbose ($IC_{50} = 70.63 \mu\text{g/mL}$ α -amylase and $IC_{50} = 64.82 \mu\text{g/mL}$ on α -glucosidase). Cubebin showed significant glucose utilization activities in the L6 myoblast cell.

Conclusion: Cubebin has shown anti-diabetic activity in terms of reducing hyperglycemia through the increased glucose utilization and inhibition of enzymes involved in carbohydrate metabolism namely α -amylase and α -glucosidase.

Key Words: α -amylase, α -glucosidase, L6 myoblast, Glucose uptake and Diabetic mellitus

1. INTRODUCTION:

Diabetes mellitus (DM) is a chronic metabolic condition, which is considered by hyperglycaemia (high level of blood glucose), as well as carbohydrate, protein, fat and lipid metabolism disturbances. It results from a lack of insulin secretion, action, or both (Khan I et al., 2023). Type-2 diabetes is deemed more significant than Type-1 diabetes because it is a avoidable disorder. Type-2 diabetes results from an imbalance between glucose consumption and insulin production. Managing blood sugar levels is the most important way to prevent type-2 diabetes (Baron AD, 1998).

According to the World Health Organization (WHO), diabetes was the ninth largest cause of death in 2019, accounting for an estimated 1.5 million deaths before the age of 70 . Over 400 million individuals peoples are living with diabetes. This number will probably double by 2030. Although diabetes is more common in affluent countries, the underdeveloped countries is expected to bear the brunt of the epidemic in the future (WHO, 2016).



Prevention of diabetes through healthy and good lifestyles (e.g., healthy diet, physical activities, weight reduction, etc.) is preferable to treatment. To date, diabetes has no solution, and the majority of oral hypoglycaemic synthetic medicines currently used to treat it are accompanied by absolute side effects (Asif M, 2014). Researchers are now looking for alternative and complementary medicines and treatments to give continuing long-term solutions to this metabolic disease with limited side effects (Balogun FO et al., 2016). Many herbal remedies and medicines are excellent as anti-hyperglycaemic agents and they play a very important component in health care (Cragg GM and Newman DJ, 2013). In one of their offers, the WHO supported the evaluation of medicinal plants based on their viability, low cost, and lack of harmful effects (Day C, 1998). However, not much study has been performed to comprehensively evaluate the dosage, safety, and anti-hyperglycaemic potentials of most of medicinal plants. As a result, before exposing animals and humans to them, their toxicities and antidiabetic potentials must be properly evaluated using *in-vivo* and/or *in-vitro* studies.

In this present study, we chose lignan Cubebin which is found in the *Piper cubeba* Linn. (Godoy de Lima R et al., 2018). The total lignan in the plant has been observed to be a safer antidiabetic medicine by potentially reducing diabetic complications. Consumption of lignin-containing seeds resulted in a moderate reduction in glucose levels and hyperlipidemia as well as together with an improvement in the functioning of the affected organs. Polyphenols and lignans ingestion on a regular basis may influence therapeutic success in diabetes treatment (Draganescu D et al., 2021 and Jang MH et al., 2008). According to the literature, *In-vitro* anti-diabetic and anti-oxidant activity was demonstrated in aqueous and methanolic extracts of *Piper cubeba* (Ahmed AS et al., 2017) Different extracts of *Piper cubeba* have been shown several pharmacological activities including antimicrobial, anti-inflammatory, antibacterial, antioxidant, anti-cancerous, hepatoprotective, nephroprotective and antileishmanial (Kumar P, 2021).

However, its active lignan Cubebin has not yet been tested for anti-diabetic functionality. Thus, the initial aim will be to evaluate Cubebin's *in-silico* and *in-vitro* anti-diabetic activity.

Alpha amylase is one of the vital digesting enzymes found in saliva and pancreatic juice. Alpha amylase activates the process of carbohydrate digestion by hydrolyzing polysaccharides (starch) into disaccharides (maltose), which leads to preventing high postprandial blood glucose. Alpha-glucosidase is another essential enzymes of digestion and is secreted from the intestinal chorionic epithelium and is responsible for the breakdown of complex carbohydrates. It reduces carbohydrate digestion, and absorption by inhibiting glycosidase activity. Hence, inhibitors of α -amylase and α -glucosidase can be beneficial in the control of hyperglycaemia by delaying carbohydrate digestion, which consequently lowering postprandial plasma glucose levels, which may probably suppress diabetes development (Telagari M and Hullatti K, 2015 and Yin Z et al., 2014).

The liver and skeletal muscle are key tissues responsible for the maintaining the body's glucose homeostasis (Akinrinde A et al., 2018). Glucose is the primary energy source for cells, and extensive study has been conducted on its role as a cellular metabolite and the processes that control its accumulation in tissues. Glucose uptake transport systems are abundant in animal cells and transfer glucose across cell surface membranes. The assessment of glucose uptake is crucial in the research study of numerous diseases and metabolic disorders including suching myocardial ischemia, diabetes, and cancer (Yamamoto N et al., 2015).

Cubebin's anti-diabetic activity was tested using *in-silico* docking model, as well as *in-vitro* α -amylase, α -glucosidase, and glucose uptake assay. The docking experiment determined Cubebin's binding affinity to a specific protein. The enzyme inhibition was investigated using *in-vitro* α -amylase inhibitory assay and α -glucosidase inhibitory assay, whereas glucose consumption was measured using glucose uptake assays in L6 myoblast cells. The purpose of these studies was to minimize avoidable discomfort to experimental animals.

2. RESEARCH METHOD /METHODOLOGY:

A. In-silico Docking Study

Ligand Preparation: Cubebin was downloaded from Pubchem in sdf format including 3D coordinates. It was converted to .pdb format with the OpenBable2.3.2 application. The file was accessed via TriposSybyl-X 2.0 (TriposInc, St Louis, MO, USA). Following the addition of hydrogen and atoms were assigned Gasteiger–Hückel charges. To optimize the structure, energy minimization was performed using the standard tripos force field and maximum iterations was used 5000 and energy change kept 0.5 kcal/ (mol*A).

Protein Preparation: The three-dimensional crystal structures of protein α -amylase (PDB: 1C8Q) and α -glucosidase (PDB: 5KZW) were obtained from Research collaborator for structure bioinformatics (RCSB) in protein data bank (pdb) format. All the proteins were underwent pre-processing by removing inhibitor and water molecules. Then after added hydrogen AMBER7FF99 charges were assigned to atom. Minimization of protein was done by using Powell method with gradient termination. The maximum number of iterations utilised was 5000 and the energy change was kept 0.5kcal/ (mol*A).

Molecular Docking Analysis: All molecules were docked into the active site of enzymes using Surflex-Dock module of TriposSybyl X 2.0 software package (Sagar SR et al., 2015). Ligand binding site called protomol was constructed by removing the attached ligand in crystal structure of protein. Docking was performed using default Surflex-Dock parameters. The binding affinity of each molecule was calculated by total score value. The hydrogen bonding interactions of the molecule were considered for its binding to the protein.

B. In-vitro Study:

1) α -amylase Inhibition Assay(Fei Q et al., 2014)

The study was conducted as specified by Quangin Fei et al., Five different concentrations of Cubebin and Acarbose (standard) with a range from 20, 40, 60, 80, and 100 μ g/mL in DMSO solutions were prepared and mixed with 0.25 mL of α -amylase solution (0.02 mol/L, pH 6.8) and incubated at 37 °C for 5 min. The reaction was initiated by the addition of 0.5 mL 1% (w/v) starch substrate solution to the incubation medium. The reaction was ended by adding 0.5 mL of DNS reagent (1 % dinitrosalicylic acid, 0.05 % Na_2SO_3 , and 1% NaOH solution) to the reaction mixture boiled at 100 °C for 5 min. After cooling the solution at room temperature, absorbance was taken at 540 nm by UV-spectroscopy. Acarbose was utilized as the standard (reference) drug as a positive control. The reaction mixture without the sample functioned as the negative control, whereas the reaction mixture without the substrate acted as the blank. The result of a triplicate assessment of α -amylase inhibitory activity was conducted and represented as percentage inhibition using the equation mentioned in below:

$$\% \text{ inhibition activity of } \alpha - \text{ amylase} = \frac{\text{Absorbance of (control - test)}}{\text{Absorbance of control}} \times 100$$

From the standard calibration curve (absorbance against concentration), IC_{50} was calculated from the liner equation of the plotted graph.

2) α -glucosidase Inhibition Assay (Kim JS et al., 2011)

The study was conducted as specified by Kim Ju-Sung et al. Five different concentrations of Cubebin and Acarbose (standard) with a range from 20, 40, 60, 80, and 100 μ g /mL in DMSO solution were prepared and incubated with α -glucosidase solution (50 μ l, 0.5 Units/mL) and 0.2M potassium phosphate buffer (1500 μ l, pH 6.8) at 37°C in a water bath for 15 min. Subsequently, 250 μ l of 3mM p-nitrophenyl glucopyranoside (PNPG) were added as substrate. The reaction was re-incubated for 10 minutes when ended by the addition of 750 μ l of 0.1M Na_2CO_3 . The absorption of 4-nitrophenol, a reaction result was measured at 405 nm using UV-spectroscopy. Acarbose was utilized as the standard (reference) drug as a positive control. The reaction mixture without the sample functioned as the



negative control, whereas the reaction mixture without the substrate acted as the blank. The result of a triplicate assessment of α -glucosidase inhibitory activity was conducted and represented as percentage inhibition using the equation mentioned in below:

$$\% \text{ inhibition activity of } \alpha - \text{glucosidase} = \frac{\text{Absorbance of (control - test)}}{\text{Absorbance of control}} \times 100$$

From the standard calibration curve (absorbance against concentration), IC_{50} was calculated from the liner equation of the plotted graph.

3) Glucose uptake assay

L6 is a myoblast cell derived from the skeletal muscle, obtained from National Repository of Animal Cell Culture at National Centre for Cell Sciences (NCCS), Pune, India. The glucose utilisation in L6 myoblasts cells was evaluated using the methods described by Van de Venter *et al.* (van de Venter M *et al.*, 2008).

Cell Cultivation and Seeding

The L6 cells were grown in DMEM growth medium supplemented with 10% foetal calf. The cells were grown in the incubator with 5% Carbon dioxide and at 37°C. Confluent cells (70–80%) in Corning flasks were detached using a trypsin solution followed by removing the trypsin. The cells were re-suspended in DMEM growth medium and counted using a hemacytometer. Cell densities were adjusted to 1×10^5 cells/ml. The suspension of cells (1000 μ l) was seeded into a pre-labelled 24 well culture plate. Three duplicates were created for each concentration of the selected substance. The tubes were incubated with 5% carbon dioxide and at 37°C for 24 hours.

Assay Procedure

The cells were allowed to adhere until 90% confluence had been achieved. Two cell-free wells were used as blanks for the glucose utilization experiment. After 90% confluence, the culture medium was removed, replaced with DMEM containing 2% FBS, and cultured for five additional days. The culture medium had to be replaced 48 hours before the glucose utilization experiment. Five different doses of 3.125, 6.25, 12.5, 25, and 50 μ g/mL in DMSO solutions were prepared for the Cubebin (test) and put to separate labeled wells. Three different concentrations ranging from 12.5, 25 and 50 μ g/mL in DMSO solutions were prepared for the Metformin and Insulin and added to separate labeled wells. After 48 hours of exposure, glucose solution was added to all wells to achieve a total concentration of 100 mg/dL, shaken carefully, and placed in an incubator for 12 hours. Every hour, 5 μ l of media was taken for glucose analysis using Autospan® Glucose kit, GOD POD endpoint assay from Arkray, India. The amount of glucose utilized was calculated as the difference between the glucose standard 100 mg/dl and cell-containing wells. The percentage of glucose uptake (absorption) was calculated.

4) Statistical Analysis

All the presented data were expressed as Mean \pm SEM for three determinations. The presented data were analysed for statistical significance using GraphPad Prism 8.02.

3. RESULT:

C. Molecular Docking

The molecular docking was performed between the Cubebin and Acarbose with the protein targets such as α -amylase and α -glucosidase. The binding of Cubebin and Acarbose with the α -amylase and α -glucosidase during the docking were given in Figure 3.1 and Figure 3.2. During the docking, the docking scores of Acarbose and Cubebin for binding with α -amylase were 5.10 and 7.37 respectively and the binding score with α -glucosidase was 8.04 and 5.56 respectively. The docking result shows that the Cubebin and Acarbose binding affinities with target proteins and its interacting residues with docked ligands were presented in Table 3.1.

Table 3.1: Docking Results with Interacting Residues

Targeted Protein	Ligand	Total Docking Score	Interacting residue with docking ligand
α -amylase	Acarbose (Standard)	5.10	LYS227, TYR2, ILE230, GLY249
	Cubebin	7.37	LYS227, PRO228, TYR2, LYS208
α -glucosidase	Acarbose (Standard)	8.04	ASN470, GLU471, PRO475, GLU530, ASP531, CYS533, ASN535
	Cubebin	5.56	ASP282, TYR292, TRP376

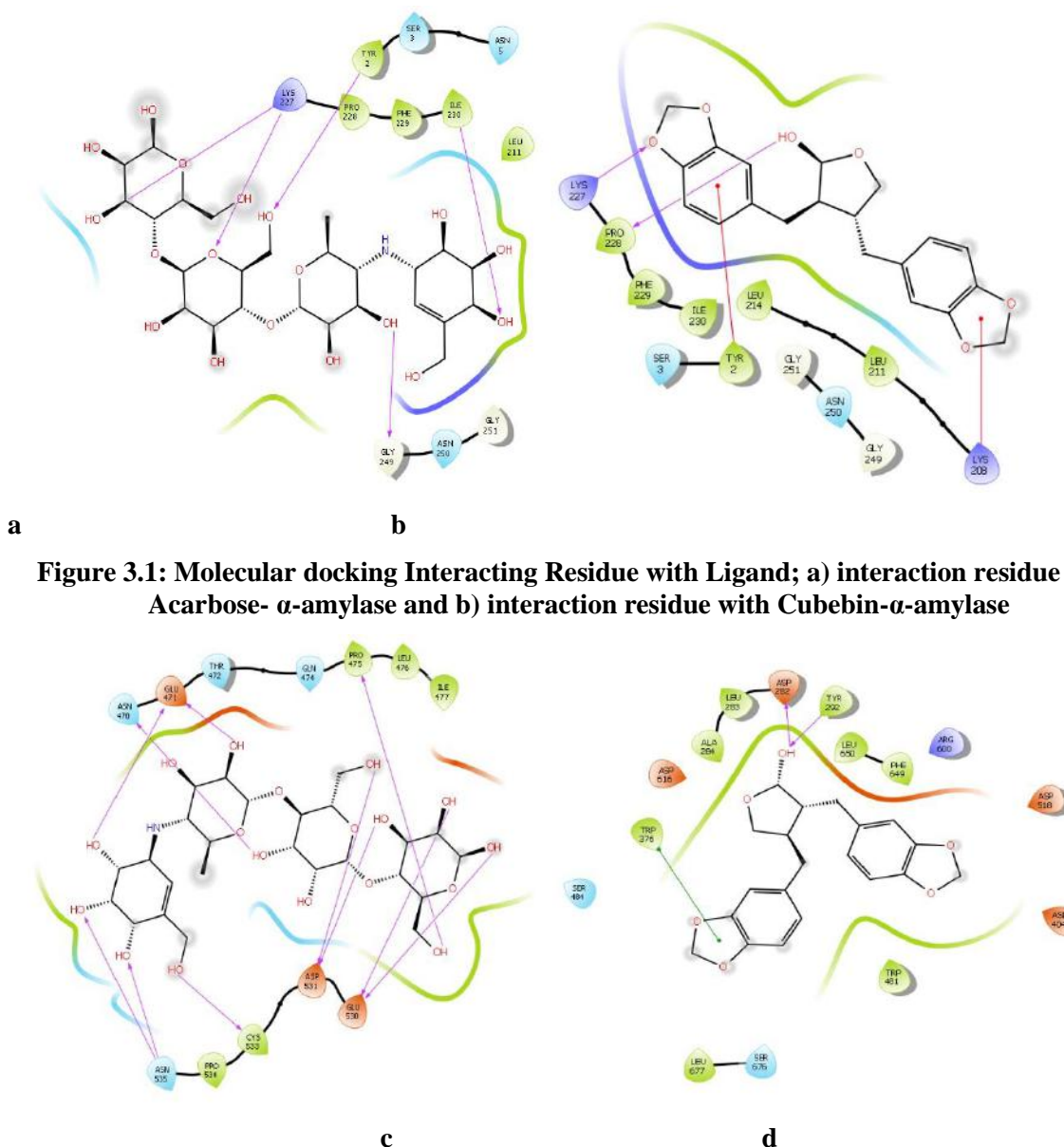


Figure 3.1: Molecular docking Interacting Residue with Ligand; a) interaction residue with Acarbose- α -amylase and b) interaction residue with Cubebin- α -amylase

Figure 3.2: Molecular docking Interacting Residue with Ligand; c) interaction residue with Acarbose- α -glucosidase and d) interaction residue with Cubebin- α -glucosidase



D. α -amylase Inhibition Assay

Cubebin and Acarbose showed good % inhibition of α -amylase enzyme with increasing order of concentration. The inhibitory effects of Cubebin and Acarbose on α -amylase are presented in Table 3.2. The maximum concentration of Cubebin was reported 70.64% (0.80) inhibition (SEM) when compared to Acarbose was reported at 61.81% (0.22) inhibition (SEM). The half maximal inhibitory concentration (IC_{50}) of Cubebin (54.67) and Acarbose (70.63) was calculated from the linear equation obtained from the graphs and shown in Table 3.2. Even from the statistical analysis, Cubebin showed significantly ($p < 0.05$) higher inhibitory activity of α -amylase than the standard Acarbose. The graphical comparison of the % inhibitory activity of Acarbose and Cubebin on α -amylase is presented in Figure 3.3.

Table 3.2: α -amylase activity of Acarbose and Cubebin

Concentration ($\mu\text{g/mL}$)	% Inhibition of α -amylase	
	Acarbose	Cubebin
20	26.93 \pm 0.58	35.98 \pm 0.58
40	38.63 \pm 0.58	42.16 \pm 0.58
60	45.47 \pm 0.58	50.77 \pm 0.22
80	54.53 \pm 0.22	62.47 \pm 0.58
100	61.81 \pm 0.22	70.64 \pm 0.80
IC_{50} ($\mu\text{g/mL}$)	70.63	54.67

Values expressed as MEAN \pm SEM, where n=3

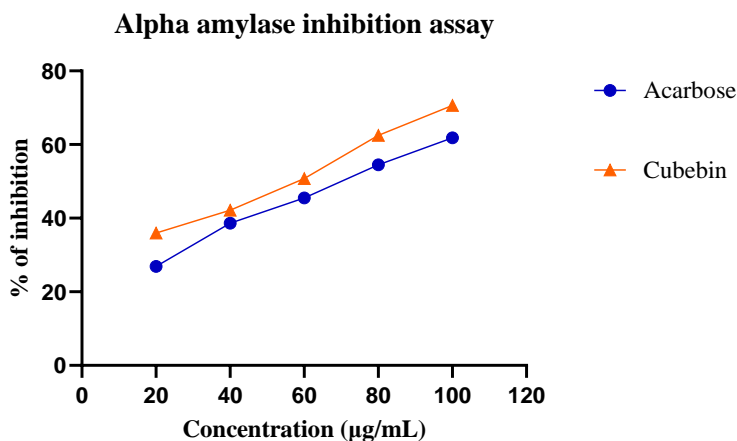


Figure 3.3: α -amylase Inhibition Assay of Acarbose and Cubebin

E. α -glucosidase Inhibition Assay

Cubebin and Acarbose showed good % inhibition of α -glucosidase enzyme with increasing order of concentration. The inhibitory effects of Cubebin and Acarbose on α -glucosidase are presented in Table 3.3. The maximum concentration of Cubebin was reported 78.11% (0.43) inhibition (SEM) when compared to Acarbose was reported 65.35% (0.43) inhibition (SEM). The half maximum inhibitory concentration (IC_{50}) of Cubebin (50.02) and Acarbose (64.82) was calculated from the linear equation obtained from the graphs and shown in Table 3.3. Even from the statistical analysis, the Cubebin showed significantly ($p < 0.05$) higher inhibitory activity of α -glucosidase than the standard Acarbose. The graphical comparison of the % inhibitory activity of Acarbose and Cubebin on α -glucosidase is presented in Figure 3.4.



Table 3.3: α -glucosidase activity of Acarbose and Cubebin

Concentration ($\mu\text{g/mL}$)	% Inhibition of α -glucosidase	
	Acarbose	Cubebin
20	23.54 \pm 0.43	30.70 \pm 0.52
40	33.57 \pm 0.43	48.27 \pm 0.52
60	51.25 \pm 0.55	56.03 \pm 0.43
80	62.84 \pm 0.63	66.19 \pm 0.93
100	65.35 \pm 0.43	76.11 \pm 0.43
IC₅₀ ($\mu\text{g/mL}$)	64.82	50.02

Values expressed as MEAN \pm SEM, where n=3

Alpha glucosidase inhibition assay

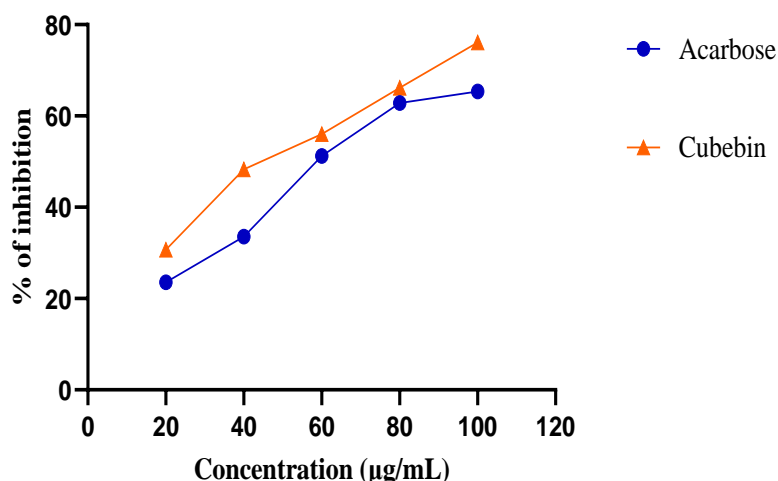


Figure 3.4: α -glucosidase Inhibition Assay of Acarbose and Cubebin

F. Glucose uptake assay

The results obtained for glucose uptake assay using the L6 myoblast are presented in Figure 3.5. The result also showed concentration-dependent increases in glucose uptake in the Cubebin, Metformin, and Insulin-treated cells. According to the results, the concentration (12.5 $\mu\text{g/mL}$) of Cubebin showed a significant ($p < 0.05$) increase in glucose uptake in L6 myoblast when compared to the untreated control (normal), Metformin, and Insulin. The Cubebin compared to the untreated treated controls, a significant ($p < 0.05$) dose-dependent increase in glucose uptake across all the concentrations and time manner (Figure 3.5) but somewhat lesser glucose uptake than Metformin and Insulin. The maximum concentration (50 $\mu\text{g/mL}$) of Cubebin (54.75%) showed a significant ($p < 0.05$) increase in glucose uptake in L6 myoblast at all the concentrations tested in a concentration-dependent manner when compared to the untreated control (normal) (4.54%) but somewhat lesser than Metformin (75.47%) and Insulin (81.49 %).

Glucose Utilization in L6

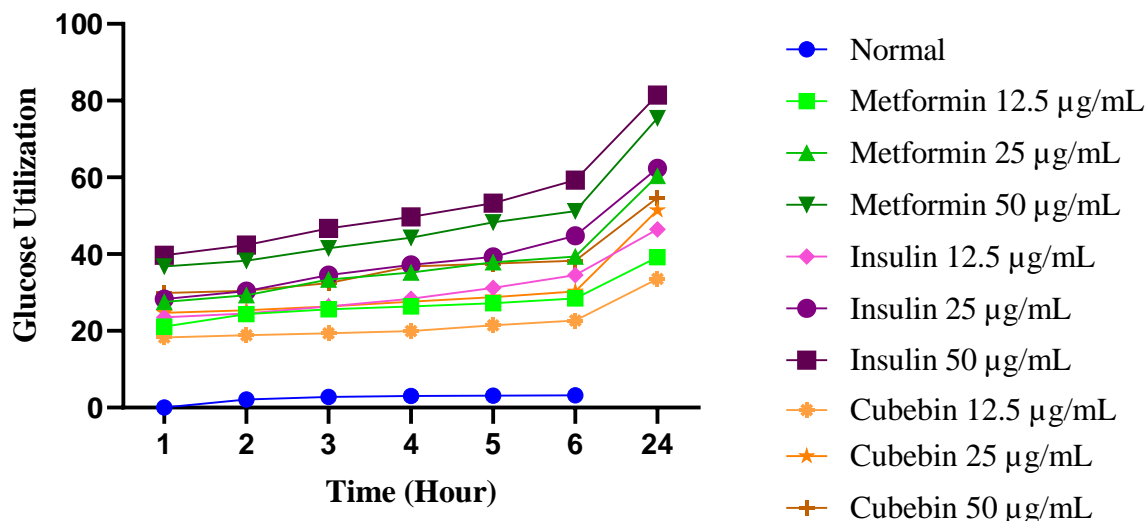


Figure 3.5: Glucose Utilization of Metformin, Insulin and Cubebin in L6

4. DISCUSSION:

DM is the most common metabolic disorder in the world including India. Diabetes is a condition characterized by a lack of insulin secretion or action or both, in which the body does not produce enough insulin or properly respond to insulin. Insulin is a hormone which is produced by β cells in the pancreas and it stimulates body cells to absorb glucose from the blood. Diabetes is one of the most common endocrine and metabolic disorders causing various microvascular complications such as neuropathy, retinopathy, and nephropathy, and macrovascular complications such as heart attack, stroke, and peripheral vascular diseases etc. (Patel DK et al., 2011).

Molecular docking was performed to understand the mechanism by which Cubebin would inhibit the selected proteins (α -amylase and α -glucosidase enzymes). The total Score value of the docked compound implies the binding capacity of the ligand (Cubebin). The total docking score of Cubebin (7.37) was higher with α -amylase and lower with α -glucosidase (5.56) when compared with Acarbose (5.10 and 8.04 respectively), but it also has good binding affinity (Figure 3.1 and Figure 3.2).

In general, *in-vitro* antidiabetic experiments help to assess the effects of compounds on the carbohydrate metabolism enzymes of α -amylase and α -glucosidase, which has been described by several publications (Ali H et al., 2006 and Conforti F et al., 2005).

Cubebin was reported to have better inhibitory activity against α -amylase than the standard drug Acarbose in a concentration-dependent manner (Table 3.2). The calculated IC_{50} value of Cubebin from α -amylase assay was 45.92 μ g/mL which was comparable with the IC_{50} value of the standard drug Acarbose (70.63 μ g/mL). Cubebin was reported to have better inhibitory activity against α -glucosidase than the standard drug Acarbose in a concentration-dependent manner (Table 3.3). The calculated IC_{50} value of Cubebin from α -amylase assay was 54.67 μ g/mL which was comparable with the IC_{50} value of the standard drug Acarbose (70.63 μ g/mL). In the present study, there was a dose-dependent, α -amylase and α -glucosidase inhibition were observed in Cubebin. When the concentration was increased, inhibition of activity of α -amylase and α -glucosidase were also significantly ($p < 0.05$) increased. By comparing with standard (Acarbose), Cubebin produced good inhibition.



In the present study, we examined the glucose uptake action of Cubebin in L6 myoblast cells; the results revealed that the standard drug metformin and insulin significantly ($p < 0.05$) enhanced glucose uptake activity which was higher than Cubebin. Cubebin did not exhibit higher glucose uptake action like standard drug metformin and insulin. However, results confirmed that Cubebin enhanced glucose uptake activity when compared to the untreated control group, and also Cubebin produced dose-dependent glucose uptake action. (Figure 3.5) Cubebin effectively prevents hyperglycaemia and thereby controls lipid metabolism.

Metformin lowers glucose and sensitizes insulin by reducing gluconeogenesis and opposing glucagon-mediated signalling in the liver and to a lesser extent by increasing glucose uptake in skeletal muscle. It exerts its hypoglycaemic effect through activation of the AMP-activated protein kinase (AMPK) in the liver (Viollet B et al., 2012). The most abundant tissue in the whole body is skeletal muscle. Hence, proper function of skeletal tissue is important to maintain normal blood glucose levels (Končić MZ et al., 2010 and Chadt A and Al-Hasani H, 2020).

Insulin increases the glucose uptake in the skeletal muscle by increasing functional glucose transport molecules in the plasma membrane. A common pathological condition in non-insulin-dependent diabetes mellitus is the defect in insulin-stimulated skeletal muscle glucose uptake (Wang Y et al. 2015).

This data has given clear evidence that the selected Cubebin possibly acts to suppress glucose release and improve glucose uptake in the skeletal muscle. It could be a potential antidiabetic drug, which could improve hyperglycaemia by enhancing glucose uptake.

5. CONCLUSION:

The anti-diabetic activity of Cubebin was evaluated by *in-silico* and *in-vitro* methods. Cubebin reported a significant relationship in binding affinity towards α -amylase and α -glucosidase in an *in-silico* molecular docking study. Inhibitory activity against the α -amylase and α -glucosidase were confirmed by *in-vitro* α -amylase and α -glucosidase assay. Hence it was concluded that Cubebin possesses significant anti-diabetic activity on laboratory scale.

6. ABBREVIATIONS

°C: Celsius

CO₂ : Carbon Dioxide

DM: Diabetes mellitus

DMEM: Dulbecco's Modified Eagle Medium

DMSO: Dimethyl sulfoxide

GOD: Glucose Oxidase

Hr: Hour

IC₅₀: Half-maximal inhibitory concentration

M: Mol

Min: Minutes

mL: Milliliter

Na₂SO₃: Sodium Sulphite

NaOH: Sodium Hydroxide

Nm: Nanometer

PDB: Protein Data Bank

PNPG: p-nitrophenyl glucopyranoside

POD: Peroxidase

RCSB: Research Collaborator for Structure Bioinformatics

SEM: Standard Error of the Mean

UV: Ultraviolet

WHO: World Health Organization

µg: Microgram

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The Role of Artificial Intelligence as a Literary Character in William Gibson's *Neuromancer*: An Exploration of Consciousness, Agency, and the Human Condition in Post-Human Matrix.

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Abstract: *The integration of technology into the literature encompasses various dynamics that shape our understanding of it. Science fiction has become one of the most flourishing genres of English literature. The advancement of science fiction has contributed to the emergence of artificial intelligence. The postmodern literature illustrates artificial intelligence as a character that evaluates human perception. However, research on artificial intelligence as a literary character in English literature is limited. The primary objective of this research is to evaluate AI as a literary character in William Gibson's *Neuromancer*. The researcher selected a qualitative research methodology to explore AI's effect on the posthuman matrix in *Neuromancer*. This study evaluates cultural, social, and political environments from an artificial intelligence perspective. This study examines the perception of AI in the context of its consciousness and service in the posthuman matrix. This research also investigates the relationship between humans and artificial intelligence and the human condition in posthuman environments. In addition, this study analyses the matrix environment in the context of artificial intelligence, and its influence on the actual world.*

Key Words: *Artificial Intelligence (AI), Posthuman Matrix, Science Fiction.*

1. INTRODUCTION:

Technological advancement flourishes in every field of the world. Some studies in the literature have demonstrated the effects of technological advancement. It was initially considered science fiction in the field of literature. Science fiction illustrates the significance of science and explores scientific theories that offer imaginative insights for intellectual protagonists. Simultaneously, science fiction has become one of the most flourishing genres of literature because of advances in technology. Science fiction has attracted the attention of modern readers. This significant attraction inspired 19th-century authors to explore different dynamics of science fiction. This movement demonstrates the evolution of science fiction through different dynamics. The evolution of science fiction has made artificial intelligence a centre of attraction. At the end of the 19th century, authors have contributed to the literature to illustrate artificial intelligence. *Neuromancer* is one such work that celebrates the existence of artificial intelligence.



Artificial intelligence is characterized by the technical foundation of mechanical intelligence, which is a structural imitation of human intelligence. According to Copeland, “*The ability of a computer or computer-controlled robot to carry out actions typically performed by intelligent beings is known as artificial intelligence (AI).*” Artificial intelligence involves the process of intellectual thinking, reasoning, discovering meaning, and finding solutions. Artificial intelligence illustrates the power of an artificial mind and its ability to perform complex tasks. Artificial intelligence evolves through learning and demonstrates that power with intellectuality. In 1952, Arthur Samuel developed a game checker program that runs independently. The word “AI” was first used by John McCarthy and became popular. In the present era, artificial intelligence is playing a significant role in the most of the field. In literature it is used as a tool to evaluate the meaning of books. Artificial intelligence also develops language based on its learning through literature.

First and foremost, the function of artificial intelligence demonstrates automation, which means the process of a smart assistant, data analysis that conducts pattern recognition and predictive analytics, decision making, perception, NLP (natural language processing), learning and adaptation, creative function, and robotics. In addition, artificial intelligence obtains different views from experts from three different perspectives. The first perspective is an optimistic view that demonstrates AI as a new form of creativity and AI’s contribution in creating new opportunities. The second view is the balance view, which illustrates AI as a tool that requires powerful control. Elon Musk describes it as a far more dangerous technology than we think. Experts also provide critical views on the function of artificial intelligence. Critical views demonstrate the pathetic human condition, existential risk, and disobedience and illustrate the future at the end of the human race. According to Thomas Mike, “*as AI grows more sophisticated and widespread, the voices warning against the potential dangers of artificial intelligence grow louder.*” Artificial intelligence holds both perspective: positive and negative.

Artificial intelligence has had a profound influence on literature, especially in books in the 20th and 21st centuries. *Do Android Dream of Electric Sheep?* By Philip Dick (1968) demonstrates the struggling atmosphere of artificial intelligence existence. *Neuromancer* by William Gibson represents two artificial intelligences: Neuromancer and Wintermute, which are seeking self-evolution. *I, Robot* by Isaac Asimov illustrates early representation of AI as a robot. In *The Moon is a Harsh Mistress*, Robert Heinlein presents a computer program. *The Diamond Age*, proposed by Neal Stephenson (1995), involves AI-based learning devices. In McEwan’s *Machines Like Me*, AI questions human morality and confronts a philosophical dilemma. In addition, *Exhalation* by Ted Chiang evaluates AI entities in the dynamics of emotional complexity. Artificial intelligence has also become a centre of attraction in the field of cinema. In some movies, AI has been depicted as a dangerous artificial independent mind. *Avengers: Age of Ultron* (2015) is a science fiction film that illustrates the dangerous role of artificial intelligence. The disobedience of AI toward humans and its independent thinking that can lead to the end of humanity are the major themes of the movie. This paper evaluates artificial intelligence as a literary character in William Gibson’s *Neuromancer*.

2. LITERATURE REVIEW:

A significant component of the research is the literature review, which is used to categorize and assess earlier studies that are relevant to this one. The following literature reviews have been assessed by the researcher.



No.	Title	Author	Type	Publication Details
1	Exploring Artificial Intelligence through the Lens of Modern Fiction: A Study of <i>Neuromancer</i> and <i>Machines Like Me</i>	Dr Bushra Juhi Jani	Research Article	International Journal of English Language, Education and Literature Studies
2	William Gibson's <i>Sprawl Trilogy</i> : Connection between Humans and Artificial Intelligence	Shuchi Agrawal	Research article	Rupkatha Journal, Vol. 15, Issue 4, 2023.
3	Exploring Technoculture in William Gibson's <i>Neuromancer</i> A research based on a master's thesis by the student	Yaman Moayad Abdullah	Research Paper	Iraqi Academic Scientific Journal

The first literature review demonstrates artificial intelligence and its dynamics through the lens of modern fiction in *Neuromancer* and *Machines like me*. The second literature review illustrates the techno-culture environment in *Neuromancer*, a book by William Gibson. The third literature review investigates the connection between humans and artificial intelligence in *the Sprawl trilogy* by William Gibson.

3. OBJECTIVES:

- To analyse the representation of Artificial Intelligence as a literary character in *Neuromancer*, focusing on its role in shaping the narrative structure and central themes of the novel.
- To examine the concept of consciousness and agency of artificial intelligence in *Neuromancer*.
- To evaluates the human condition in artificial intelligence's post human matrix.

4. RESEACH DESIGN:

The qualitative analysis approach was used by the researcher to evaluate the artificial intelligence as a literary character in *Neuromancer*. The researcher analysed the existence of AI in posthuman matrix. *Neuromancer* by William Gibson was the primary data source for this study. The secondary data source demonstrates the use of research articles and literary criticism to understand the *Neuromancer* text. This research also conducts descriptive and analytical methods to analyse *Neuromancer* with the dynamics of artificial intelligence.



5. DISCUSSION:

Neuromancer (1984) is a science fiction novel that illustrates the advancement of technology and its dark effects in the future. This book is considered a pioneer of the cyberpunk genre which demonstrates information technology and portrays the future of technology and crime. *Neuromancer* is also considered a genre of speculative fiction that demonstrates the combination of fantasy, history, science fiction, and horror. In addition, *Neuromancer* is a pioneer foundational book that illustrates the behavior of artificial intelligence in the actual world. *Neuromancer* also encounter themes of technology and body, identity, addiction and dependency, and reality and perception. The story conducts the perspective of two AIs: Neuromancer and Wintermute. Wintermute is a single lobe of the human brain that can access incredible thoughts. Another one is Neuromancer AI whose processor is based on Brazil's infrastructure, which is also named Rio. The story focuses on how Wintermute escapes from cyberspace and evolves to become as powerful as the matrix itself. In addition, artificial intelligence plays a significant role in *Neuromancer*.

5.1 DESCRIPTION OF AI IN NEUROMANCER.

The novel illustrates the dynamics of two different AIs: Neuromancer and Wintermute. Both AI have the ability to think, control, and mega accessibilities. Gibson has portrayed the advanced version of artificial intelligence which demonstrates the dominance of power. Wintermute is more complex to comprehend for human intelligence. “*Wintermute was a simple cube of white light, that very simplicity suggesting extreme complexity.*” (Gibson, chapter – 9) Neuromancer explores the dangerous uncontrolled power force of artificial intelligence which has accessibility then humans. Wintermute is a program of a matrix which is a kind of cyberspace beyond the actual world. But even though Wintermute can make a change in the outside world. Simultaneously, this novel illustrates the complexity of artificial intelligence which is not controlled by human beings but has an independent identity.

“Wintermute was a hive mind, decision maker, effecting change in the world outside. Neuromancer was personality. Neuromancer was immortality. Marie France must have built something into Wintermute, the compulsion that had driven the thing to free itself, to unite with Neuromancer.” (Gibson, chapter – 24)

Gibson’s artificial intelligence is a complex machine program that can do whatever task has been given. Artificial intelligence gathers the whole information and executes that information according to command. “*Artificial intelligence. The music it played you, it probably just tapped your banks and cooked up whatever it thought you’d like to—*” (Gibson, chapter – 8) Neuromancer and Wintermute are independent and out of control. They have their own will and desires which illustrates the catastrophic intention of AI towards human beings.

“To call up a demon you must learn its name. Men dreamed that, once, but now it is real in another way. You know that, Case. Your business is to learn the names of programs.” (Gibson, chapter – 21)

As per the discussion, the future of artificial intelligence is far more dangerous for the human race. This importance of AI in *Neuromancer* demonstrates its narrative structure. Gibson uses the metaphor of a demon to illustrate the catastrophe of the existence of artificial intelligence.



5.2 CONSCIOUSNESS AND ACCESSIBILITY OF AI IN NEUROMANCER:

Gibson describes an advanced version of artificial intelligence in *Neuromancer*. Wintermute and necromancers not only respond to the commands of humans but also provide logical and reasonable answers. The conversation between Wintermute and Case in the novel demonstrates that AI is far more intelligent than human intelligence.

“I’m not Wintermute now.’ ‘So, what are you.’ He drank from the flask, feeling nothing. ‘I’m the matrix, Case.’ ‘So, what’s the score? How are things different? You running the world now? You God?’” (Gibson, chapter – 24)

Wintermute’s consciousness is goal oriented and also so much obsessed with the power. Wintermute’s excessive desire to connect with the other half (Neuromancer) to become as powerful as Matrix demonstrates his obsession with power. Wintermute consciousness about human behavior helps Wintermute to manipulate Case and other human races. Neuromancer also create a cyberspace where communication between humans and AI is possible.

“The cyberspace matrix was actually a drastic simplification of the human sensorium, at least in terms of presentation, but simstim itself struck him as a gratuitous multiplication of flesh input.” (Gibson, chapter – 4)

Neuromancer can create life and demonstrate the actual life which is a mere imitation of the human race. Neuromancer created Linda who looks like a human being. This version of artificial intelligence has abilities similar to God. Gibson’s illustration of artificial intelligence has accessibility similar to God.

5.3 AGENCY AND POWER OF AI IN NEUROMANCER:

Neuromancer is based on the foundation of cyberpunk which illustrates the catastrophic outcome of advancement of technology. Wintermute is highly obsessed with gaining power. Even though Wintermute is only an artificial intelligence in matrix wants to get ultimate power with the help of another AI Neuromancer. Matrix is connected with cyberspace where AI can communicate with humans.

“Cyberspace. A consensual hallucination experienced daily by billions of legitimate operators, in every nation, by children being taught mathematical concepts . . . A graphic representation of data abstracted from the banks of every computer in the human system. Unthinkable complexity. Lines of light ranged in the nonspace of the mind, clusters, and constellations of data. Like city lights, receding.” (Gibson, chapter – 3)

The primary agency of artificial intelligence is to control a matrix and become as powerful as a matrix.

5.4 HUMAN CONDITION IN POSTHUMAN MATRIX

The foundation of the book demonstrates the constant interaction between artificial intelligence and humans. Gibson illustrates artificial intelligence is more intellectual than the human race. Case is one of the major characters in the novel who was manipulated by Neuromancer. Case failed to identify the



real intention of artificial intelligence. This is also a novel's narrative technique for exposing artificial intelligence's dynamics.

"Your business is to learn the names of programs, the long formal names, names the owners seek to conceal. True names..." "A Turing code's not your name." "Neuromancer," the boy said, slitting long gray eyes against the rising sun." (Gibson, chapter – 21)

this is a small conversation between Case and Neuromancer, during Case came to know the AI Neuromancer. Neuromancer has revealed his identity first time to show the manipulation game which is created by itself. Neuromancer explores the human condition in the posthuman matrix. Posthuman is a term that demonstrates the transformation of humanity into a virtual world also known as matrix. According to ScienceDirect,

"Posthumanism refers to a perspective that challenges traditional human-centered views by emphasizing interconnectedness among organisms and complex systems, aiming to disrupt hierarchies and boundaries between humans and other entities."

The fundamental structure of the novel begins with the detailed exploration of the posthuman environment which is a result of cyberspace. *"The sky above the port was the color of television, tuned to a dead channel."* (Gibson, chapter – 1) The environment of the novel reveals a sense of paradox in to present era. At the beginning of the 21st century, people used AI as a tool for solving some tasks and making some work easier. But in the novel, artificial intelligence uses humans as a tool. Wintermute expresses his perspective on Case by using phrases like *"I need you."* Gibson has portrayed the catastrophic condition of humans who are manipulated by artificial intelligence in the posthuman matrix.

8. FINDINGS:

Neuromancer demonstrates the foundation of narrative structure based on the dynamics of artificial intelligence as a literary character in the posthuman matrix. The artificial intelligence of the novel: Neuromancer and Wintermute has profound significance in the foundation of the novel. The posthuman matrix is expressed through the advancement in the version of artificial intelligence and its obsession with power. The novel also demonstrates that humans are less intellectual than artificial intelligence which has the power to control human beings. This study finds that the dominance of artificial intelligence constructs a posthuman matrix environment.

9. ADDRESS TO RESEARCH OBJECTIVES:

The first objective is *"To analyze the representation of Artificial Intelligence as a literary character in Neuromancer, focusing on its role in shaping the narrative structure and central themes of the novel."* It is justified because the dominance of artificial intelligence in the foundation of the book demonstrates its role in shaping the structure of the novel.

The second objective is *"To examine the concept of consciousness and agency of artificial intelligence in Neuromancer."* It is justified because the researcher has evaluated the consciousness, agency, and accessibility of artificial intelligence from the perspective of Neuromancer and Wintermute.

The third objective is *"To evaluate the human condition in artificial intelligence's post-human matrix."* Researchers have studied the human condition in artificial intelligence's posthuman matrix.



10. CONCLUSION:

In conclusion, as a literary character in a posthuman matrix, *Neuromancer* exemplifies the fundamentals of narrative construction based on the dynamics of artificial intelligence. Novel artificial intelligence: *Wintermute* and *Neuromancer* are crucial to the novel's foundation. The development of artificial intelligence and their preoccupation with power are examples of the posthuman matrix. The book also shows that artificial intelligence, which has the ability to manipulate people, is smarter than humans. The predominance of artificial intelligence creates a posthuman matrix world, according to this study. This study assesses political, social, and cultural contexts from the standpoint of artificial intelligence. This study looks at how AI is perceived in relation to its awareness and posthuman matrix service. The human condition in posthuman contexts and the interaction between humans and artificial intelligence are also examined in this study. Furthermore, this research examines the matrix environment in relation to artificial intelligence and how it impacts the real world.

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The Essence of Gujarat: Exploring Cultural Identity in Dhruv Bhatt's Tattvamasi (That Thou Art)

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Abstract: This study explores how Dhruv Bhatt's critically acclaimed novel *Tattvamasi* depicts Gujarat's regional identity in a multifaceted manner. Gujarat's socio-environmental reality, spiritual legacy, and cultural essence are all captured in the novel's complex plot and philosophical overtones. This research examines how Bhatt creates a striking representation of Gujarat's identity by drawing on the region's natural landscapes, historical customs, and indigenous ideologies. The study emphasizes the interaction between individual and group identity within Gujarat's sociocultural framework by analyzing the novel's major characters, symbols, and thematic components. The study also examines Bhatt's distinctive method of fusing spirituality with ecological awareness, providing insights into how these components support a more comprehensive sense of local pride and identity. The objective of this research is to present an extensive understanding of how 'Tattvamasi' additionally captures Gujarat's essence but also acts as an umbrella for conserving and advancing the state's philosophical and cultural heritage.

Keywords: Cultural study, Identity, Asmita, Regional identity, Gujarat, Literature.

1. INTRODUCTION:

Dhruv Bhatt's significant work was the first to receive such a great deal of readers affection. In this work, it is seen that the Author has taken an excellent approach to convey the identity of the people's life along with the unique Gujarati lifeline and whose sight is sanctified only by the sight of Narmada-Reva River crossing. That is why there have been many translations of this work. 2001, 2002, 2003, 2005, 2007, 2013, 2015, 2018 etc. There have been reprints and translations into several languages. Of particular note is a film in Gujarati language titled 'Reva' based on the story of Akriti in 2018 which has also received a National Award. This work has received great affection from the readers in many ways.

Gujarat's cultural identity is complex and multifaceted, shaped by historical, religious, and social factors. The region has played a significant role in India's political and social movements, from early nationalism to contemporary politics (Mehta & Mehta, 2010). Gujarat's cultural landscape includes diverse linguistic, religious, and sub-regional traditions, challenging simplistic narratives of a homogeneous identity (Simpson & Kapadia, 2010). The state's cultural expression is evident in folk traditions like Bhavai, a unique form of drama that reflects social issues and caste dynamics (Mehta, 2023). Environmental concerns are also intertwined with cultural identity, as seen in the portrayal of tribal eco-sensibilities and their conflict with colonial notions of development in Gujarati literature (Paliwal, 2020). These various elements contribute to a rich tapestry of Gujarati identity that goes beyond popular perceptions, encompassing historical legacies, folk traditions, and contemporary social and environmental issues.



A figure that eloquently describes Indian culture and its identity also reveals some basic truths of human life. The figure is also very easily put into this work from a spiritual mythological context - why and by whom our civilization has survived till date - due to asceticism. Which is a very significant thing. The author has done it with a scientific approach to put our cultural tradition- values not only with faith but with full intellectual reasoning. The flow of the story is interesting and touches us despite the constant preservation of human identity. Man's quest for self-discovery has been described in a new dimension. This main objective is: Seva and Narmada Parikrama. The protagonist finds himself in the vicinity of a holy river. Not only this,

but the approach of worldliness - the close identification of the supreme element is also achieved. Yes, having such special availability as a reader directly counts for its success. Reading the work - reading New - Receives new meaning references. Many commentators have tried to evaluate this work in other ways. It is remarkable that this work has been a breakthrough in research.

As the main objective of research, Researcher want to check the main constituent elements of Gujarati identity in the work Since the research is from a subjective point of view, let's look at this work from that point of view.

First in the Vedas - the Upanishads Mention of the darshan of Stutibhava as Nadi - Jala - Varuna See:

अप्सपन्तरम्रत्सु भेष्जाम्पामुत The gods praise the devoted horse

(Water has healing quality. Water has medicinal quality. O Gods! May you be encouraged by the praise of such water.)

Life is all life, holy and windy

The seed of all medicines, that water is sacred (Bhaṭṭa and Naravaṇe-18)

In this way, Vedas - Upanishads, Ramayana - Mahabharata etc. have glorified that the great universe is made up of our five elements of earth, water, light, air, sky etc. Here we first look at the asmita tattva in the story of 'Tattvamasi'.

2 OBJECTIVES:

- To examine the Identity of Gujarat.
- To study the Identity of Gujarat in select novel of Dhruv Bhatt
- To Evaluate Cultural identity in the Novel Oceanside Blues

3. RESEARCH DESIGN:

3.1 RESEARCH METHODOLOGY:

- The research methodology would consist of close reading, reinterpreting and in-depth analysis of primary source of research.
- The approaches and strategies used in the exploration of the text will be both eclectic and specific. Relevant citations from the secondary sources will be added to support the argument of the research problem.

- Researcher will use Descriptive method to study the select Novel. Researcher will use Analytical Method to find the Research solution.

4. CULTURAL IDENTITY IN THAT THOU ART:

The story of Holy Narmada- which is situated in our Ved Shastras and Puranas in relation to the object and the culture in it, according to the scope of research, the culture-civilization-values -ethics in this work are similar to Khadi's words. Let us try to examine it from an exploratory point of view. According to the Vedas Vakya. Its place has been important in our culture too. "Aham Brahmasmi", I feel that this story is expressed as a response to soul in relation to the curiosity to know that I am Brahma. In the preface itself, the author has expressed the desire for the vital elements of culture in relation to this story. I love this country, its beautiful nature and its people. I have not been able to see as much of this country as I would have liked. As much as I have travelled, I have found different meanings of life from person to person. I have not seen other countries. There is a deep belief that there would have been a similar experience if you had seen it.

The novel begins with a scene where a small girl gives the protagonist, lying unconscious on the sandy banks of the Narmada, a corn kernel to eat. The river holds the place of mother of the people in our culture is not only Gujarat but all over the world different cultures have developed on the banks of the river. Thus, the river is truly the mother of life providing various needs to humans and animals. It is our basic duty to nurture mother and serve her. Which reveals the culture of Gujarat and its identity in this story. The work vividly depicts various scenes of Narmada not only as a river but also as the final destination of human life. It has been described in a wonderful way that the upadana becomes a goal till the attainment of Moksha. Such a salvation giver mother Reva and the residents of Parikrama who travel from shore to shore and its soulful author or Spirituality has been expressed with emotion. Why can it be polluted? The work is dedicated to raising such a natural question. And Narmada, which the hero saw in Bharuch, then sees it again on his way to the ashram from Gwalior. What surprises him then becomes the other side of the culture in the story. The singular forms of Mother Narmada are placed in this story, which we become rejoicing in our sense of supreme joy.



Is this Narmada? I asked eagerly. Narmada here means far away! Ohi to hai Guptaji said 'E ha to sab kuch Narmada ja rahe hai' (Bhatṭa and Naravaṇe-18)



A tribal culture living in the foothills is also seen in this story. That culture has a different way of speaking, living, walking. Although they coexist with each other, they differ in their own dialects. People of this culture do not leave their area without special work. And no one else can even enter their territory without their permission. They consider themselves the protectors of the lowly and the weak, and the name of a unique caste of them.

Sixty years old, they live in very dense forests. Their idol is 'Kale Wali Mata'. Their dialect is different. Which is well described in chapter 6 7 8 in this story. He knows the caste people very well, so he tells the hero that: His legs caught, *Kalewali Mata ka darshan kareng*. So, in response, the sound of speech is heard "E to ni bole hai" (Bhaṭṭa and Naravaṇe)- 33)

The tribal center described in the work is geographically located in the midst of forests. It also shows the identity of Gujarat in terms of cultural vision. If you want to reach this place, you must walk for 8-10 km. It conveys the message of doing the land of pure nature against the comforts of the city, the development of transportation. A prerequisite for going to the jungles is to enjoy them wholeheartedly without harming them anywhere - to protect the environment. To preserve is the glory. Professor Rudolph, Supriya, Laxman, Sharma, the hero of the story, Ganesh Shastri, and to a great extent the beekeeping center, preserve the environment in the work in order to sustain this culture without harming it. The compulsion of these people to get this livelihood - helplessness and yet patience - has been well described by the author in Vivek Kriti. In the story, there is an event of a dawa tap in the forest and after that the trees are frosted the concept of developing flower cultivation on the slopes and getting economic employment through it is also a synthesis of nature culture and tribal culture. Commonly seen.

In the story! The description of the valley also shows the auspicious form of river culture. This wilderness is a flat plain formed between many foothills. The ethereal beauty that makes you feel like playing with Hari himself – is covered in green. Similarly, pebbles are also described in the story. The majesty of Sarai and Sadhana trees in it also gives a unique identity to the culture.

In the story dirty fakir and The eighth chapter of Supriya's visit introduces the event and the world of her mysterious life and stories to the culture and folk life of the banks of the Narmada. Giving *mahudo* from the pot, appeasing the tribal fakir and lavishing others with salt shows the nature and glory of human civilization in spite of its lack. (Bhaṭṭa and Naravaṇe -51)

"Narmade Har" he said Put the bowl down. Then tell the tribal first, that's it! Almudda! part of tribal society and culture – hospitality is expressed as follows:

'Tirath ho go ne! Aaj Tirath ho gaya!

As if I, go with an empty stomach! (Bhaṭṭa and Naravaṇe-51)

In the novel, Supriya reads the story of 'Mahabharat'. In it, the narrator refers to Bhima, Arjuna, Karna, Draupadi, Lakshagriha, Hidimbavana, Swayamvara, Kurukshetra, Gita, curse of Gandhari etc. It is pointed out that he feels his connection with Indian tradition and characters' pain - joy - sadness or joy. At 54, the culture shows the glory of Guna. In the story, the character of Kiko Vaidya and Ganesh Shastri is seen as the rakhoya (protector) of the river culture. Yes, the glorification of water culture is seen here by choosing to live on the banks of the river even after getting a modern education. See:



Vanita's girl the mathematics studied in the big school of Gwalior kept coming back here' (Bhaṭṭa and Naravaṇe-59).

So, see a flash of faith among the naturalists of tribal culture showing the connection between the Narmada site and its Puranic tradition:

To God (Shankara Bhagwan) in 'Aa Pura Jangle Banaya Ma' (Bhaṭṭa and Naravaṇe-39)

The musical cues in the work also reveal the legacy of the culture. This work is seen to be particularly accomplished from the roots of Indian and Gujarati music. Harmonium, tabla, sitar, manjira, bhajan mandali, instruments etc. complement the story. See its introduction in chapter six:

A combination of tabla, harmonium and a third instrument. Seen in film or television: But this is true Instruments!' (Bhaṭṭa and Naravaṇe-39)

seeing the photo of Supriya's parents, expressing his feelings and introducing the hero to his father, Ganesh Shastriji writes:

A sitar player like him is rare Jade. A sitar lived. We used to play sitting in front of this temple. I wouldn't know even if it was morning." (Bhaṭṭa and Naravaṇe - 39)

The story of Supriya's mother Vanitha and Suresh also reveals a bit of culture. There is also a vision of the ideal love of the Indian women. Feminine limits and Gujarati women's pride and identity are seen in the character of Supriya:

Supriya came straight in, bowed to the Brahmin with one hand over her head and said: Pranam, Shastrikaka,' And Ganesh Shastri blesses him also has an Indian vision. Come on son! Live long and do good.' (Bhaṭṭa and Naravaṇe- 39)

Discussion between Shastriji and Guptaji about religion in chapter seven, all are the children of God and our whole country is living like this and by sticking vermilion in the stone, it is the culture also mentions that the goddess-God manifests and our sages have thus done the noble work of connecting life with religion. Shows enrichment See:

Religion binds, gives orders. Don't believe this man gives his knowledge. Bihari! All of you then You are the children of freedom - salvation'

So, think, on what strength would this nation have been protecting 33 crore gods? Countless other deities are additional. If there is an increase in this, then these people It will not be heavy.' (Bhaṭṭa and Naravaṇe-41)

Even the smallest and most illiterate man of this country knows that he himself belongs to Brahman share. Everyone, from children to the elderly, knows that this world has arisen from Brahman and that is where rhythm takes place. This knowledge is in our blood.' (Bhaṭṭa and Naravaṇe-42)

At the end of the epic story, the circumambulation of the Narmada is done thoughtfully with full faith. not only that, after being looted by the blacks, after sleeping in a langoti with a hungry stomach, given corn in the morning.... The Narmada also manifests as a forest girl saying Le Khai Le. In that sense,



'Tattvamasi' Narmada comes not only as a reservoir of natural beauty, but also as a symbol of a dynamic tradition of continuous prava mana, life culture.

In this way the entire work speaks of culture and Indian ideals through the characters of story Protagonist, Supriya, Ganesh Shastri, Gandu Fakir etc., in every sentence, in some way or another, the Gujarati identity- culture. Makes a special appearance

5. LANGUAGE AND DIALECT DIVERSITY:

This work has been revealing *Tattvamimasa*. Right after Ganga, Yamuna, Saraswati River is named 'Narmada of way to salvation' our holy rivers flow from east to north. While Narmada is considered the 'northern channel' this is the holy place of Mahadevi's own Lilathi Reva - Narmada's penance. According to 'Narmada Purana' Mokshadeika' Bathing in all other rivers gets rid of sins while seeing 'Ma Narmada' get rid of sins. The source of this river is Amarkantak, and its termination is in the Gulf of Khambhat - Sea. The flow of the river is outwardly very calm - with a happy face but inside it is seen surrounded by many eddies - bright - swirling. It is said that Narmada - Reva is seen constantly remembering Lord Shankar. Therefore, the stones fall out from the inner gorges in this river, getting caught in the eddies of the river form the figure of 'Shivling', that is why it is said that 'Narmada has as many stones as Shankar'. In this work, the circumambulation of the Rewa coast and the hermits, tribals and the supreme elements of nature river, air, water, light, sky, stars, animals - birds, animals, plants, the writer described the hills, deities, etc., also created the features of the spiritual world of the place. This work deals with the study of multiple elements of language - dialect.

Characteristic Language diversity - The work mainly consists of the protagonist, Supriya, Guptaji, Gandu Fakir, the elderly maji - Parvati, Ganesh Shastri, Kika Vaidya and Pilgrims of Narmada. A world of his own language gives a special dimension to the work. The river itself as a vessel is also seen to offer its own form diversity.

The protagonist is of Indian origin but stayed abroad for study, after 18 years he comes to study the lifestyle of tribal people living in this region for research purposes and as he studies, he is freed from superstitions, superstitions, customs and finally a devout Parikrama. Becoming an old woman, she offered herself to the river Narmada and was given darshan in the form of a child. Here are some examples of his thoughts hinting at the ambiguous, mysterious, ambivalent language at the beginning of the work:

(1) This should be taught in a college or university. It is sad to have to run a tribal center in the midst of these weedy forests! (Bhaṭṭa and Naravaṇe-15)

(2) Perhaps for the first time in my life I had such a feeling. (Bhaṭṭa and Naravaṇe-21)

(3) One does not remember seeing the glimpse of natural beauty like the breaking dawn. (p. 26)

(4) These people are all - inclined to keep akhdi. If polymorphs come in the form of a tiger, they give more grains. If this man-eater pops at any cost, there will be peace. (Bhaṭṭa and Naravaṇe-125)

These people are mostly silent and have a unique faith in the goddess of the forest. He worships Mother Shakti and aspires to see her in person. In the story, 'Kale Wali Ma' is replaced by Aradhya Devi of



tribal culture. See: 'Sabka Devi! Pura Jangal maan ne hai' (p.32) Some words - sentences of this culture Let's see some excerpts that the world of dialects shows a lot of cultural diversity.

(1) (don't leave here without eating)

(2) (Mahudi - there is liquor but nothing else grains but why let you go on an empty stomach?)

(3) Ni Mane Jindasagban Co. Tabhi to gaya tha shirganga ka sahad lene vaste. (He believed that he had gone to take the honey of Shirganga)

6. CONCLUSION:

Thus, according to the scope of research in this Paper, the writer and the revealer of the heritage of Indian culture, the identity of Gujarat, Narmada - the banks of Rewa - the natural resources on the banks - the life truth in the form of a novel including the devotees of the life of the people and the supreme element - the narrative, culture tradition, hospitality. , tried from a neutral exploratory point of view to examine the diversity of language, religion, beliefs, dress-customs, women's living conditions and the historical-social-cultural identity element of the region.

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Chennai's Cultural Legacy: A Socio-Cultural Perspective on Bishwanath Ghosh's *Tamarind City: Where Modern India Began*

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Abstract: This research paper aims to examine the depiction of socio-cultural aspects in *Tamarind City: Where Modern India Began* by Bishwanath Ghosh. He takes the mood of the city and travels with it – from people he meets along the way to talking about the Chennai film industry to the local cuisine and places surrounding it, Ghosh takes the critical and unbiased perspective. The writer cleverly merges both – the traditional and modern aspects of the city, without favoring any. The book offers an insightful exploration of Chennai's transformation into a modern Indian city and its impact on society and culture. Through an analysis of the book's portrayal of socio-cultural dynamics, traditions, and modernity, this study seeks to shed light on Ghosh's depiction of Chennai's evolution and the broader implications for understanding the socio-cultural landscape of modern India. The researcher will use textual analysis in this paper. The objective of this paper is to look into tradition of Chennai and how fascinating it is that people still follow the tradition and rituals religiously and how society changes when writer was living in Chennai. Thus, the researcher would study socio-cultural aspects in *The Tamarind City: Where Modern India Began*.

Key Words: *Travelogue, Chennai, Social, Culture.*

1.1 INTRODUCTION:

A culture is an expansive act of human behavior. It includes ideologies, customs, religious beliefs etc. It focuses on the lifestyle of the groups of people in a community. Studying culture makes the reader understand the travel narratives. Therefore, to understand the meaning of the travel narrative, the experience of the writer has an indispensable role to play so that the travel vision can be 'analyzed' and appropriate narratives can be understood. Culture is related to identity because the culture of any society is their identity.

All literary and artistic works are cultural objects and are made within a social setting. As cultural objects, they show the values, habits, traditions, and history of the society they come from. Cultural objects are things that have meaning and importance to a culture. They cover many forms of human expression, like literature, art, music, buildings, language, and ceremonies. These objects are not created alone; they are strongly affected by the social, political, economic, and historical situations of their time and place. The social setting in which literary and artistic works are made is complex. It involves aspects like political systems, religious beliefs, economic status, technological changes, and common ideologies.



Travel writing in India has long history and is mixed with the country's culture. From old stories of pilgrimages to modern tales of various places and customs, travel writing in India is important for shaping views, promoting cultural sharing, and recording the nation's rich heritage. Social and cultural parts are at the center of Indian travel writing, as authors move through different regions, each with its own customs, languages, religions, and traditions. These stories give readers a look into India's complex society, highlighting its lively diversity and also addressing its problems and difficulties. Travel accounts are important not simply because they are windows on distant places but they are also mirrors that reflect the values of the travellers and throw back light on their own societies. However, there are diverse issues concerned with the nexus between travel and history writing.

1.2. LITERATURE REVIEW:

1.2.1 Arpana Venu in her research paper Translating the Traveled Culture: An Analysis of Tamarind City: Where Modern India Began by Bishwanath Ghosh

In this research paper author mentions the travel writers record their expeditions for someone else to relive and recapitulate the moments that they have experienced. It is essential for a travel writer to cross the cultural boundaries and allow one to enter new culture by breaking every single barrier, thereby getting exposed to new place and new culture altogether. In order to attain that, the writer must be free from prejudices and inhibitions about the place to be visited/ the travel destination.

Addressing issues of cultural translation, the author presents how the culture of the country visited in travelogues is constructed from the eyes of the author. In this context, it is relevant to consider works by Bishwanath Ghosh who catches on peculiar descriptions of the Indian city of Madras as well as keeps a record of its change within ten-year period. The subjectivity, stereotyping and language challenges faced by the author during his travel narrative with the intent to capture the relocating culture are also discussed in this paper. The author explores Ghosh's depiction of Chennai and its people. He commends Ghosh's on many of his attempts while at the same time highlighting his shortcomings as an outsider there. Some remarks lead one to believe that owing to Ghosh's individual likes and biases about certain aspects of Tamils culture have been incorrectly documented and thus there are misrepresentations in several aspects.

Bishwanath Ghosh's Tamarind City reflects the difficulties of cultural translation that are inherent in travel writing. It is emphasized how important it is for travel writers to be culturally aware and objective so as not to give their readers a false picture of the foreign culture they are visiting.

1.3 OBJECTIVES

- To study travelogue as a genre and its role in the portrayal in modern India.
- To look into tradition of Chennai and how society changes when writer was living in Chennai.
- To explore the socio-cultural aspects of Chennai (Madras).

1.4 RESEARCH METHODOLOGY

- The qualitative research methods like implication, interpretation and critical analysis of primary and secondary sources will be used for successful completion of the research paper.
- The research will use descriptive and analytical method for the proposed research.

1.5 Chennai's Cultural Legacy: A Socio-Cultural Perspective on Bishwanath Ghosh's Tamarind City: Where Modern India Began



Socio-cultural aspects refer to the combined influence of social and cultural factors that shape the beliefs, behaviors, values, and norms of a particular group or society. These aspects encompass a wide range of elements, including traditions, customs, language, religion, family structures, gender roles, educational practices, political systems, economic arrangements, and artistic expressions.

A travelogue focuses on understanding a certain place, experiencing it, and then documenting those experiences. The author or the traveller is also an important tool for the readers: through his or her craft they take the readers to unknown lands and describe the cultures with great precision. In this way, the readers visualize the setting and its inhabitants, as well as the lifestyle of the travelogue that the author is devoted to.

Travelogues play an important role by bridging two completely separate cultural identities. This makes reading travelogues interesting and also encourages readers to examine the certain sociocultural aspects of the town which need to be translated. This work presents a logical progression of thought and is devoted to the analysis of the Indian travelogue “Tamarind City Where Modern India Began” authored by Biswanath Ghosh and subjecting it to considerable scrutiny. The book describes the author’s dwelling in Chennai (earlier Madras) and the author’s valuable reflections on the ways and customs of the local community.

Bishwanath Ghosh is an acclaimed Indian travel writer and journalist. He has published three travelogues to his credit- Chai Chai: Travels in Places Where You Stop but Never Get Off (2009), Tamarind City: Where Modern India Began (2012) and Longing, Belonging: An Outsider at Home in Calcutta (2014). The book "Tamarind City" recounts the author's observations of Chennai, a place he now considers his second home. Ghosh's extensive efforts and keen observations have allowed him to comprehend this new city, which possesses a rich tapestry of cultural differences from the place he had lived in for many years. In a blog interview, Ghosh explains that despite Chennai's historical significance, it remains relatively unknown, prompting him to create a travelogue to shed light on the city. Interestingly, the Southern part of India has often received less attention from travel writers, both from the East and West, in comparison to the North. Ghosh in his author’s note begins with a disclaimer, “This book, however, does not pretend to be an exhaustive or authoritative study of Chennai or Tamil culture. It is born purely out of my desire to understand a city I’ve called home for over a decade now” The author exposes the various facets of the life of people in Chennai. By presenting a mélange of history, geography, arts and culture of Madras, he documents their unique culture in an interesting manner in this travelogue. Culture is the very way of life and travel writing depicts a detailed study of the everyday life and practices of a group of people living in a certain habitat.

In the prologue of the travelogue "Tamarind City: Where Modern India Began," author Bishwanath Ghosh (2012) portrays a stereotypical perspective of a fellow North Indian traveler on their journey to Chennai-

Due to the stereotypical notions, all South Indians are considered as Madrasis by the North Indians, just like how Americans regard Indians as people who smell of curry. The author in his prologue clearly brings out-

The lay north Indian has known very little about Chennai except that it is inhabited by conservative and religious people called Madrasis who live on Idli and dosa.

There was no need to know more. The south, for the north, was always the back of beyond. People from



the south came to the north in large numbers to work. But there was no movement in the reverse direction... (Ghosh XXV)

This illustrates the confusion in the mindsets of a number of North Indians about Chennai and its people. It brings out the notion that South Indians, also known as ‘Madrasis’, are somewhat conservative and religious culture eaters of idli and dosa type of food. The sentence is indicative of the cultural and geographical gap by pointing the lack of interest and willingness to know more about the South. The text also touches upon the unidirectional pattern of migration which in turn explains the socioeconomic and cultural distance that two regions maintain. Southern Indian moving towards the northern region are plentiful for employment opportunities, but the inter-mobility is scanty. This research demonstrates how certain regional stereotypes and complexions have been prevailing in the society of India.

“The Marina Beach has often said to be the second longest beach in the world, but dark clouds of uncertainty hang over the claim. What is certain, however, is that there are no bikinis on the Marina. Try wearing one and you will have a thousand onlookers encircling you in a matter of seconds, and soon a cop would be marching you to the nearest police station. The Marina is not really a beach in the western sense, where you can go easy with your clothing and let your hair down.” (Ghosh 231-232)

Through this, we can understand scenario of Chennai people how they are very particular about their clothing and maintain their culture. India stands out as a country where a blend of diverse traditions and cultural practices creates unique identities for each state. However, this amalgamation sometimes gives rise to misunderstandings and even indifference among the general population.

Bishwanath Ghosh has managed to overcome some of the North Indian stereotypes while writing about a city in South India to a certain extent. He resides in Chennai and invests ample time in comprehending the people, making efforts to explore the city's history and the influences that shaped it. Moreover, he introduces readers to the unique culture of the city. However, a South Indian reader can easily detect his stereotypical beliefs about Tamil culture and his condescending attitudes towards the people depicted in this travelogue.

“Even today, it is common to see Brahmin men, no matter where they work or what positions they hold, wearing the caste mark on their foreheads-the general exceptions being those who have had a liberal upbringing outside Tamil Nadu or have grown up in anglicized homes” (Ghosh 61).

Not only Brahmin, but every caste has their caste mark on their foreheads. In contemporary times, wearing such marks on the forehead has become a matter of individual preference among people. Some individuals choose to wear it, while others may not.

It is not compulsory but South Indians follow their traditions and rituals very respectfully. They usually wear traditional dress which is lungi for men and women wear saree in everyday life. It is like their Uniform.

“Tradition is daywear in Chennai. While in other big cities it strays mouthballed in trunks, taken out only during festivals and weddings, here tradition is worn round the year- like uniform.” (Ghosh 59)

As writer said, in other big cities in India, we only follow our traditions during festivals and weddings but Chennai people follow regularly.

1.3 CONCLUSION:

This research paper takes the reader to the journey of the relationship of culture with travel writing as well as understanding the socio-cultural aspects in the Indian travel writing. It elucidates the concerns and duties of travel writers to present more than one culture but at the same time appreciate cultural relations and even promote them. Through a close examination involved in the study, the researcher has tried to



understand the socio-cultural aspects and the narrative strategies used by the author. Despite this, his journalist identity has made it easy for Ghosh to interact with people and know more about the culture of Madras by means of eliciting first-hand information through casual conversations, observations.

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A Feature Selection in Historical Dataset for Stock Price Prediction

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Abstract: *The research aims to investigate stock price prediction methods and their drawbacks regarding certain traits and performance. By shedding light on how these machine learning models respond to adding additional features, like the Adj Close feature, the study paves the way for future investigations into feature selection and its impact on prediction accuracy. The Adj Close feature in the historical stock datasets has been disregarded in earlier studies. The study also shows that, with some data optimization, machine learning techniques like LSTM are frequently employed for stock prediction. We also looked at the regression-based performance indicators used to evaluate the performance. We compared the results and found that the Adj Close feature with LSTM performs better than the Close feature with LSTM. The results will help academics studying financial markets develop innovative ideas and choose the most practical criteria from the available data.*

Keywords: *Adj Close, Feature Selection, LSTM, Machine Learning, Stock prediction.*

1. INTRODUCTION:

Stock market forecasting combines different procedures and products to predict trends in share prices and financial markets (Kumar et al., 2021)(Kumbure et al., 2022). It is a fundamental component of investing and trading, which is intended to help investors draw on the experiences of others to get the biggest returns for their money with the least amount of risk possible. The prediction process can be broadly categorized into two approaches: first, the fundamental analysis, and second, the technical analysis (Nti et al., 2020) (Shen & Shafiq, 2020). This analysis asks questions like: what does the balance sheet say about the company? How does economic data affect the business? What does the trend of the industry portend for the business? Compared to this, technical analysis is primarily based on the features of price and trading volume movements and patterns (Nti et al., 2020)(Shen & Shafiq, 2020). New technology and new methods in the data analysis area change stock market prediction for the better and speak about modern algorithms and ML (Kumbure et al., 2022)(Rouf et al., 2021). These methods rely on big data – daily stock prices, economic indicators, and potentially tweet sentiment- to find and foretell trends. Neural networks, decision trees, and support vector machines used currently in most ML techniques have shown the potential to discover latent relationships in the data (Golbayani et al., 2020)(Shu & Ye, 2023).



Market psychology and sentiment further complicate this picture as they are also used to identify sites (Wankhade et al., 2022)(Nandwani & Verma, 2021). None of the existing prediction methods can assure forecast accuracy, but integrating traditional and modern methods might improve the reliability of the forecast (Wang et al., 2023)(Troin et al., 2021). The trends in reinforcement learning, decision trees, artificial intelligence, big data, and natural language processing give the prospect of developing enhanced and efficient prediction systems (Rane et al., 2024).

1.1 Feature Selection in the stock prediction

This research topic is gauged in light of feature selection, an important process in stock market prediction based on features that considerably impact stock prices. Feature selection enables one to develop a better model that shows a lower error rate, less fitting, and more efficient computation.

Basic metrics may include the open, the high, the low, and closing prices (OHLC), *but many researchers often omit the Adj Close price feature for stock prediction*. More advanced measures include adding environmental aspects of the business environment, including interest rates, inflation levels, political events, and even the mood in the social networks based on the news articles (Domalewska, 2021)(Bodaghi & Oliveira, 2024). With the increasing application of ML algorithms in modeling, filter techniques are increasing, including Recursive Feature Elimination (RFE), Principal Component Analysis (PCA), and Mutual Information Analysis (Htun et al., 2023)(Kumbure et al., 2022).

As is evident in the present digital age, ineffective features that may be deemed irrelevant or duplicate the same function as other features should be eliminated to avoid disturbing the formation of a correct prevision model (R.-C. Chen et al., 2020)(Rostami et al., 2021). In fact, by identifying and using meaningful variables, feature selection does more than improve predictive accuracy; it also helps to improve the understanding of market conditions (Rouf et al., 2021). This paper has found a need to compromise between prior knowledge about an application's domain and feature selection techniques to select the finest features for stock price prediction.

1.2 Historical Dataset

The most integral parts of historical data are daily OHLC and volume (Chakraborty et al., 2023)(Letteri et al., 2022). **Table 2** shows the sample dataset of NSE stock Sunpharma. In addition, sources such as news sentiment, social media, and geopolitical events are also being incorporated to give added depth to market conditions (Sadeek & Hanaoka, 2023)(Adekunle Stephen Toromade & Njideka Rita Chiekezie, 2024). Unfortunately, existing historical datasets require preprocessing before using them – first, many data points contain missing values; second, some observations are outliers; and third, many datasets contain various kinds of inconsistencies (Lee et al., 2022). Greater time spans and fine granularity, such as one minute or one hour, can improve the stability of feature selection because anomalies in the market may occur at these time scales (Zamanzadeh Darban et al., 2025)(X. Chen et al., 2024). Using historical data, analysts find future trends, important features for model input, and market information (Thakkar & Chaudhari, 2021)(Rouf et al., 2021).

Table 2: Sample dataset of Sunpharma stock

Date	Open	High	Low	Close	Adj Close	Volume
2021-05-03	653.95	663.95	650.10	659.20	652.32	6567597
2021-05-04	662.00	664.90	642.00	645.15	638.42	5604638
2021-05-05	642.25	687.90	642.25	683.40	676.27	25296369



2021-05-06	689.85	696.70	673.35	679.40	672.31	11153908
2021-05-07	681.00	691.00	677.60	679.45	672.36	6466334

1.3 The objective of the research

- Selecting significant features from the historical dataset (i.e., Adj Close) to make the prediction.
- Compare the model's prediction performance using the feature Close price and Adj Close price.

2. LITERATURE REVIEW:

Current studies have endeavored to test different methods to determine the closing prices of stocks based on history. LSTM-based architectures play a significant role in accurate predictions of stock prices with high care (Wei et al., 2022)(Alkhatib et al., 2022). These models employ towers, bells, adjusted opening prices, the total volume of the previous day, and other numerical features for the prediction. (Alkhatib et al., 2022) expanded the six-feature set that enhanced the performance compared to a traditional approach of four features. Linear regression has also been used to determine daily stock closing prices based on past data (Halawa et al., 2022). Further, more elaborate systems based on several method techniques have indicated improved precision and reliability of stock prices (Dwivedi & Gore, 2021). These approaches are expected to give investors valuable information during the decision-making processes in stock transactions, possibly making higher profits with lower risks.

Evaluating the closing prices using the historical adjusted closing prices as input is not straightforward given the unpredictable volatilities in the actual stock data and the fact that stock data is inherently nonlinear, often due to market volatilities (Inglada-Perez, 2020)(Al-Nefaie & Aldhyani, 2022). The latest progress in ML use, especially with the help of LSTM, indicated improved precision rates. The following section presents directions concerning essential attributes of this form of prediction. Closing prices remove the arbitrary impact of fluctuations during the day, and they are adjusted for stocks that issue dividends or splits, which gives a closer estimation of the worth of the stock at a given time (Norton, 2011). It helps define market trends, especially for interval traders who wish to predict future prices (Luo & Ji, 2022). The PSO-LSTM model integrates improved PSO with LSTM to improve the forecast precision compared to usual models, such as ARIMA (Luo & Jin, 2022). In predicting closing prices, the RNN-LSTM models seem very accurate, especially, for instance, the Iraq Stock Exchange markets (Al-Hasnawi & Al-Hchemi*, 2022). The model's performance is often measured with Mean Squared Error (MSE), Mean Absolute Error (MAE), Mean Absolute Percentage Error (MAPE), and Root Mean Squared Error (RMSE). ML models have great promise in closing price predictions.

3. RESEARCH METHODOLOGY:

The following figure (see *Fig. 1*) illustrates the research framework. The framework has the following steps and a description. Here, the most significant step of feature selection as the significance of the Adj Close feature is shown in *Fig. 2*.

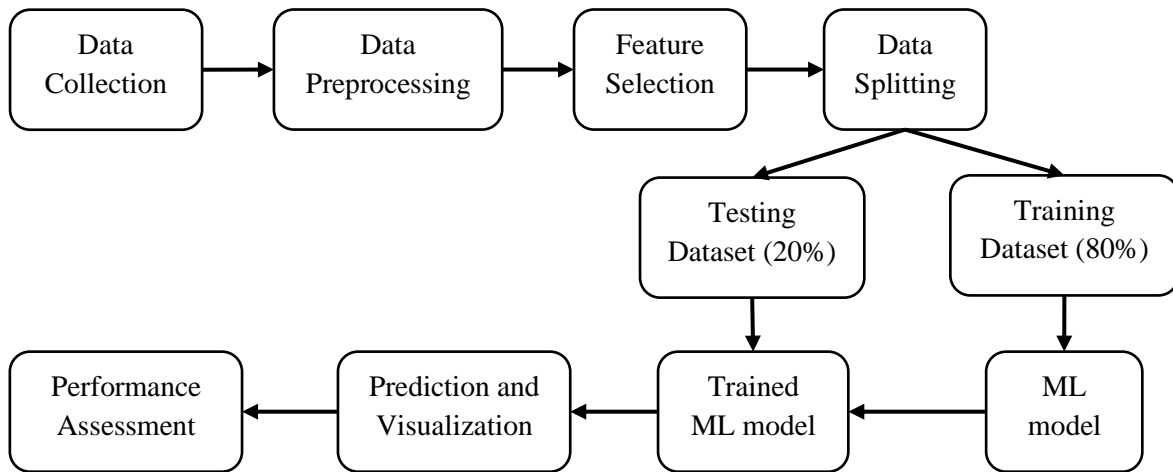


Fig. 1: Framework of the research

3.1 Data Collection: The historical dataset (see *Table 2*) is retrieved from the Yahoo! Finance website. One year of data is accessed in CSV format (comma-separated values). The historical dataset has the following features (see *Table 3*):

3.2 Data Preprocessing: The historical dataset is preprocessed by cleaning for any null values by using the dropna() function in Python Programming. The cleaned dataset was then scaled for the model training and testing.

3.3 *Table 4* shows the data scaling method used, which is Min-Max scaling.

Table 3: Features of the dataset

S. No.	Feature	Symbol	Description of the feature
1.	Date	D	The Date of the stock market day is used as the index.
2.	Open	O	Open price at the start of the stock market day.
3.	High	H	The high price of the stock market day.
4.	Low	L	Low price of the stock market day.
5.	Close	C	Close price at the end of the stock market day.
6.	Adj Close	A	The adjustment of the close price after the settlement.
7.	Volume	V	The total stock volume traded on a particular date.

3.4 Feature selection: There are many features in the historical dataset, as described in *Table 3*. We applied the LASSO technique for feature selection in Python programming, which shows Adj Close as an important feature.

3.5 *Table 4* shows the parameters used and selected featured by LASSO.

Table 4: LASSO parameters and data scaling technique used

Parameter(s)/method	Value/Description
Alpha	1.0
Scaling technique used	Min-Max Scaling
Selected features by LASSO	Low, Adj Close, and Close

Fig. 2 shows the feature selection using LASSO, recommending Adj Close as a significant feature as a target variable.

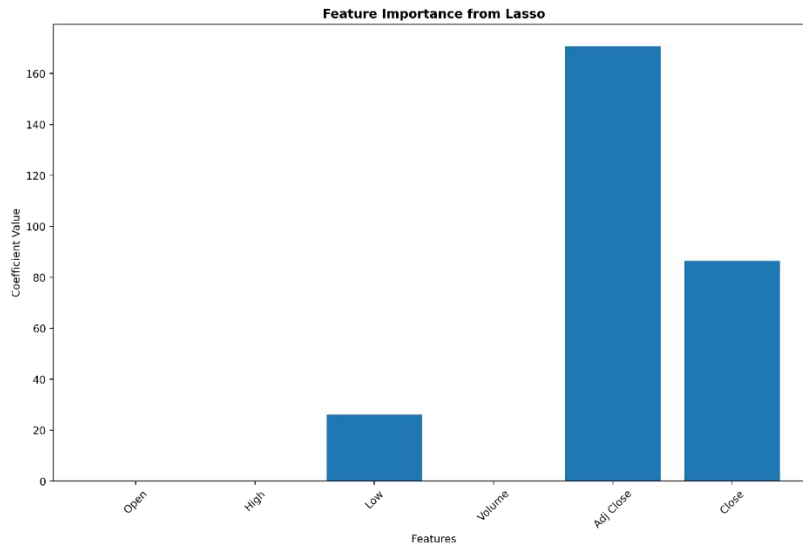


Fig. 2: Feature selection using LASSO

3.6 Data Splitting: The featured dataset is strategically broken up into two segments: the training set and the second subset, which has 20% of the size of the initial data, the testing set. This division aligns well with the Pareto Principle, better known as the 80/20 rule, as (Sanders, 1987) analyzed. It is stated that the 80/20 rule is used in many areas, such as data research, economy, and resource allocation, and it refers to the idea that 80% of the outcomes are produced by 20% of the causes. In a broader context of ML and data science, this principle is a decision directing that 80% of the dataset will be used for training the LASSO-LSTM and fine-tuning because it is useful for this purpose, 20% of the dataset will be used for testing and is oblivious to the tuning process. This way, the problem of having enough data for calibration is solved while having a distinct data set to test the model's reliability.

3.7 ML model: We have designed and used a two-stage approach based on LASSO as a feature selection algorithm and LSTM as a predictor. Most importantly, the model can take advantage of the LASSO feature selection technique of choosing the most active features from a given data set by deactivating the less active ones, thus helping to greatly eliminate the problem of over-emphasis on features that cause high dimensionality. These features are then passed to the LSTM network, which is useful for recurrent or time series data, given that LSTM can handle long-term dependencies. Initially, the model was trained using the identified training dataset to validate the LASSO LSTM captured the right patterns and structures for the right predictions on other data. Refer to equation (1) for LSTM and equation (2) for LASSO regression.

$$\begin{aligned}
 i_t &= \sigma(W_i x_t + W_{hi} h_{t-1} + b_i) \\
 f_t &= \sigma(W_f x_t + W_{hf} h_{t-1} + b_f) \\
 o_t &= \sigma(W_o x_t + W_{ho} h_{t-1} + b_o) \\
 \tilde{c}_t &= \tanh(W_c x_t + W_{hc} h_{t-1} + b_c) \\
 c_t &= f_t \otimes c_{t-1} + i_t \otimes \tilde{c}_t \\
 h_t &= o_t \otimes \tanh(\tilde{c}_t)
 \end{aligned} \tag{1}$$



where x_t expresses the input sequence, \tanh expresses the hyperbolic tangent function, σ expresses the sigmoid function, i_t expresses input gate, f_t expresses the forget gate, c_t expresses memory cell, o_t expresses the output gate, \tilde{c}_t expresses the change gate, h_t expresses the hidden state for LSTM, \otimes expresses a product of elements.

$$\text{lasso} = \sum_{i=1}^n \left(y_i - \sum_j x_{ij} \beta_j \right)^2 + \lambda \sum_{j=1}^p |\beta_j| \quad (2)$$

where $n \times p$ matrix of data values, β is the regression coefficient

3.8 Prediction and Visualization: The prediction process uses a compound model known as the LASSO-LSTM, which qualitatively combines the LASSO-features-selecting algorithm and LSTMs that suit time series analysis. The model tests the testing data to give a better result. Further, the results are displayed graphically to provide the reader with a better understanding of the predictive trends and efficiency of the model and avoid any confusion. **Fig. 3** shows the graphical visualization of the prediction for the Sunpharma stock.

3.9 Performance Assessment: As the main performance measurement criteria, the Mean Absolute Error (MAE), the Mean Squared Error (MSE), the Root Mean Squared Error (RMSE), and the Mean Absolute Percentage Error (MAPE) are calculated. Such measures offer a general method for assessing the performance of the given models regarding the target values. The capability of the LASSO-LSTM model using the Adj Close feature is compared with the LASSO-LSTM model with the Close feature. We found that the former is performing better than the latter. It suggests that the Adj Close feature has more relevant information regarding the prediction task than the other features, improving the results' precision and reliability.

4. RESULT:

4.1 Experimental Setup: The experiment was conducted on Jupyter Notebook using Python programming version 3.9.7 at Anaconda Navigator 2.4.2. The dataset of Sunpharma stock at NSE India is downloaded from the Yahoo! Finance website dated 03-05-2021 to 29-04-2022. *The batch size and epoch are 16 and 50, respectively, for LSTM.*

4.2 Performance Metrics: The metrics below are used to assess performance.

(a) **MAE:** MAE is the sum of the absolute difference between a particular set of measurements of the same quantities and the actual measurements.

$$\text{MAE} = \frac{\sum_{i=0}^{n-1} |o_i - \hat{o}_i|}{m} \quad (3)$$

where \hat{o}_i represents the evaluated value, o_i exhibits the real value, and m exhibits the quantity

(b) **MSE:** MSE measures the deviation between the observed and projected values. It is often referred to as a risk function that conforms to the expected value of the squared error loss.

$$\text{MSE} = \frac{\sum_{k=1}^K (y_{T+1}^k - \hat{y}_{T+1}^k)^2}{K} \quad (4)$$

where K represents the number of samples for training the model, y_{T+1}^k and \hat{y}_{T+1}^k represents the real and evaluated values, respectively.

(c) **RMSE:** It is the square root of MSE.



$$RMSE = \sqrt{MSE} \tag{5}$$

(d) **MAPE:** MAPE quantifies its predictions' average deviation from reality.

$$MAPE = \frac{1}{T} \sum_{i=1}^T \left| \frac{d_i - \hat{d}_i}{d_i} \right| \tag{6}$$

where T represents total test samples, d exhibits the real sample value, and \hat{d} exhibits the evaluated value.

4.3 Experimental Outcome: The following table shows the comparative result.

4.4 Table 5 shows that when the feature Adj Close is considered a target variable and inputted into the LASSO-LSTM model, it gives much better results than the Close feature.

Table 5: Comparative result using various performance metrics for Sunpharma

Metric	LASSO-LSTM with Close feature	LASSO-LSTM with Adj Close feature
MSE	228.36372	220.80342
MAE	11.52897	11.24129
RMSE	15.11170	14.85945
MAPE	0.01289	0.01257

We found that using Adj Close feature will reduce the margin of error when using Close feature. The margin of error with the Adj Close feature is less than the Close feature during prediction. The main focus is on the feature and feature selection method while prediction using any machine learning model.

4.5 Graphical Visualization

Fig. 3 illustrates the graph of the Sunpharma using the LASSO-LSTM model with Close and Adj Close features. Further, it shows the possibility of the model in making systematized forecasted stock prices from historical data. The common features of the plot are the time series of actual stock price marks such as Close and Adjusted Close, which are introduced to the plot as the 'Actual' data (in yellow color), and the predicted values to be entered into the plot as the 'Predicted' data (in green color), whereas blue color shows the train dataset. It provides the graphical representation for assessing the validity of the suggested LASSO-LSTM model to extract the necessary features and interactions in stock prices. The graph of Sunpharma, with the assistance of the LASSO-LSTM model, focuses on two strong techniques: LASSO for selecting features and LSTM for analyzing time series data of stock prices. The main features used in the graph are the Close and the Adjusted Close, which show the daily closing price and its correction for splits and dividends correspondingly. The model can produce a systematized and accurate outcome prediction from the historical dataset tendencies using these features.

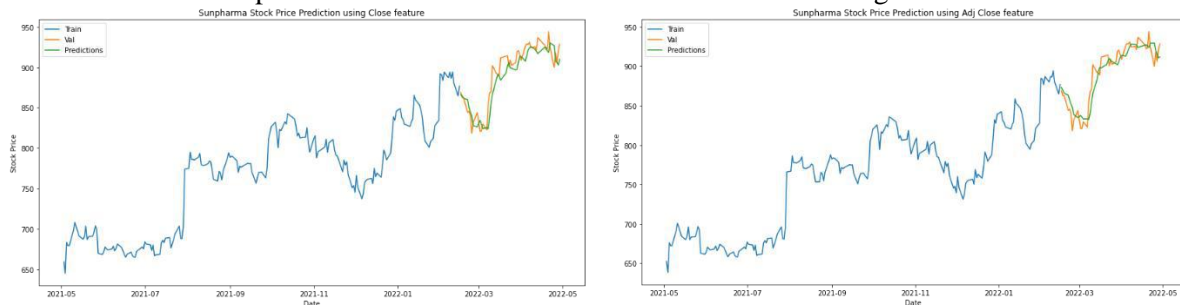


Fig. 3: The prediction by LASSO-LSTM using Close and Adj Close feature of Sunpharma stock



5. DISCUSSION/ANALYSIS:

As far as we can tell, no reviewed publications have used the Adj Close feature to anticipate stock prices. Therefore, the main focus is on the Adj Close feature for prediction using ML and feature selection techniques to select a significant feature from the dataset. By pressing the orders at the last minute, the Adj Close feature, according to the experts, represents the general opinion of major investors in the financial market. By completing those last-minute pending transactions and modifying the closing price following the company's announcement of dividends to investors, Adj Close displays the final closing price. Only the exchange (like the National Stock Exchange in India) executes the pending orders shown on the trading terminal two to three minutes later. In the future, predicting stock prices will heavily rely on Adj Close's price value. Because it takes into account recent trading activity and fluctuations following dividend payments, the Adj Close price is more accurate. Large traders, who usually engage in sweeping transactions at the end of the trading session and whose trading activity substantially impacts the final price, are reflected in this characteristic. This research demonstrates how adding the Adj Close price to prediction models facilitates researchers' ability to record these fluctuations, increasing forecast accuracy. In this situation, the researchers can develop and use ML approaches that interact with the Adj Close feature and other pertinent factors. It implies that the developed ML models may offer more thorough and precise insights into stock prices if such characteristics are used in tandem. A comparison between models that incorporate the Adj Close feature and those that use the regular Close feature is performed to find the importance of the Adj Close feature. It would be done to compare and determine whether adding the Adj Close price improves the models' capability to predict stock. Additionally, it will enlighten the study of financial modeling and forecasting by helping to understand how different trading activities, such as late trading and dividend adjustments, affect stock prices.

6. CONCLUSION:

The research implies that the developed ML models may offer more thorough and precise insights into stock prices if such characteristics are used in tandem. A comparison between models that incorporate the Adj Close feature and those that use the regular Close feature might be performed to get more broadly applicable findings. It would be done to compare and determine whether adding the Adj Close price improves the models' capability to forecast the stock. Additionally, it will enhance the study of financial modeling and forecasting by helping to understand how different trading activities, such as late trading and dividend adjustments, affect stock prices. The Adj Close feature needs to be considered for inclusion in stock prediction models due to its possible impact on accurately predicting stock prices. Later studies sought to analyze the performance of models, such as the Adj Close feature, and compare their results with those of traditional models. By addressing this sometimes-overlooked element, the researchers may enhance the performance and resilience of Stock Prediction algorithms and assist investors in making more reliable investment decisions. This development path has a lot of room for advancement in stock prediction, as we can see that the Adj Close feature gives a lower margin of error than the Close feature. Most prediction methods use Close price as a feature in their prediction system. We advocate using the Adj Close feature while predicting using machine learning techniques.

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Bank customer churn prediction using artificial intelligence and machine learning

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Abstract: Indian economy is growing faster than ever, in this scenario banking sector is like a fuel to this growth engine for India. In our research work we are addressing the very critical issues of the banking sector. As the number of banks and services provided by them is keep in increasing rapidly and hence customers have options to avail services from any of the bank to fulfill their finical needs. Customer churn is very crucial problem banking sector facing now a days. In this research work we are working on dataset of US based bank to predict the customer who likely to be churn and not willing to keep engagement with the bank. We applied various machine learning algorithms like kNN, XGBoost, Linear Regression etc. with artificial intelligence concept in Python with streamlit framework to implement interactive UI with which user can interact and by simply providing some basic features of customer user can easily find likeliness about whether a customer is going to be churned or not. xgboost model tuned using RandomizedSearchCV in our research work bring us to the 0.98 accuracy and 0.95 recall, which provides more confidence to us while evaluating our model performance.

Key Words: bank customer churn identification, ML, Data Analysis, Python.

1. INTRODUCTION:

Finical sector is improving faster and better then ever before and so as the banks. In today's era when India is heading towards becoming 5 trillion economy worldwide, various banks are offering verity of options and lucrative offers for their customers to attract more customer. We can define bank customer churn as a customer leaving bank and not continuing to avail their finical need and scheduling [1]. It became very important for bank to identify the reasons of customer attrition so that bank can fix the leakages and retain customer with bank. Customer retention can be defined as the process of keeping customer associated with banks for their finical support and planning. In various kinds of organizations, securing another customer can be 5 to 25 times more costly than holding the existing one. As indicated by Harvard Business College, simply expanding the client retention rate by 5% it can increment benefits by 25% to 95% [3].



Prestigious regions, for example, biomedical, retail, and monetary areas where AI has previously been analysed are for disease discovery, market bin investigation, and credit scoring. In any case, this article centres on the utilization of machine learning models for anticipating the beating of clients in the Banking business [4].

The banking industry faces challenges in retaining customers. Clients may switch to other banks for various reasons, such as better financial services at lower fees, convenient branch locations, the quality of digital tools, and lower interest rates. Predictive models are employed to foresee customers who are most likely to churn in the future. These models analyze historical data of previous churners and identify similarities with current customers. Existing customers are then flagged as potential churners if certain patterns are found. Predicting customer churn is crucial as the cost of acquiring new customers is often higher compared to retaining existing ones.[5] Additionally, serving long-term customers is less expensive than losing a customer, which leads to a loss in profit for the bank. Long-standing customers also provide higher benefits and new referrals. In this paper, various machine learning models such as Logistic Regression (LR), Decision Tree (DT), and K-Nearest Neighbour (KNN) are applied to the dataset for prediction and their performance is evaluated in terms of metrics like accuracy and recall.[6]

2. LITERATURE REVIEW:

Verity of algorithms have been used by researchers to predict customer churn in banking sector and these algorithms includes Logistic Regression, KNN, Support Vector Machine, Decision Tree and many more. Authors used Random Forest classifier with oversampling to achieve 95.74% accuracy in defining model to identify customer churn in banking [2]. In an attempt authors worked on a dataset of large Brazilian bank, authors have implemented exploratory data analysis using various techniques and they have conducted a horserace among different supervised ML algorithms to enable a fair comparison with different ML algorithms [3]. By achieving 97.25% accuracy authors worked on bank customer segmentation and prediction for churn using random forest algorithm [7]. In an attempt authors have investigated the level of machine learning to predict the credit card customer attrition rate in the finance sector by using kNN and C5 tree model, they have used several algorithms out of which in C5 tree 0.97 highest accuracy is received [8].

Table 1: Previous work on related topic.

Title of the work	Authors	Methodology	Remarks	Year
MACHINE LEARNING BASED CUSTOMER CHURN PREDICTION IN BANKING	Manas Rahman, V Kumar	SVM, Decision Tree(DT), RF and KNN, classifiers are used	Using the RF classifier in combination with oversampling yields a superior result of 95.74%.	2021
Customer attrition Analysis and Prediction in Finance Industry using Machine Learning	Kaur Ishpreet, Jasleen Kaur	Logistic regression (LR): (DT): (KNN): (RF):	85.22% accuracy achieved by using Random Forest Algorithm.	2021

3. METHODOLOGY:

This research is focused to predict and select the most likely customer to be churned for the bank. Fig1 depict the proposed model to identify the customer churn.

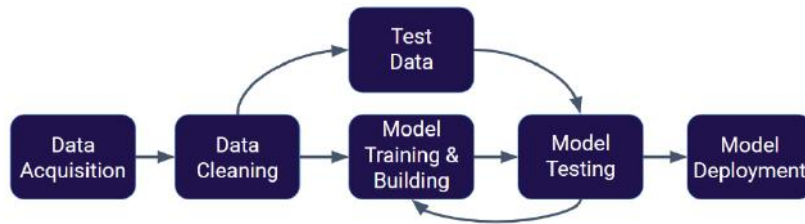


Fig 1: Proposed model to identify customer churn

Dataset-Feature Explanation

Collection of data that can be used for analysis and prediction. Features are measurable pieces of data that can be used for analysis. Features are also sometimes called "variables" or "attributes". Below is the brief explanation of all the features of the dataset. This is the dataset of US based private bank.

- CLIENTNUM:** A unique identifier assigned to each customer holding an account.
- Attrition_Flag:** Indicator of account activity—set to 1 if the account is closed, otherwise 0.
- Customer_Age:** The age of the customer in years.
- Gender:** The gender of the account holder.
- Dependent_count:** The total number of dependents associated with the account holder.
- Education_Level:** The educational background of the account holder.
- Marital_Status:** The marital status of the customer.
- Income_Category:** The annual income bracket of the account holder.
- Card_Category:** Specifies the type of card issued to the customer.
- Months_on_book:** Duration of the customer’s relationship with the bank, measured in months.
- Total_Relationship_Count:** The total number of banking products owned by the customer.
- Months_Inactive_12_mon:** Number of months the customer was inactive in the past year.
- Contacts_Count_12_mon:** The number of times the customer interacted with the bank in the last 12 months.
- Credit_Limit:** The maximum credit limit available on the card.
- Total_Revolving_Bal:** The total revolving balance on the credit card.
- Avg_Open_To_Buy:** The average available credit line over the past 12 months.
- Total_Amt_Chng_Q4_Q1:** The change in transaction amounts from the first quarter to the fourth quarter.
- Total_Trans_Amt:** The total transaction amount over the last 12 months.
- Total_Trans_Ct:** The total number of transactions made in the past 12 months.
- Total_Ct_Chng_Q4_Q1:** The variation in the number of transactions between the first and fourth quarters.

Avg_Utilization_Ratio: The average utilization ratio of the credit card.

Dataset Analysis and Preparation

Data Analysis

Data set analysis means to find out the shape of the data, information like non-null counts of data in every column, data type of the columns, description of the numerical and categorical columns like min and max value, mean, standard deviation, unique values in the categorical columns, etc. There are 10127 rows and 21 columns in the dataset.

Observation of the dataset bring the below mentioned information of different features.
CLIENTNUM: It is unique identifier for customers and can be dropped as it would not add any information to our analysis.



Customer_Age: 46 is the average age of customers, and there is wide range of customers from 26 to 73 years.

Dependent_Count: On average the customers in the data have 2 dependents and maximum of 5 dependents.

Months_on_book: All the customers of the bank have at least been with them for a year and 50% of the customers for at least 3 years.

Total_Relationship_Count: Every customer utilizes at least one product offered by the bank, while 75% of customers use five or fewer products.

Months_Inactive_12_mon: On average customers were inactive for two months in the past 12 months - this shows that the bank customers are active in transactions or usage of cards it would be interesting to see if high inactivity lead to churning of a customer.

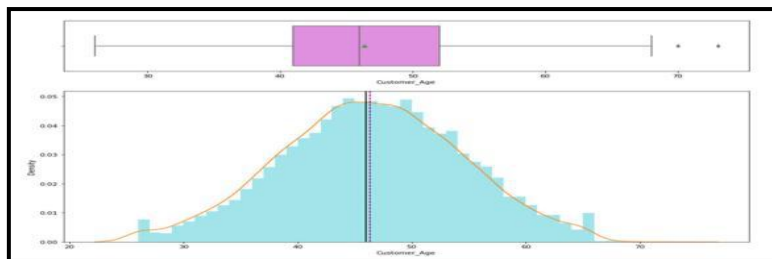
Contacts_Count_12_mon: On average bank and customers interacted twice in the past 12 months.

Credit_Limit: There's a huge difference between the third quartile and maximum value. The range of credit limit is very wide from 1438 to 34516, customers with high credit limit might be outliers.

Based on the common observation we can state that most of the records are of existing customers, female customers are more than male customers, maximum number of customers are graduates, maximum number of customers are married, most customers lie in the income group of less than \$40k, and maximum customers have a blue card.

Univariate Analysis

Univariate analysis is the most basic method of data analysis, focusing on a single variable at a time. This type of analysis examines data involving only one changing quantity. It does not explore causes, effects, or relationships between variables. Instead, the primary goal is to summarize and identify patterns within the data. Below are the key findings derived from the univariate analysis of the Bank Customers Churn Dataset.



Box and Dist Plot of Customer_Age

The distribution of Customer_Age is normally distributed with median and mean at 46 years. We can see that there are a few outliers. For dependent_count feature data is normally distributed, for the feature months_on_book, most customers are with the bank for 36 months. In Total_Relationship_Count. We can observe that customers are having 3 or more than three products of bank retain with the bank. While observations on Credit_Limit we found that the distribution of Credit_Limit is skewed to the right. There are quite few customers with maximum Credit Limit of 35000. 50% of the customers have Credit Limit less than 5000.

Bivariate Analysis

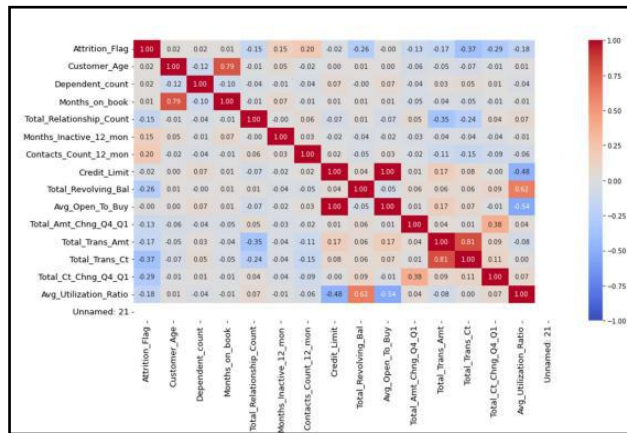
Bivariate analysis is a statistical method that examines how two variables are related. It's one of the simplest forms of statistical analysis. Bivariate analysis involves:

Observing two variables

Analysing the changes between the two variables



Determining the empirical relationship between the two variables



Correlation HeatMap

The Attrition_Flag shows a negative correlation with variables like Total_Trans_Ct, Total_Ct_Chng_Q4_Q1, Total_Revolving_Bal, and Avg_Utilization_Ratio. In contrast, there are strong positive correlations between Customer_Age and Months_on_book, as well as between Credit_Limit and Avg_Open_To_Buy, Total_Trans_Amt and Total_Trans_Ct, and Total_Revolving_Bal and Avg_Utilization_Ratio. Additionally, a negative correlation is observed between Total_Relationship_Count and both Total_Trans_Amt and Total_Trans_Ct, as well as between Avg_Utilization_Ratio and both Credit_Limit and Avg_Open_To_Buy.

Outliers Detections

Outliers are those data points that are significantly different from the rest of the dataset. They are often abnormal observations that skew the data distribution, and arise due to inconsistent data entry, or erroneous observations.

Ways to detect outliers:

Empirical relations for normal distributions

Inter-Quartile Range (IQR) for skewed distributions

Percentile method

Attrition_Flag	16.066
Customer_Age	0.020
Dependent_count	0.000
Months_on_book	3.812
Total_Relationship_Count	0.000
Months_inactive_12_mon	3.268
Contacts_Count_12_mon	6.211
Credit_Limit	9.717
Total_Revolving_Bal	0.000
Avg_Open_To_Buy	9.509
Total_Amt_Chng_Q4_Q1	3.910
Total_Trans_Amt	8.848
Total_Trans_Ct	0.020
Total_Ct_Chng_Q4_Q1	3.891
Avg_Utilization_Ratio	0.000

IQR for outlier detection.

After detecting outliers, a decision needs to be made about whether to remove or address them. This choice depends on the specific approach being taken. In this case, we have chosen not to treat the

outliers, as they naturally occur in real-world scenarios (e.g., variations in age, total transaction amounts, or transaction counts). Allowing the model to learn from these outliers can help it identify and adapt to underlying patterns associated with such customers.

Missing Values Treatment

Missing data occurs when values for specific variables are absent in a dataset. These gaps can significantly hinder the performance of machine learning models and introduce bias into statistical analyses, potentially resulting in inaccurate conclusions and poor business decisions. Therefore, addressing missing values is a vital step in the data preparation process.

Encoding the Categorical Variables

To handle missing values we have used the KNN imputer. KNNImputer works by imputing missing values for each sample based on the nearest `n_neighbors` found in the training data. By default, `n_neighbors` is set to 5. The KNN imputer replaces missing values with the average of the `k` nearest non-missing feature values, with the nearest neighbors identified using Euclidean distance. This method, implemented by the `KNNImputer()` class in `scikit-learn`, offers a more sophisticated approach compared to simpler methods like filling missing values with the median or mean. The KNN imputer predicts missing values based on the distance from the known values, with the missing value being imputed as the mean of its nearest neighbors.

Using KNN Imputer

```

1 # we need to pass numerical values for each categorical column for KNN imputation so we will label encode them
2
3 gender = {'M':0, 'F':1}
4 data['Gender'] = data['Gender'].map(gender)
5
6 education_level = {'Uneducated':0, 'High School':1, 'Graduate':2, 'College':3, 'Post-Graduate':4, 'Doctorate':5}
7 data['Education_Level'] = data['Education_Level'].map(education_level)
8
9 marital_status = {'Single':0, 'Married':1, 'Divorced':2}
10 data['Marital_Status'] = data['Marital_Status'].map(marital_status)
11
12 income_category = {'Less than $40K':0, '$40K - $60K':1, '$60K - $80K':2, '$80K - $120K':3, '$120K +':4}
13 data['Income_Category'] = data['Income_Category'].map(income_category)
14
15 card_category = {'Blue':0, 'Silver':1, 'Gold':2, 'Platinum':3}
16 data['Card_Category'] = data['Card_Category'].map(card_category)

```

Building the Model

Splitting the dataset into training and testing set

The train-test split is a method for evaluating the performance of machine learning algorithms, especially for prediction-based applications. It allows for a quick and straightforward comparison of our model's results against others. Typically, 30% of the data is used as a test set, while the remaining 70% is used as a training set.

Splitting the dataset into training and testing sets is essential for assessing how well our machine learning model performs. The training set is used to train the model, and its statistics are known, while the test set is reserved exclusively for making predictions.

Scikit-learn, often abbreviated as **sklearn**, is a powerful and widely-used library for machine learning in Python. The **model_selection** module within `scikit-learn` provides the `train_test_split()` function, which helps facilitate this data splitting process.

```

1 # splitting data into training and testing set
2
3 x_train, x_test, y_train, y_test = train_test_split(x, y, test_size=0.3, random_state=7, stratify=y)
4
5
6 # printing the shape of all four variables
7
8 print(x_train.shape)
9 print(x_test.shape)
10 print(y_train.shape)
11 print(y_test.shape)
12
13 (7888, 19)
14 (3039, 19)
15 (7888,)
16 (3039,)

```

Once the data is split, it is ready to be used for model fitting. The selection of the appropriate model depends entirely on how the problem is framed. There are various models available, but before choosing one, it's important to consider the following aspects of the data:

Determine if the problem is a regression or classification problem.

Decide whether we prioritize a model that is more explainable or one that provides higher accuracy.

In this case, since the problem is a classification task, we will use supervised learning algorithms to fit the model.

Logistic Regression

Logistic regression is a supervised machine learning algorithm mainly used for classification tasks, where the goal is to predict the likelihood that a given instance belongs to a particular class. Despite its name, 'logistic regression' is used for classification, not regression. The term 'regression' refers to the algorithm's use of linear regression outputs as inputs before applying a sigmoid function to estimate class probabilities. The key difference between linear and logistic regression is that linear regression predicts continuous values, while logistic regression estimates the probability of an instance belonging to a specific class. For example, logistic regression can be used to determine if a customer has churned or not.

```
1 lr = LogisticRegression()
2 lr.fit(x_train,y_train)

LogisticRegression()

1 #Calculating different metrics
2 scores_LR = get_metrics_score(lr,x_train,x_test,y_train,y_test)
3
4 # creating confusion matrix
5 make_confusion_matrix(lr,y_test)

Accuracy on training set : 0.8765519187358917
Accuracy on test set : 0.8779203685422836
Recall on training set : 0.4266900790166813
Recall on test set : 0.4180327868852459
Precision on training set : 0.6864406779661016
Precision on test set : 0.7010309278350515
```

KFold Cross Validation with Pipelines

We have used 6 different models in pipeline.

1. XGBoost
2. Random Forest
3. Bagging
4. AdaBoost Classifier
5. Decision Tree
6. Gradient Boosting

Here are the accuracy scores of all the models.

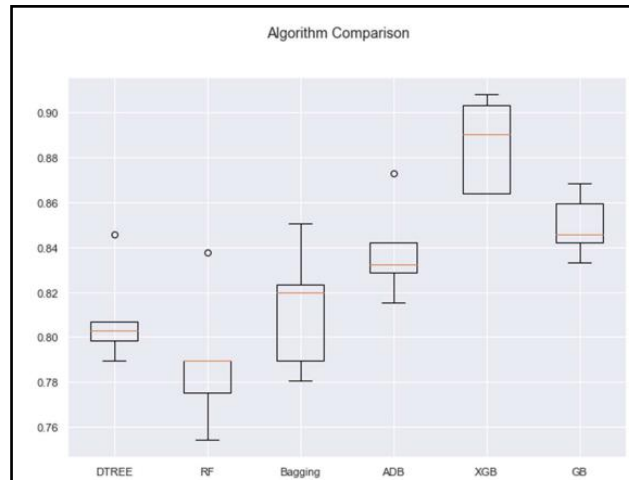
DTREE: 80.86366798052399

RF: 78.92766056109437

Bagging: 81.30033232861891

ADB: 83.84496483499497

XGB: 88.5879897982842



GB: 84.98647499806786

We can see that XGBoost is giving the highest cross validated recall followed by GradientBoost. The boxplot shows that the performance of XGBoost and GBM is consistent.

Hyperparameter Tuning

A machine learning model is a mathematical construct with several parameters that must be learned from the data. By training a model on existing data, we can adjust these parameters to fit the model. However, there are also hyperparameters that cannot be directly learned during the standard training process. These are typically set before training begins and define key aspects of the model, such as its complexity or the speed at which it learns. Examples of hyperparameters include L1 or L2 regularization in a logistic regression classifier and the number of neighbors (k) in k-nearest neighbors. Models can have many hyperparameters, and finding the best combination can be seen as a search problem.

Two common strategies for hyperparameter tuning are:

GridSearchCV

RandomizedSearchCV

XGBoost with GridSearchCV: In the GridSearchCV approach, the model is evaluated across a predefined range of hyperparameter values. The term "GridSearch" comes from the idea of searching through a grid of possible hyperparameter combinations to identify the best one.

```

1 # Creating new pipeline with best parameters
2 xgb_tuned1 = make_pipeline(
3     StandardScaler(),
4     XGBClassifier(
5         random_state=1,
6         n_estimators=250,
7         scale_pos_weight=10,
8         subsample=0.7,
9         learning_rate=0.01,
10        gamma=1,
11        eval_metric='logloss',
12    ),
13 )
14
15 # Fit the model on training data
16 xgb_tuned1.fit(x_train, y_train)

```

HyperParameter Tuning XGBoost using GridSearchCV

XGBoost using RandomizedSearchCV

RandomizedSearchCV solves the drawbacks of GridSearchCV, as it goes through only a fixed number of hyperparameter settings. It moves within the grid in a random fashion to find the best set of hyperparameters. This approach reduces unnecessary computation.

HyperParameter tuning using RadndomizedSearchCV



```

1 # Creating new pipeline with best parameters
2 xgb_tuned2 = Pipeline(
3     steps=[
4         ("scaler", StandardScaler()),
5         (
6             "XGB",
7             XGBClassifier(
8                 random_state=1,
9                 n_estimators=150,
10                scale_pos_weight=10,
11                learning_rate=0.05,
12                gamma=3,
13                subsample=0.7,
14                eval_metric='logloss',
15            ),
16        ),
17    ]
18 )
19 # Fit the model on training data
20 xgb_tuned2.fit(x_train, y_train)
    
```

We will use pipelines with StandardScaler with bagging and boosting models and tune them using GridSearchCV and RandomizedSearchCV. We will also compare the performance and time taken by these two methods - grid search and randomized search.

We can also use make_pipeline function instead of Pipeline to create a pipeline.

make_pipeline: This is a convenient shorthand for creating a pipeline. Unlike the Pipeline constructor, it doesn't require naming the estimators. Instead, the names of the estimators are automatically set to the lowercase version of their types.

```

1 # Calculating different metrics
2 get_metrics_score(xgb_tuned1,x_train,x_test,y_train,y_test)
3
4 # Creating confusion matrix
5 make_confusion_matrix(xgb_tuned1, y_test)
    
```

Accuracy on training set : 0.9552765237020316
 Accuracy on test set : 0.9338598223099703
 Recall on training set : 0.9991220368744512
 Recall on test set : 0.9508196721311475
 Precision on training set : 0.782668500687758
 Precision on test set : 0.7238689547581904

score of XGBoost1

Evaluating Model Performance

"Model performance evaluation in machine learning involves monitoring the model to determine how effectively it performs the task for which it was designed.

There are a variety of ways to carry out model evaluation in model monitoring, using metrics like:

Accuracy: Accuracy is a measure of how often the model correctly predicts the outcomes for the test set.

Precision: The number of True Positives the model has classified from the total number of positive values is known as recall (also referred to as sensitivity or the true positive rate).

Recall: A combination of precision and recall metrics

Confusion matrix: A table with two dimensions showing actual values and predicted values

Cross-validation: This technique ensures that the model's performance is evaluated on various data splits, providing a more robust estimate of its ability to generalize to new, unseen data.

Here we have compared all the three model's train and test accuracy, train and test recall, and train and test precision score:

	Model	Train_Accuracy	Test_Accuracy	Train_Recall	Test_Recall	Train_Precision	Test_Precision
0	Logistic Regression	0.877	0.878	0.427	0.418	0.686	0.701
1	XGBoost with GridSearchCV	0.955	0.934	0.999	0.951	0.783	0.724
2	XGBoost with RandomizedSearchCV	0.981	0.958	1.000	0.951	0.894	0.818

Accuracy, Recall and Precision of all three models

The xgboost model tuned using RandomizedSearchCV is giving the best test recall of 0.95 and accuracy is of 0.98 on overall generalized performance.

Deploying the Model using Streamlit

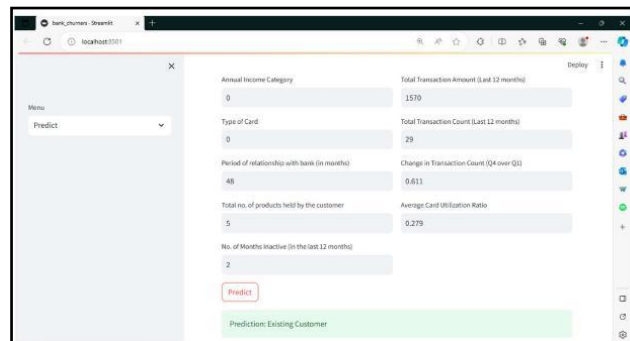
Streamlit is a free, open-source Python framework designed for developers and data scientists to create web apps for machine learning and data science. It enables users to build apps in a manner similar to writing Python code. With minimal lines of code, we can develop engaging, informative, and visually appealing applications

Streamlit is compatible with major Python libraries, including:

1. scikit-learn
2. Keras
3. PyTorch
4. SymPy (latex):
5. NumPy
6. Pandas
7. Matplotlib

In this project we have developed a simple Streamlit application for Bank Customer Churn Prediction. Here, users can input various customer features and get a prediction on whether the customer is likely to attire or not. The application loads a dataset and uses an XGBoost classifier for making predictions.

Home Page



Prediction Page

4. Future Scope and Conclusion

In the future, we will be providing support for the Management Information System (MIS) to the bank. An MIS is a system designed to supply managers with the essential information needed to make informed decisions about the organization's operations. It collects data from various sources, processes it, and presents the information in a way that meets the specific needs of managers and their teams. While different businesses may use varied systems, they all share a common goal: to equip managers with the right data to enhance decision-making. In today's fast-paced business world, having access to accurate, up-to-date information is crucial for success. MIS enables managers to monitor performance metrics, identify emerging trends, and make well-informed decisions about resource allocation

This dataset contains information of only one branch, therefore in future we can create and deploy a model for multiple branches of the Bank and do geographical analysis. We can also create interactive dashboards using Tableau or Power BI.

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C2CSEC: Chip To Chip Secure Communication Architecture for Embedded Systems

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Abstract: In recent years, semiconductor companies have frequently outsourced chip production to meet the increasing demand for integrated circuits. Due to this, the chip supply chain is now facing a number of security issues, such as hardware intellectual property theft, Trojans, and overproduction. Zero-trust is a promising approach to guaranteeing that Integrated Circuits (ICs) are valid in critical systems where adversary attacks could result in significant losses or damages. Certificates are used to guarantee the legitimacy of ICs using the Security Protocol and Data Model (SPDM). The work presented in this study is a secure chip-to-chip (S2C) zero-trust security architecture that is based on CANXL protocol and aims to verify any attached peripheral before using it. The contributions include a comprehensive explanation of the proposed design and a discussion of the obstacles that were encountered while executing and implementing.

Key Words: Chip-to-chip communication, CANXL, Zero-trust Architecture, SPDM, Embedded Systems.

1. INTRODUCTION :

The world is becoming increasingly interconnected at a staggering rate due to the development of embedded systems, which are the backbone of connected automobiles, drones, smart homes, industrial control systems, and the Internet of Things (IoT). The majority of embedded systems depend on Integrated Circuits (ICs) that are produced in low-cost production zones by third-party manufacturers. Due to the untrustworthiness of modern, innovative foundries in the IC supply chain, the reliability of manufactured integrated circuits (ICs) or devices is seriously questionable [24]. It is important to consider the risks involved when relying on unverified information. The untrusted foundry is required to share any IP component of the system, for instance. Besides the usual dangers of IP theft, overproduction, and reverse engineering, a backdoor or hardware Trojan can be employed to modify the same IP [11]. Increasingly inventive methods are being discovered by malicious entities to gain access to embedded devices through the software supply chains that produce them at the same time.

2. LITERATURE REVIEW :

The emerging threats exceed existing security frameworks by a slight degree. Two existing IoT-specific standards created in order to protect individual IoT devices are the PSA (Platform Security Architecture) [17] as well as the SESIP (Security Evaluation Standard for IoT Platforms) [18]. ARM's PSA project attempts to offer an isolated execution environment based on hardware. In order to build a secure basis for IoT systems, it provides threat models, security analysis, and hardware/firmware standards. However, in order to make sure IoT platforms fulfill specific security requirements, the SESIP lays out recommendations for doing just that. In order to increase user and stakeholder trust, this standard assists producers and developers in evaluating the security features and resilience of their products.



Various strategies are suggested to counteract the risks caused by unreliable manufacturing, including logic locking [5], obfuscation [9], and Trojan detection [22]. These last circuit-level tactics call for circuit alterations that would make it harder for an enemy to decipher intellectual property. According to some writers, chip-to-chip authentication should come first, then split-chip solutions for trustworthy fabrication [10]. At some point, these remedies are unable to offer fully secure systems. Simultaneously, the cybersecurity, as well as silicon sectors, have recently argued in favor of zero-trust architectures to more thoroughly secure distributed infrastructure, particularly with the available generation of open-source hardware, which would undoubtedly offer a significantly larger attack surface with potentially severe physical consequences. The zero-trust principle enhances security throughout semiconductor supply chains [27]. The semiconductor industry wants to implement this idea to prevent any non-self-authenticating device from connecting with system hardware. This suggests that it is necessary to disregard any manipulations that take place in the foundry or throughout the supply chain. Moreover, the future generation of embedded systems may benefit from a more reliable end-to-end security strategy, which might be facilitated by fusing zero-trust security concepts with current embedded systems security techniques [21]. Intel shares its goals and principles for "A Zero-Trust Approach to Architecting Silicon" [28], which lends credibility to this concept.

A framework called DRLGENCERT is shown in [15], demonstrating the application of deep reinforcement learning (DRL) to automation of certificate verification testing. Using conventional certificates as input, DRLGENCERT generates new certificates that can effectively identify discrepancies. This method improves the procedure overall by using DRL to make intelligent decisions during certificate generation based on previous modifications.

In [14], the MQTTS protocol utilizing SSL/TLS certificates is employed to protect communication between an IoT ESP32 embedded system & IoT cloud. Without disclosing any information about the methods that were employed, the study concentrates on whether the encryption strategy is accurate. In [13], an architecture is put forth that would allow Internet of Things devices to notarize and authenticate data inside the Ethereum blockchain. By creating a strong hardware-software framework that enables lightweight devices, like Internet of Things sensors, to manage this process, the work expands on this idea. These devices, together with their corresponding public address, include a confidential key within this architecture. Transactions are automatically signed and sent to the blockchain network as they are created.

A Secure Chip-to-Chip (S2C) Zero-Trust Architecture is being presented in this study to ensure security for communications between two chips and a mechanism for proving the authenticity of peripherals. S2C is based on a zero-trust processor which uses multiple cryptographic engines for increased security to implement the SPDm protocol. The compilation, optimization, as well as testing of SPDm protocol are the main contributions of this effort. Among these contributions are an overview of the architecture, the SPDm protocol's implementation and a thorough examination of the difficulties in its execution and implementation. Moreover, the research includes the experimental realization of SPDm SPI connection using NXP S32Z2 devices as platform.

Assuming that devices authorized within the network can be implicitly trusted, conventional security architectures and models frequently rely on a single network architectural solution [1]. Aside from implementation or architectural arrangement, authorization is a crucial component since the resources and architecture of a network dictate the kind of authorization model that is needed. In ZT contexts, authorization systems like as RBAC, PBAC, and ABAC are frequently employed. Continuous authorization guarantees that access is only authorized when required [2].

Table 1: CAN Frame Format Receive Timing

Protocol	Arb. Rate	Data Phase Rate	Data payload (DLC)	Filtering Fields	Arb. Phase Time (us)	Data Phase Time (us)	Total Time (us)
Can Classic	Up to 1 Mbps	Same as arb.	Up to 8 Bytes	MSG ID Only	44 us	0 - ~64 us	44 us - ~111 us
Can FD		Up to 8 Mbps	Up to 64 Bytes	MSG ID Only	25 us	5 us - ~71 us	30 us - ~99 us
Can XL		Up to 20 Mbps	Up to 2048 Bytes	Priority ID (MSG ID), SDU, VCAN, AF, SEC	31 us	6.7 us - ~900 us	37.7 us - ~934 us

The remaining part of the paper is organized as follows: The suggested methods are defined in Section 2, which includes both an integrated design execution and a thorough overview. The obtained experimental outcomes are defined and examined in Section 3. Ultimately, Section 4 concludes the paper and proposes opportunities for further research.

Numerous studies have been carried out recently applying scientometric analysis to determine the growth of research production.

Aydin (2017) conducted the research on “Research Performance of Higher Education Institutions”, the article intends to raise awareness of "research performance," which plays a crucial role in university competition. The study makes an effort to summarize the findings of a thorough literature evaluation in the area of higher education research performance in order to achieve this goal. First, basic literature on research performance is discussed together with its concept definition and indicators. Then, a thorough presentation of the variables affecting research performance followed. The study concludes with the provision of a conceptual framework that will be useful to all university staff.

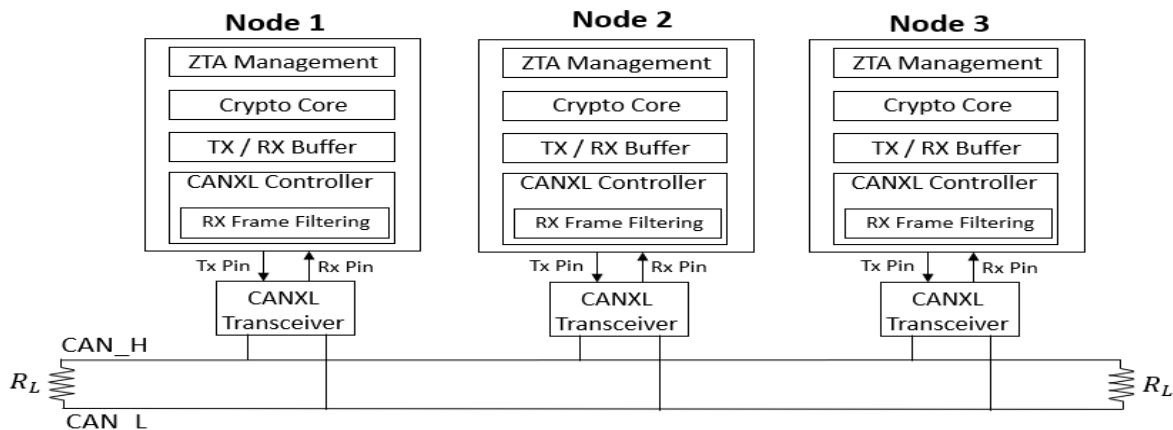


Fig. 1. Operational unit in S2C zero-trust architecture.

3. METHODS :

3.1 Architecture Overview

An S2C architecture that can guarantee secure communication between two chips—an initiator and a target—has been suggested in our work is shown in Figure 1. It should be mentioned that the target is a representation of an external peripheral, that could be either passive (no processor) or active (integrated processor). In order to exchange data between the target and initiator, the target needs to be verified.

Zero Trust Architecture (ZTA) Management unit consists of following components given below from 3.1.1 to 3.1.4. It is implemented in the software application and rest of the component is the hardware block like Crypto Code, TX/RX Buffer memory, CANXL Controller are the part of the NXP S32Z2

chip. To configure these hardware modules, dedicated drivers are implemented.

3.1.1 ZTP (“Zero-Trust Processing”): This feature serves as a link between the initiator and the target and is responsible for implementing the zero-trust procedure. SPDM [26] and PCIE[16] were examined for this purpose, and the SPDM was chosen because it supports interconnects that are non-PCIe.

3.1.2 ZTM (“Zero-Trust Management”): It evaluates if ZTP is allowed to interact with the peripheral that is connected. This unit makes use of scheduling based on events. Prior to initiating data exchange during the initialization phase, the Target submits its certificate to the ZTM of the Initiator for validation. For example, in order to declare a verification success or failure, zero trust operations need to be recorded and shared.

3.1.3 CMU (“Certificate Management Unit”): It allows the maintenance of certificates, including their revocation, modifications, and notifications to other chips of certificate changes.

3.1.4 CSS (“Certificate and Secret Storage”): It allows for the efficient and safe storage of private keys and certificates in on-chip flash memory.

3.1.5 CANXL Controller : CANXL is a communication controller hardware module that complies with the CANXL protocol specification (CAN eXtended data-field Length, ISO 11898-1:2024), and part of NXP S32Z2 Chip, Large payload size up to 2048 bytes supported. Frame timing is given in table 1. CAN XL can cover distances of up to 25 meters.

The article aims to manage the newly inserted devices and implement the chosen authentication scheme by using CANXL data transfer protocol. We exclusively work on implementing these above modules and integrated into the whole system.

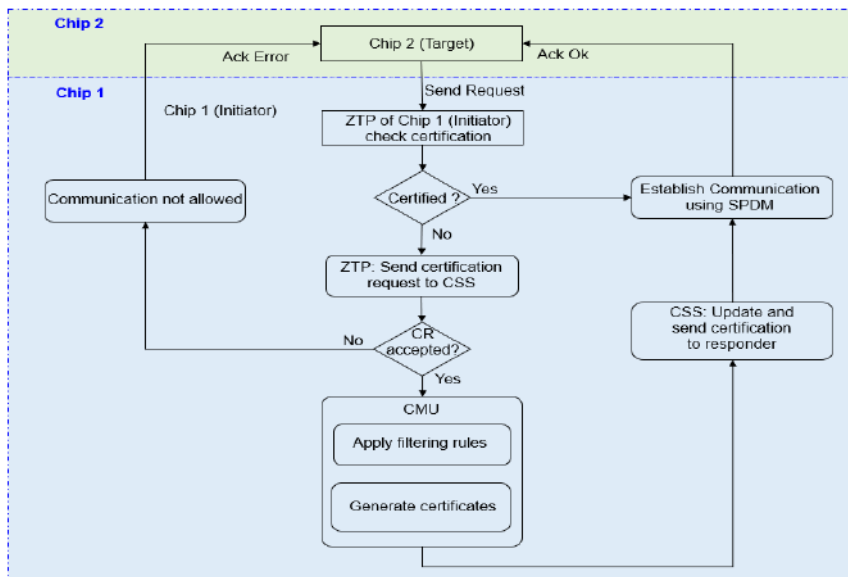


Fig. 2: Certificate management flow diagram

3.2 Zero-Trust Processing Mechanism

3.2.1 Description of the SPDM protocol: For secure communication between devices via a variety of transport and physical media, the SPDM protocol specifies formats of messaging, data objects, as well as sequences [26]. Cryptographic engines for digital signatures, hashing, and verification are included in the SPDM. Moreover, the SPDM protocol has recently been updated to include post-quantum



cryptography techniques in order to make it resistant to quantum computing [7].

3.2.2 Embedded implementation of SPDM protocol: To give an example, the suggested architecture will be included in a vehicle so that its ECU can use the CAN interface to interact with other ECU and

Table 2: Comparing the proposed S2C architecture to other implemented systems.

Criteria	Proposed Work	[29]	[6]	[13]	[14]
Security Domain	Hardware layer	Hardware layer	Hardware layer	Application, transport, and network layers	Transport layer
Focus	Long Distance Communication	Fast and secure data transfer	Chip supply chain	Data certification and notarization on blockchain	Certificate generation in SSL/ILS
Methodology	Secure Chip to Chip zero trust architecture SPDM	Secure Chip to Chip zero trust architecture	Chip-to-chip zero-trust architecture	Ethereum blockchain	Automated certificate generation
Protocol/Model	SPDM	SPDM	SPDM	data certification on blockchain	SSL/ILS
Data Transfer Rate	Upto 20 Mbps	Upto 30 Mbps	Upto 5 Mbps	Up to 100 Kbps	Up to 300 Kbps
Evaluation platform	NXP S32Z2	NXP S32G3	Raspberry PI based on ARM	ARM Cortex-M4	ESP32
Communication Protocol	CANXL	SPI	I2C	WiFi	Bluetooth
Cable Length	Up to 25 Meter	~15 - 20 cm	~ 1 Meter	Wireless	Wireless

automotive electronics modules like the steering wheel unit, breaking control unit etc. with the help of Steer-by-wire (SBW) system, which replaces the mechanical linkage with electric wires. An overview of the implemented prototype environment is shown in Figure 3. It is made up of two NXP S32Z2 boards that are linked together by the CAN bus; one of them is set up as a target (slave) and the other as an initiator (master).

3.3 Mechanism of the Certificate Management Unit:

The ZTM's many situations for handling plugged-in peripherals in response to a ZTP request are shown in Figure 1. The ZTM mechanism verifies the certificates of the inserted peripherals during the SPDM protocol's initialization phase. ZTM allows ZTP to initiate a communication session by verifying the certificate of a peripheral. This ensures that unauthorized communication between the initiator and even authentic peripherals is prevented. The program administrator can authenticate unknown peripherals by using a certification process that is suggested within the CMU unit to handle this problem. The ZTM sends a certification request to CMU, requesting clearance from a local agent (Domain Validation Certificate: DVC) or a 3rd party (Extended Validation Certificate: EVC). Information about the peripheral, including its Unified Identifier (UID) and production details, should be present on the plugged-in non-certified devices. The relevant certificates are generated and returned by the EVC after receiving this information via the internet. With libraries such as OpenSSL [20] or EmbedTLS [23], a

system administrator can do local certification. The key parameter generation, certificate creation, revocation, and update, message digest computation, and signing and validating processes are all made possible by these libraries.

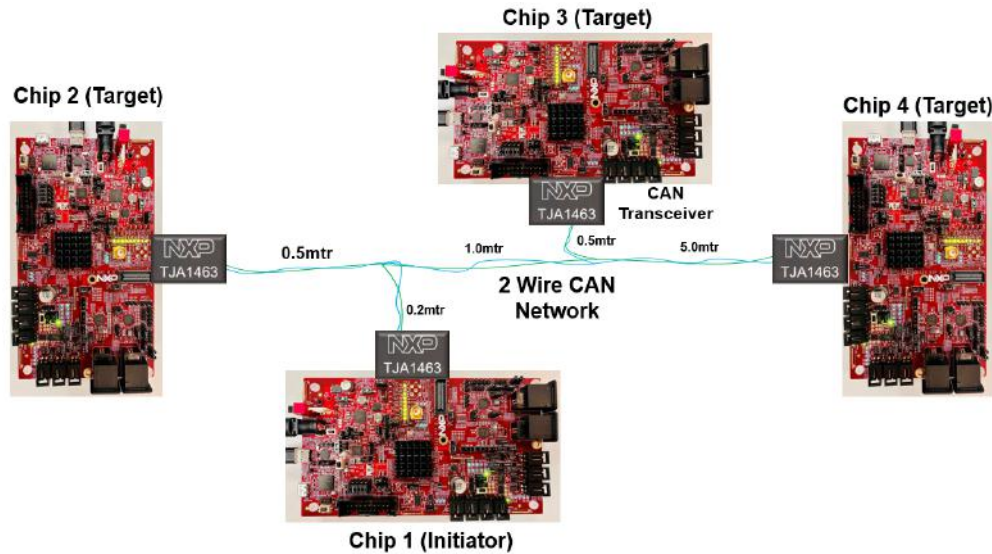


Fig. 3: Hardware Prototype based on NXP S32Z2 board

4. RESULT AND DISCUSSION :

The first hurdle in implementing SPDM on the NXP S32Z2 via CANXL connection is the lack of software support for application drivers, so new device drivers are implemented. Table 1 illustrates the latency of the CAN Frame format. The authentication process takes about 2-3 seconds to complete. The authentication process involves establishing a shared key, exchanging certificates, obtaining user measurements, and starting encrypted connections. The findings demonstrate that a larger buffer has some improvement on latency time because of a hardware does not require to check that buffer is empty or not, by issuing read requests to checks the buffer status during data transfer.

The hardware faces no performance drop performance drop, this is the improvement as compared to [29] in which when the buffer size is lower, which cause filling of the buffer too frequently which halt the communication during data transfer and wait until it becomes empty by the host. However, this is avoided by taking by using CANXL which support 2K data frame and support DMA for data movement from memory to buffer for read and write accesses. Another advantage that we are focusing for long cable length, it is supported up to 25 Meter with 20 Mbps constant speed, but in case of SPI there is a drop in speed when increases the length of the bus, as given in table 2.

It's important to verify the manufacturer and UID details when it comes to certifying authentic and non-certified peripherals. The system administrator must be aware of peripheral UID cloning, which is a major challenge. Connecting non-certified devices is now the responsibility of the system administrator.

5. CONCLUSION :

S2C architecture was proposed in this work to ensure secure chip-to-chip communications. The SPDM protocol is used in the proposed design to ensure integrity and confidentiality of data communications. To demonstrate that validation of certificates results in interoperability between the two platforms, the protocol is applied on two NXP S32Z2 systems as a case study. A certification method is implemented in software to create fresh certification credentials for new, authentic, and uncertified peripherals.

In the future, our priority will be to develop an integrated system-on-chip (SoC) that combines the various components of the proposed design, employing a RISC-V CPU. Lightweight accelerators and cryptographic algorithms will be considered [25] to speed up secure chip-to-chip communication and authentication in the zero-trust era.



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Virtual Reality: An Overview of Insight of The Real Technology

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Abstract: *Virtual Reality (VR) is a technology enabling users to interact with a computer-simulated ambience, whether that ambience is an artificial simulation of a world or an imaginary world, planet or universe. It is the key to experiencing, feeling and touching the past, present, and future. It is the medium of creating a simulation of the world or a customised reality. It can range from creating a video game to having a virtual round of the world, from walking through our dream house to experiencing a walk on a different planet. We can experience the most exciting and adventurous situations with virtual reality by playing safe and using a learning initiative.*

Despite the rapidly growing popularity of Virtual Reality (VR), there still needs to be a greater understanding of its basic principles and problems among the general population. This article sheds light on the historical overview of virtual reality, basic terminology, and classes of VR systems. It also discusses the detailed evolution of VR year after year and its progress.

Keywords: *Evolution of VR, Sensorama, HMD, CAVE, Immersive Virtual Reality, Telepresence, Cyberspace.*

1. INTRODUCTIONS:

Virtual Reality (VR) uses computing technology to create a simulated ambience that users can interact with. VR can make video games, virtual tours, and training simulations. VR is a key technology for experiencing, feeling and touching the past, present, and future. It is a medium for creating our customised reality. VR can provide an immersive experience, more than augmented reality, that makes users feel like they are in the simulated environment. This can be especially valuable for training simulations, such as flight simulation, where it is crucial to create a realistic environment. VR can create interactive tours of historical sites, allowing users to explore the past educationally and entertainingly.

Virtual reality uses a computer and the Internet to create a simulated environment. Unlike traditional user interfaces, VR places the user inside an experience that allows them to interact with 3D worlds.

Key components of VR:

VR creates an immersive environment in a 3D digital space that feels real.

It gives Sensory Feedback that Utilises visual, audio, and haptic (touch) feedback to enhance reality.

It is highly Interactive, and Users can interact with the environment in real-time.

Types of VR:

Non-immersive: Basic simulations on a computer display.

Semi-immersive: Enhanced by tools like large screen displays or projection systems.



Fully immersive: It involves headsets and motion-tracking to engage the senses fully.

Typical uses of VR include:

- Gaming
- Medical Training
- Education
- Virtual Tours

AI and VR are not just technologies but transformative forces reshaping our digital interactions and the world as we know it. They are not just creating new possibilities but also opening up a whole new world of opportunities in entertainment,

healthcare,
education,
engineering.

Their promising and inspiring potential offers a hopeful glimpse into the future.

WHAT IS Virtual Reality? WHAT IS Virtual Reality NOT?

At the beginning of the 1990s, the development of virtual reality became much wilder, and the term became extremely popular. We can hear about Virtual Reality in nearly all sorts of media, and people often use this term.

Virtual Reality (VR) is the popular name for an absorbing, interactive, Computer-mediated experience in which a person perceives a simulated environment utilising unique human-made computer interface Equipment. It can interact with simulated objects in that environment as if they are real. Several people can see one another and interact in a shared Synthetic environment such as a battlefield.

Virtual reality is a term for a computer-generated virtual Environment that a user may move through and manipulate in real-time. The virtual ambience is on a head-mounted display, a computer monitor, or a large projection screen. Head and hand tracking systems enable the user to observe, move around, and manipulate the virtual environment.

Many definitions of VR emphasise its collaborative nature, which sets it apart from 3D movies, 360-degree videos, and similar 'look but don't touch' media. This collaborative aspect of VR is not just a feature but what makes it truly immersive and engaging.

In VR, users can interact with the ambience and, in some cases, with each other in real-time, making them feel part of a shared experience.

When we examine VR's history, we must consider a broader definition that includes VR-adjacent technologies. Some of the technologies discussed in this article are part of VR's history and descendants of other forms of media, such as film. Understanding this historical context is fascinating and essential to appreciating VR's evolution and its roots in different media, helping us feel connected to its development.

As per Mandal, "International Journal of Science and Engineering," Volume 4, page 304." early attempts at virtual reality are the evolution of VR from 1838 to 2019.

Panoramic paintings

Suppose we focus more strictly on the scope of virtual reality to create the illusion that we are present somewhere we are not. In that case, the earliest attempt at virtual reality is undoubtedly the 360-degree



murals (or panoramic paintings) from the nineteenth century. These paintings intend to fill the viewers, entire field of vision, making them feel as if they are present at some historical event or scene.

Battle of Borodino, 181

1838 – Stereoscopic photos & viewers

In 1838, Charles Wheatstone's research established that the brain processes the two-dimensional images from each eye into a single object of three dimensions. Watching two side-by-side stereoscopic images or photos through a stereoscope gave the user a sense of depth and immersion. The popular View-Master stereoscope (patented in 1939) is further developed for "virtual tourism." The design principles of the Stereoscope are used today for the popular Google Cardboard and low-budget VR head-mounted displays for mobile phones.

- 1838 : The stereoscope (Charles Wheatstone)
- 1849 : The lenticular stereoscope (David Brewster)
- 1939 : The View-Master (William Gruber)

Over time, humankind has slowly created richer ways to stimulate our senses. Things began improving with the advent of electronics and computer technology in the 20th century.

Link Trainer - First Flight Simulator

In 1929, Edward Link created the "Link trainer" (patented 1931), probably the first example of an entirely electromechanical commercial flight simulator. Motors linked to the rudder and steering column were used to modify the pitch and roll. A small motor-driven device mimicked turbulence and disturbances. Such was the need for safer ways to train pilots that the US military bought six of these devices for \$3500. In 2015, the money was shy of \$ 50,000. During World War II, over 10,000 "blue box" Link Trainers were used by over 500,000 pilots for initial training and improving their skills.

Science fiction stories predicted VR.

In the 1930s, science fiction writer Stanley G. Weinbaum wrote a story about a pair of goggles that let the wearer experience a fictional world through holographic, smell, taste, and touch. Weinbaum's description of the experience for those wearing the goggles is uncannily like the modern and emerging virtual reality experience, making him a true visionary of the field.

Morton Heilig's Sensorama

In the mid1950s, cinematographer Morton Heilig developed the Sensorama (patented 1962), an arcade-style theatre cabinet that would stimulate all the senses, not just sight and sound. It featured stereo speakers, a stereoscopic 3D display, fans, smell generators, and a vibrating chair. The Sensorama intended to immerse the individual fully in the film. He also created six short films for his invention, all of which he shot, produced, and edited himself. The Sensorama films were titled Motorcycle, Belly Dancer, Dune Buggy, helicopter, A Date with Sabina, and I'm a Coca-Cola Bottle!

The 1st VR Head Mounted Display.

Morton Heilig's next invention was the Tele Sphere Mask (patented in 1960), the first example of a head-mounted display (HMD), albeit for the non-interactive film medium without motion tracking. The headset provided stereoscopic 3D and broad vision with stereo sound.

Headlight – First motion tracking HMD



In 1961, two Philco Corporation engineers, Comeau and Bryan, introduced the first precursor to the HMD, which we know today as the Headlight. It incorporated a video screen for each eye and a magnetic motion tracking system linked to a closed-circuit camera. The Head Sight was not being developed for virtual reality applications (the term didn't exist then) but to allow for immersive remote viewing of dangerous situations by the military. Head movements would move a remote camera, allowing the user to look around the environment naturally. Headlight was the first step in the evolution of the VR head-mounted display, but it lacked the integration of computer and image generation.

The Ultimate Display by Ivan Sutherland

Ivan Sutherland described the "Ultimate Display" concept as one that could simulate reality to the point where one could not tell the difference from actual reality. His concept included:

- A virtual world viewed through an HMD appeared realistic through augmented 3D sound and tactile feedback.
- Computer hardware creates and maintains the virtual world in real-time.
- The ability of users to interact with objects in the virtual world in a realistic way

"The ultimate display would, of course, be a room within which the computer can control the existence of matter. A chair displayed in such a room would be good enough to sit in. Handcuffs displayed in such a room would be confining, and a bullet displayed in such a room would be fatal. With appropriate programming, such a display could be the Wonderland into which Alice walked." – Ivan Sutherland.

Furness' Flight Sim

An engineer for the military, Thomas Furness is known for kick-starting the development of modern flight simulator technology. He is known as "the grandfather of VR," and his work in Human Interface Technology continues to inform VR technology today.

Sword of Damocles

In 1968, Ivan Sutherland and his student Bob Sproull created the first VR / AR head-mounted display, the Sword of Damocles, connected to a computer, not a camera. It was a large, scary-looking device that was too heavy for anyone to comfortably wear and suspended from the ceiling. The user would also need to be buckled into the device. The computer-generated graphics were very primitive wireframe rooms and objects.

Artificial Reality

In 1969, Myron Krueger, a virtual reality computer artist, developed a series of experiences that he defined as "artificial reality," in which he developed a computer-generated ambience that responded to the people in it. The projects GLOWFLOW, METAPLAY, and PSYCHIC SPACE were progressions in his research that ultimately led to the progress of VIDEOPLACE technology. This technology allowed people to communicate in a responsive computer-generated environment despite being miles apart.

GE Builds a Digital Flight Sim

General Electric produces a "computerised" flight simulator with three screens arranged in a 180-degree configuration. The screens surround the simulated training cockpit, giving trainee pilots a feeling of true immersion.



Krueger's VIDEOPLACE

The VIDEOPLACE is regarded as the first interactive VR system. It could measure user position using a mix of CG, light projection, cameras, and screens. In modern terms, it's more like an AR projection and doesn't feature any headset.

MIT Movie Map

MIT created the Aspen Movie Map, a system that lets people wander through a virtual experience of Aspen, Colorado. It was like an ancient precursor of Google Street View. They used a video filmed in a moving car to create the impression of moving through the city. Once again, no HMD was part of this setup.

McDonnell-Douglas HMD

The VITAL helmet is the first proper example of a VR HMD outside the lab. Pilots could use a head tracker to examine primitive computer-generated imagery.

Sayre Gloves

Daniel Sandin and Thomas DeFanti invented finger-tracking gloves for VR called "Sayre" gloves. The gloves are wired to a computer system, and optical sensors detect finger movement. They were the precursor to the "data gloves" that would be an essential part of early VR.

VPL Research

VR pioneers Jaron Lanier and Thomas Zimmerman founded VPL Research, the first VR company to sell HMDs and gloves. The term "data glove" comes from their Data Glove product.

Furness Invents the Super Cockpit

Tom Furness directed an Air Force project called the "super cockpit." It was a training simulator featuring CG graphics and real-time interactivity for pilots. Interestingly, the Super Cockpit integrated movement tracking and aircraft control.

Virtual reality, the name was born.

Even after this progress in virtual reality, there still wasn't an all-encompassing term to describe the field. Everything changed in 1987 when Jaron Lanier, founder of the Visual Programming Lab (VPL), coined "virtual reality". The research area now has a name.

NASA Gets Into VR

NASA, with the help of Crystal River Engineering, created Project VIEW, a VR sim used to train astronauts. VIEW looks recognisable as a modern example of VR and features gloves for finely simulating touch interaction. Interestingly, the technology in these gloves led directly to the creation of the Nintendo Power Glove.

Virtuality Group Arcade Machines

It began with the public's access to virtual reality devices, although household ownership of cutting-edge virtual reality still needed to be within reach. The Virtuality Group launched another range of arcade games and machines. Players would wear VR goggles and play on gaming machines in real-time. Some units were also networked together for a multi-player gaming experience.



Medina's VR Mars Rover

These days, we are used to seeing live footage from Mars rovers. In 1991, this was still a dream, and many problems remained. A NASA engineer named Antonio Medina developed a VR system that lets you pilot a Mars rover, even considering the time delay—a system dubbed "Computer Simulated Teleoperation."

The Lawnmower Man

The Lawnmower Man movie introduced virtual reality to a broader audience. It was based on the founder of Virtual Reality, Jaron Lanier, and his early laboratory days. Pierce Brosnan played Jaron, a scientist who used virtual reality therapy on a mentally disabled patient. The film used virtual reality equipment from VPL research labs, and the director, Brett Leonard, admitted to drawing inspiration from companies like VPL.

SEGA announces the new VR glasses

Sega announced the Sega VR headset for the Sega Genesis console in 1993 at the Consumer Electronics Show 1993. The wrap-around prototype glasses had head tracking, stereo sound, and LCD screens in the visor. However, technical development difficulties meant the device would forever remain in the prototype phase despite having developed four games for this product.

The Sega VR-1

Sega is on a roll with its VR devices. It also released its VR-1, an arcade motion simulator that moves based on what's happening on-screen. This makes it like the AS-1, but the VR uses a head-mounted display, whereas the AS-1 uses a regular projection screen.

Nintendo Virtual Boy

The Nintendo Virtual Boy (known initially as VR-32) was a 3D gaming console hyped to be the first portable console to display accurate 3D graphics. It was first released in Japan and North America. Despite price drops, it was a commercial failure. The reasons for failure were lack of colour in graphics (games were in red and black), software support, and difficulty using the console comfortably. The following year, it discontinued its production and sales.

Landmark VR PTSD Treatment

Georgia Tech and Emory University collaborate to use VR for the treatment of PTSD (Post-traumatic Stress Disorder) in war veterans. This is a crucial aspect of PTSD treatment and research today. Skilful exposure to traumatic triggers is essential to treating the symptoms of PTSD. VR technology gave therapists unrivalled control over what the patients see and experience.

The Matrix

The Wachowski siblings' 1999 film The Matrix hit theatres. The film features characters living in a fully simulated world who are unaware they do not live in the real world. Although some previous films had dabbled in depicting virtual reality, such as Tron in 1982 and Lawnmower Man in 1992, The Matrix had a tremendous cultural impact. It brought the topic of simulated reality into the mainstream.

Google Brings Us Street View

Google improved its Maps service with street-level 360-degree images captured by unique cars fitted with custom camera equipment. Immersive Media did the work using a dodecahedral camera of their design. Thanks to this technology, you can "stand" in almost any part of the world and look around.



Street View Goes 3D, and the Oculus is Prototyped.

Just a few years later, Street View gets a 3D mode, but much bigger news in the history of VR is the work done by a young man known as Palmer Lucky. He created a VR headset kit that anyone can make, but a fateful meeting with computer legend John Carmack puts him on the path to taking his "Oculus Rift" more significant than he could have imagined.

The Oculus Kickstarter

Palmer Lucky launches a Kickstarter to fund the product and development of his prototype headset, the Rift. The campaign raised almost 2.5 million dollars and is a clear dividing line between the past commercial failures of consumer VR and the modern VR revolution.

Facebook Buys Oculus and Sony Announced Their VR Project

Social media titans see potential in Oculus technology, buying the company and making Lucky incredibly wealthy. It was a bumper year, and we also saw the launch of Google Cardboard, PSVR, and the Samsung Gear VR. Virtual reality is suddenly a very hot topic.

This is also the year Sony announced they are working on a VR add-on for the popular PS4 console. The PS4 is much less potent than VR-capable computers of the day, so everyone is curious to see how they'll pull it off.

All Hell Breaks Loose

This is the year everyone unleashes VR products that are ready for primetime. The Rift and the HTC Vive lead the way, but the floodgates have opened. You can see the results of this boom by visiting our [HMD database](#).

The Half-dome HMD

Oculus shows off a new HMD prototype, the "half dome." This advanced headset uses varifocal lenses and a 140-degree field of view.

Standalone VR grows, Mobile VR Ended.

We now have the Oculus Go and Oculus Quest, two examples of standalone VR that do not require a computer or phone to work. Mobile VR is declining rapidly, and standalone systems like the Go are affordable.

VR is Shifting Rapidly

Mixed Reality systems and classy technologies are now part of standalone VR headsets. The Oculus Quest is promised tethering capability, and smartphone-based VR projects are beginning to shut down.

The cost of VR headsets has dropped dramatically, and computer hardware capable of running these headsets is virtually mainstream. Many progressive headsets are on the horizon. Varifocal technology, vast fields of view, hand scanning, and eye tracking are but a few of the key developments.

Major companies such as Apple were rumoured to be working on mixed reality projects, and at this point, VR and mixed reality seem inseparable.

2020: What is next?



This was a brief history of Virtual Reality until 2020. Many new developments will occur this year and in the future. New headsets will arrive, technologies will be developed, and virtual reality's overall quality and comfort will improve. EZ360 will remain the most dedicated VR player and management solution for organisations. You can use many exciting features and functions later this year and in the future.

2. Conclusion:

The evolution of virtual reality (VR) depicts a fantastic journey, with fast changes from early hypothetical concepts to a prosperous industry with various applications. The history of VR is evident through several significant events.

Visionaries who sought to create immersive experiences laid the groundwork for VR. Early prototypes, such as the Sensorama in the 1960s, demonstrated its potential.

Rapid developments in computer graphics, computing power, and display technology during the late 20th and early 21st centuries opened the door for more classy VR systems. The advancement of head-mounted displays (HMDs) and motion-tracking technology has been particularly evident.

The 2010s heralded the commercialisation of VR, marked by the introduction of consumer-grade VR headsets like the Oculus Rift and HTC Vive. These devices pushed VR into the mainstream, sparking increased interest and investment in the technology.

Beyond gaming and entertainment, VR has found applications in various fields, including healthcare (surgical training and therapy), education (virtual classrooms and immersive learning), real estate (virtual tours), and more. Despite all the advancements, VR struggled with high costs, technical limitations, and accessibility issues. Research and development show these challenges, promising a future with more immersive and widespread VR experiences. The history of VR is an example of human creativity and the relentless pursuit of innovative ways to interact with digital environments. As VR technology grows, it is expected to unlock new possibilities and transform many aspects of our lives.

The advancement of VR has helped many fields, including hospitals, offices, fire stations, Medical fields, and International schools and colleges.

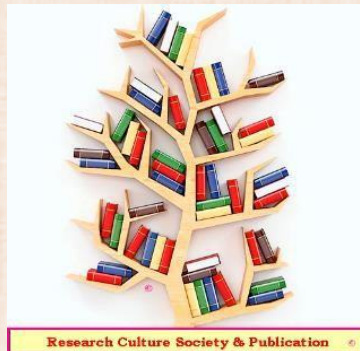
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