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EDITORIAL

"The real voyage of discovery consists not in seeking new landscapes, but in having new eyes." - Marcel Proust

In today's rapidly evolving landscape of knowledge creation, the boundaries between fields blur and global challenges grow increasingly complex. The most pressing challenges of our time — from AI-driven threats and global health crises to identity conflicts and entrenched socio-economic and cultural inequities—defy resolution within the confines of any single academic discipline. They demand a collaborative, holistic approach that bridges the divides between the sciences, humanities, and social sciences. It is within this context that Aquinas Journal of Multidisciplinary Research reaffirms its commitment to fostering dialogue and innovation at the intersections of diverse fields.

It is with great pleasure that we present the tenth edition of the Aquinas Journal of Multidisciplinary Research, a testament to our continued commitment to scholarly excellence. By exploring the intersections of diverse fields and synthesizing ideas across domains, we strive to cultivate a culture of innovation and collective discovery. This journal provides a dynamic platform for scholars and researchers to engage in insightful dialogue, share pioneering work, and illuminate new paths for exploration. In this issue, we present a tapestry of work that exemplifies the power and potential of multidisciplinary inquiry.

We extend our heartfelt gratitude to the distinguished contributors whose insightful research has greatly enriched this edition of the journal. Our sincere thanks to the peer review committee for their rigorous and thoughtful evaluations, which uphold the academic integrity of our publication. We are equally grateful to the editorial board for their unwavering commitment and invaluable contributions, which have been instrumental in shaping the success of this issue.

Each contribution in this issue reflects a commitment to innovation, a willingness to challenge convention, and a desire to understand the world in all its richness and nuance. It is our hope that these pages not only inform but inspire — prompting new questions, fresh perspectives, and fertile ground for future inquiry. May these pages inspire you to look beyond the familiar — for the true voyage of discovery lies not in seeking new landscapes, but in seeing with new eyes and an open mind.

Editors:

Prof. Dr. Joseph John, Principal

Dr. Tania John, Assistant Professor and HOD, Department of English

CONTENT

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Comparative Structural and Optical Properties of Bismuth Oxide Nanoparticles Synthesized via Chemical and Neem-Based Green Methods

[1] Venkidesh T. Venu, [2] *Dr. Manjusha M.V., [3]Smrithi S. Mallya, [3]T.S. Archana

[1, 2, 3] Postgraduate and Research Department of Physics, The Cochin College, Kochi, Kerala

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ABSTRACT

The study aimed to prepare Bi2O3 nanoparticles using chemical and green synthesis methods, with neem leaf used for green synthesis method. X-ray diffraction (XRD) proved that the chemical method produced larger crystallite sizes than the green synthesis method and produced Bi2O3 with higher lattice distortion. The chemical method produced nanoparticles with lower mineral stress, better crystallinity, and more uniformity. The green method offers environmental and economic benefits, including eco-friendly reducing agents, lower toxicity, and sustainable large-scale production. Both samples showed promising optical characteristics, with the green-synthesized Bi2O3 showing a lower band gap and higher refractive index. However, the chemically synthesised sample exhibited superior optical conductivity and a more ordered structure, making it suitable for high-performance optical devices.

****Corresponding Author***

Dr. Manjusha M.V.

Associate Professor, Postgraduate and Research Department of Physics,

The Cochin College, Kochi, Kerala

Highlights

- Bi_2O_3 nanoparticles were synthesised via both chemical and neem-based green methods.
- The Scherrer equation confirmed smaller crystallite sizes in green-synthesized Bi_2O_3 compared to the chemically synthesised sample.
- Green-synthesized Bi_2O_3 exhibited higher lattice distortion and a slightly lower optical band gap.
- The chemical method yielded higher optical conductivity, while the green route offered eco-friendly and sustainable synthesis.
- The correlation between lattice strain, crystallinity, and optical conductivity provides insights for application-specific material design.

1. Introduction

Bismuth oxide (Bi_2O_3) is a significant compound due to its considerable band gap (approximately 2.0–2.8 eV), [1–3] which influences chemical reactions [4]. Bismuth oxide (Bi_2O_3) consists of multiple crystalline phases, each exhibiting distinct structural, thermal, and electrical properties, enhancing its versatility. The four main phases are α-Bi_2O_3, β-Bi_2O_3, γ-Bi_2O_3, and δ-Bi_2O_3. [5] This material is appropriate for high-performance applications, including photocatalysis [6–8], optoelectronic devices [9], electric devices [10–13] and antibacterial coatings [6].

The Monoclinic α-phase demonstrates stability at room temperature and can endure temperatures less than 726.85 °C [14, 15], marked by a yellow colour [14, 15]. This material exhibits a broadband gap of around 2.1–3.0 eV and displays low ionic conductivity, rendering it especially effective for the photodegradation of pollutants and dielectric applications [16].

At temperatures around 330 °C to 650 °C, the α-phase changes into the β-phase, which can return to α upon fast cooling, a process termed quenching. The β-phase has a tetragonal crystal structure [17] and experiences a colour change from orange to yellow while demonstrating a somewhat lower characteristic than the α-phase [18]. The bandgap around us 2.0–2.8 eV. The attributes include improved ionic conductivity relative to the α-phase, reduced stability compared to the α- and δ-phases, and frequent use in transient thermal phases throughout the calcination process. The γ phases indicated that the crystal structure is body-centred cubic (bcc). The results were acquired by quenching from elevated temperatures (~500 °C to 639 °C) [17]. The colour is Pale yellow to white [15]. The band gap is around 1.9–2.8 eV, exhibiting atypical properties that are challenging to stable, with less symmetry and decreased conductivity relative to the δ-phase.

Upon thermal exposure, α-Bi_2O_3 undergoes a phase transition to the δ-phase at around 729 °C, characterised by a cubic structure (Fluorite-type, face-centred cubic). The δ-phase exhibits thermodynamic stability only within the temperature range of around 729 °C to 824 °C [17], which is somewhat below the melting point of Bi_2O_3. The colour changes from yellow-green to black [19]. The band gap is around 1.7–2.0 eV. This phase demonstrates remarkably high oxygen ion conductivity, surpassing that of conventional electrolytes such as yttria-stabilized zirconia (YSZ), rendering it particularly appealing for solid oxide fuel cell (SOFC) applications [20].

The ecologically friendly, cost-effective, and sustainable technology utilised for their production has garnered significant interest in bismuth oxide (Bi_2O_3) nanoparticles. Utilising the natural phytochemicals from a diverse [21,22] array of medicinal and aromatic plants as stabilisers and reducing agents has shown to be an advantageous approach for employing these plants. The three most significant examples of plants whose leaf extracts possess a high concentration of terpenoids, flavonoids, and polyphenols, compounds recognised [23,24] for their ability to facilitate nanoparticle production, are Mentha pulegium [25], commonly referred to as pennyroyal, Mentha species, known as mint [26], and Costus ignus, also called the insulin plant[27]. Similarly, previously reported articles, due to the elevated phenolic concentration in walnut shells [28], Juglans regia L. shell [29], have experienced significant utilisation. Other plants frequently utilised in the green synthesis of Bi Oxide include Azadirachta indica (neem) [30, 31], Cassia fistula plant [32], Rubus ellipticus [33], Millettia pinnata [34], Aloe vera [35], Jatropha multifida [36]. Preventing agglomeration helps achieve this objective. Plant-based synthesis ensures that these particles are suitable for various applications in environmental and biological sciences by removing hazardous substances and controlling particle morphology, dimensions, and surface properties.

Different methods can produce bismuth oxide (Bi_2O_3) nanoparticles with different particle sizes, crystallinity, purity, and shapes. Traditional chemical techniques are used for preparation in Bi_2O_3 there are most used methods are sol-gel [37], hydrothermal [38], co-precipitation [39, 40], solvothermal [41, 42], microwave-assisted [43, 44], and thermal [45]. Usually, these methods use bismuth precursors like bismuth nitrate or acetate and chemical reducing agents and stabilisers. The hydrothermal procedure produces crystalline Bi_2O_3 at low temperatures, while the sol-gel process produces pure, uniform nanoparticles [46]. Its quality, capacity to be changed in size, and cost-effectiveness have made co-precipitation popular. Recently, eco-friendly synthesis methods have gained popularity. Avoiding harmful chemicals, these methods use natural plant extracts as reducing and capping agents. Bioactive chemicals from Mentha pulegium [24, 25], Azadirachta indica [47], Costus ignus [27], Aloe vera, Jatropha multifida, etc... are used in this eco-friendly technology. They reduce bismuth ions and stabilise nanoparticles produced by the process. The environmentally friendly green synthesis produces biocompatible nanoparticles for biomedical and environmental applications.

This study concentrated on synthesising bismuth oxide using traditional chemical and environmentally friendly green methods. The primary objectives were to conduct comprehensive structural and optical evaluations of the resulting bismuth oxide and to compare these findings with information from earlier studies and analysis reports. Notably, the green synthesis method leveraged extracts from neem leaves (Azadirachta indica), known for their beneficial properties and low environmental impact. By utilising this natural extract, the research aimed to demonstrate a sustainable alternative to conventional synthesis methods while also investigating the resulting material's properties in depth.

2. Materials and Methods

Bismuth oxide (Bi_2O_3) nanoparticles were prepared using chemical and green coprecipitation techniques. The green method used for neem (Azadirachta indica) leaf extract is a reducing, stabilising, and capping agent in the green synthesis process.

2.1 Materials

This study used analytical-grade chemicals without further purification. We prepared all solutions using deionised (DI) water. The following materials are used: bismuth nitrate (98%) [$Bi(NO_3)_3 \cdot 5H_2O$], sodium hydroxide (> 98%) [NaOH], nitric acid [HNO_3], neem (Azadirachta indica) and Whatman filter paper.

2.2 Chemical Co-precipitation Techniques Synthesis of Bi_2O_3

They prepared the bismuth oxide (Bi_2O_3) in the 0.2 M solution. They took $Bi(NO_3)_3 \cdot 5H_2O$ (0.2 M) and mixed it with 50 ml of deionised (DI) water and 2 M HNO_3 while stirring for 30 minutes until the solution became clear. Add a 2M NaOH solution dropwise until the pH reaches around 8-10. We agitated the reaction mixture at room temperature. Wait for 30 minutes to get the precipitation to show. After the precipitation solution, the liquid is filtered using Whatman filter paper, washed 4 to 5 times with hot deionised (DI) water, and placed in a hot air oven at 100°C for 24 hours. After that, the powder is crushed and heated at 500°C for three hours, and once it cools down to room temperature, the crushing produces bismuth oxide (Bi_2O_3).

2.3 Preparation of Neem (Azadirachta indica) Leaf Solution

Green preparation using fresh neem (Azadirachta indica) leaves were collected and washed with distilled water. Then, 40 g of leaf cut into small pieces are transferred to 100 ml of deionised (DI) water and boiled at 60 to 80°C for 60 to 120 minutes. The extract produced a clear liquid rich in beneficial compounds like flavonoids, tannins, and alkaloids, using Whatman filter paper to remove solid bits.

2.4 Green Co-precipitation Techniques Synthesis of Bi_2O_3

They prepared the bismuth oxide (Bi_2O_3) in the 0.2 M solution. They took Bi(NO3)3·5H2O (0.2 M) and mixed it with 50 ml of deionised (DI) water while stirring for 30 minutes until the solution became milky in colour. After that, add dropwise a neem (Azadirachta indica) leaf solution until the pH reaches around 8-10. We agitated the reaction mixture at room temperature. Wait for 30 minutes to get the precipitation to show. After the precipitation solution, the liquid that passes through the Whatman filter paper is collected and washed 4 to 5 times with hot deionised (DI) water and placed in a hot air oven at 100°C for 24 hours. Then, the dried material is crushed and heated for three hours at 500°C, and once it cools down to room temperature, the crushing produces bismuth oxide (Bi_2O_3).

3. Experimental details

3.1 X-ray diffraction (XRD)

X-ray diffraction (XRD) analysis was carried out using a multipurpose X-ray diffractometer (Rigaku, Japan) equipped with CuKα radiation (λ = 1.5418 Å), a D/teX Ultra 250 1D detector, and SmartLab SE II software with an intelligent guidance system. The diffraction patterns were recorded over a 2θ range of 20° to 80°, with a step size of 0.01°, ensuring highresolution phase identification and structural analysis. Figures 3.1a and 3.1b show the XRD patterns of Bi_2O_3 nanoparticles produced by chemical and green methods using Azadirachta indica.

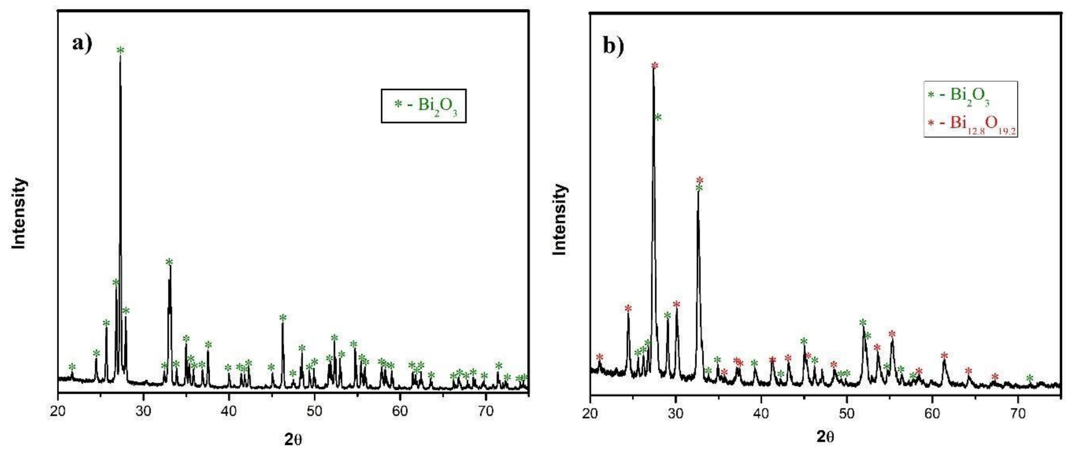

Figure 3.1 XRD pattern of a) chemical b) green (Azadirachta indica) method Bi_2O_3 nanoparticles

In the X-ray diffraction (XRD) analysis, we investigated the chemical properties of Bi_2O_3 nanoparticles produced through chemical and green synthesis. The chemical method yielded pure Bi_2O_3 nanoparticles, whereas the green approach identified Bi_2O_3 and $Bi_{12.8}O_{19.2}$ elements.

The chemical method used to prepare Bi_2O_3 resulted in sharp, well-defined peaks in the Xray diffraction (XRD) pattern of the Bi_2O_3 nanoparticles, indicating a crystalline structure. All diffraction peaks correspond to the standard data for monoclinic α-Bi_2O_3 (DB Card Number 01071-0465)[48], which belongs to the space group $P2_1/c$ (No. 14). The unit cell often possesses angles $\alpha = \gamma = 90°$ and $\beta \neq 90°$, including four symmetry-independent places. This identifies the peak and confirms the formation of a single-phase material without any other impurities. The most prominent intense peak observed, 27.9° (2θ), corresponds to the (012) crystal plane and is characteristic of the monoclinic phase. This information validates the successful synthesis of αBi_2O_3.

The green method used to prepare Bi_2O_3 nanoparticles confirms that the material is crystalline and exhibits two phases. The prominent peaks, indicated by green asterisks, correspond to monoclinic α-Bi_2O_3, as identified by DB Card Number 01-071-0465, with the space group P21/c (No: 14). A secondary phase, $Bi_{12}O_{19\cdot2}$, identified by DB Card Number 01-081-0563, is represented by minor peaks marked with red asterisks. This secondary phase has a cubic structure with the space group I23 (No: 197). The presence of $Bi_{12}O_{19\cdot2}$ may arise from oxidation changes that occur during the green synthesis process. The diffraction pattern indicates a high degree of crystallinity, with the α-Bi_2O_3 phase being the dominant formation.

The Scherrer formula, which is based on the width of the diffraction peaks obtained from X-ray diffraction (XRD) analysis, is commonly used to estimate the average crystallite or particle size of nanomaterials, especially nanoparticles. The formula is $D=k\lambda/\beta \cos\theta$ is D refers to the average particle or crystal size [49]. The Scherrer constant, K, is typically around 0.9; however, it can vary based on several factors, including the shape of the crystallites. The wavelength of the Xray radiation used in the analysis is denoted by λ, while the full width at half maximum (FWHM) of the diffraction peak is represented by. The Bragg angle is indicated by θ. In the chemical method of synthesising Bi_2O_3, the average particle size (D) is found to be 52 nm, whereas the green method yields an average size of 45 nm, both determined using the Scherrer formula. The size of the chemical method compared to the green method is smaller than that of the green method.

In X-ray Diffraction (XRD), microstrain denotes non-uniform lattice distortions inside the crystal structure, resulting in the widening of diffraction peaks—distortions like crystal defects, Size effects, Residual stress, and Substitution of atoms. We found the microstrain $\varepsilon= \beta/(4 \tan \theta)$ [50]. In the determination of microstrain, Bi_2O_3 nanoparticles exhibit values of 1.97 x 10^{-3} for the chemical method and 3.29 x 10^{-3} for the green method. The green synthesised Bi_2O_3 has higher lattice distortion, possibly due to the interaction of phytochemicals with crystal phanes growing. The chemical method produces crystals with lower mineral stress, better crystallinity and possibly more uniformity [51].

Dislocation density (δ) is a key parameter from X-ray diffraction (XRD) data that reflects the crystalline quality of a material, measuring the density of dislocation lines in a unit volume, typically expressed in m^{-2}. The Dislocation Density (δ) can be calculated using the formula associated with the crystallite size (D). The formula is $\delta= 1/D^2$. The calculated dislocation density of Bi_2O_3 nanoparticles in the chemical method is 3.70×10^{14} calligraphy lines/m^2, and in the Green method, 4.75×10^{14} calligraphy lines/m^2. The chemical method has a lower defect density, and the green method has a slightly higher one. Chemically synthesised samples indicate better crystallinity and fewer lattice imperfections, enhancing the material's stability [52]. The green method offers notable environmental and economic benefits, such as eco-friendly reducing agents, lower toxicity, and potential for sustainable large-scale production.

3.2 UV-Visible Spectroscopy

The optical properties of Bismuth Oxide (Bi_2O_3) nanoparticles were studied using various synthesis methods, including a chemical method and a green method utilising neem (Azadirachta indica) leaf-based green method, which was analysed using UV-visible spectroscopy. To determine the band energy used for the Tauc plotting method for the equation is $(\alpha h\nu)^n = A(h\nu - Eg)$ [53], Where n=2 is the direct allowed transition. In this section, we plot Figures 3.2a and 3.2b as the equation is satisfied. The curve is an extrapolation of the liner portion that gets the band gap of 2.96 eV in the chemically synthesised Bi_2O_3 nanoparticle, and the green method utilising the neem (Azadirachta indica) band gap is 2.73 eV for the sample. This indicates that the green method results in a slightly narrower band gap, making it more suitable for visible light absorption applications.

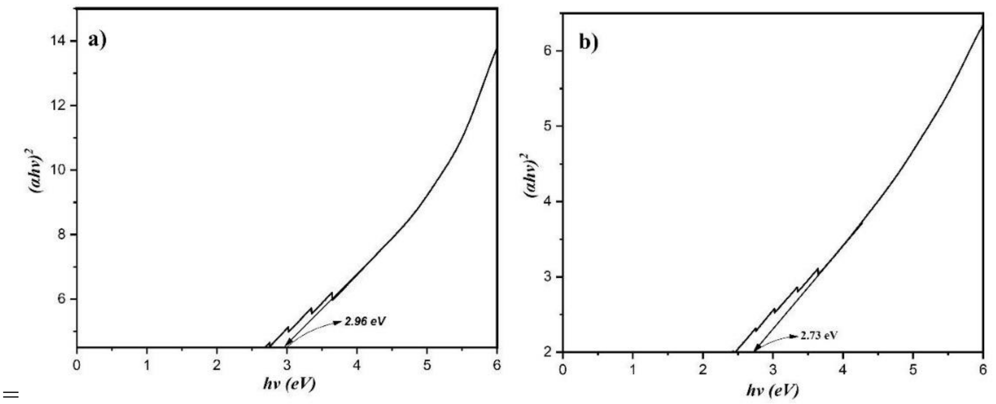

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Figure 3.2 Tauc plot of a) chemical b) green (Azadirachta indica) method Bi_2O_3 nanoparticles

The determination of absorption edge from the inverse of the bandgap energy using the formula $\lambda = 1240/E_g$ was found to be a chemical method synthesising Bi_2O_3 sample is 419.0 nm, and the green Bi_2O_3 synthesising method utilising the neem (Azadirachta indica) is 454.2 nm. This further supports the green synthesising method's enhanced visible light absorption capability utilising the neem (Azadirachta indica) Bi_2O_3 sample.

The absorption coefficient (α), which indicates how much light is absorbed per unit distance, is an important parameter. We calculated the formula using α=2.303xA/t, where A is Absorbance, and t is the path length. At 400 nm, the Bi_2O_3, the chemical method sample, shows us an absorption coefficient of 0.76 cm^{-1} and shows green Bi_2O_3 synthesising method utilising the neem (Azadirachta indica) is

0.60 cm^{-1}. The green process of synthesising a sample of Bi_2O_3 indicates stronger photon absorption in the study [54].

The disorder of understanding the materials using the Urbach energy (E_u) was derived from the slope of In(α) v/s hv plot[55]. The Urbach energy was 0.16 eV for the chemical method synthesising the Bi_2O_3 sample and 0.21 eV for the green Bi_2O_3 synthesising method utilising the neem (Azadirachta indica). The higher Urbach energy is the green Bi_2O_3 synthesising method utilising the neem (Azadirachta indica), indicating a more significant structural disorder and higher density of localized states in the bandgap [55–57].

The refractive index (n) in the Bi_2O_3 nanoparticles was estimated using an empirical relation involving the bandgap energy the formula is used for $= \sqrt{1 + (13.6/E_g)}^2$. They found refractive indices calculated in Bi_2O_3 in the chemical synthesising sample to be 2.31, and the green Bi_2O_3 synthesising method utilising the neem (Azadirachta indica) is 2.43 in the sample, with the higher value for the green sample corresponding to its lower band gap [58–60].

Finally, the optical conductivity (σ_{opt}) was determined using the equation σ_{opt}= α.n.c/4π, where the speed of light is denoted as c. the Chemmal method Bi_2O_3 synthesising sample exhibited an optical conductivity of approximately 4.19×10^9 S/cm, and green Bi_2O_3 synthesising method utilising the neem (Azadirachta indica) sample is 3.49×10^9 S/cm, The higher value of optical conductivity of chemical method prepared sample is attributed to its more significant absorption coefficient and slightly lower refractive index[61,62].

4. Conclusion

The project aimed to create pure Bi_2O_3 nanoparticles utilising neem in the green synthesis approach combining chemical and ecologically friendly techniques. Though the green technique created Bi_2O_3 and $Bi_{12.8}O_{19.2}$ components, X-ray diffraction (XRD) showed the chemical approach produced a larger crystallite size. The chemical method produced more regular and crystalline structures by reducing mineral stress. In the ecologically friendly method, phytochemicals interacting with crystal phanes might cause more lattice deformation. Lower defect density and more crystallinity helped the chemical process to improve material stability. Sustainable largescale manufacturing, lower toxicity, and eco-friendly reducing agents are among the economic and environmental benefits of the green approach. Both samples showed promising optical characteristics, particularly because of the reduced band gap and improved refractive index of the green-synthesized Bi_2O_3. On the other hand, the improved organisation and higher optical conductivity of the chemically produced sample qualified it for optical devices with decent performance. Specific application requirements and environmental considerations might affect the choice of many synthesis techniques.

Declaration of competing interest

The authors wish to clarify that no financial interests or personal relationships might be seen as influencing the research presented in this paper. They affirm their work is free from external pressures or conflicts that could compromise its integrity.

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An Investigation into the Conductivity Domains of Pure and Doped Multiferroic Bismuth Ferrite Employing Dielectric Spectroscopy

[1]Krishnendhu N.S., [1]Sreelakshmi Jain, [2*] Dr. Sivaraj K.S.

[1]Department of Physics, The Cochin College, Kochi, Kerala

[2]Assistant Professor, Department of Physics, Aquinas College, Edakochi, Kochi, Kerala

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ABSTRACT

Multiferroics are gaining significant interest as potential materials for advanced devices. This paper provides a general overview of multiferroic materials, with a primary focus on Bismuth Ferrite ($BiFeO_3$ or BFO). BFO exhibits both magnetism and strong ferroelectricity at room temperature, making it highly influential in multiferroic research. Pristine and Silver-doped BFO samples were synthesized using soft chemistry and green synthesis methods. X-ray Diffraction confirmed phase purity, while Scanning Electron Microscopy revealed surface morphology. Dielectric properties were examined through Cole-Cole plots, revealing interesting characteristics.

***Corresponding Author:**

Dr. Sivaraj K.S.

Assistant Professor, Department of Physics

Aquinas College, Edakochi, Kochi, Kerala

Introduction

Multiferroic materials have garnered significant attention due to their potential applications in next-generation technologies. These materials are particularly promising for the development of multistate memory devices, magnetoelectric sensors, and energy-efficient electronics. Traditional electronic devices often incorporate both ferroelectric and magnetic materials; however, for a long time, no single material was known to exhibit both properties at room temperature. Multiferroics, on the other hand, belong to a unique class of materials that simultaneously display two or more ferroic orders, such as ferroelectricity and ferromagnetism, either at or near room temperature [1].

Among various types of multiferroic materials, perovskite-based compounds have been extensively studied due to their exceptional multiferroic, photocatalytic, and magnetic properties [2]. These properties make them suitable for a wide range of applications, including non-volatile memory devices, thin-film capacitors, nonlinear optics, and photoelectrochemical cells. One of the most promising materials in this category is bismuth ferrite ($BiFeO_3$ or BFO), which exhibits the coexistence of both ferroelectricity and antiferromagnetic ordering.

Bismuth ferrite, a well-known perovskite material, has been widely explored in recent years due to its ability to maintain both ferroelectric and antiferromagnetic properties within a single phase. Its perovskite structure allows for potential applications in nonlinear optical devices, thin-film capacitors, non-volatile memories, and photoelectrochemical cells. The coexistence of these ferroic orders in a single compound makes BFO an attractive candidate for multifunctional device applications [3-4].

One of the key advantages of $BiFeO_3$ is its ability to retain both ferroelectric and magnetic properties above room temperature. This is attributed to its high transition temperatures. The material undergoes a ferroelectric phase transition below its Curie temperature of approximately 1100 K, making it one of the few materials that remain ferroelectric at such high temperatures. Additionally, its antiferromagnetic ordering, accompanied by a weak ferromagnetic moment, appears below the Néel temperature of 643 K. These characteristics make BFO unique among multiferroics, as it is one of the few materials that maintain both magnetic and ferroelectric properties at room temperature. The magnetoelectric coupling in BFO is particularly interesting, as it can be significantly enhanced through appropriate doping techniques, making it highly valuable for technological applications.

Structurally, bulk $BiFeO_3$ can be described as a rhombohedrally distorted perovskite with an R3c space group symmetry. The magnetic structure of BFO is characterized by a G-type antiferromagnetic arrangement, where each Fe^{3+} ion is surrounded by six nearest Fe^{3+} neighbors with antiparallel spin alignment. This results in a unique spin configuration that contributes to the material's weak ferromagnetic behavior. Additionally, as a room-temperature ferroelectric material, bulk BFO exhibits spontaneous electric polarization along one of the [111] crystallographic directions in the perovskite structure.

Due to these exceptional properties, $BiFeO_3$ has become one of the most studied multiferroic materials, offering promising avenues for the development of future electronic and spintronic devices. Researchers continue to explore ways to optimize its properties through doping, nanostructuring, and thin-film engineering, further enhancing its potential for practical applications in modern technology.

MATERIALS AND METHODS

All the reagents were of analytical grade and used without further purification. Synthesis was carried out by soft chemical route using bismuth nitrate, ferric nitrate, nitric acid and tartaric acid as source materials. In a typical experimental procedure 0.1 M of $Bi(NO_3)_3 . 5H_2O$ and 0.1 M of $Fe(NO_3)_3 . 9H_2O$ were prepared separately in 100 ml deionized water. Nitric acid was added to both solutions until it became saturated. These solutions were mixed together. 1 M of tartaric acid solution was added drop wise until a yellow precipitate is formed. The reaction mixture was stirred using a magnetic stirrer. Then the solution was heated at a temperature of about 100^0C to 120^0C for 3 hours till the residue was completely burned. A brownish red sol was obtained. The synthesis was repeated by adding $AgNO_3$ for preparing silver substituted BFO.

Green synthesis method was employed using Moringa oleifera. 30 g of dried Moringa oleifera leaves was immersed in 300 ml of boiled deionized water (DI-H_20) and kept at 50° C for about 1 hour and 45 minutes. About 50 ml of the natural plant extract was used to dissolve 3 g Bi $(NO_3)_3 .9H_2O$ and Fe $(NO_3)_3. 5H_2O$ each. The solution was dried at 100° C in an oven and the remaining residue was collected, and crushed in to fine powder.

The structural phase formation is confirmed using Rigaku D-Max X-Ray Diffractometer and morphology was analysed using scanning electron microscopy. Dielectric studies were performed using a home-made dielectric cell and HP 4285A LCR meter automated using LabView Software.

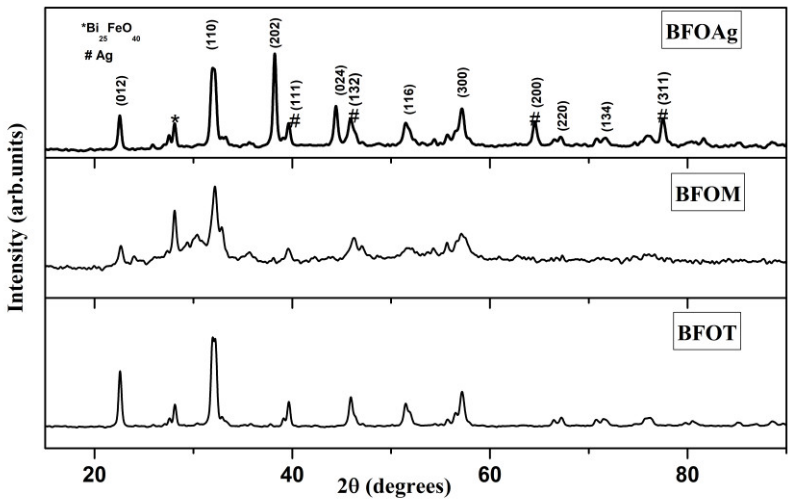
RESULTS AND DISCUSSIONS

Structural Characterization

The characteristic peaks in the X-Ray diffraction pattern clearly indicate the presence of a perovskite structure, and the obtained results were cross-verified using the ICDD database. The synthesis method utilizing tartaric acid produced phase-pure $BiFeO_3$ (BFOT), with only minor impurity peaks observed (Figure 1). This demonstrates that tartaric acid effectively facilitates the low-temperature synthesis of $BiFeO_3$.

Additionally, a green synthesis approach was employed to prepare another set of samples, labeled BFOM. The XRD analysis of BFOM exhibited impurity peaks along with a slightly amorphous phase. To further modify the properties, silver was introduced in stoichiometric proportions into the reaction mixture used for tartaric acid-assisted synthesis, leading to the formation of BFOAg.

The particle sizes of BFOT and BFOM were determined using the Debye-Scherrer equation, revealing an approximate size of 15 nm, whereas BFOAg exhibited a larger particle size of around 30 nm. Typically, $BiFeO_3$ is non-magnetic at room temperature due to the antiparallel spin alignment of Fe ions and its inherent cycloidal spin structure. However, the formation of the sillenite phase ($Bi_{25}FeO_{40}$) can introduce strain within the $BiFeO_3$ crystal lattice. This strain has the potential to alter the magnetic exchange interactions between Fe ions, leading to modifications in the antiferromagnetic alignment and potentially enhancing the magnetic properties of $BiFeO_3$

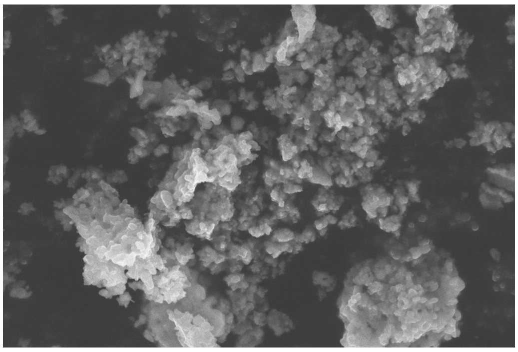


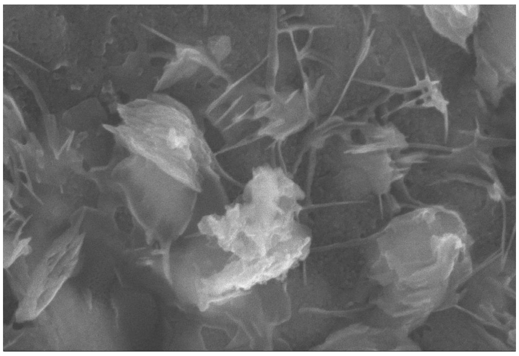
a)

Fig 1: X-Ray Diffractogram of a) BFOT, BFOM and BFOAg.

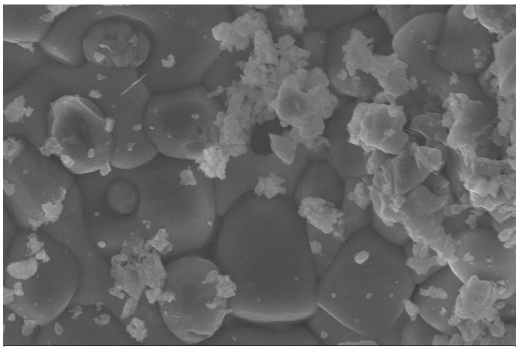
Scanning Electron Microscopy (SEM) images reveal distinct grain formation with well-defined grain boundaries across all samples. These images are utilized for phase identification through qualitative analysis and crystalline structure examination. The SEM micrographs indicate that samples synthesized using a 1:1 molar ratio with tartaric acid as a chemical agent exhibit well-defined grains with clearly visible boundaries (Figure 2a). The grain boundaries are distinct at scales of 100 nm and 20 nm.

The SEM image of the BFOM sample distinctly displays fiber-like structures, which can be attributed to its amorphous nature caused by the presence of impurities (Figure b). In contrast, the SEM images of the third sample, which was synthesized with silver nitrate (BFOAg), reveal two distinct grain types with white and grey-colored boundaries. The white circular formations represent silver nanoparticles, which are surrounded by grey-circled BFO particles (Figure 2c).





a) **b)**



c)

Figure 2: Scanning Electron Micrographs of a) BFOT, b) BFOM and c) BFOAg Compositional Analysis using X-ray Photoelectron Spectroscopy

The X-ray Photoelectron Spectroscopy survey scan of BFO-T is as shown in figure 3. The spectrum display characteristic photoelectron lines of Bi, Fe, O and C. A slow scan of the peaks corresponding to Bi4f, Fe2p and O1s is carried out for detailed investigation.

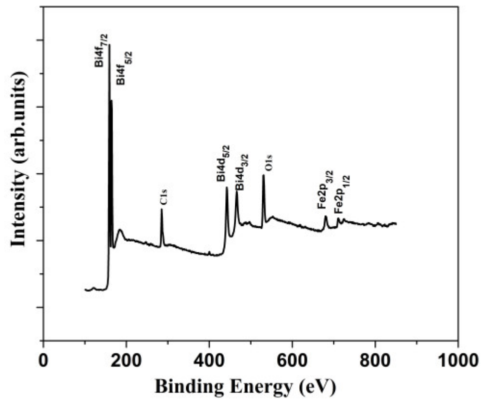
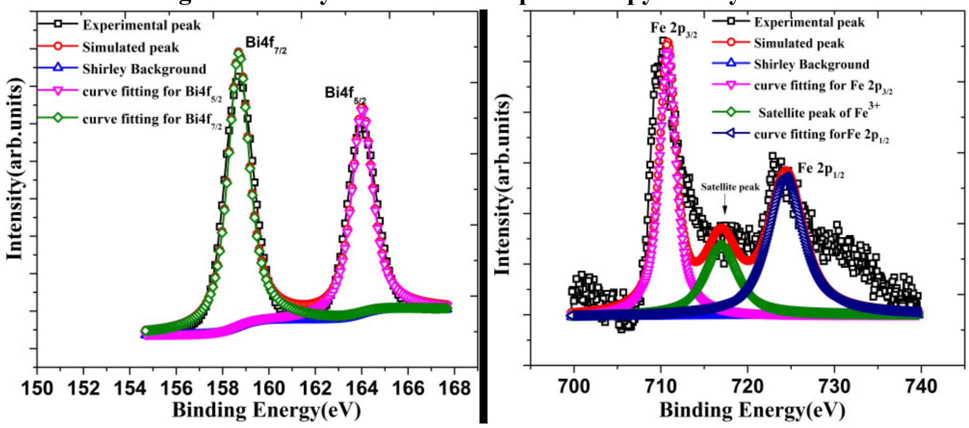


Figure 3: X-ray Photoelectron Spectroscopy Survey scan of BFOT



(a) **(b)**

Figure 4: X-ray Photoelectron Spectra of BFOT corresponding to a) Bi4f and b) Fe2p

Figure 4.a shows the detailed X-ray Photoelectron Spectra of Bi4f which contains a doublet where the peak positions of Bi4f7/2 and Bi4f5/2 are respectively assigned to binding energies at 158.7 eV and 164.1 eV with a spin orbit splitting of 5.4 eV which is in good agreement with already reported values. The presence of oxygen vacancies and the presence of mixed valence states of Fe can be evaluated by analyzing the detailed spectrum of Fe2p states (Figure 4.b). The peak positions of Fe2p3/2 and Fe2p1/2 are assigned with binding energies at 710 eV and 724 eV similar to the ones reported earlier in literature. The sintering process leads to the formation of oxygen vacancy which creates mixed valence states of Fe (Fe^{2+} and Fe^{3+}). These states have the same energy values in the spectrum and hence cannot be resolved from the XPS analysis. Corresponding to each oxidation state a satellite

peak is also present in the spectrum above the principal peak having a specific energy value. The satellite peak observed at 8eV above the principal peak corresponds to Fe^{3+} while that observed at around 5eV above the principal peak corresponds to Fe^{2+}. Hence as observed from the spectrum analysis in figure 4.b, the satellite peak at 117.7 eV is assigned to that of Fe^{3+}, thus confirming its major contribution.

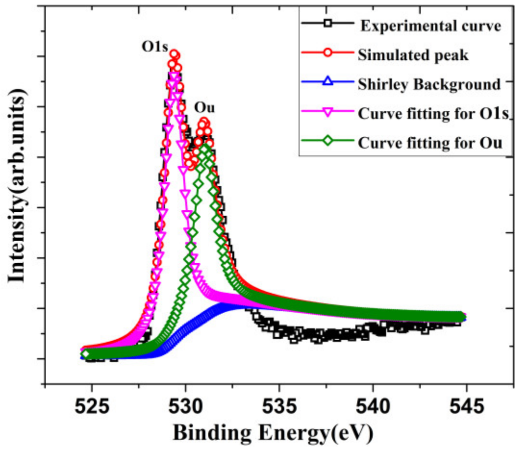
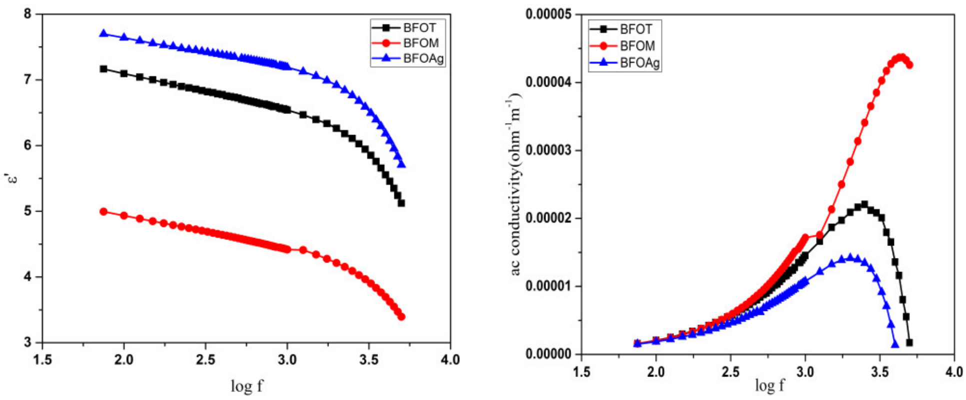


Figure 5: X-ray Photoelectron Spectra of BFOT corresponding to O1s

Even though the presence of Fe^{2+} is less, its formation is a byproduct of the synthesis procedure. The presence of oxygen vacancies aids this formation which again is confirmed by analysing the spectrum of O1s (Figure 5). The peak observed at lower binding energy corresponds to the oxygen in the bulk while that assigned at higher binding energy corresponds to the oxygen vacancies. Its intensity is comparatively less than that of the bulk counterpart.

Dielectric Studies

The variation of dielectric constant is in accordance with the Maxwell-Wagner Theory. According to the theory, a dielectric material is considered as a two layered structure formed of grains and grain boundaries. The grains form a conducting layer mainly dominant at high frequency giving low dielectric constant while the grain boundaries are poorly conducting mainly dominant at low frequency and having high dielectric permittivity values.



a) b)

Figure 6: Frequency variation of a) dielectric constant and b) ac conductivity

Figure 5 depicts the variation of dielectric properties in accordance with the Koops phenomenological theory. At lower frequencies the dielectric constant remains almost constant while at higher frequencies the polarization lags behind the ac frequency leading to decrease in dielectric constant [5-6].The conductivity values also display a generic nature in accordance with the dielectric nature of BFO while there is a slight anomaly in the green synthesized BFO probably due to an uncompensated element.

Cole-Cole Analysis

A very simple and effective way for measuring the dielectric properties of a material is to analyze the frequency dependent behaviour of dielectric values. A widely used technique to analyze this frequency dependence of complex dielectric permittivity is to plot the real dielectric permittivity, ε' on x axis against the imaginary dielectric permittivity, ε'' on y axis, which is known as the Cole-Cole plot. This tool for studying dielectric spectroscopy is particularly useful for materials which possess one or more separated relaxation mechanisms with comparable magnitude and obeying Debye response. For a Debye relaxation, the Cole-Cole plot reduces to a semi-circle. However, when the material possesses a conducting behavior due to inherent or acquired charge carriers, the Cole- Cole plot diverges from the semicircular pattern. The shift from Debye response to a non-Debye response can be clearly observed from the broadening of a Cole-Cole plot.

Thus Cole-Cole can be considered as a very effective tool in distinguishing the polarization and relaxation prosivcesses of any material which is subjected to different conduction mechanisms [7-10].

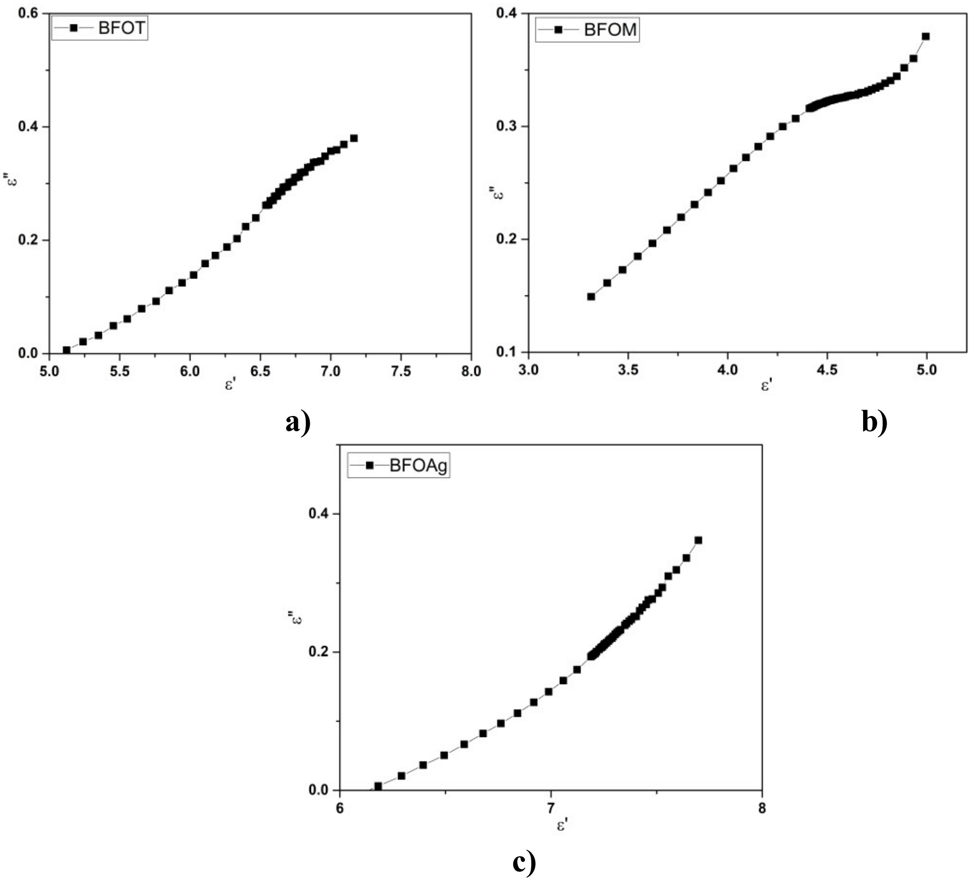


Figure 7: Cole-Cole plots of a) BFOT, b) BFOM and c) BFOAg

The Cole-Cole analysis of BFOT and BFOAg show a single semicircular arc deviating from the Debye response indicating relaxation mechanisms. The Cole-Cole plot of BFOM displays the possibility of multiple semi circles indicating complex relaxation processes.

CONCLUSION

The importance of multifunctional devices and materials are increasing at a very fast pace. Bismuth ferrite has captivated the interest of scientists all over the world due to its multifunctional ability and multiferroic properties making it a potential candidate for memory applications. In the current study one of the main objectives was to overcome the challenge of synthesizing phase-pure Bismuth Ferrite (BFO). We selected sol-gel method which is reported to require minimal resources and gives better results. Tartaric acid was used as a chelating agent, after trying out various options for better reaction product. The project also envisaged the utilization of green synthesis methods for the preparation of BFO using the extract of Muringa Oleifera leaves as the chemical agent. Metal incorporated nanomaterials have been an area of interest for various multifunctional applications. In this regard Silver substituted BFO was also synthesized for further characterization. The structural characterization confirmed the phase of BFO. The particle size increases from 15nm to the order of 30 nm when Silver is added. We analyzed the grain formation with clear boundaries for all the samples. The dielectric analysis reveals the grain boundary contributions to the conductivity. The Cole- Cole analysis reveals interesting relaxation mechanisms providing ample scope for investigating the internal conductivity dynamics of perovskite systems.

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Beyond Firewalls: Implementing Zero Trust & Defending Against AI-Powered Threats

Steffin Antony

Specialist – App & Ops Allianz Technology

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ABSTRACT

In today's digital landscape, cybersecurity is undergoing a transformation due to increasingly sophisticated threats and the limitations of traditional measures like firewalls. Zero Trust Architecture (ZTA) is emerging as a key paradigm, fundamentally altering security approaches by eliminating the assumption of trust within the network perimeter. ZTA operates on the principle that threats can originate from both external and internal sources, requiring a "never trust, always verify" mindset. It demands continuous authentication and authorization for every user and device accessing network resources, mitigating unauthorized access and lateral movement, thus securing sensitive data and operations. Cyber attackers increasingly use artificial intelligence to automate and enhance their tactics, making traditional defenses inadequate. AI can improve threat detection and response capabilities, allowing real-time analysis of data to identify anomalies and potential attacks before damage occurs. By combining Zero Trust with advanced AI capabilities, organizations can protect their digital assets in a hostile cyber environment, enhancing resilience against current threats and preparing for future challenges.

***Corresponding Author**

Steffin Antony
Specialist – App & Ops
Allianz Technology

1. Introduction

The introduction sets the stage for the article by highlighting the critical need for evolving cybersecurity strategies in response to increasingly sophisticated threats. As digital transformation accelerates across industries, organizations are more interconnected than ever, creating vast opportunities for cybercriminals to exploit vulnerabilities. Traditional security measures, once deemed sufficient, are now inadequate in the face of advanced persistent threats and AI-driven attacks. This article explores the limitations of conventional defenses such as firewalls, introduces the concept of Zero Trust Architecture (ZTA), and emphasizes the necessity of integrating AI technologies into cybersecurity frameworks to defend against emerging threats effectively.

1.1 Background on Cybersecurity Landscape:

Over the past few decades, the cybersecurity landscape has undergone significant changes, driven by technological advancements and the increasing sophistication of cyber threats. Initially, cyber threats were relatively simple, often involving viruses and worms that spread through email attachments or infected software. As the internet expanded, so did the scope and complexity of attacks. Cybercriminals began utilizing more advanced techniques, including phishing, ransomware, and Distributed Denial of Service (DDoS) attacks, targeting not just individuals but also large organizations and critical infrastructure.

The rise of AI and machine learning has further transformed the threat landscape. Cyber attackers now leverage AI to automate and enhance their tactics, making threats more dynamic and difficult to detect. AI-powered attacks can analyze vast amounts of data to identify vulnerabilities, craft personalized phishing schemes, and even adapt their strategies in real-time to bypass traditional defenses. This evolution necessitates a shift in cybersecurity strategies, moving beyond reactive measures to proactive and adaptive defenses.

Limitations of Traditional Security Measures like Firewalls

Firewalls have long been a cornerstone of network security, acting as a barrier between trusted internal networks and untrusted external networks. They operate by monitoring and controlling incoming and outgoing network traffic based on predetermined security rules. However, the effectiveness of firewalls is increasingly challenged by the complexity of modern cyber threats.

- Perimeter-Based Security Model: Traditional firewalls are designed to protect the network perimeter, assuming that threats originate externally. This model is less effective in today's environment, where threats can also arise internally due to insider threats or compromised devices within the network.
- Static Rules and Policies: Firewalls typically rely on static rules to filter traffic, which may not be sufficient against dynamic and evolving threats. Sophisticated attackers can use techniques like port hopping and encrypted traffic to bypass these rules.
- Lack of Granular Control: While firewalls can block or allow traffic based on IP addresses and ports, they often lack the capability to provide granular control over user identities and device behaviors. This limitation makes it difficult to enforce strict access controls and monitor lateral movement within the network.
- Inability to Detect Advanced Threats: Firewalls alone are inadequate in detecting advanced threats such as zero-day exploits and AI-driven attacks, which require more sophisticated detection mechanisms that can analyze patterns and behaviors rather than relying solely on known signatures.

1.2 Emergence of AI-Powered Threats:

The integration of artificial intelligence (AI) into various domains has revolutionized industries, offering enhanced efficiency, automation, and analytics capabilities. However, the same advancements in AI technology also present significant challenges in cybersecurity, as malicious actors increasingly leverage AI to amplify the effectiveness and sophistication of their attacks. Understanding the role of AI in cyber threats and examining specific examples of AI-driven attacks is crucial for developing effective defense strategies.

Overview of AI in Cyber Threats

- AI technology enables cybercriminals to automate and enhance their attack methodologies, making them more dynamic and difficult to detect. AI's ability to process vast amounts of data and identify patterns allows attackers to craft more personalized and targeted attacks. Some key aspects of AI's role in cyber threats include:

- Automation: AI can automate the reconnaissance phase of an attack, rapidly scanning networks and systems to identify vulnerabilities. This reduces the time and effort required for attackers to find weaknesses and plan their exploits.

- Adaptability: AI-driven attacks can adapt in real-time, modifying their strategies based on the defenses they encounter. This adaptability allows attackers to bypass traditional security measures that rely on static rules and signatures.

- Sophistication: AI can enhance the sophistication of attacks, enabling the creation of more convincing phishing schemes, the development of polymorphic malware that changes its code to avoid detection, and the coordination of large-scale botnet operations.

- Speed and Scale: AI-powered threats can operate at a speed and scale that is challenging for human defenders to match. AI can simultaneously target multiple systems, analyze responses, and optimize attack vectors.

Examples of AI-Driven Attacks and Their Implications

- AI-Enhanced Phishing Attacks
- Polymorphic Malware
- Automated Vulnerability Exploitation

- AI-Driven DDoS Attacks

1.3 Need for Enhanced Security Frameworks

As cyber threats become increasingly sophisticated, traditional security measures are proving inadequate in providing comprehensive protection against modern attacks. The evolving threat landscape, characterized by AI-driven tactics and internal vulnerabilities, necessitates the adoption of enhanced security frameworks that can offer robust, adaptive, and proactive defenses. Two critical components in this evolution are the implementation of Zero Trust Architecture (ZTA) and the integration of AI into cybersecurity strategies.

Introduce the Concept of Zero Trust Architecture:

Zero Trust Architecture represents a paradigm shift in cybersecurity, moving away from the traditional perimeter-based security model that assumes trust within the network. Instead, Zero Trust operates on the fundamental principle of "never trust, always verify," which assumes that threats can originate both externally and internally. Key elements of Zero Trust Architecture include:

- Continuous Verification: Every user and device attempting to access network resources must be continuously authenticated and authorized, regardless of their location or previous access rights. This ensures that access is granted based on identity and context, rather than assumptions of trust.

- Least Privilege Access: Zero Trust enforces the principle of least privilege, granting users and devices only the minimum level of access necessary to perform their functions. This reduces the risk of unauthorized access and limits potential damage from compromised accounts.

- Micro-Segmentation: The network is divided into smaller, isolated segments, each with its own security controls. This segmentation prevents lateral movement within the network, restricting attackers' ability to access multiple resources if they breach one segment.

- Real-Time Monitoring: Zero Trust requires continuous monitoring and analysis of network traffic and user behavior to detect anomalies and potential threats. This proactive approach enables rapid identification and response to suspicious activities.

Highlight the Importance of Integrating AI into Cybersecurity Strategies

The integration of AI into cybersecurity strategies is essential for enhancing threat detection, response, and overall security posture. AI offers several advantages that can significantly bolster an organization's defenses:

- Advanced Threat Detection: AI can analyze vast amounts of data in real-time, identifying patterns and anomalies that may indicate a cyber threat. Machine learning algorithms can learn from historical data to predict potential attacks, enabling proactive defenses.
- Automated Response: AI can automate the response to detected threats, reducing the time between detection and mitigation. Automated responses can include isolating compromised devices, blocking malicious traffic, and alerting security teams to take further action.
- Behavioral Analysis: AI can monitor user and device behavior, establishing baseline patterns and identifying deviations that may suggest malicious activity. This capability is crucial for detecting insider threats and sophisticated external attacks.
- Scalability and Efficiency: AI-driven systems can scale to accommodate large volumes of data and network traffic, providing efficient and effective security measures without requiring extensive manual intervention.

2. Understanding Zero Trust Architecture

Zero Trust Architecture (ZTA) is a transformative approach to cybersecurity that fundamentally changes how organizations secure their networks and data. Unlike traditional security models that rely on perimeter defenses and implicit trust within the network, Zero Trust assumes that threats can exist both outside and inside the network. Therefore, it requires rigorous verification processes for every access request, ensuring that only authenticated and authorized users and devices can interact with network resources. This architecture is designed to minimize the risk of data breaches and unauthorized access by implementing strict access controls and continuous monitoring.

2.1 Principles of Zero Trust

The Zero Trust model is built on several core principles that redefine how security is managed within an organization:

"Never Trust, Always Verify" Mindset: The central tenet of Zero Trust is the notion that trust should never be assumed. This mindset challenges the traditional model where anything inside the network perimeter is considered trustworthy. Instead, Zero Trust requires that every access request is verified, regardless of whether it originates from inside or outside the network. This principle helps protect against insider threats and ensures that compromised devices or accounts cannot exploit implicit trust to gain unauthorized access.

- **Verification of Identity**: Each user and device must be authenticated using robust identity verification methods, such as multi-factor authentication (MFA), before gaining access to any resources.
- **Validation of Context**: Access decisions are based on contextual factors, such as the user's role, location, device health, and the sensitivity of the data or application being accessed.

Continuous Authentication and Authorization: Critical components of Zero Trust, ensuring that access permissions are dynamically evaluated and adjusted as needed. Unlike traditional models where access is granted based on initial authentication, Zero Trust requires ongoing verification throughout the duration of a session.

- **Dynamic Access Control**: Access rights are continuously assessed based on real-time data, allowing for immediate revocation or modification if suspicious activity is detected.

- **Adaptive Security Policies**: Security policies are not static; they adapt to changing conditions, such as shifts in user behaviour or emerging threats, to maintain a secure environment.

The implementation of continuous authentication and authorization helps prevent lateral movement within the network, where attackers attempt to expand their access after breaching a single point. By constantly verifying the legitimacy of access requests, Zero Trust minimizes the risk of unauthorized access and ensures that only legitimate users and devices can interact with sensitive data and applications.

2.2 Components of Zero Trust

Zero Trust Architecture is built upon several key components that collectively ensure comprehensive security by continuously verifying and validating access requests. These components work together to create a secure environment where trust is never assumed and access is rigorously controlled. The primary components of Zero Trust include identity verification, device security, and network segmentation.

- **Identity Verification:** Main cornerstone of Zero Trust, focusing on ensuring that only authenticated users can access network resources. This involves robust methods to confirm the identity of users before granting access, thereby preventing unauthorized access and reducing the risk of identity-related breaches.

- **Multi-Factor Authentication (MFA):** MFA requires users to provide multiple forms of verification, such as a password, a fingerprint, or a one-time code sent to a mobile device. This adds layers of security, making it more difficult for attackers to impersonate legitimate users.

- **Role-Based Access Control (RBAC):** Access rights are assigned based on user roles within the organization, ensuring that individuals only have access to the resources necessary for their job functions. This minimizes the risk of privilege escalation and unauthorized access.

Device Security

Device security focuses on ensuring that only secure and compliant devices are allowed to access network resources. This component addresses the risks associated with compromised or untrusted devices, which can serve as entry points for attackers.

- **Device Health Checks:** Before granting access, devices are evaluated for security compliance, including the presence of up-to-date antivirus software, operating system patches, and encryption settings. Devices that fail to meet security standards are denied access or quarantined until they are compliant.
- **Endpoint Detection and Response (EDR):** EDR solutions monitor devices for suspicious activity, providing real-time detection and response capabilities to mitigate threats. This ensures that compromised devices can be quickly identified and isolated to prevent further damage.

Network Segmentation

Network segmentation involves dividing the network into smaller, isolated segments, each with its own security controls. This component is crucial for preventing lateral movement within the network, where attackers attempt to access multiple resources after breaching a single point.

- **Micro-Segmentation:** The network is segmented into granular units, allowing for precise control over access rights and data flow between segments. This reduces the attack surface and limits the potential impact of a breach.

- **Access Control Lists (ACLs):** ACLs define the rules for traffic flow between network segments, specifying which users and devices can access specific resources. This ensures that sensitive data is protected and access is tightly controlled.

2.3 Benefits of Zero Trust

Zero Trust Architecture offers numerous advantages that address the limitations of traditional security models and enhance an organization's ability to protect its digital assets. By implementing Zero Trust principles, organizations can significantly reduce the risk of unauthorized access and limit lateral movement within networks, thereby strengthening their overall security posture.

Reducing Risk of Unauthorized Access

One of the primary benefits of Zero Trust is its ability to minimize the risk of unauthorized access to network resources. By requiring continuous verification of identity and context for every access request, Zero Trust ensures that only authenticated and authorized users and devices can interact with sensitive data and applications.

- **Rigorous Authentication**: Through multi-factor authentication (MFA) and dynamic access controls, Zero Trust verifies the legitimacy of users before granting access. This makes it difficult for attackers to impersonate legitimate users or exploit stolen credentials.
- **Contextual Access Decisions**: Access decisions are based on real-time contextual information, such as user location, device health, and the sensitivity of the requested resource. This ensures that access is granted only under appropriate conditions, reducing the likelihood of unauthorized access.

By reducing the risk of unauthorized access, Zero Trust helps prevent data breaches and protects sensitive information from being compromised, thereby safeguarding the organization's reputation and trustworthiness.

Limiting Lateral Movement within Networks

Zero Trust effectively limits lateral movement within networks, a common tactic used by attackers to expand their access after breaching a single point. This is achieved through network segmentation and continuous monitoring, which restrict attackers' ability to move freely and access multiple resources.

- **Micro-Segmentation**: By dividing the network into smaller, isolated segments, Zero Trust prevents attackers from easily moving between different parts of the network. Each segment has its own security controls, ensuring that even if one segment is compromised, the rest of the network remains protected.
- **Real-Time Monitoring and Response**: Continuous monitoring of network traffic and user behavior allows for rapid detection and response to suspicious activities. If an attacker attempts to move laterally, security teams can quickly identify and isolate the threat, minimizing potential damage.

Limiting lateral movement not only reduces the impact of breaches but also enhances the organization's ability to contain and mitigate threats before they escalate. This capability is crucial for maintaining the integrity and availability of critical systems and data.

3. Implementing Zero Trust Architecture

Implementing Zero Trust Architecture (ZTA) requires a strategic approach that transforms how security is managed within an organization. It involves a shift from traditional perimeter-based defenses to a model where trust is continuously verified, ensuring robust protection against both external and internal threats. The implementation process involves several key steps that help organizations transition to a Zero Trust framework effectively.

3.1 Steps to Implement Zero Trust

- **Assess Current Security Posture**

  The first step in implementing Zero Trust is to conduct a comprehensive assessment of the organization's current security posture. This involves evaluating existing security measures, identifying vulnerabilities, and understanding the flow of data and access patterns within the network.

- **Inventory of Assets**: Create an inventory of all digital assets, including hardware, software, data repositories, and network infrastructure. This helps identify critical resources that require protection under Zero Trust principles.
- **Risk Analysis**: Perform a risk analysis to identify potential threats and vulnerabilities. This includes assessing the likelihood and impact of various attack vectors, such as insider threats, phishing, and malware.
- **Gap Identification**: Identify gaps in current security measures that could be addressed by Zero Trust, such as insufficient authentication processes, lack of network segmentation, or inadequate monitoring capabilities.

Assessing the current security posture provides a baseline for developing a tailored Zero Trust strategy that addresses specific organizational needs and risks.

- **Define Trust Boundaries**

Defining trust boundaries is a crucial step in Zero Trust implementation, as it establishes the limits within which access must be verified and controlled. This involves segmenting the network and defining clear boundaries for data and resource access.

- **Network Segmentation**: Divide the network into smaller, isolated segments based on factors such as data sensitivity, user roles, and business functions. This prevents lateral movement and ensures that access is tightly controlled within each segment.
- **Access Control Policies**: Develop access control policies that specify the conditions under which users and devices can access resources within defined boundaries. These policies should be dynamic and adaptable to changing conditions.

- **Trust Zones**: Establish trust zones that group resources with similar security requirements, allowing for consistent application of security controls and monitoring practices.

Defining trust boundaries helps create a structured environment where access is rigorously controlled, reducing the risk of unauthorized access and lateral movement.

- **Implement Identity and Access Management (IAM)**

Identity and Access Management (IAM) is a critical component of Zero Trust, ensuring that only authenticated and authorized users can access network resources. Implementing IAM involves deploying technologies and processes that verify identity and manage access rights.

- **Multi-Factor Authentication (MFA)**: Deploy MFA to enhance the security of user authentication processes. MFA requires users to provide multiple forms of verification, reducing the risk of credential theft and impersonation.
- **Role-Based Access Control (RBAC)**: Implement RBAC to assign access rights based on user roles and responsibilities. This ensures that users only have access to the resources necessary for their job functions, minimizing the risk of privilege escalation.
- **Continuous Monitoring**: Establish continuous monitoring of user and device behavior to detect anomalies and potential threats. This allows for real-time adjustments to access rights and rapid response to suspicious activities.

Implementing IAM provides a robust framework for managing user identities and access rights, ensuring that access decisions are based on verified identity and contextual information.

3.2 Challenges in Adoption

Adopting Zero Trust Architecture (ZTA) can be transformative for an organization's cybersecurity posture, but it also presents several challenges that must be addressed to ensure successful implementation. These challenges often stem from cultural and organizational resistance, as well as technical complexities involved in transitioning to this new security model.

- **Cultural and Organizational Resistance**

One of the primary challenges in adopting Zero Trust is overcoming cultural and organizational resistance. This resistance can arise from various factors, including established practices, perceived disruptions, and a lack of understanding of the benefits of Zero Trust.

- **Change Management**: Implementing Zero Trust requires significant changes to existing security practices and workflows. Employees and stakeholders may be resistant to altering familiar processes and adapting to new technologies, creating friction during the transition.
- **Perception of Complexity**: Some organizations may perceive Zero Trust as overly complex or burdensome, especially if they lack a clear understanding of its principles and advantages. This perception can lead to reluctance in adopting the framework.
- **Communication and Training**: Effective communication and training are essential to address resistance. Organizations must educate employees about the importance of Zero Trust, its benefits, and how it enhances security. Training programs can help build confidence in using new tools and processes.

To mitigate cultural and organizational resistance, organizations should engage stakeholders early in the adoption process, clearly communicate the rationale and benefits of Zero Trust, and provide comprehensive training and support to facilitate the transition.

- **Technical Complexities**

Implementing Zero Trust involves technical complexities that can pose challenges, particularly for organizations with legacy systems or limited resources. These complexities stem from the need to integrate new technologies, reconfigure existing infrastructure, and manage ongoing operations.

- **Integration with Existing Systems**: Zero Trust requires integration with existing IT infrastructure, including identity management systems, network devices, and security tools. This integration can be challenging, especially if systems are outdated or incompatible with Zero Trust technologies.
- **Network Segmentation**: Achieving effective network segmentation involves reconfiguring network architecture, which can be technically demanding. Organizations must ensure that segmentation aligns with business functions and security requirements, requiring careful planning and execution.
- **Continuous Monitoring and Management**: Zero Trust demands continuous monitoring and management of network traffic, user behavior, and device health. Implementing these capabilities can require substantial investment in technology and personnel, particularly for organizations with limited cybersecurity resources.

Addressing technical complexities requires a strategic approach that includes thorough planning, investment in compatible technologies, and collaboration with skilled cybersecurity professionals. Organizations may also consider phased implementation, starting with critical areas and gradually expanding Zero Trust principles across the entire network.

3.3 Case Studies:

Examples of Successful Zero Trust Implementations

Examining real-world case studies of successful Zero Trust implementations can provide valuable insights into the practical benefits and challenges of adopting this security framework. These examples highlight how organizations across various sectors have leveraged Zero Trust principles to enhance their cybersecurity posture, protect sensitive data, and mitigate risks associated with modern cyber threats.

1. **Financial Sector: A Leading Bank's Zero Trust Journey**

A major international bank faced increasing threats from sophisticated cyber attacks and insider threats. To address these challenges, the bank implemented Zero Trust Architecture across its global operations. Key elements of their successful implementation included:

- **Identity and Access Management (IAM)**: The bank deployed robust IAM solutions with multi-factor authentication (MFA) to ensure secure access to sensitive financial data and systems. Role-based access controls (RBAC) were used to limit access based on job functions, reducing the risk of privilege escalation.
- **Network Segmentation**: The bank segmented its network into distinct zones, isolating critical financial systems from general user access. This segmentation minimized the impact of potential breaches and restricted lateral movement within the network.
- **Continuous Monitoring**: Advanced monitoring tools were integrated to provide real-time visibility into network traffic and user activities. Anomalies and suspicious behaviors were quickly detected and addressed, enhancing threat detection and response capabilities.

As a result of these measures, the bank significantly reduced the risk of data breaches and improved its ability to comply with regulatory requirements for data protection.

2. **Healthcare Sector: Hospital Network Security Enhancement**

A large healthcare provider sought to protect patient data and ensure compliance with healthcare regulations such as HIPAA. The organization adopted Zero Trust principles to strengthen its cybersecurity framework, focusing on:

- **Device Security**: The healthcare provider implemented endpoint protection solutions to ensure that only secure devices could access patient records and clinical applications. Device health checks were conducted regularly to maintain compliance with security standards.

- **Micro-Segmentation**: The hospital network was divided into micro-segments, with strict access controls applied to each segment. This approach protected sensitive patient data and medical devices from unauthorized access and potential cyber threats.
- **Behavioral Analysis**: AI-driven tools were used to analyze user and device behavior, establishing baseline patterns and identifying deviations that could indicate malicious activity. This proactive approach helped detect insider threats and external attacks early.

The implementation of Zero Trust Architecture resulted in enhanced data security, improved patient privacy, and increased resilience against cyber threats targeting healthcare systems.

3. **Technology Sector: A Software Company's Security Transformation**

A software development company faced challenges in securing its intellectual property and development environments. By adopting Zero Trust Architecture, the company achieved the following:

- **Dynamic Access Control**: Access to development environments was strictly controlled based on real-time contextual information, ensuring that only authorized developers could access sensitive code repositories. MFA and adaptive security policies were implemented to enhance access security.
- **Cloud Security Integration**: The company integrated Zero Trust principles with its cloud infrastructure, ensuring secure access to cloud-based applications and data. This integration provided consistent security across both on-premises and cloud environments.
- **Threat Intelligence**: Continuous monitoring and threat intelligence capabilities were deployed to identify and respond to emerging threats. The company leveraged AI-driven analytics to predict and mitigate potential attacks before they could cause harm.

Through these efforts, the software company protected its intellectual property, reduced the risk of data breaches, and enhanced collaboration among development teams while maintaining stringent security controls.

4. AI-Powered Threats: A New Frontier

The advent of artificial intelligence (AI) in cybersecurity has not only transformed defense mechanisms but also empowered cybercriminals to develop more sophisticated and challenging threats. AI-powered threats represent a new frontier in cyber warfare, characterized by their ability to automate, scale, and evade traditional security measures. Understanding these characteristics is crucial for developing effective countermeasures and enhancing organizational resilience.

4.1 Characteristics of AI-Powered Threats:

Automation and Scaling of Attacks

AI enables cybercriminals to automate various stages of an attack, from reconnaissance to execution, significantly increasing the speed and scale at which they can operate. This automation allows attackers to efficiently target multiple systems and organizations simultaneously, maximizing their impact while minimizing manual effort.

- **Automated Vulnerability Scanning**: AI can rapidly scan networks and systems to identify vulnerabilities, automating the reconnaissance phase of an attack. This enables attackers to quickly pinpoint weaknesses and deploy exploits without the need for extensive manual analysis.

- **Mass Phishing Campaigns**: AI can generate highly personalized phishing emails by analyzing vast amounts of data, such as social media profiles and communication patterns. These automated campaigns can target thousands of individuals at once, increasing the likelihood of successful credential harvesting or malware delivery.

- **Botnet Coordination**: AI can efficiently manage and coordinate large-scale botnets, automating the execution of Distributed Denial of Service (DDoS) attacks. This scalability allows attackers to flood targets with traffic, disrupting services and infrastructure on a massive scale.

Sophisticated Evasion Techniques

AI-powered threats are adept at evading traditional security measures, employing sophisticated techniques to avoid detection and prolong their presence within compromised systems. These evasion tactics make it challenging for security teams to identify and mitigate threats effectively.

- **Polymorphic Malware**: AI can create malware that continuously changes its code and behavior, making it difficult for signature-based detection systems to identify and block. This polymorphism allows malware to evade antivirus software and persist within networks.
- **Adaptive Attack Strategies**: AI-driven attacks can adjust their strategies in real-time based on the defenses they encounter. For example, if a security measure blocks one attack vector, AI can dynamically switch to another, circumventing security controls and maintaining access.
- **Stealthy Data Exfiltration**: AI can optimize data exfiltration techniques to minimize detection, such as slowly siphoning data over extended periods or disguising traffic patterns to blend with legitimate network activity. This stealthy approach reduces the likelihood of triggering alarms and allows attackers to extract valuable information undetected.

The characteristics of AI-powered threats underscore the need for advanced cybersecurity strategies that can effectively counter these sophisticated attacks. Organizations must leverage AI-driven defense mechanisms, such as machine learning-based anomaly detection and real-time threat intelligence, to anticipate and respond to AI-powered threats. By understanding the automation, scaling, and evasion capabilities of AI-driven attacks, security teams can develop proactive measures to safeguard their digital assets and maintain robust protection against this emerging threat landscape.

4.2 Examples of AI in Cyber Threats

The integration of artificial intelligence (AI) into cyber threats has enabled attackers to enhance the effectiveness and sophistication of their tactics. Two notable examples of AI in cyber threats include malware using AI for obfuscation and AI-driven phishing attacks. These examples illustrate how AI can be leveraged to bypass traditional security measures and increase the success rate of malicious activities.

1. **Malware Using AI for Obfuscation**

   Malware obfuscation refers to techniques used to hide the malicious nature of software, making it difficult for security systems to detect and analyze. AI enhances these techniques by enabling malware to adapt and evolve, increasing its ability to evade detection.

   - **Polymorphic Code**: AI can generate polymorphic code that continuously changes its structure and appearance, making it challenging for signature-based detection systems to identify the malware. This dynamic nature allows the malware to avoid being flagged by antivirus software, prolonging its presence within infected systems.

   - **Behavioral Adaptation**: AI-driven malware can analyze the environment in which it operates and adapt its behavior accordingly. For example, it may alter its execution patterns or communication methods to mimic legitimate software, reducing the likelihood of triggering security alerts.

   - **Intelligent Evasion**: AI can optimize evasion techniques, such as encrypting payloads or using stealthy communication channels, to minimize detection. These intelligent strategies make it difficult for security teams to analyze and mitigate the threat effectively.

The use of AI for obfuscation significantly enhances the resilience of malware against traditional security measures, necessitating advanced detection mechanisms that can analyze behavior and patterns rather than relying solely on static signatures.

2. **AI-Driven Phishing Attacks**

Phishing attacks involve tricking individuals into revealing sensitive information, such as login credentials or financial details, often through deceptive emails or websites. AI-driven phishing attacks leverage AI to increase the effectiveness and personalization of these schemes.

- **Personalization and Targeting**: AI can analyze vast amounts of data, including social media profiles, email communication, and online behavior, to craft highly personalized phishing messages. These tailored messages are designed to appear legitimate and relevant to the recipient, increasing the likelihood of engagement.
- **Natural Language Processing (NLP)**: AI can employ NLP to generate phishing messages that mimic human language and communication styles. This capability allows attackers to create convincing emails that closely resemble genuine correspondence from trusted sources.
- **Automated Campaigns**: AI can automate the deployment of phishing campaigns, targeting large numbers of individuals simultaneously. This scalability enables attackers to reach a broad audience, increasing the potential impact of the attack.

AI-driven phishing attacks pose a significant challenge to traditional security measures, as their personalization and sophistication can bypass standard filters and detection systems. Organizations must implement advanced security solutions, such as machine learning-based anomaly detection and user education programs, to effectively counter these threats.

5. **Defending Against AI-Powered Threats**

As AI-powered threats continue to evolve and challenge traditional security measures, leveraging AI in cyber defense becomes crucial for enhancing threat detection and response capabilities. AI-driven technologies offer advanced solutions for real-time analysis and anomaly detection, enabling organizations to proactively identify and mitigate sophisticated cyber threats.

5.1 Role of AI in Cyber Defense

Enhancing Threat Detection and Response

- **Automated Threat Identification**: AI can process large volumes of network traffic, user behavior, and system logs to identify patterns and anomalies indicative of cyber threats. Machine learning algorithms can learn from historical data to predict potential attacks, enabling proactive defenses.

- **Rapid Response Capabilities**: AI can automate the response to detected threats, reducing the time between detection and mitigation. Automated responses can include isolating compromised devices, blocking malicious traffic, and alerting security teams to take further action. This rapid response minimizes the potential impact of an attack and prevents further damage.

- **Adaptive Security Measures**: AI can dynamically adjust security measures based on real-time threat intelligence, ensuring that defenses remain effective against evolving attack strategies. This adaptability allows organizations to maintain robust protection even as threats change and become more sophisticated.

By enhancing threat detection and response, AI-driven cyber defense solutions help organizations stay ahead of attackers, reducing the risk of successful breaches and minimizing the impact of potential threats.

Real-Time Analysis and Anomaly Detection

- **Behavioral Analysis**: AI can monitor user and device behavior, establishing baseline patterns and identifying deviations that may suggest malicious activity. This capability is crucial for detecting insider threats and sophisticated external attacks that may bypass traditional security measures.
- **Anomaly Detection**: AI-driven systems can analyze network traffic and system logs in real-time to identify anomalies that may indicate a cyber threat. Machine learning algorithms can differentiate between normal variations and suspicious activities, allowing for rapid identification of potential threats.
- **Continuous Monitoring**: AI enables continuous monitoring of network environments, ensuring that security teams have real-time visibility into potential threats. This proactive approach allows for immediate detection and response, reducing the likelihood of successful attacks.

The role of AI in real-time analysis and anomaly detection provides organizations with a powerful tool for maintaining security resilience. By leveraging AI-driven technologies, organizations can enhance their ability to detect and respond to threats in a timely and effective manner, ensuring robust protection against AI-powered cyber threats.

5.2 Integrating AI with Zero Trust

The integration of AI with Zero Trust Architecture creates a powerful synergy that enhances cybersecurity by combining the strengths of both approaches. AI's capabilities complement Zero Trust principles, providing advanced solutions for identity verification and behavioral analysis, which are critical for maintaining a secure and resilient digital environment.

Synergy between AI Capabilities and Zero Trust Principles:

The synergy between AI and Zero Trust lies in their shared focus on continuous verification, dynamic adaptation, and proactive threat detection. Together, they offer a comprehensive framework for addressing modern cyber threats.

- **Continuous Verification**: AI enhances Zero Trust's principle of "never trust, always verify" by automating and improving the accuracy of verification processes. AI can analyze vast amounts of data in real-time, ensuring that every access request is thoroughly evaluated based on identity, context, and behavior.
- **Dynamic Adaptation**: AI-driven systems can adapt to changing conditions, such as emerging threats or shifts in user behavior, by dynamically adjusting security measures. This adaptability aligns with Zero Trust's requirement for continuous monitoring and adjustment of access controls.
- **Proactive Threat Detection**: AI provides advanced threat detection capabilities that complement Zero Trust's focus on minimizing attack surfaces and preventing lateral movement. Machine learning algorithms can identify patterns and anomalies indicative of cyber threats, enabling proactive defenses and rapid response.
- By integrating AI with Zero Trust, organizations can achieve a robust security posture that addresses the complexities of the modern threat landscape, ensuring comprehensive protection for digital assets.

AI-Driven Identity Verification and Behavioural Analysis:

AI-driven identity verification and behavioral analysis are key components of the integration, enhancing the effectiveness of Zero Trust's security measures.

- **AI-Driven Identity Verification**: AI can improve identity verification processes by leveraging machine learning algorithms to analyze and authenticate user identities. This includes biometric data, device characteristics, and user behavior, to ensure secure access. AI can also detect anomalies in identity verification attempts, reducing the risk of impersonation and unauthorized access.

- **Behavioral Analysis**: AI can monitor and analyze user and device behavior to establish baseline patterns and identify deviations that may indicate malicious activity. This capability is crucial for detecting insider threats and sophisticated external attacks that traditional security measures might miss. AI-driven behavioral analysis can automate the detection of suspicious activities, allowing for rapid response and mitigation.
- **Adaptive Access Controls**: AI can dynamically adjust access controls based on real-time behavioral analysis, ensuring that access permissions align with current conditions. This adaptability helps maintain security even as user behavior or threat landscapes change.

Integrating AI-driven identity verification and behavioral analysis with Zero Trust principles provides organizations with enhanced capabilities to secure their networks and data. By leveraging AI's advanced analytical and adaptive capabilities, organizations can ensure continuous verification, proactive threat detection, and dynamic access control, achieving a resilient and effective security posture.

5.3 Developing Adaptive Defense Strategies

Adaptive defense strategies are crucial for organizations to effectively protect against the dynamic and evolving nature of cyber threats. By leveraging continuous monitoring, learning, and predictive analytics, organizations can anticipate and respond to threats proactively, maintaining robust security in an ever-changing digital landscape.

Continuous Monitoring and Learning: Continuous monitoring and learning are foundational elements of adaptive defense and insights into network activities and potential threats.

- **Real-Time Visibility**: Continuous monitoring involves the ongoing observation of network traffic, user behavior, and system activities, ensuring that security teams have up-to-date information about potential threats. This real-time visibility allows for immediate detection of anomalies and suspicious activities, enabling rapid response and mitigation.
- **Machine Learning Algorithms**: Machine learning algorithms play a critical role in continuous learning, analyzing vast amounts of data to identify patterns and trends associated with cyber threats. These algorithms can adapt to new information, improving their accuracy and effectiveness over time.
- **Feedback Loops**: Continuous learning involves establishing feedback loops where insights gained from monitoring and threat detection are used to refine security measures and enhance defenses. This iterative process ensures that defense strategies remain effective against emerging threats and changing conditions.

Predictive Analytics for Threat Anticipation: Predictive analytics involves using data analysis techniques to anticipate potential threats before they occur, allowing organizations to take preventive measures and reduce the risk of successful attacks.

- **Data Analysis and Modeling**: Predictive analytics leverages historical data, machine learning models, and statistical techniques to identify patterns and predict future threat scenarios. By analyzing past incidents and current trends, organizations can anticipate potential attack vectors and prepare defenses accordingly.
- **Threat Intelligence Integration**: Predictive analytics can be enhanced by integrating threat intelligence feeds, which provide information about

emerging threats, vulnerabilities, and attacker tactics. This integration allows organizations to stay informed about the latest developments in the threat landscape and adjust their strategies accordingly.

- **Proactive Defense Measures**: By anticipating threats, organizations can implement proactive defense measures, such as patching vulnerabilities, adjusting access controls, and deploying additional security technologies. These measures help prevent attacks before they can cause harm, reducing the likelihood of successful breaches.

Predictive analytics provides organizations with the ability to anticipate and prepare for potential threats, ensuring that defense strategies remain ahead of attackers and minimize the impact of cyber incidents.

6. Future Directions and Challenges: Evolving Cyber Threat Landscape

As technology continues to advance, the cyber threat landscape is expected to evolve, presenting new challenges and opportunities for organizations to enhance their cybersecurity strategies. Understanding potential future threats and vulnerabilities is crucial for developing effective defenses and maintaining resilience against emerging risks.

6.1 Potential Future Threats and Vulnerabilities

1. **Increased Use of AI in Cyber Attacks**

   As AI technology becomes more accessible, cybercriminals are likely to leverage AI to enhance the sophistication and effectiveness of their attacks. This includes:

   - **Advanced Automation**: AI will enable attackers to automate complex processes, such as vulnerability scanning, exploit development, and attack execution, at an unprecedented scale. This automation could lead to more frequent and widespread attacks, overwhelming traditional defense mechanisms.

- **Adaptive Malware**: AI-driven malware will become increasingly adaptive, capable of modifying its behavior in real-time to evade detection and persist within compromised systems. This adaptability will challenge existing security measures and require organizations to implement more dynamic defenses.

2. **IoT and Connected Device Vulnerabilities**

The proliferation of Internet of Things (IoT) devices and connected technologies introduces new vulnerabilities that attackers can exploit. Potential threats include:

- **Device Exploitation**: IoT devices often have limited security features, making them attractive targets for attackers seeking to gain unauthorized access or launch attacks. Vulnerabilities in device firmware or communication protocols could be exploited to compromise networks and data.
- **Botnet Expansion**: IoT devices can be co-opted into botnets, enabling large-scale Distributed Denial of Service (DDoS) attacks. As IoT adoption grows, the potential for massive botnet-driven disruptions increases.

3. **Supply Chain Attacks**

Supply chain attacks, where attackers target vulnerabilities in third-party vendors or service providers, are expected to become more prevalent. These attacks can lead to:

- **Indirect Breaches**: By compromising a supplier or partner, attackers can gain access to an organization's systems and data, bypassing direct defenses. This indirect approach can be challenging to detect and mitigate.

- **Data Manipulation**: Attackers may alter data or software in the supply chain, introducing malicious code or inaccuracies that affect downstream processes and operations.

4. **Quantum Computing Threats**

The development of quantum computing poses potential challenges to current encryption methods, which rely on mathematical complexity for security. Quantum computing could:

- **Decrypt Encrypted Data**: Quantum computers may eventually be able to break encryption algorithms that protect sensitive data, leading to significant breaches of privacy and confidentiality.
- **Necessitate New Cryptographic Standards**: Organizations will need to adopt quantum-resistant cryptographic standards to safeguard data against future quantum computing threats.

Future Directions

To address these evolving threats and vulnerabilities, organizations must proactively adapt their cybersecurity strategies. Potential directions include:

- **AI-Enhanced Defense Mechanisms**: Leveraging AI to enhance threat detection, response, and predictive analytics will be crucial for countering AI-driven attacks and maintaining robust security.
- **IoT Security Standards**: Developing and implementing comprehensive security standards for IoT devices and connected technologies will help mitigate vulnerabilities and protect networks.
- **Supply Chain Security**: Enhancing supply chain security through rigorous vendor assessments, continuous monitoring, and collaboration with partners will reduce the risk of indirect breaches.
- **Quantum-Resistant Cryptography**: Investing in research and development of quantum-resistant cryptographic solutions will ensure data protection against future quantum computing capabilities.

6.2 Advancements in AI and Security Technologies

The rapid evolution of artificial intelligence (AI) and security technologies is reshaping the cybersecurity landscape, offering new opportunities to enhance protection against sophisticated threats. Emerging AI technologies in cybersecurity are driving significant advancements, particularly in the implementation and effectiveness of Zero Trust models.

Emerging AI Technologies in Cybersecurity:

- Machine Learning and Deep Learning
- Anomaly Detection
- Behavioral Analysis
- Automated Threat Intelligence
- Natural Language Processing (NLP)
- Phishing Detection
- Automated Analysis of Security Logs
- AI-Driven Automation
- Automated Incident Response
- Security Orchestration
- Impact on Zero Trust Models
- Enhanced Identity Verification
- Biometric Authentication
- Contextual Analysis
- Dynamic Access Controls
- Real-Time Adjustments
- Predictive Threat Detection
- Proactive Threat Mitigation
- Anomaly Detection and Response
- Automated Threat Intelligence Integration

6.3 Policy and Regulatory Considerations

In today's digital landscape, organizations must navigate complex policy and regulatory considerations to ensure compliance with data protection regulations and effectively balance security and privacy concerns. These considerations are crucial for maintaining trust, safeguarding sensitive information, and avoiding legal and financial repercussions.

Compliance with Data Protection Regulations

Data protection regulations establish legal requirements for how organizations collect, store, process, and protect personal information. Compliance with these regulations is essential for ensuring the privacy and security of individuals' data.

1. **Understanding Regulatory Frameworks**

   Organizations must familiarize themselves with relevant data protection regulations, which may vary by region and industry. Key regulations include:

   - **General Data Protection Regulation (GDPR)**: Applicable to organizations operating within the European Union, GDPR mandates strict requirements for data handling, consent, and breach notification. Compliance involves implementing robust data protection measures and ensuring transparency in data processing activities.

   - **California Consumer Privacy Act (CCPA)**: This U.S. state-level regulation grants California residents specific rights regarding their personal data, including the right to know, delete, and opt-out of data collection. Organizations must adjust their data handling practices to align with CCPA requirements.

   - **Health Insurance Portability and Accountability Act (HIPAA)**: Applicable to healthcare organizations in the U.S., HIPAA establishes standards for protecting sensitive patient information. Compliance involves implementing safeguards for data privacy and security.

2. **Implementing Data Protection Measures**

   To achieve compliance, organizations must implement comprehensive data protection measures, such as:

   - **Data Encryption**: Encrypting data both at rest and in transit ensures that sensitive information remains secure and inaccessible to unauthorized parties.
   - **Access Controls**: Implementing strict access controls and authentication measures helps prevent unauthorized access to personal data.
   - **Regular Audits and Assessments**: Conducting regular audits and assessments of data protection practices ensures compliance with regulatory requirements and identifies areas for improvement.

Balancing Security and Privacy Concerns

Balancing security and privacy is a critical challenge for organizations in today's digital landscape, essential for effective data protection, maintaining stakeholder trust, and ensuring regulatory compliance. Organizations must integrate security and privacy into their operations to safeguard sensitive information and uphold individual rights.

Privacy by Design involves embedding privacy considerations into systems from the outset. It includes strategies like Data Minimization, which advocates collecting only necessary data to reduce exposure risks and enhance privacy, and Transparent Data Practices, which build trust by clearly communicating how data is collected, processed, and shared.

Security Measures are vital for protecting data from cyber threats while respecting privacy. Techniques like Anonymization and Pseudonymization protect personal data, allowing its use without revealing identities.

Achieving balance requires a nuanced approach considering regulatory requirements and individual rights. Stakeholder Engagement involves employees, customers, and regulators to address concerns and build trust. Adaptive Policies evolve with changing regulations and threats, ensuring security and privacy remain effective. This comprehensive approach helps organizations manage security risks while protecting individual privacy.

Conclusion

In the modern digital landscape, integrating Zero Trust Architecture with AI offers a powerful cybersecurity framework that addresses complex threats, enhances security, and maintains trust. Zero Trust principles emphasize continuous verification to prevent unauthorized access and minimize attack surfaces through network segmentation. AI capabilities provide advanced threat detection and automated incident response, improving security efficiency. The synergy between AI and Zero Trust enhances identity verification, enables dynamic access controls, and facilitates proactive threat mitigation through predictive analytics. Organizations are urged to adopt holistic security measures that integrate these technologies, fostering a culture of security awareness, ensuring regulatory compliance, and balancing security with privacy concerns. This proactive approach is essential for safeguarding digital assets against evolving cyber threats.

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Comparative Study of Silver Nanoparticle Synthesis: Chemical Reduction versus Green Synthesis method using Moringa oleifera Leaf Extract

[1]Athira Prakash, [2*]Prof. Dr. Joseph John

[1,2]Department of Physics, Aquinas College, Edakochi, Kochi, Kerala

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ABSTRACT

Silver nanoparticles (AgNPs) are widely studied due to their unique physicochemical properties and applications across medicine, energy, and environmental remediation. This study presents synthesis of AgNPs via two methods: (i) a conventional chemical reduction method using silver nitrate, sodium chloride, ethylene glycol (EG), and polyvinylpyrrolidone (PVP), and (ii) a green synthesis approach utilizing Moringa oleifera leaf extract. Characterization was performed using UV-Vis spectroscopy, X-ray diffraction (XRD), scanning electron microscopy (SEM), and transmission electron microscopy (TEM). The green synthesis method demonstrated effective nanoparticle formation with improved environmental compatibility. This work underscores the potential of plant-based synthesis as a sustainable alternative to conventional chemical routes.

[*]*Corresponding Author*

Prof. Dr. Joseph John

Principal

Aquinas College, Edakochi, Kochi, Kerala

Introduction

The field of nanotechnology has introduced an era of materials with unique size-dependent properties, among which metal nanoparticles stand out due to their vast potential. Silver nanoparticles (AgNPs), in particular, have garnered significant scientific and commercial interest owing to their distinct physicochemical characteristics [1]. These characteristics make AgNPs highly versatile, finding applications across a remarkable range of fields including medicine, energy storage solutions, catalysis, food processing and packaging, water purification technologies, and advanced electronics [2-4].

To meet the demand for AgNPs tailored to these diverse applications, numerous synthesis methodologies have been developed. Chemical methods, such as chemical reduction, sol-gel processes, and microemulsion techniques, are well-established and widely employed [5]. These approaches often allow for good control over particle size, shape, and concentration, enabling the production of AgNPs suited for specific functional requirements. Common chemical routes involve reducing silver salts like silver nitrate using chemical reducing agents in the presence of stabilizing or capping agents like polyvinylpyrrolidone (PVP) to prevent agglomeration [6].

'Green synthesis' has emerged as an attractive, eco-friendly, and cost-effective paradigm for nanoparticle production [7]. This approach utilizes biological entities, predominantly microorganisms or plant extracts, as natural factories for nanoparticle synthesis. Plant extracts, rich in phytochemicals such as polyphenols, flavonoids, terpenoids, alkaloids, and vitamins, can serve dual roles as both reducing agents (donating electrons to reduce metal ions) and capping/stabilizing agents (adsorbing onto the nanoparticle surface, preventing aggregation and providing biocompatibility) [8, 9]. It is now well-reported that AgNPs can be successfully synthesized using extracts from various plants, including *Azadirachta indica* (Neem), *Ocimum tenuiflorum* (Tulsi), and notably, *Moringa oleifera* [10-14]. AgNPs produced via these green routes, particularly using medicinal plants, have shown biomedical applications due to their potentially enhanced biocompatibility [15].

Moringa oleifera, known for its rich nutritional and medicinal properties attributed to its abundance of antioxidants and bioactive compounds, presents itself as an excellent candidate for green AgNP synthesis [16]. While both chemical and *Moringa*-mediated green synthesis of AgNPs are individually documented, a direct comparative study evaluating the nanoparticles produced by a specific chemical route versus this particular green route under consistent analytical conditions is essential. Such a comparison can elucidate the differences in particle characteristics (size, morphology, stability, surface chemistry) dictated by the synthesis pathway and provide valuable insights into the advantages and limitations of each approach.

Therefore, this study aims to synthesize AgNPs using two distinct methods: a conventional chemical reflux method involving ethylene glycol and PVP, and a green synthesis method utilizing an aqueous leaf extract of *Moringa oleifera*. The synthesized nanoparticles from both routes will be thoroughly characterized using various analytical techniques, and their properties will be systematically compared to evaluate the efficacy and potential advantages of the green synthesis approach relative to the established chemical method.

MATERIALS AND METHODS

Chemical Method

Here we incorporated the usual solvothermal method with reflux method. All of the chemical reagents used in our experiments were analytical grade. 40 millilitre EG solution of sodium chloride with different concentrations (0.2 mM and 20mM) was vigorously stirred after the addition of 1.8 g of PVP. The mixed solution was injected drop by drop using a syringe into 40 mL of a magnetically stirred EG solution of silver nitrate (0.1 mol) for 5 minutes. The solution became milky white at low sodium chloride concentration but cloudy at a high sodium chloride concentration. Afterwards the solution is moderately heated by reflux method. After 45 minutes of distillation, the solution is cooled to room temperature. Finally the products were washed with acetone and deionised water. Supernatant solution containing redundant EG and PVP was removed, and the samples retrieved from the bottom were preserved for characterisation.

Green Synthesis Method

Moringa oleifera green leaves were washed with tap water and then with deionized water three times and dried using sterile filter paper. After drying, it is grinded using an electric grinder and then stored in sealed and labeled bags until used. Initially, 30 mL of distilled water was heated to 80°C in a beaker. Subsequently, 4.9 g of silver nitrate ($AgNO_3$) was added to the heated water under magnetic stirring until complete dissolution. The solution was placed in darkness after stirring. Concurrently, 100 mL of distilled water was heated to 60 °C and 10 g of powdered Moringa oleifera leaves were added. The mixture was maintained at 60 °C for 2-3 hours with continuous stirring until a concentrated liquid extract was obtained. The extract was then filtered through gauze and the resultant solution centrifuged at 3000 rpm for 6 minutes. The centrifuged Moringa oleifera leaf extract was collected in a dark bottle to which the prepared $AgNO_3$ solution was added slowly, resulting in a noticeable color change from green to yellow then reddish brown, indicative of nanoparticle formation. [16]

Finally, the mixture was kept undisturbed in darkness for 5 days to allow for further nanoparticle growth and stabilization. After that it was purified, dried and saved for characterisation

Results and Discussion

The initial evidence of silver nanoparticle (AgNP) formation in both chemical and green synthesis methods was indicated by distinct color changes in the reaction mixtures. In the chemical method, the solution transformed from colourless to dark pink, (figure1) while the green synthesis involving *Moringa oleifera* leaf extract caused a change from deep green to pale yellow then dark reddish-brown (Figure 2). These colour transitions are well-known indicators of AgNP formation, attributed to the excitation of surface plasmon resonance (SPR) among conduction electrons on the nanoparticle surface. [17]

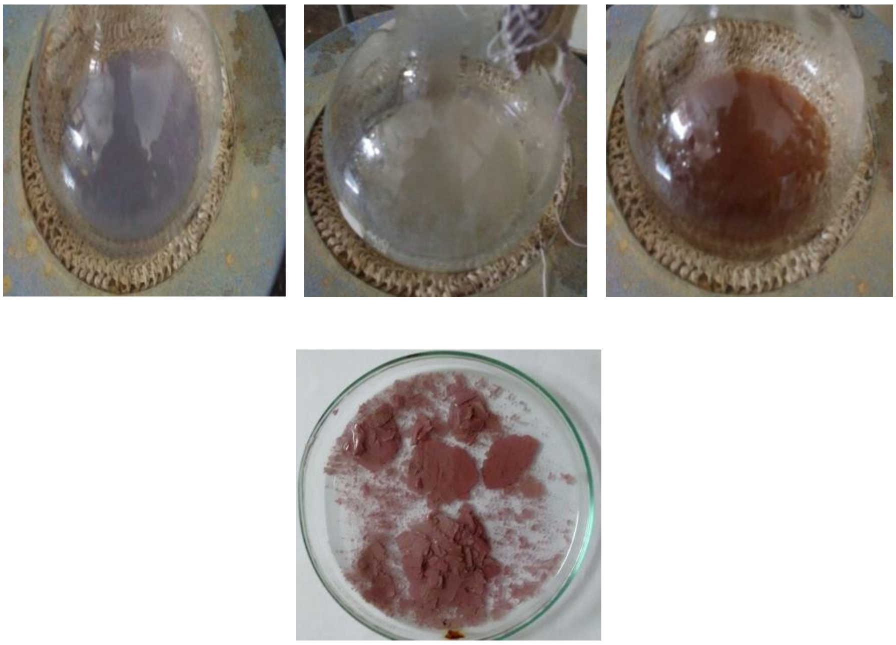
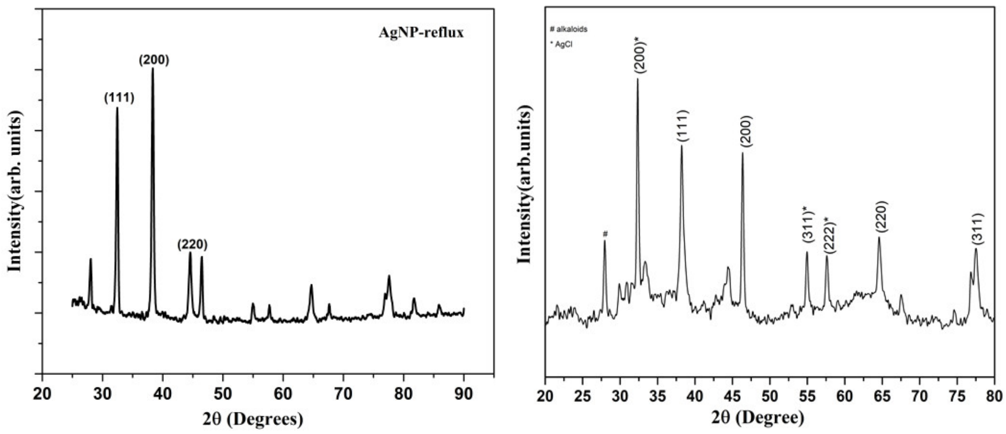


Figure 1: Colour transformation of the sample prepared via Chemical synthesis method

Green Synthesis Method

Figure 2: Colour transformation of the sample prepared via green synthesis method

Structural Characterization: X-ray Diffraction (XRD) Analysis



a) **b)**

Figure 3: XRD of a) AgNP by reflux method and b) Green Synthesised AgNP

Comparison of XRD peaks with standard crystallographic data confirmed that they correspond to the face-centered cubic (FCC) lattice structure of metallic silver (JCPDS File No. 04-0783). XRD analysis of the chemically synthesized AgNPs revealed peaks corresponding to the (111), (200), and (220) planes of face-centered cubic (FCC) silver, along with an additional peak related to AgCl (111). The presence of both Ag and AgCl phases suggests incomplete reduction or secondary reactions involving chloride ions from NaCl. The relatively higher intensity of the AgCl peak indicates its substantial presence in the sample (Figure 3a).

In contrast, the XRD pattern of the green-synthesized AgNPs showed sharp diffraction peaks at 2θ values of 38.20°, 44.40°, 64.63°, and 77.53°, indexed to the (111), (200), (220), and (311) planes of pure FCC silver (JCPDS No. 04-0783). The absence of secondary peaks indicates high phase purity. The average crystallite size, estimated using the Debye-Scherrer equation, falls within the nanoscale range, aligning with other reports on biologically synthesized AgNPs (Figure 3 b).

The average crystallite size of the silver nanoparticles synthesized via the chemical method was calculated using the Debye–Scherrer equation and found to be approximately 23 nm, whereas the green synthesis method yielded nanoparticles with an average crystallite size of about 30 nm.

Morphological Characterization

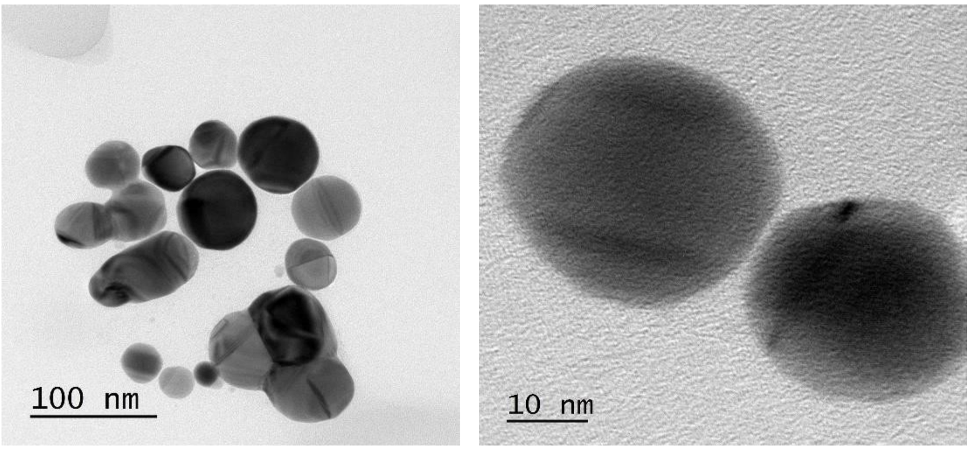


Figure 4: Transmission Electron Micrographs of chemically synthesized AgNP

Transmission Electron Microscopy images revealed well-dispersed, spherical AgNPs with diameters ranging from 10 to 60 nm. This confirms the effectiveness of the chemical reduction and capping by PVP in controlling particle morphology (Figure 4).

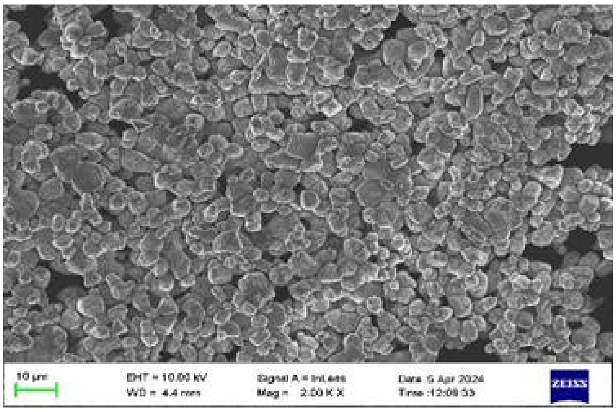


Figure 5: Scanning Electron Micrographs of Green Synthesized AgNP

Scanning Electron Microscopy showed that the green-synthesized AgNPs were also spherical with a slightly broader size distribution, predominantly between

20 to 60 nm. The particles were well-dispersed with minimal aggregation, indicating efficient stabilization by the phytochemicals in the Moringa extract (Figure 5).

Optical characterization: UV-Vis Spectroscopy

Figure 6 shows the absorption spectra acquired from the silver nano structure produced by 20 mM of NaCl. It is clear that the morphologies of the particle have a great impact on the absorption peak. In 20 mM sample, the absorption peak appears at 383 nm. The silver nanoparticles were measured in a wavelength ranging from 200-1100 nm. The peaks between 347 and 390 nm are associated with nanocubes and bipyramids.

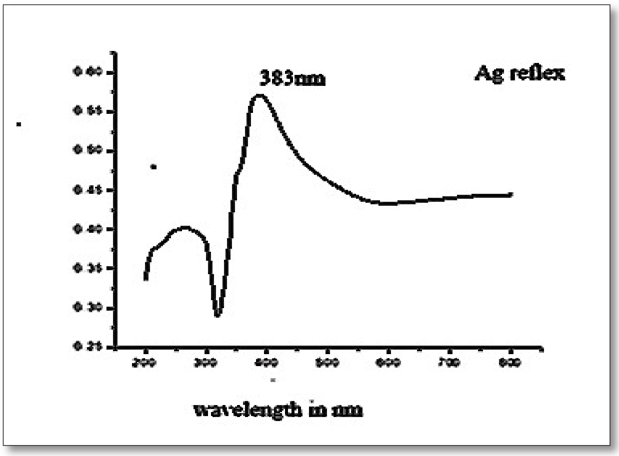


Figure 6: a) Absorption spectrum of Ag NP by Reflex method

The UV-Vis spectroscopic analysis of green synthesized sample exhibited a distinct absorption peak at 415 nm, indicative of silver nanoparticles (AgNPs) formation due to their characteristic surface plasmon resonance (SPR). The appearance of well-defined peaks in the UV-Vis spectrum reinforces the successful fabrication of AgNPs. These optical features suggest promising potential for integration into energy storage technologies.

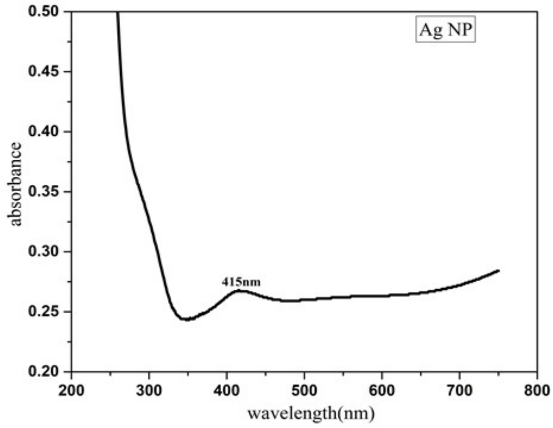


Figure 6: b) Absorption spectrum of Ag NP byGreen method

Compared to the green synthesis method, the reflux approach using 20 mM NaCl resulted in a noticeable blue shift in the absorption peak to 383 nm, indicating a variation in nanoparticle morphology—such as the formation of nanocubes and bipyramids—which highlights the influence of synthetic conditions on the optical properties and shape control of silver nanostructures. A comparison of important parameters essential for functionalizing AgNP is analysed based on the change in synthesis approach as shown in the table 1.

Parameter	**Chemical Method**	**Green Synthesis**
Reducing Agent	Ethylene glycol + NaCl	Moringa oleifera extract
Stabilizer	PVP	Phytochemicals in extract
Particle Shape	Spherical	Spherical
Size Range	10–60 nm (TEM)	20–60 nm (SEM)
XRD Pattern	Ag and AgCl peaks	Pure FCC silver
Environmental Impact	Moderate (chemical waste)	Low (green and sustainable)

Table 1: Comparative results of various parameters with respect to the chemical and green synthesis approach

Conclusion

The green synthesis method using Moringa oleifera extract offers a cleaner, sustainable, and effective route to produce silver nanoparticles with comparable size and morphology to those obtained via the conventional chemical method. Moreover, the elimination of toxic reducing/stabilizing agents and the production of phase-pure silver nanoparticles enhance the environmental and biological applicability of the green-synthesized AgNPs. XRD diffraction confirms a phase purity of the green synthesized samples and also the morphological characterization employing TEM and SEM confirm the formation of nanosized Ag. UV-Vis spectroscopic studies clearly display the optical characteristics of the nanoparticles. These findings underscore the potential of green-synthesized AgNPs for applications in biomedicine, environmental remediation, and energy-related technologies. Their favourable optical, structural, and morphological properties, combined with eco-friendly synthesis, make them highly suitable for integration into sustainable nanomaterial-based devices.

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Advanced Statistical and Machine Learning Techniques for IPL Data Analysis: A Comprehensive Approach

Mary Mrudhula P. L.

Govt. Guest Faculty, P. G. Department of Statistics, Aquinas College, Edakochi, Kerala

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ABSTRACT

This study applies advanced statistical tools and machine learning methods to analyze Indian Premier League (IPL) cricket data, which aims to uncover hidden patterns, to predict match outcomes and to evaluate player performance. Exploratory Data Analysis (EDA) provides a detailed overview of trends, while hypothesis testing includes independent t- test, ANOVA and chi- square test. Also, Zero- Truncated Negative Binomial Regression is employed to model count- based data with overdispersion, focusing on scoring trends. Moreover, Functional Data Analysis (FDA) which includes Functional Principal Component Analysis (FPCA) and Functional Regression, explores time- dependent performance patterns. Clustering using Gaussian Mixture Models (GMM) categorizes players based on performance characteristics. This paper integrates traditional and modern techniques to advance IPL analytics and improve strategic decision making for teams and analysts.

Corresponding Author:*

Mary Mrudhula P. L.

Govt. Guest Faculty, P. G. Department of Statistics

Aquinas College, Edakochi, Kochi, Kerala.

Introduction

Cricket has witnessed an exponential rise in data- driven analytics, particularly with the advent of leagues such as the Indian Premier League (IPL), where each match generates vast amounts of data. The growing interest in sports analytics has led to the application of statistical and machine learning techniques for performance assessment, outcome prediction, and strategy formulation. Traditional cricket analytics relied on simplistic measures like batting averages and strike rates; however, the dynamic nature of T20 cricket demands more sophisticated approaches.

Advanced statistical methods, including regression models, machine learning algorithms, and time-series analysis, offer deeper insights into match outcomes and player efficiency. Understanding the impact of various factors—such as venue conditions, player form, team combinations, and in-game scenarios—has become essential for coaches, analysts, and enthusiasts. This study systematically applies multiple statistical methods to IPL data to evaluate different facets of the game, providing a holistic approach to performance evaluation and strategic forecasting.

Literature Review

Recent advancements in sports analytics have revolutionized how cricket performance is measured. Traditional methods, such as batting averages and economy rates, have been supplemented by more advanced approaches, including survival analysis, machine learning models, and functional data analysis. Bailey and Clarke (2006) introduced predictive models for one-day cricket, laying the foundation for match outcome prediction using statistical forecasting techniques. Clarke and Norman (1998) developed dynamic programming strategies for optimizing one-day cricket decisions. More recently, Chhabra et al. (2021) applied survival analysis to cricket, demonstrating its utility in evaluating player longevity and consistency. Markov chain models have been widely employed in sports analytics, with applications in cricket by Perera et al. (2016) to model match state transitions. Extreme Value Theory (EVT) has been used in sports to model peak performances, as illustrated by Glickman and Hennessy (2020). The integration of machine learning models, such as Random Forest and clustering techniques, has enhanced player classification and performance prediction, as explored by Gao et al. (2018). This paper builds upon previous research by integrating multiple advanced techniques to provide a comprehensive IPL performance analysis.

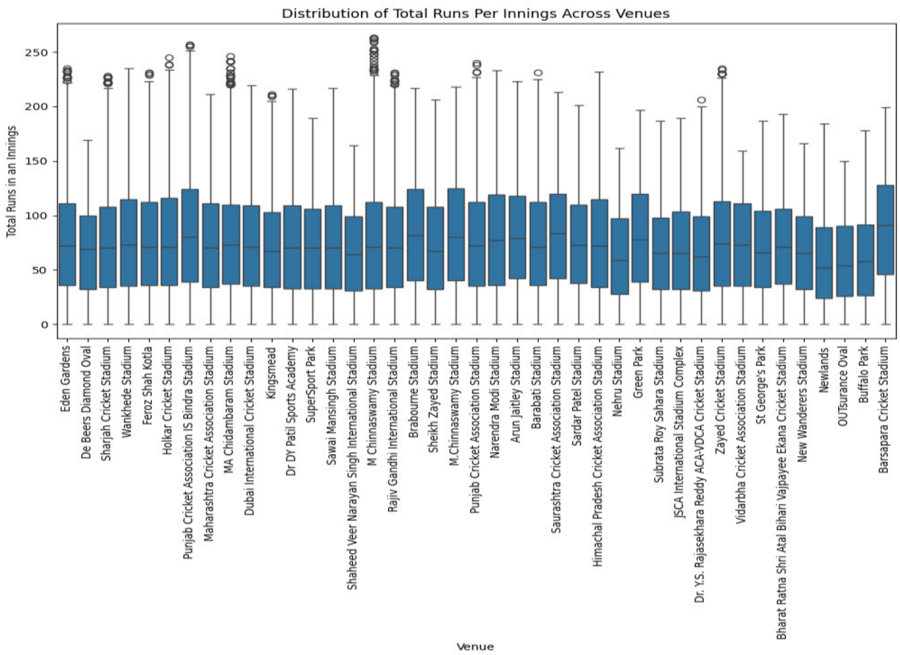
5. Analysis of the data

5.1 Exploratory Data Analysis (EDA)

Exploratory Data Analysis (EDA) is used to summarize the dataset, detect patterns, and uncover relationships between different variables. In this study, EDA techniques such as box plots and correlation matrices are applied to understand the influence of venues on total runs and the relationships between key performance variables.

The hypothesis of box plot is given by:

H_0: The venue does not significantly impact the total runs scored in an innings.
H_1: The venue has a significant influence on the total runs scored in an innings.

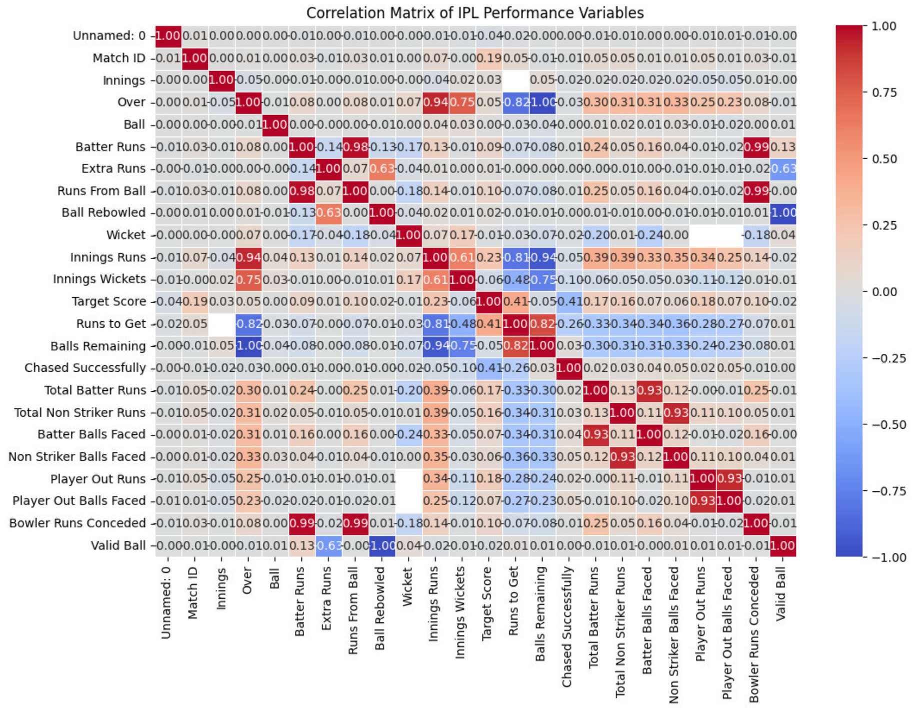


The box plot shows the distribution of total runs per innings across different IPL venues. Each box represents the interquartile range (IQR), with the median run score marked inside it. The spread of total runs varies by venue, indicating that certain stadiums tend to produce higher-scoring matches compared to others. Some venues have a wider spread, meaning matches there experience a greater variation in total runs. The presence of outliers (points above and below the whiskers) suggests that in certain matches, extremely high or low runs were scored, potentially influenced by pitch conditions, team performance, or weather. Some venues show a tighter IQR, meaning scores at those venues are more consistent, whereas others exhibit a wider range, indicating variability in team performances.
Similarly,

The hypothesis for correlation matrix is:

H_0: There is no significant correlation between key performance variables such as total runs, balls faced, and wickets lost.

H_1: There exist significant correlations among key performance variables, indicating underlying relationships in scoring patterns.



The probability of Innings Runs vs. Over (0.94) indicates that as the innings progress (more overs), more runs tend to be accumulated. Also, the probability of Total Batter Runs vs. Batter Balls Faced (0.93) suggests that players who face more balls tend to score more runs. Similarly, the probability of Runs from Ball vs. Batter Runs (0.98) implies that most runs come directly from legal deliveries rather than extras. These all shows that there is a strong positive correlation. Furthermore, Runs to Get vs. Balls Remaining (-0.82) indicates that as the number of remaining balls decreases, the required runs to win also decrease. Moving further, the probability of Innings Wickets vs. Innings Runs (-0.75) suggests that higher wicket losses reduce the total innings runs.

5.2 Hypothesis Testing for Statistical Significance

Hypothesis testing is a crucial step in statistical analysis to determine whether observed differences or relationships in data are statistically significant. In this section, we apply different hypothesis tests to evaluate key performance metrics in IPL matches.

- **To check if batting performance varies by venue (ANOVA test)**
  H_0: Batting performance does not vary significantly across different venues.
  H_1: Batting performance varies significantly across venues.

The F- statistic is 26.71 and the p- value is 1.89×10^{-197}. The extremely small p- value indicates strong evidence against the null hypothesis, suggesting that batting performance significantly differ across different venues. This could be due to variations in pitch conditions, weather or ground dimensions.

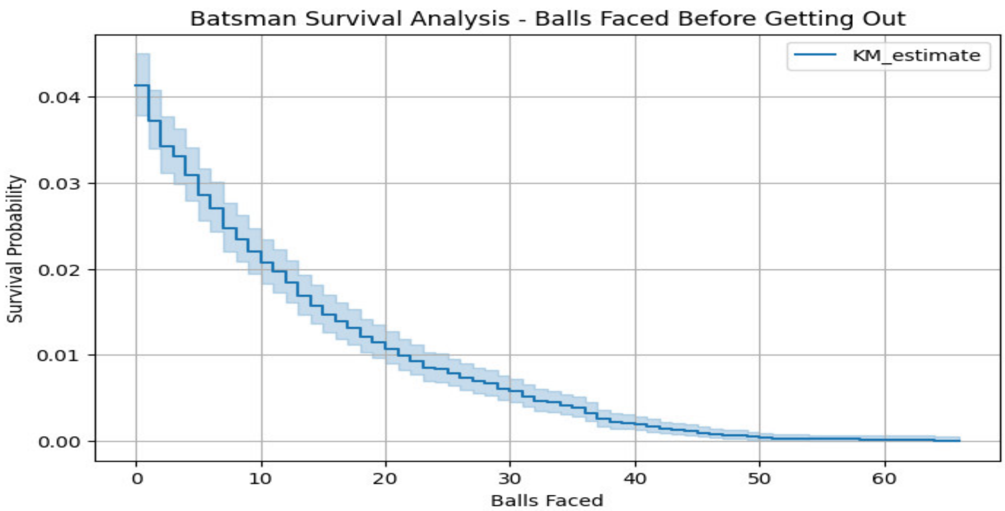
- **To check whether winning the toss affect match outcome**
  H_0: Winning the toss does not significantly impact the match outcome.
  H_1: Winning the toss significantly influences the match outcome.

The chi- square statistic is 828455.71 and since the p- value is effectively zero, we reject the null hypothesis, confirming a significant relationship between the toss result and match outcome. This suggests that winning the toss provides a strategic advantage, possibly due to pitch conditions, dew factor or other tactical decisions. Thus, the chi-square test established a strong relationship between toss results and match outcomes, indicating that the toss can influence a team's chances of winning.

5.3 Survival Analysis

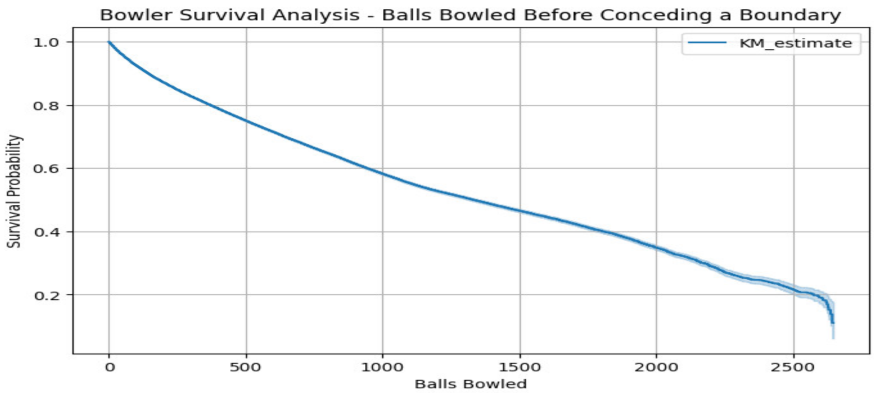
- **Batsman Survival Analysis**

Here, the objective is to analyze how long a batsman survives at the crease before getting out, measured in terms of balls faced. The Kaplan-Meier estimator is used to estimate the survival function of batsmen based on the number of balls they face before dismissal.



From the graph it is clear that the survival probability decreases as the number of balls faced increases, indicating that batsmen have a higher chance of getting out as they spend more time at the crease. The steep drop initially suggests that early dismissals are common.

- **Bowler Survival Before Conceding a Boundary**
  The objective is to evaluate how long a bowler can bowl without conceding a boundary. As discussed above the Kaplan-Meier estimator is applied to analyze the survival probability of bowlers based on the number of balls bowled before they concede a boundary.



The survival curve shows a gradual decline, indicating that the probability of a bowler conceding a boundary increases as they deliver more balls. A slower decline suggests that some bowlers maintain economic bowling spells over long periods.

5.4 Zero- Truncated Negative Binomial (ZTNB) Regression

The Zero-Truncated Negative Binomial (ZTNB) Regression is used to model count data where zero values are not observed, making it suitable for analyzing total batter runs in an innings. This approach helps in understanding how different factors influence batting performance in IPL matches. The objective concerns here is to analyze how different playing venues affect total batter runs and identify distinct venue effects. In order to evaluate this Venue-wise data is incorporated into the ZTNB regression model as a predictor. By examining venue coefficients, we determine which stadiums significantly impact batting performance.

Dep. Variable:	Q('Total Batter Runs')	No. Observations:	212310
Model:	GLM	Df Residuals:	212251
Model Family:	NegativeBinomial	Df Model:	58
Link Function:	Log	Scale:	1.0000
Method:	IRLS	Log-Likelihood:	-7.7944e+05
Date:	Wed, 05 Feb 2025	Deviance:	64858.
Time:	16:11:46	Pearson chi2:	5.63e+04
No. Iterations:	13	Pseudo R-squ. (CS):	0.4719
Covariance Type:	nonrobust		

By analyzing the above, we can understand that some venues may have a higher tendency to produce high-scoring games due to pitch conditions, ground dimensions, or weather factors. The model allows us to isolate the effect of each venue and understand its impact on total batter runs. Similarly, to assess whether batting first or second significantly affects total batter runs. Here, the model includes a categorical variable indicating whether the team batted first and also the impact of batting first is analyzed through regression coefficients.

The statistical summary of the model is as follows:

Mean of Total Batter Runs: 19.40

Variance: 334.93

Ratio (Variance-to-Mean): 17.27

The statistical summary shows that for batting first has a significant positive effect, it implies that teams scoring freely in the first innings tend to achieve higher totals. A variance-to-mean ratio much greater than 1 indicates overdispersion, which justifies the use of the Negative Binomial model over a Poisson model.

The model performance metrices is given as:

Log-Likelihood: -779,440

Pseudo R-Squared (CS): 0.4719 (indicating moderate explanatory power)

Pearson Chi-Square Statistic: 56,300

Deviance: 64,858

From the above performance metrices it is clear that the goodness-of-fit metrics suggest that the Zero- Truncated Negative Binomial (ZTNB) model is well-suited for analyzing batter runs data.

5.5 Random Forest Regression

Random Forest Regression is a powerful ensemble learning technique that combines multiple decision trees to improve predictive accuracy and handle non-linearity in data. In the context of IPL match data, Random Forest is used to predict the total runs scored in an innings based on various match-related factors such as venue, batting order, bowler type, and previous performance metrics. The primary goal of this analysis is to predict the total runs in an innings using Random Forest

Regression. The model incorporates historical IPL data to understand patterns in scoring and make accurate run predictions. In this context, the model considers several predictors such as Venue, Batting First or Chasing, Team Strength, Bowler Type, Previous Performance Metrics. The dataset is split into training and testing sets, and the Random Forest model is trained on past match data.

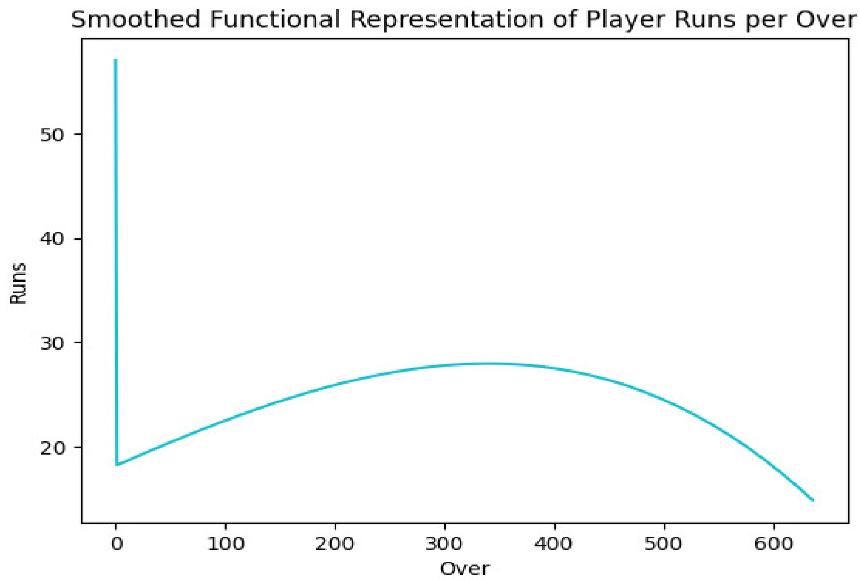
The result is obtained is as follows:
Predicted Runs (Random Forest): 41.06

This value of Predicted Runs represents the expected total runs for a given match scenario based on past trends and key influencing factors. The prediction aligns with historical data trends, suggesting that the model captures essential scoring patterns. The model benefits from Random Forest's ability to handle complex relationships between multiple match conditions. Hence, Random Forest Regression proves to be an effective tool for run prediction, offering valuable insights for analysts, coaches, and betting models.

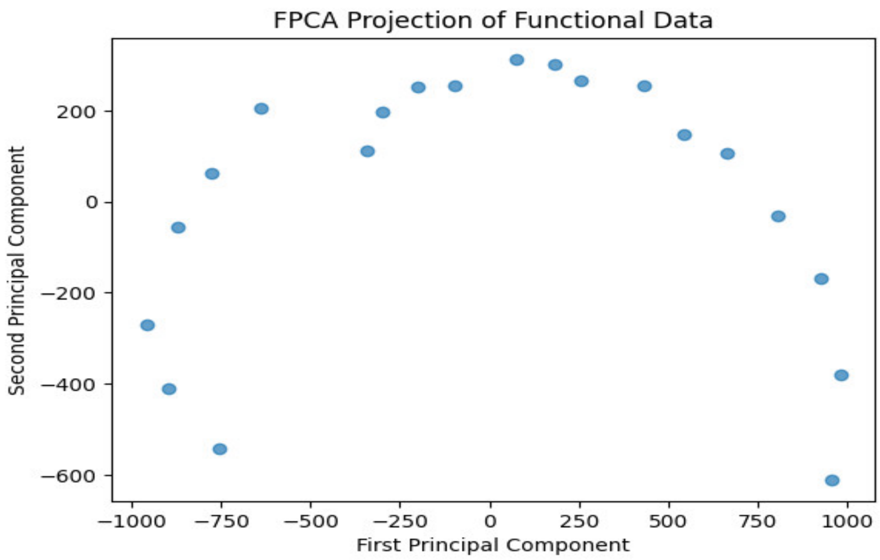
5.6 Functional Data Analysis

Functional Data Analysis (FDA) provides a powerful framework for analyzing data where observations are recorded over a continuous domain. In this study, we apply FDA techniques to analyze player runs per over, transforming discrete observations into smooth functional representations and extracting meaningful insights.

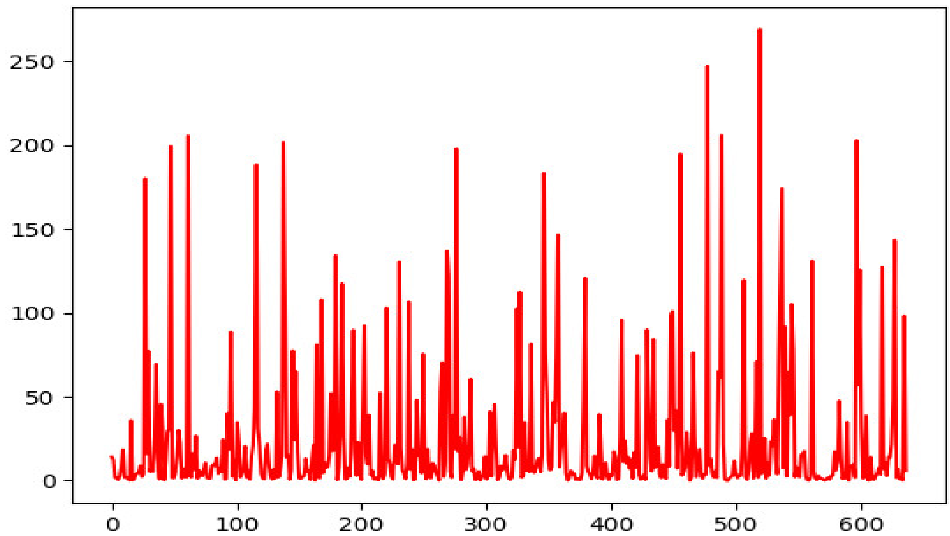
The first step in the analysis involved converting the discrete player runs per over into a continuous functional format. Smoothing techniques, such as B-splines or Fourier basis expansion, were applied to represent the runs as smooth functions. This process allows for better visualization and statistical modeling of the data.



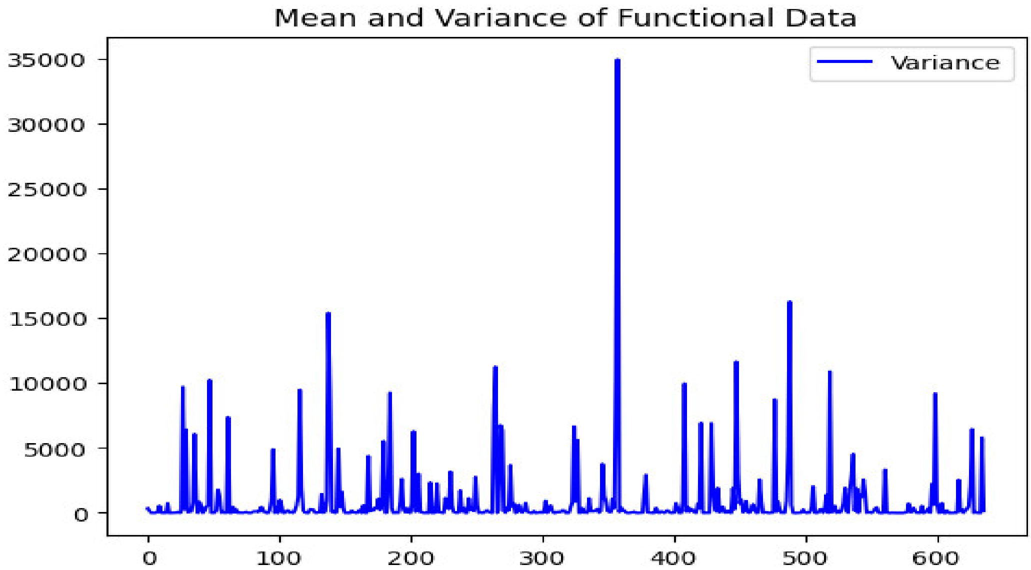
The graph represents the functional data of player runs per over. The different colored lines indicate the performance of multiple players or instances, showing variations in scoring patterns across different overs. The high variance suggests that some overs were highly productive, while others had significantly lower run contributions.



A basis expansion method was used to generate smooth representations of the runs data. The runs per over were transformed into functional curves, eliminating noise while preserving the underlying trends. The smoothed functional data were plotted to visualize individual player performance over time. The curve suggests that the initial overs had a low but stable scoring rate. Also, A peak is observed in the middle overs, indicating a phase where players scored more runs. Moreover, the run rate gradually declined towards the latter part of the game, possibly due to factors like fatigue or risk-taking strategies.

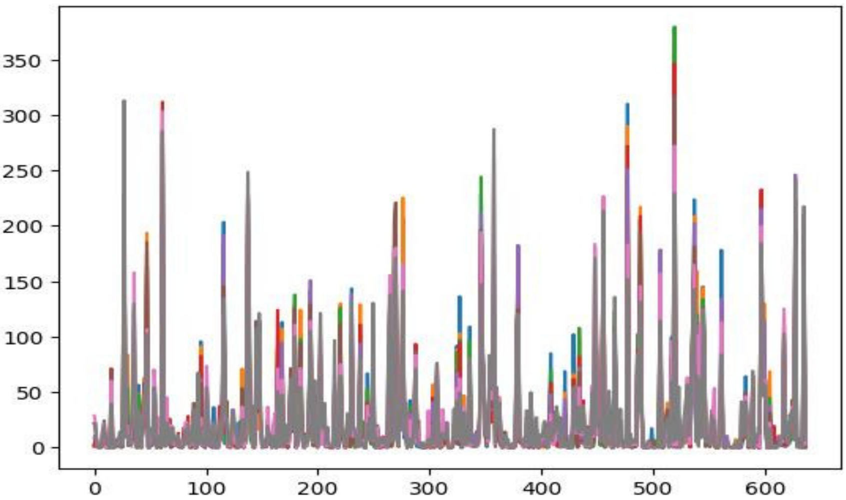


The graph illustrates the distribution of runs scored per over across different IPL matches. The highly fluctuating nature of the data suggests significant variability in scoring patterns among players. Peaks in the graph indicate overs where players have scored exceptionally high runs, while the dense clustering of smaller values suggests overs with lower-scoring contributions. The presence of multiple colors signifies different players, highlighting individual variability in performance.



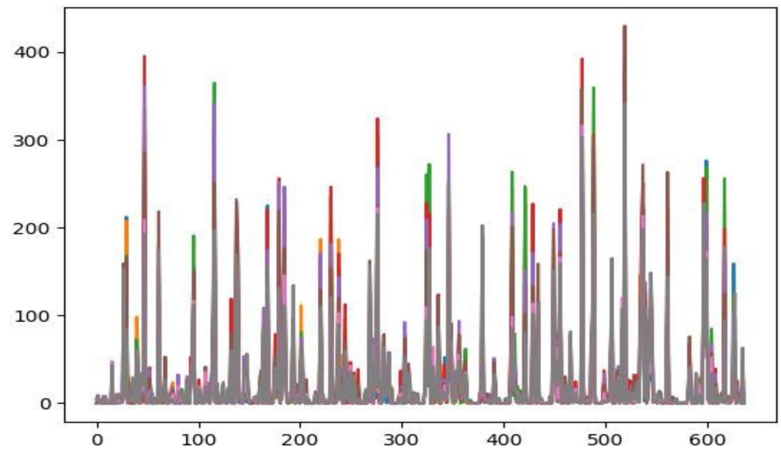
The provided graph displays the variance of functional data, which is crucial in understanding the fluctuations in player performance across different overs. The x-axis represents the different observations (likely overs or matches), while the y-axis indicates the magnitude of variance in player runs. The graph exhibits sharp spikes at specific points, suggesting certain overs or matches where there was extreme variability in player performance. These peaks may indicate inconsistent batting performances, where some players scored heavily while others failed in the same situation. The flat or low variance sections suggest that in certain overs, player performances were consistent across different matches. These could correspond to middle overs where teams generally aim to stabilize their innings.

By analyzing this variance, teams and analysts can identify overs that contribute most to unpredictable outcomes. If high variance occurs in death overs, teams can strategize to either capitalize on aggressive batting or improve their bowling attack during that phase. If variance is unexpectedly high in powerplay, it might indicate inconsistent performances by top-order batsmen.



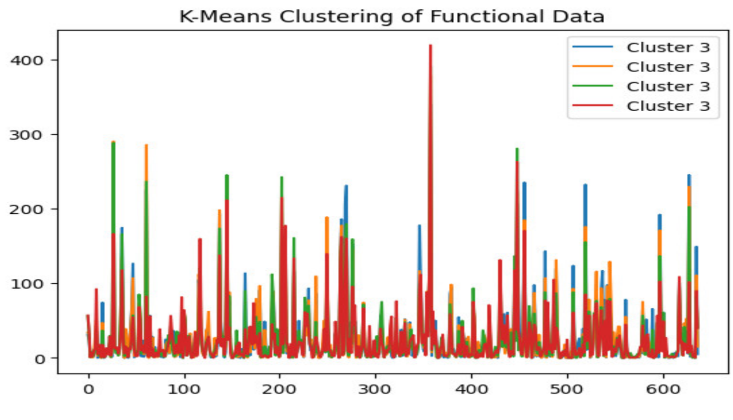
This graph represents the functional representation of player runs per over using smoothing techniques. The goal of smoothing is to reduce noise while preserving important trends in the data. The black curve represents the smoothed data, capturing the overall trends in player performance across overs. Different colors correspond to individual instances or players' raw data points, which have been incorporated into the functional representation.

The smoothed curve highlights peaks, which indicate overs where players scored significantly high runs. The general increasing trend shows that as the innings progress, players tend to take more risks and score higher runs in certain overs. The variability in scoring is evident, with some overs having much higher run accumulations than others.



This graph displays the variance of functional data over different overs. The variance function is crucial in understanding how much scoring patterns fluctuate throughout the match. The y-axis represents variance values, while the x-axis represents overs.

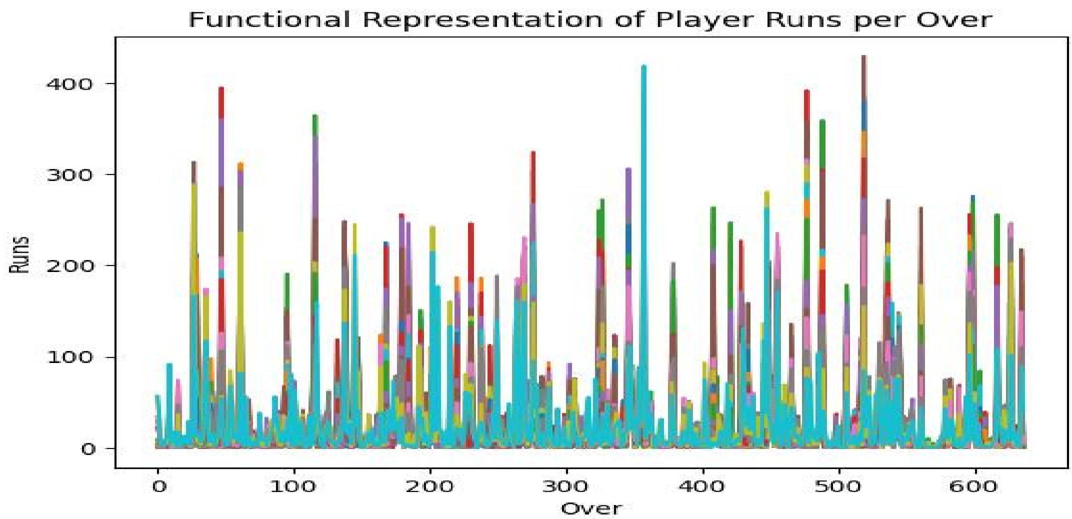
The variance graph shows significant fluctuations, with sharp peaks at certain overs, indicating high variability in runs scored. Overs with low variance suggest that players' performances are relatively stable, with minimal deviation from the mean. The presence of high variance at certain overs suggests that some players take aggressive approaches during those periods, leading to a higher deviation from the mean. The largest peak in variance suggests an over where some players scored significantly higher runs, while others had minimal contributions.



This graph represents the results of functional clustering using K-Means. The clustering helps group similar run-scoring patterns across overs. Each color represents a different cluster, grouping players based on their scoring trends.

The different colors indicate distinct clusters, showing that players exhibit varying run-scoring behaviors across different overs. Some clusters represent consistently high scorers, while others capture inconsistent or sporadic performances. The clustering technique enables player categorization based on their playing style, helping in comparative analysis and team strategy formulation. Overs with more dispersion across clusters indicate varied scoring approaches among players in those overs.

Graph 1 provides a smoothed functional representation of player runs per over, capturing key trends while reducing noise. Whereas, graph 2 focuses on variance, showing how scoring trends fluctuate across overs and identifying high-variance overs where individual performance is unpredictable. At last, graph 3 presents clustering results, identifying groups of players with similar scoring behaviors, which can be used for comparative player performance evaluation. These visualizations offer valuable insights into player performance trends, variability, and clustering, making Functional Data Analysis (FDA) a powerful tool for cricket analytics.



The graph presents a functional representation of player runs per over, capturing the scoring patterns of multiple players over a series of overs. Each colored curve represents the run accumulation of a player across different overs, allowing for a comparative visualization of performance trends.

The graph displays significant fluctuations in runs scored across overs. Some overs have sharp peaks, indicating explosive scoring, while others have consistently lower values. Certain overs exhibit extreme spikes, signifying periods where some players have scored exceptionally high runs. The troughs represent overs where players consistently scored fewer runs. This variation can be attributed to different playing styles, match situations, or bowler effectiveness in those overs. The different colors represent distinct functional data curves for individual players. Some players exhibit consistent scoring trends, while others have intermittent high-scoring overs. The overlapping nature of these curves suggests variations in how different players approach each over. The graph indicates that in certain sections (potentially towards the later stages), more extreme peaks appear, suggesting aggressive batting strategies in the death overs. This aligns with common cricketing strategies, where teams aim to maximize runs in the final overs of an innings.

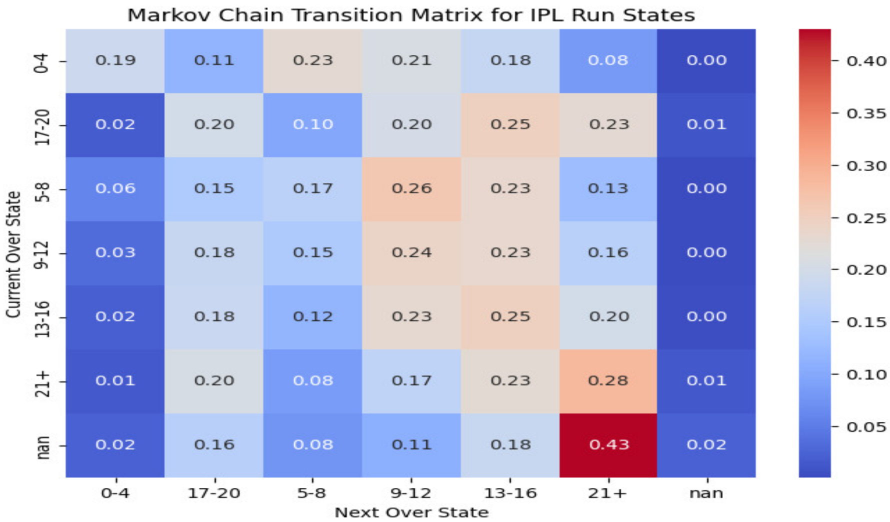
The functional data approach allows for smoothing and better visualization of patterns without being affected by minor variations. It helps in identifying trends that may not be apparent from raw tabular data. This graph provides valuable insights into how players score runs across different overs, helping in performance evaluation. By applying functional data analysis, we can derive meaningful conclusions about scoring trends, player consistency, and strategic gameplay. The variability in runs across overs highlights key moments in the game that influence match outcomes.

5.7 Markov Chain Analysis

A Markov Chain is a stochastic model that describes a sequence of possible events in which the probability of each event depends only on the state attained in the previous event. In the context of IPL (Indian Premier League) cricket, we use a Markov Chain model to analyze how the scoring pattern transitions from one over to the next. In this study, overs are categorized into different run states, and the probability of transitioning from one state to another is captured in a transition probability matrix. This approach helps in understanding batting strategies, scoring momentum, and predicting run patterns across different phases of an innings.

The structure of the Transition Matrix is as follows:

The rows represent the current over's run state. The columns represent the possible run states for the next over. Each cell contains the probability of transitioning from a given run state in the current over to a new run state in the next over. The color gradient helps visualize the probabilities, where darker shades indicate higher probabilities.

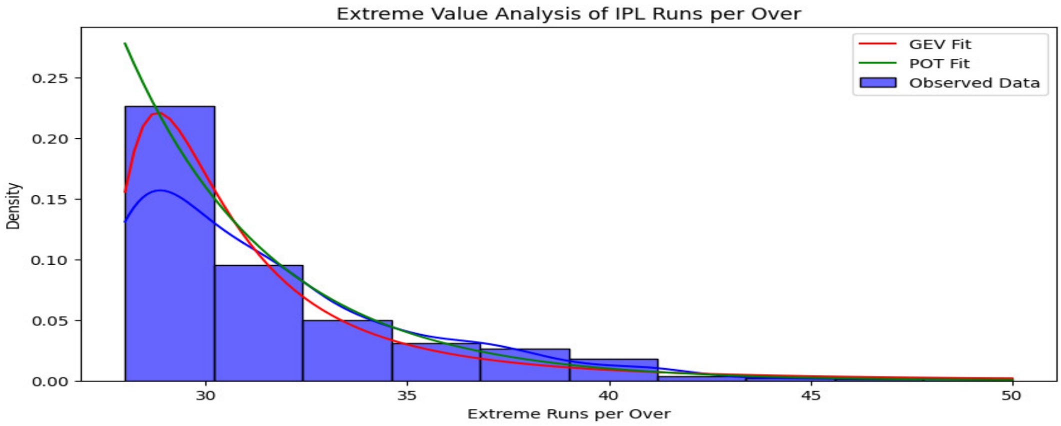


Slow starts usually recover within 1-2 overs, suggesting a cautious but adaptive approach in the powerplay. Middle overs (5-12 runs) are the most stable phase, where teams focus on strike rotation and setting up for a strong finish. Death overs (17+ runs) show a strong continuation effect, reinforcing the importance of finishers in IPL. Bowling strategies should focus on breaking momentum, especially after high-scoring overs, as batters tend to capitalize on form.

5.8 Extreme Value Analysis

Extreme Value Theory (EVT) is a statistical approach used to analyze rare, extreme events. In the context of IPL, EVT helps in understanding exceptional high-scoring overs, which can significantly impact match outcomes. Two key EVT models used in this analysis are:

- **Generalized Extreme Value (GEV) Distribution**: Models the maximum or minimum values over a given period, capturing extreme run-scoring behaviors.
- **Peaks Over Threshold (POT) Model**: Focuses on values exceeding a specific threshold, identifying unusually high-scoring overs.



The blue histogram represents the observed extreme run totals per over in IPL matches. These are overs where batters have scored exceptionally high runs. The red curve (GEV fit) represents the fitted Generalized Extreme Value distribution, showing how extreme run totals behave over time. The green curve (POT fit) represents the Peaks over Threshold model, focusing on values beyond a critical threshold.

The majority of extreme overs have run totals between, 27-35 runs per over, with a declining density for higher scores. The GEV fit (red curve) closely follows the observed data, suggesting that extreme overs in IPL exhibit a structured pattern. The POT model (green curve) fits the data well for higher values, indicating that overs beyond 35 runs per over are truly exceptional and occur with low probability. The tail behavior of both models suggests that overs exceeding 40 runs are extremely rare but still possible, reinforcing the unpredictability of IPL power-hitting.

IPL innings are often defined by rare, high-scoring overs that significantly impact match results. Extreme run bursts (beyond 35 runs per over) are low probability but high-impact events, often driven by power-hitters and favorable pitch/bowling conditions. GEV and POT models can help teams assess the probability of extreme overs occurring, guiding strategic decisions in death-over bowling, field placements, and batting approaches. Franchise analysts can use this model to identify batters capable of extreme overs and devise bowling tactics to mitigate these high-impact events.

This EVT analysis highlights the importance of statistical modeling in T20 cricket and its role in predicting match-defining moments.

6. Conclusion

This study explores advanced statistical and machine learning techniques for analyzing IPL data, leveraging functional data analysis, clustering, Markov chain modeling, and extreme value theory. The results reveal significant insights into player performance, scoring patterns, and transitions between different run states across overs. Functional data analysis provides a comprehensive visualization of run distributions, while clustering techniques like K-Means effectively categorize player performance trends. Markov chain models help understand scoring transitions, offering predictive insights into gameplay strategies. Additionally, extreme value theory highlights the distribution of extreme runs per over, allowing for better assessment of rare but impactful scoring events.

These findings have significant implications for team strategy, player selection, and match predictions. By applying robust statistical techniques, teams can make data-driven decisions, enhancing their competitive edge in the IPL. Future research could incorporate deep learning models and ensemble techniques to further refine predictive accuracy and strategic planning.

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Narrating the Chaos: A Reading of David Diop's *At Night All Blood is Black*

Dr. Anu S.

Assistant Professor, PG Department of English, Union Christian College, Aluva, Kerala

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ABSTRACT

Trauma often eludes direct articulation, making it challenging for victims to fully comprehend and convey their experiences. This difficulty in expression complicates the process of recording and understanding trauma. Literature, however, serves as a powerful medium for representing traumatic experiences, offering a narrative framework through which they can be processed and communicated. This paper explores the role of literature in depicting trauma by analyzing David Diop's novella, *At Night All Blood is Black.* The study examines how literary narration can effectively engage with trauma, providing insight into its complexities and enabling a deeper understanding of its impact.

****Corresponding Author:***

Dr. Anu S.

Assistant Professor, PG Department of English

Union Christian College, Aluva, Kerala.

Sigmund Freud, in Beyond the Pleasure Principle, reinterprets trauma as a wound of the mind, an experience that resists direct assimilation and often manifests belatedly in distressing, repetitive symptoms such as hallucinations and intrusive recollections. Trauma is characterized by an overwhelming experience of sudden or catastrophic events, wherein the response is not immediate but emerges later in uncontrolled and fragmented ways. This delayed effect challenges conventional notions of memory, history, and representation, making trauma a complex subject of study in literary and theoretical discourse.

Cathy Caruth poses a fundamental question of whether trauma is the encounter with death or the ongoing experience of having survived it. This question underscores the dual nature of trauma, which is not only rooted in the initial moment of crisis but also in the persistent struggle of living with its aftermath. Trauma, therefore, does not conclude with the traumatic event itself; rather, it lingers in the survivor's psyche, often manifesting in involuntary recollections, nightmares, and fragmented memories. She approaches this question by analyzing the "double telling," an oscillation between a "crisis of death" and "the correlative crisis of life" (7); or, a confrontation of death and then of survival, which is elucidated by an intersection between the language of literature and psychoanalytic theory. This duality suggests that trauma involves both the confrontation with death and the subsequent challenge of continuing to live in its shadow. The survivor experiences a rupture in time, where the past trauma intrudes upon the present, creating a repetitive cycle of reliving the event.This oscillation between death and survival finds expression through literature and psychoanalytic theory.

Trauma often results in what has been described as "speechless fright"—a state in which the individual is unable to put their experience into words. This speechlessness arises from the sheer intensity of the trauma, which disrupts not only memory and cognition but also language itself. The inability to express trauma creates a rupture in communication, severing the survivor from others and even from their own sense of identity. The self becomes fragmented, unable to bridge the gap between past and present, between personal experience and social expression.

Literature, with its capacity for fragmented storytelling, unreliable narration, and layered temporalities, mirrors the disrupted consciousness of trauma survivors. Through literature, trauma may find a voice, even if it remains incomplete, allowing for a form of representation that acknowledges the depth of the survivor's experience. Through narrative, both survivors and readers are invited to confront the complexities of trauma, acknowledging its disruptions while also recognizing its potential to foster new forms of understanding and connection. The challenge of representing trauma, therefore, requires a shift in how we read and listen—moving beyond traditional narrative structures to forms that acknowledge trauma's disjointed and repetitive nature. The dynamic use of language enables literature to convey experiences that cannot be fully expressed through conventional storytelling. By offering new modes of narration, literature provides a space where silenced voices can be heard and where the lingering effects of trauma can find expression. Certain events, particularly traumatic ones, often escape full comprehension at the moment of their occurrence. In this sense, literature becomes a bridge between the personal and the collective, offering a means for traumatic experiences to be acknowledged, witnessed, and ultimately given a form of meaning.

David Diop is a Franco-Senegalese writer, born in Paris in 1966 to a French mother and a Senegalese father. His literary work explores themes of colonial history, identity, and trauma, particularly through the lens of France's colonial past. His novella *At Night All Blood Is Black* won the International Booker Prize, with its English translation by Anna Moschovakis receiving critical acclaim for its powerful and evocative prose.

The novella follows the story of Alfa Ndiaye, a Senegalese infantryman fighting for France during World War I. As the narrator, Alfa recounts his harrowing experiences on the battlefield, offering a deeply personal perspective on war, violence, and psychological trauma. His closest companion, Mademba Diop, whom he considers more than a brother, suffers a gruesome death in combat. Witnessing this tragedy leaves Alfa overwhelmed with guilt and grief, driving him into a downward spiral of trauma and insanity.

The narrative intricately weaves together themes of childhood trauma, colonial exploitation, war, guilt, and psychological pain, offering a haunting exploration of the human cost of violence. The protagonist, Alfa Ndiaye, serves as both a witness and a victim of these forces, as his past and present experiences converge to shape his descent into madness.

Alfa's heroism soon turns into something far more disturbing as he starts avenging his fallen brother by repeatedly killing German soldiers in brutal hand-to-hand combat. However, his actions go beyond mere revenge, he obsessively recreates the traumatic scene of Mademba's death. As a grotesque ritual, he begins severing the hands of his slain enemies, carrying them as trophies. This act, symptomatic of what was historically referred to as war neurosis, highlights the psychological toll of war and the way trauma manifests in compulsive repetition and violent obsession.

Alfa's childhood is marked by loss and abandonment, particularly the absence of his mother, which leaves an unspoken void in his life. Though the novel primarily focuses on his experiences during World War I, there are recurring references to his past that suggest an early foundation of emotional trauma. His relationships, particularly with Mademba Diop, become essential in providing him with a sense of connection and belonging. However, when Mademba is gruesomely killed in battle, Alfa is left with an unbearable guilt that exacerbates his psychological unravelling.

The defining moment of the novel is the death of Mademba Diop, which becomes the catalyst for Alfa's descent into madness. Mademba, mortally wounded, begs Alfa three times to end his suffering, but Alfa, bound by an internalized sense of duty, refuses. This moment haunts him, as he later reflects: "Like no one would ever know that Mademba had begged me three times to finish him, that I had remained deaf to his three supplications, that I had been inhuman by obeying duty's voice" (Diop 5). This unresolved guilt consumes him, driving him to reenact his trauma in increasingly violent ways. In an attempt to cope with his anguish, he begins to hunt down German soldiers, not simply as an act of war, but as a means of reliving and rewriting the moment of Mademba's death. His ritualistic severing of their hands is not only an act of brutality but a symptom of his fractured psyche, illustrating how trauma manifests in obsessive repetition.In a particularly disturbing passage, he describes the process of killing his enemy:

> His white belly is exposed, it rises and falls in jerks. The enemy from the other side gasps and screams, now in stark silence because of the gag I've cinched around his mouth. He screams in stark silence when I take all the insides of his belly and put them outside in the rain, in the wind, in the snow, or in the bright moonlight. If at this moment his blue eyes don't dim forever, then I lie down next to him, I turn his face toward mine and I watch him die a little, then I slit his throat, cleanly, humanely. At night, all blood is black. (Diop 87)

The imagery of inside and outside is significant. The enemy's insides, his organs, his very essence, are removed and placed outside, symbolizing not only the physical act of killing but also Alfa's psychological disintegration. This inversion reflects his own mental state; his mind, like the enemy's body, has been turned inside out, exposing the raw chaos of trauma and war.

The weight of pain and psychological suffering is vividly captured in Alfa's descriptions of his grief, which he likens to an unbearable, physical blow: "It hit me brutally in the head, like a giant seed of war dropped from the metallic sky, the day Mademba died" (Diop 4). This imagery reflects the way trauma disrupts time and perception, making past wounds feel ever-present. Alfa is unable to move forward, as his grief continually reasserts itself in his consciousness, shaping his actions and distorting his reality. Diop masterfully captures the fragmented nature of trauma, illustrating how Alfa's past and present bleed into one another, making his suffering inescapable.

The narrative explores the psychological toll of war and the fine line between acceptable and unacceptable madness on the battlefield. Through the protagonist, Alfa Ndiaye, Diop reveals the expectations placed upon soldiers: they are permitted— even encouraged— to exhibit a controlled form of rage and violence during combat, but they must quickly suppress these emotions once the battle is over. Alfa comes to realize this brutal truth:

> Yes, I understood, God's truth, that on the battlefield they wanted only fleeting madness. Madmen of rage, madmen of pain, furious madmen, but temporary ones. No continuous madmen. As soon as the fighting ends, we're to file away our rage, our pain, and our fury. Pain is tolerated, we can bring our pain home on the condition that we keep it to ourselves. (Diop 47)

Here, Alfa acknowledges the unspoken rule of war: violence must be controlled, performed on command, and then discarded once it is no longer necessary. Soldiers are allowed to experience rage and suffering, but only in ways that serve the war effort. They must transform their fear and pain into a temporary madness that enables them to kill, but once the battle ends, they are expected to return to a state of discipline and order. Any lingering trauma, grief, or psychological distress must be internalized, hidden from the world.

Diop further explores the distinction between sanctioned and unsanctioned madness in warfare. Temporary madness— a brief loss of control in the heat of battle— is not only accepted but even equated with bravery. However, when this madness persists beyond the battlefield, it becomes a source of fear and alienation. Alfa reflects on this dangerous shift in perception, when he says "Temporary madness makes it possible to forget the truth about bullets. Temporary madness, in war, is bravery's sister. But when you seem crazy all the time, continuously, without stopping, that's when you make people afraid, even your war brothers" (Diop 48). He acknowledges that temporary insanity is necessary for survival in war. It allows soldiers to overcome their fear, numbing them to the horrors around them. However, this form of madness is only tolerated so long as it serves a purpose. Once it becomes continuous, it is no longer seen as bravery but as a dangerous, uncontrollable force. Those who are unable to suppress their madness, who remain consumed by violence even after the battle ends, become a threat not only to the enemy but to their own comrades.

This exploration of controlled versus uncontrolled madness reflects a broader critique of how societies treat soldiers. While they are glorified for their bravery in war, their trauma and suffering are often ignored or dismissed once they return home. Pain is tolerated, but only if it remains invisible. Those who fail to repress their trauma are cast aside, left to struggle with the psychological scars of war in silence.

Sigmund Freud, in his exploration of trauma, observed the uncanny way in which catastrophic events tend to repeat themselves for those who have experienced them. This phenomenon, which he termed traumatic neurosis, manifests as an uncontrollable compulsion to relive a traumatic event, whether through nightmares, intrusive thoughts, or repeated actions. Alfa Ndiaye exhibits this very tendency—his trauma does not remain confined to memory but manifests physically and obsessively. He recreates the scene of Mademba's death over and over, attempting to replace his guilt with a perverse sense of control and even playfulness.

Freud describes trauma as something "experienced too soon, too unexpectedly, to be fully known and is therefore not available to consciousness until it imposes itself again, repeatedly, in the nightmares and repetitive actions of the survivor" (Caruth 4). Alfa's repeated acts of violence mirror this concept—he compulsively relives Mademba's final moments in an unconscious effort to process the past. However, rather than finding closure, his actions deepen his psychological distress. Instead of simply mourning his friend, he reenacts the trauma, each time escalating his brutality in an effort to reclaim a sense of power over the event.

A crucial aspect of Alfa's descent is his inability to separate the past from the present. His unconscious mind refuses to betray the past, so instead, he recreates it, lives it again. Each time he kills a German soldier, he repeats the moment he failed Mademba, turning war into a personal ritual of redemption and self-punishment. His guilt and his failure to grant his friend mercy, transforms into a grotesque cycle of violence, in which he plays the role of both executioner and savior. He does not simply kill; he prolongs the moment of death, stretching it into a performance of vengeance and distorted atonement.

This compulsive repetition reveals the thin boundary between knowing and not knowing, between the conscious and the unconscious. Alfa exists in a liminal psychological space, he is aware of his actions, yet he is unable to fully comprehend their significance. He convinces himself that his killings are acts of justice, yet deep down, they are desperate attempts to fill an ever-expanding void in his mind. Instead of healing, his repetitions multiply his suffering, reinforcing his isolation from others and his own sense of reality. The narrative is structured around repetition, both in language and in the protagonist's psychological state. The phrase "God's truth, I know, I understand" (5) recurs throughout the novel, creating a hypnotic rhythm that transcends a conventional linear narrative. This repetition reflects Alfa Ndiaye's fractured mind, as he oscillates between awareness and self-deception, between sanity and madness. His words become incantations, reinforcing his beliefs while simultaneously exposing his unraveling psyche.

As Alfa descends further into his trauma, his perception of reality becomes increasingly distorted. He describes a moment of overwhelming awareness: "The insides of the earth were outside, the insides of my mind were outside, and I knew…so I locked thoughts at the back of my head after observing them from up close. Strange" (Diop 10). These words encapsulate his disorientation. The inversion of inside and outside suggests a world turned inside out, mirroring his own unraveling sense of self. He is hyper-aware of his thoughts, yet he actively suppresses them, indicating his struggle to reconcile the horrors he has witnessed with his own actions. This self-imposed mental distancing becomes his survival mechanism, as he locks away unbearable truths rather than confront them directly.

Alfa is also acutely aware of how others perceive him. As his behavior grows more erratic, his fellow soldiers begin to fear and distance themselves from him. He acknowledges their judgment but resists it: "THEY THOUGHT I WAS AN IDIOT, but I'm not" (Diop 69).The use of capitalization in this line emphasizes Alfa's defiance. He insists on his awareness, his intelligence, and his understanding of the world. Yet, his insistence also reveals his desperation, he is trying to convince himself that he is still in control. This moment highlights the gap between perception and reality, as Alfa's internal world becomes increasingly alienated from those around him.

Finally, the closing line, "At night, all blood is black", is one of the novel's most powerful statements. On a literal level, it refers to how blood, when it dries, darkens to black. Symbolically, however, it speaks to both racial identity and psychological turmoil. Blackness here signifies multiple things: the color of Alfa's skin, the darkness of his mind as he loses himself to violence, and the state of unconsciousness, both literal (sleep, dreams, death) and metaphorical (madness, loss of self). Night is a space where distinctions blur, where identity dissolves, where all blood, regardless of race, becomes the same. Through this line and its unsettling imagery, Diop crafts a narrative that is not just about war, but about the darkness—both external and internal—that consumes those who are forced to fight in it. Alfa's physical actions reflect his inner turmoil, and as he descends further into violence, the boundaries between sanity and madness, self and other, life and death begin to collapse, leaving behind only blood, darkness, and the void of night.

David Diop also explores how trauma manifests through art and allegory, revealing suppressed truths that the mind struggles to articulate directly. As Alfa Ndiaye descends into madness, his violent actions begin to speak for him, but it is his art that ultimately becomes his most damning confession. He acknowledges this when he states: "My seven hands spoke, they confessed all to my judges. God's truth, I know, I understand that my drawings denounced me" (Diop 127). This highlights the paradox of trauma: even when words fail, expression finds a way. The seven hands, tokens Alfa has collected from his slain enemies, serve as a tangible representation of his unraveling psyche. However, it is through his drawings that his guilt and fractured state of mind become fully exposed. In a sense, his art acts as both a testimony and an indictment, revealing the horrors he cannot verbally articulate. The act of drawing, like his repetitive acts of violence, becomes an unconscious confession, a way for trauma to surface despite his attempts to suppress it.

Beyond literal expression, the novella also engages with allegory as a means of storytelling and truth-telling. This is particularly evident in the tale of the lion sorcerer and the fickle princess, an allegorical story that carries deeper, hidden meanings. Alfa reflects on the power of such stories, stating: "The hidden story has to let itself be guessed at. It has to be transparent. When it is understood by those for whom it is intended, the story hidden beneath the well-known story can change the course of their lives" (Diop 142).

This statement speaks to the layered nature of trauma narratives. Like the allegory, trauma is often not directly spoken but rather conveyed through metaphor, symbolism, and repetition. The hidden story mirrors the repressed experiences within Alfa's own mind, his guilt over Mademba's death, his struggle with his identity as both victim and perpetrator, and his inability to reintegrate into a rational world. The tale of the lion sorcerer and the princess serves as an echo of his own journey, illustrating how storytelling functions as a bridge between lived experience and understanding.

As Alfa Ndiaye descends further into his psychological torment, he begins to merge his identity with that of his fallen friend, Mademba Diop. This fusion is evident in his haunting realization: "I swear to you that now, whenever I think of us, he is me and I am him" (Diop 112).This statement underscores the fundamental nature of trauma, in which the line between the self and the lost other begins to blur. Alfa, burdened by guilt over his failure to grant Mademba a merciful death, unconsciously takes on his friend's suffering. His violent reenactments of the original trauma, his systematic killings of enemy soldiers, function as an attempt to bridge the gap between life and death, presence and absence. However, rather than finding closure, Alfa becomes trapped in an endless cycle of reliving Mademba's final moments, his identity fracturing under the weight of memory and remorse.

The structure of the novel itself mirrors this psychological unraveling. The ending suggests that the narrative could be read in reverse, beginning with Alfa's hospitalization and working backward to his self-imposed quest for redemption. In this reading, we see the story not as a linear progression but as the fragmented recollections of a man suffering from post-traumatic stress disorder (PTSD). His experiences are not recounted in a coherent, chronological manner but rather in a looping, repetitive fashion, much like the intrusive memories and flashbacks characteristic of trauma.

Alfa's confinement in the hospital, an ambiguous space that could symbolize both literal institutionalization and the mental entrapment of trauma, frames the novella as a psychological case study. His actions, which initially appear as the product of controlled vengeance, are later understood as symptoms of a deeply damaged mind attempting to process the unprocessable. The novel's circular structure reinforces this, suggesting that his story is one of inescapable repetition, where the past continuously imposes itself on the present.

Alfa's journey is not one of healing but of endless return, his identity dissolving into the ghost of Mademba, his actions dictated by a past that refuses to remain buried. It masterfully employs literary language and techniques of defamiliarization to create an unsettling interplay between knowing and not knowing. Trauma, in its very nature, resists full comprehension, and the novel reflects this through its fragmented structure, unreliable narration, and shifts in perspective. The reader, much like Alfa Ndiaye himself, is caught between moments of clarity and distortion, between what is consciously understood and what lingers in the shadows of the subconscious.The novella highlights the widening distance between the self and the other, particularly in the way trauma alters one's perception of reality. This distance is not only psychological but also linguistic, as Alfa's narration becomes increasingly fragmented, mirroring his disintegrating sense of self. As the novella progresses, his language shifts from a coherent recounting of events to dream-like sequences filled with repetition, contradiction, and a hypnotic rhythm that pulls the reader deeper into his fractured consciousness.This split in consciousness is further reinforced through the novel's structure, which does not follow a traditional linear narrative. Instead, it unfolds in a cyclical, looping fashion, much like the mind of a trauma survivor whore-experiences the past in an uncontrolled and intrusive manner.

The narrative blurs the boundaries between past and present, reality and hallucination, self and other, creating a narrative that reflects the disorienting nature of post-traumatic stress. The ending does not offer resolution or redemption; rather, it leaves us in the same haunting uncertainty that defines Alfa's reality, a world where the past refuses to remain buried and where language itself becomes both a tool for understanding and an instrument of alienation.

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Exiled but Unyielding: The Diasporic Tibetans' Struggle for Freedom in Thupten Samphel's *Falling Through the Roof*

[1*]Dr. Vidya Rajagopal, [2]Rani Vineeta

[1.] *Associate Professor, PG Department of English, NSS College, Pandalam, University of Kerala*

[2.] *Assistant Professor, Department of English, Iqbal College, Peringammala, University of Kerala*

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ABSTRACT

As a target of global geopolitics, the indigenous and spiritually rooted land of Tibet has been struggling against the trauma of hegemonic assimilation, cultural erasure and mystification. Diasporic hubs or spaces serve as cultural and religious landscapes wherein the displaced natives gather to relive their national identity and consciousness. *Falling Through the Roof* is Thupten Samphel's attempt to interweave ancient Tibetan history with the resistance story of radical young Tibetan students' living-in-exile in India. Drowned in mysticism, the novel gives an insight into the indigenous and hybrid world of Tibetans-in-exile who experience statelessness and the pathos of forced diaspora. This paper is an attempt to make an in-depth analyse of how Samphel records the predicament of displaced Tibetans and the resistance-liberation movement of young radical Tibetans-in-exile in India.

Corresponding Author:

Dr. Vidya Rajagopal

Associate Professor, PG Department of English

NSS College, Pandalam, University of Kerala

"Tibet may lie crushed beneath the dead weight of Chinese tyranny, but the truth about Tibet cannot be so easily buried; and even such a strange fragment of history such as this, may contribute to nailing at least a few lines of the tyrants" (xv-xvi), writes the Tibetan novelist and activist Jamyang Norbu in the Preface to his novel *The Mandala of Sherlock Holmes*.

Studies on trauma and memory have been revolutionized in the last two decades by a shift of focus from the trauma of the colonized people to the struggle for resistance and liberation of the trauma victims. Recent trauma narratives strive to expose the false representations of colonial reality. Tibet has been the victim of global geopolitics since its invasion by the People's Republic of China in 1959. While Chinese and other narratives have been misrepresenting the indigenous land of Tibet as a utopian Shangri La – a land of monasteries, nuns, monks and lamas, Tibetan writers and those who stand for the Tibetan cause strive to break free from the veil of such mystical representations. They tend to represent the struggle of Tibetans to preserve their nationhood by 'working through' various modes of decolonization and resistance which includes representation of Tibetan reality in literature, self-immolations and resistance-liberation movements.

Amongst many, Jamyang Norbu and Thubten Samphel are two exiled Tibetan English novelists who explore Tibetan history in their novels. This paper is an attempt to make an analytical reading of Samphel's first novel *Falling Through the Roof* and to identify how Samphel depicts the strategies adopted by Tibetans living-in-exile in India to rejuvenate their identity. As the author of several books on Tibet including *Copper Mountain, Tibet: Reports from Exile, The Dalai Lamas of Tibet* and *Tibet from Tranquility to Turmoil*, Thubten Samphel sets *Falling Through the Roof* on Mt. Kailash, a sacred location for Buddhists, Hindus and Jains. This novel is Samphel's sharp meditation on a culture that nurtured its environment and resisted assaults by a resource-hungry authoritarian state. The novel recounts the story of how a small group of multi-cultural meditators who have nothing but ancient wisdom and courage, protest and resist against a mega-mining corporation's plan to excavate the foremost holy mountains on Tibet. The novel further explores the real predicament of displaced Tibetans living-in-exile in India and all across the world, through the medium of Tibetanized English.

The novel interweaves Tibetan history – the invention of Tibetan script, the Mongol invasion of Tibet, the inter-tribal conflicts in Tibet, and the present history of the refugee settlement at Majnu Ka Tilla. It tells the story of a set of young students in Delhi who form the Tibetan Communist Party (TCP) to express their resistance against the Chinese colonizers of Tibet. Tashi, a Tibetan student and the new chairman of the TCP, proclaims to liberate Tibet with Communism – the same weapon that caused its downfall and colonisation. As a trauma narrative, the novel expresses the restlessness, frustration and diasporic consciousness of Tashi and his fellow refugees and how they try to come together to decolonize their trauma.

According to Renya Ramirez's theory of 'native hubs', hubs are geographical sites or shared spaces in urban settlements where the refugees strive to reconstitute their nationhood by creating a diasporic consciousness, irrespective of differences in tribal origin, age, gender, and other differences. That is, hubs become spaces that crosses large expanses of geographical terrain and which are capable of bridging not only tribal but also national-state boundaries where the refugees are settled. While discourses on diaspora focus on themes like displacement and memory of homeland, the concept of hubs tends to relive all this through various means. In the novel, Majnu Ka Tilla, a Tibetan refugee place and one of the settings of the novel, becomes a diasporic hub for the Tibetans. The trauma and struggles endured by the Tibetans is exposed in the way in which Samphel describes Majnu Ka Tilla: "a ghetto of desperation, a jungle representing the elemental struggle for survival" (3).

The very first paragraph of the novel catches the attention of the readers; it describes the pathetic plight of Tibetan refugees living in such place as refugees:

> No, there was no way out. There was no way they could get out of the trap, out of this poverty, out of this mess which was a product of history's injustice. More than most Tibetan refugees, Majnu Ka Tilla Tibetans were the real victims of imperial ambitions asserted and realised. Of great armies moving in, scattering small people. (3)

Majnu ka Tilla emerged as a refugee place for Tibetans in the early 1970s when the Delhi police herded and ferried the Tibetan refugees in vans up north and dumped them there, but as and when the novel begins, Majnu Ka Tilla was at "the very top of the Tibetan refugee heap" – it was "the money town of the Tibetan exiles" (4) and it was the hub of refugee enterprise – "a halo of cultural orientalism" (4).

The novel gives a glimpse of Tibetan life during the invasion of China as told in the article titled 'Memory' written by Tashi who calls himself and his generation of Tibetans as "the true children of Tibet's Age of Orphans. We have no memory, having been robbed of it by either deliberate forgetfulness or by Chinese bullets or treacherous Himalayan passes and left lying in deep green crevices and buried in snow, ice and human indifference." (14) Starvation was what basically troubled the native Tibetans in the beginning of Chinese invasion; starvation "swept through our part of Tibet like a terrible curse and lingered on like a hungry ghost." (19) Even in their own homeland, Tibetans were called refugees:

> Our ethnic identity, Tibetan, preceded and was made to qualify our new one, of being refugees, stateless, tossed about. It was a lengthy education in the various expressions of dispossession, in the vocabulary of not belonging, in the language of loss. We graduated. From refugees we became exiles, with a brand new world to ourselves, the world of the Diaspora. That was a comfort. (23)

While the characters including Tashi try to get rid of their isolated and wretched past of being a Tibetan, Tashi attempts to create TCP, in the belief that by following the strategy of the Chinese masters, they will be able to anticipate their policies. He further questions the adequacy of Buddhist philosophies of compassion and non-violence propagated for countering China's plans for Tibet. The plight of Tibetan natives is described by one of the lamas as "a bunch of Tibetans, children of the wide-open spaces of a nomadic culture . . . dislocated and confused" (65). These young Tibetans who are members of Tibetan Youth Congress, are directed by their seniors to stage a protest demonstration before the

Chinese foreign minister at Rashthrapati Bhavan. These are one of the different ways in which the Tibetans living in exile make use of every opportunity to express their protest and give vent to their traumatic frustrations. For Thupten Samphel too, Tibetan culture was something that could attract a mass of international audience. It was a culture "that would live and never die." (241)

As the novel develops, we realise the transformation of Majnu Ka Tilla from a dismal refugee camp into "a hub of refugee commerce with spokes radiating all over India, Nepal and Bhutan. There were a lot of new, younger faces. New restaurants and new chang shops, roomier, better furnished, had spring up. (206) The novel also gives us a glimpse of the state of mind of Tibetan refugees. Skelsomg remarks that the Tibetans come together, they quarrel; she accuses Don, "it's because your body is owned by China and your mind colonised by India. Contradiction, contradiction, having the misfortune of being caught between two cultures. (214)

The novel describes Tibet as a rich land of rivers and mountains. As the rivers and the mountains that feed these rivers sustain much of Asia, Tibet, as Samphel says, is a source of resource for the Chinese, "Heaven is here in Tibet." (299) The novel also makes a passing hint at the September 1987 uprisings in Lhasa that electrified Dharamsala and how it vindicated the exiled existence of Tibetans living in India. The novel culminates with Samphel's presentation of the Tibetans in Dharamsala as being "rootless, alienated and isolated." (249). Through the lines of the story, Samphel comments on the reason why China wanted to conquer Tibet: "the real issue is not class struggle, the battle between the exploiters and the exploited. The real struggle is species struggle. It is about how long man, the ultimate exploiter, will hold dominion over Earth" (276).

Interdependence is a fundamental Buddhist concept that conveys the reality that the self is devoid of intrinsic existence – it is 'empty' – if not in relation with their land, the spiritual world and one another. Regeneration of nationhood, therefore, becomes a form of "conscious re-traditionalism". It is perhaps the belief of Tibetans in this concept of interdependence or 'dependent arising' that they remain connected to each other and their land. Urban spaces like Majnu Ka Tilla are turned into cultural sites that helps in recreating Tibetanness, by Tibetans who are forced into diaspora. Such diasporic spaces and hubs help the exiled natives to relive their nationality through nation-related activities such as exchange of national symbols and banners, narrating the history and other memory of old Tibet, singing of folklore, etc. Such activities helps these exiled natives to fight against the cruel strategies of sinicization. They come together to relive their national identity and consciousness in foreign lands where they organize resistance and liberation movements as means to decolonize their trauma of forced diaspora.

To conclude, Thupten Samphel is a Tibetan diasporic writer who had served Tibetan Government-in-Exile (TGIE) and hence he has first-hand experience of Tibetan trauma and Tibetan resistance-liberation movements. His novel *Falling Through the Roof* uses Tibetan English to interweave ancient Tibetan history with the story of radical young Tibetan students living-in-exile in India, who organise resistance movements by forming Tibetan Communist Party in India as a mode of decolonization and resistance. The novel is drowned in mysticism and it gives an insight into the indigenous world of Tibet and the hybrid world of the Tibetans-in-exile who experience statelessness and the pathos of forced diaspora. This paper reveals Thupten Samphel's recordings of the predicament of displaced Tibetans and the resistance-liberation movement of radical Tibetans-in-exile in India.

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Resisting Violence and Abjection in Edwidge Danticat's *Breath, Eyes, Memory*

Dr. Deepthi T. Divakaran

Assistant Professor, Dept. of English, Maharaja's College, Ernakulam, Kerala

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ABSTRACT

Although abjection and the concept of the abject has been widely discussed by feminists and cultural theorists time and again, the actual trauma and suffering of those that are made abject has not been thoroughly considered and discussed. This article aims at examining the politics of othering and abjection endorsed by the dominant discourses and exploring how abjection is resisted and countered effectively by the marginalised population.

Edwidge Danticat's *Breath, Eyes, Memory* provides an account of how three generations of Haitian women wage a collective battle against the abjection and violence practised by the postcolonial state and the patriarchal tradition.

****Corresponding Author:***

Dr. Deepthi T. Divakaran

Assistant Professor, Department of English

Maharaja's College, Ernakulam, Kerala.

Throughout the history of western culture and thought, there are certain people, concepts, and ideas that are defined as 'Other': as monsters, aliens or savages who threaten the values of civilised society, or the stability of the rational human self. Such 'Others' have included death, the unconscious and madness, as well as the Oriental, non-western 'Other', the foreigner, the homosexual, and the feminine. (Morton 37)

The article aims at problematizing the case of these "others" who are pushed into the backgrounds accused of not fitting into the norms of a civilised society or threatening the pervasiveness of the dominant discourses which have been indubitable. The article is informed by the knowledge that the abjection and violence perpetrated against the marginalised population are strategies by the dominant discourses to control and regiment the non-conforming masses so as to sustain the hierarchical construction of the society.

Georges Bataille argues that "abjection" is a method of exclusion practised with an aim at classifying people and branding certain sections as outcastes or inferiors as "represented from the outside with disgust as the dregs of the people, populace and gutter" (9). However, the popularity that Kristeva's account of abjection gained as a psychoanalytic theory did to a considerable extent eclipse the theory launched by Bataille. Julia Kristeva's theorisation of abjection basically revolves around the post structural fluidity of identity wherein the subject has no clear boundaries and it oscillates at the boundaries of being and generates intense feelings of ambivalence. Kristeva establishes that abjection happens in the pre oedipal years of a child's life when it abjects his/her mother so as to gain entry into the symbolic realm of individual existence. The abject, Kristeva asserts in *Powers of Horror* is constantly shifting and different for everyone, but that without it, we would have no way to understand ourselves. She argues that the boundaries are always threatened by the abject which "does not respect borders, positions, rules. The in-between, the ambiguous, the composite" (4). The abject is thus "the place where meaning collapses," (2) and it simultaneously asserts the need for, and threaten the existence of boundaries and bifurcations. While the verb "to abject" signifies a casting off of something or someone terming it as inferior, filthy or even outcaste, Kristeva elaborates on how “the abject” in noun form does not classify as neither the subject nor object. However, this process is never complete as the subject who pretends to create an illusion of boundaries is constantly under the threat of the abject that is capable of puncturing the clean zone of intelligibility that the subject supposedly inhabits. It can thus be assumed that every subject is in perpetual threat of the abject and strives thereby to negate the abject in an effort to assert its superior existence.

The theorisation of the idea of the abject by Kristeva however does not seem to view the existence and the trauma of those that are abject and cast away. Though feminism has to a great extent banked on this theory of abjection as a tool to subvert the binaries and to dissolve boundaries, there is under cover of this naturalising tendency to abject what is dirty, filthy and the ambiguous, a tendency to create, continue and regularize exclusion of masses on the basis of gender, class and race. The theory of abjection contends that there is an inevitable and perpetual struggle that happens at the borders as the subject strives to maintain the existing equations. This struggle for the existence of the dominant sections happens therefore through the exclusion of abjected entities and is often naturalised and normalised. Judith Butler in her work *Bodies that Matter* has asserted that abjection as theorised by Kristeva only helps and furthers creation of unintelligible, unliveable bodies. The paper is also informed by Imogen Tyler’s work *Revolting Subjects* wherein abjection is seen as a discursive practice that creates intelligible and unintelligible bodies as per the requirements of the dominant discourses. Accounting for and soliciting inquiry into sanctioned forms of violence and abjection that is meant to ensure the subordination of these “others” is aimed at herein. The paper identifies the women characters in *Breath, Eyes, Memory* as “abject” as they are mistreated and illtreated being the “other” to man and the white westerner who adorn the garb of the ‘subject’. It is argued that though the violence practised against the abject population especially women is a method employed by the state and patriarchy to silence these masses, it causes them to revolt and resist the inhuman tendencies and threaten the very existence of the subject. An attempt to identify the methods of protest that are afforded by the abject masses against the hegemonic doctrines with special reference to the black women characters in Edwidge Danticat’s *Breath, Eyes, Memory* is made. An explication of the theory of abjection reveals how the politics of disgust and shame is wilfully manipulated into the psyche of the "abject beings' as they accept without questioning the repulsion, exploitation and violation that they are subjected to.

While abjection means casting away of those deemed insignificant, waste, impure or repulsive due to their race, colour, cast, creed or sex, it works consistently towards deeming a part of the population filthy or subject to disgust and stigmatization. Feeling of disgust is not only associated with the gut but also with actions or existence that are unacceptable or termed aversive. William Cohen argues:

> People are denounced filthy when they are felt to be unassailably other, whether because perceived attributes of their identities repulse the onlooker or because physical aspects of their bodies (appearance, odor, decrepitude) do. Actions, behaviours, and ideas are filthy when they partake of the immoral, the inappropriate, the obscene, or the unaccountable – assessments that, whilst often experienced viscerally, are culturally constrained. All of these versions of filth have one thing in common: from the point of view of the one making the judgement, they serve to establish distinctions– 'That is not me.' (x)

In *Purity and Danger: An Analysis of the Concepts of Pollution and Taboo,* an influential treatise in the study of disgust theories, anthropologist Mary Douglas argues that disgust is always a natural effect of the prevalent social beliefs and the unanimously agreed upon taboos. She opines that disgust only reiterates the existing boundaries of the social body through the process of banishing those that are collectively identified by a community or group as polluting. Thus, the notion of dirt /filth/disgust and the practice of abjection stems primarily from the rigid norms and rules imposed in a social context that continuously govern every individual and punish those that are the "other" or transgress. Martha Nussbaum argues that disgust has been used throughout history "as a powerful weapon in social efforts to exclude certain groups and persons" (107). The inhuman and deplorable ideologies that promote notions of social hygiene such as racism, casteism and misogyny are nothing but manifestations of this politics of disgust.

While feminism did address the case of the white women to an extent the case of the black women who suffer oppression at the multiple levels of race and gender has not been sufficiently addressed. An effort to uncover the multiplicities of oppression that simultaneously traumatise African American women and give voice to these underprivileged sections is aimed at herein. The novel *Breath, Eyes, Memory* is thus read as a counter narrative that focusses on how the post-colonial state, fascist rulers and the patriarchal family have abused and appropriated black bodies for their own benefits.

In his pathbreaking work, *The Imagined Island* that studies the histories of Haiti and the Dominican Republic, Pedro L. San Miguel opines that recorded history is always coloured and subjective. Although a text of history does provide us with actual accounts of events, certain omissions and inclusions as per the discretion and affiliation of the historian is natural. Therefore, the reader of history most often receives only what the historian deems suitable and relevant. An inquiry into the historical accounts of Haiti provides evidence for the fact that there is a tendency to distort, misrepresent or more easily deny representation to those deemed inconsequential. This accounts for the hushed up revolts and rebellions of the blacks, particularly the black women in the historical narratives of the Haitian republic. An in-depth scrutiny of history texts reveals that the facts have been manipulated by those that hold power.

Haiti has had a history of systemic violence against the masses from the very initial period of colonial rule. The situation only worsened after Francois Duvalier gained power in 1957. Although women were traditionally allowed the status of dependent wives and daughters in Haiti and were excluded from politics, they were accorded voting rights during the presidential election in 1957. Moreover, since the women's movement was gaining acceptance during the period, women became the primary targets of state repression and control. The systemic violence that Duvalier's henchmen, the *Tonton Macoutes* practised had a distinctive gendered component as it was directed particularly at terrorising and silencing women through methods of torture, rape and coerced marriages rendering them intimidated and helpless.

Rape has been from time immemorial used as a weapon of war capable of destroying the morale of the enemy and terrorising them into accepting the power of the oppressor. In the case of Haitian women, the atrocities came not only from external forces but also from within. The stress on female purity and chastity in Haitian tradition and the notion that the fecund body is capable of deviance and rebellion resulted in an imposition of strict control on the female body. The Haitian practice of testing that is consistently followed within every family aims to secure the chastity of the girls in the families. It is paradoxical that the women in the families become agents of this control as they also internalise and endorse the need to preserve the purity of women. This undue importance accorded to female chastity often renders the victims of rape feeling misfit and abject in the Haitian scenario. Although the physical torture associated with rape can be difficult, the psychological trauma that a rape creates more often has a very debilitating and lasting impact upon the victim. The rape victim perceives herself as an object of contempt-morally inferior and ‘dirty.’ Thus, both the practice of testing and rape tend to traumatise women and often make them hate their own body and existence. The violation of woman’s body inflicts on her body and psyche a sense of being filthy as the victim feels stigmatised and withdraws into a shell not being able to assert her identity and selfhood. Rape also creates a sense of disgust towards the victim in most communities and the victim is subjected to harsh judgement and reproval. This social abjection causes manifold suffering to the rape victim as she is thought of as an outsider or outcaste in her own community for no fault of hers. The psychological as well as physical brutality of rape creates in most women a loathing or hatred for her own body and she hates her own body as well as the child that is born out of the rape often as a defence mechanism.

Edwidge Danticat, Haitian American writer attempts to present the unheard perspective of the political history of Haiti, largely voicing the pain and struggle of women with an objective of functioning as a mouth piece for the marginalized masses refused representation by both history and the state. The author is engaged in reconstructing history and memories providing visibility to certain areas of knowledge that were consciously made invisible by the white coloniser and those instances which are conspicuous due to its absent presence in history. By weaving these hitherto unheard tales into the historical narrative of the Haitian nation-state, Danticat attempts to question and resist the systematic effacing of actual facts accomplished by various cultural apparatuses with an aim to conceal the actual sufferings and agony of women. Edwidge Danticat's *Breath, Eyes, Memory* reflect the imbalances, inequalities and violence caused as a result of European colonialism carefully weaving the plot in the larger cultural and political background of the Duvalier regime when terror was let loose upon the natives through the deployment of *Tonton Macoutes.* Through a careful blend of fact and fiction, the author highlights some of the crucial problems that are peculiar to the state of Haiti and its inhabitants.

Nancy J. Peterson asserts, "Only literature in our culture is allowed the narrative flexibility and the willing suspension of disbelief that are crucial to the telling of these histories" (7). Kathleen Brogan argues that those denied representation often return to history in their fiction since their stories are not "properly remembered" (27). Danticat furthers this tradition and popularises the sufferings, agonies and trauma that have hitherto been made to appear insignificant and writes about events and people that do not figure in history texts. She subverts the idea of authenticity and credibility of recorded history as she gives voice to those silenced and ignored by historiography. Her work focuses on the impact of the repression of a traumatic past on the silenced masses, who struggle to navigate their present because they are continually haunted by their past. Danticat uses storytelling as a means to chronicle a narrative that vociferously announces the dark realities of the Haitian population especially the women. The novel encapsulates cross-cultural themes as well as the existential crisis of dislocation, relocation and migration. Even as the saga of the fractured identities of the colonised masses in Haiti is unfurled, the novel offers a reassuring glimpse of the resilience of the women folk who wage war against the atrocities through a recovery of their indigenous culture and heritage.

Danticat explicitly presents the personal trauma of rape and female genital mutilation as an oppressive strategy that the post-colonial state intricately manipulates through internalizing notions of abjection, rejection, purity and gender roles. Her effort has been to render audible the voices and tales of suffering by articulating and resolving the trauma and its debilitating consequences. An account of how women in particular resist the social abjection is also furnished. Danticat presents the different ways each women tackle the rigid and inhuman practices peculiar to the Haitian culture. The novel also provides evidence for the fact that despite the anguish and torment borne by these masses they exhibit indomitable spirit to survive and bank on their resilience, endurance and hope as they wage a battle against eventualities. Danticat's protagonists invariably belong to the labouring or peasant class, and hence are economically backward and vulnerable. She also endeavours to present the impact of belonging to the diaspora through the course of the novel ruminating on the violent abjection that the abject-other/foreigner/women suffer and the traumatic consequences of being marginalised and stigmatised.

Breath, Eyes, Memory is the story of three generations of women narrated from the perspective of Sophie Caco, who unveils the story of tenacious women growing up amid the trauma and struggle peculiar to their status as woman-other in a post-colonial nation marred by the tradition of racial oppression. Sophie spends her childhood under the care of Tante Atie, her aunt, since she is abandoned by her mother Martine who unable to cope with the haunting memories of her rape by a Tonton Macoute flees to America. At the age of twelve, Sophie is summoned by her mother and leaves Haiti, a little unwillingly though, to pursue a "better" life in the US. But this displacement has unpleasant and horrible consequences for Sophie as she feels disconnected and dislocated in the new place away from the familiar niche of her country and home.

In New York, Sophie finds herself the victim of racism and prejudice due to her abject status as an immigrant and is destined to live under her mother's strict vigil since the Haitian obsession with virginity starts to directly impact on her life as she grows up into a woman. Sophie slowly learns about the trauma that affects her mother's life and in fact inherits part of it. Since Martine is unable to confront the ghosts of the past, Sophie in a bid to free her mother, tries to alleviate many of her mother's memories and question the political motivation of the rape which render both Martine and Sophie, unintelligible and abject. However, Sophie soon realises that the victimization continues even within families where due to the purity regimen and Foucault's panopticon model of control, women themselves police their lives making an effort to abide and conform.

Haitian culture's emphasis on virginity is evident when Atie says "Haitian men, they insist that their women are virgins and have their 10 fingers" (Danticat 151) and this definitely works toward restricting and disciplining women and the paradox is that these notions are internalised by women themselves and girls are subjected to *testing* by the mothers though it manifests as yet another form of violation. The practice of *testing*, a ritual meant to ensure that a girl is a virgin and has her hymen intact is passed on through generations of Haitian women as a part of their tradition despite being thoroughly humiliating and atrocious. Martine asserts that the *testing* is as bad as a rape. "The one good thing about my being raped was that it made the testing stop, the testing and the rape. I live both everyday" (Danticat170).

Women in Haiti are simultaneously affected by the abject status that the diaspora accords to them and the manipulation of their bodies that abound in the tradition of Haiti. The novel provides evidence for the fact that women resist such abjection and decide to take the reins of their lives as they reclaim their body and identity and assert their will to survive subverting the hegemonic proscriptions of patriarchy and the racist coloniser. When Sophie's mother starts to *test* her against her will, she ruptures her hymen using a pestle in an effort to possess control over her own body- "my flesh ripped apart as I pressed the pestle into it. I could see the blood slowly dripping onto the bed sheet. . . It was gone, the veil that always held my mother's fingers back every time she tested me" (Danticat 88). Sophie clearly works to reconcile the pain that infiltrates her family and her race and tries to resist and problematize the abjection and the violence that works towards annihilating the identity of black women, both in New York and in Haiti. She attempts to thereby question and inspect the politics of subordination employed through the gadgets of violence and abjection in the name of religion and culture which have been identified as willing accomplices in the effort by patriarchy and the state to control and regulate women. When Sophie decides to break free and subvert the cycle of violation that initiates mothers to violate their own daughters, she effects a change that could liberate generations of young girls in Haiti.

Breath, Eyes, Memory argues against abjection since the racial inferiority of Haitian population compels them to bear the brunt of violence and abjection. Sophie and Martine though seek the anonymity that a cosmopolitan country provides are constantly nostalgic about their home country. The repercussions of belonging to the diaspora-the displacement, fragmentation, loss of identity and the sense of inferiority constantly nag them even as they try hard to fit in with the "superior" race. Although there have been widespread attempts to naturalise the differences and legitimise the exclusions practised, it has only been reaffirmed time and again. This scenario is a result of the power politics and the hegemonic interests of those that are privileged. Across communities, cultures and traditions. Those in power have validated and imposed their own definitions of normality and have defined boundaries for the purpose of excluding, stigmatising and exploiting others. In *Black Skin, White Masks*, Fanon examines the manipulative psycho-politics that lead to the internalization of inferiority, which he calls 'epidermalization.' He argues that the construction of race is a fundamental method of colonial and post-colonial control.

Fanon asserts that experiencing oneself as black is essentially a result of being defined as black by a white other. He argues in the work, "not only must the black man be black; he must be black in relation to the white man" (90). Thus, the construction of the self or the subject is ensured only when the "abject" or the "other" is created at the boundary. Thus, for the subject to exist in its comfortable zone there is a need to create an abject- other who is unintelligible or doesn't fit. The novel is replete with instances where the whites/coloniser /men place the "other"-blacks/women as abject so as to satisfy this requirement of seeing themselves as superior or intelligible. The inferiority complex that haunts Martine with reference to her black skin colour, even after years of being in the US is sufficient to prove the inadequacy that the blacks experience in the wake of the discrimination on the basis of skin colour. Fanon's explanation on how 'white power' operates by excluding the blacks in an effort to exist as a subject becomes validated as Sophie feels that the Haitians in America are treated as inferior and referred to as "boat people" and "stinking Haitians."

This practice of abjection also holds true in the case of women who are evaluated on the basis of her feminine qualities and her adherence to the gendered identity that society connives. The proscriptions that bind women to their gendered role is re-emphasised time and again by all the patriarchal institutions so that women never question the hierarchical arrangements patriarchy and the state has magnanimously construed. The control of women's lives- her body and sexuality are thoroughly undertaken by patriarchy assuming that women have a natural tendency to stray and create disorder in the society. The female body thus is continually appropriated by the patriarchal society and phallocentric discourses and they are constantly exposed to the panoptic male gaze which monitors women and her "transgressions" from the patriarchal ideals. Judith Butler claims that discrete genders are part of what humanizes individuals within contemporary culture and those that do not conform to gender norms are punished and ostracised by the society. Her theory of performativity that identifies gender as discursively and socially constructed can be seen as an outcome of the effort by the subject to conform to prescribed modes of behaviour for fear of being labelled and side-lined as the abject. According to Butler, womanhood is not a manifestation of individual identity and autonomy but rather a reflection of national and cultural constructs. Women and their lives are shaped by societal and cultural norms of femininity, which they internalize and perform. Gender norms in the case of Caco women is defined as per the Catholic standards which specify certain acceptable standards to women –women were supposed to be ideal wives, ideal mothers in a heterogeneous relationship with man and were considered misfits if they don't satisfy the demands of femininity and motherhood in the patriarchal terms. In the Haitian culture, the woman is merely valued for her functionality and her identity and individuality is devalued. Atie muses that each of her fingers had a purpose:

> It was the way she had been taught to prepare herself to become a woman. Mothering. Boiling. Loving. Baking. Nursing. Frying. Healing. Washing. Ironing. Scrubbing. It wasn't her fault, she said. Her ten fingers had been named for her even before she was born. (Danticat 151)

The prevalent folklores mentioned and the history of Haiti reveal that the woman's body is not her own. Her body and her very existence are primarily meant to be of service to the family or the men folk. Her actions and conduct were supposed to be such that it preserves the family's honour. This broader allocation of the tasks and duties assigned to women and the continuous regimentation of woman's body in Haiti explains that it is the primary object of control. Danticat's efforts to question these proscriptions upon female lives, conduct and the gender role allocation is clear from her presenting characters who do not fit right into the mould of ideal femininity as Martine begets a child out of wedlock; Atie refuses marriage and Sophie refuses to cater to the requirements of her husband though these characters themselves seem to suffer pangs of guilt and shame due to the internalisation of gendered identity that prefigure in the culture.

Control and governmentality of the abject manifest in different ways in the novel, *Breath, Eyes, Memory.* The novel provides evidence for the fact that physical and emotional violence is let loose upon the abject population with an aim at terrorizing and subverting any expression of revolt from these insignificant "others." The power that the men, the state and the white wield over the bodies of women has been vehemently criticised in the novel. Culture, tradition, Catholicism and the native Vodou religion have also colluded in creating and reiterating the notion of abjection emphasised through internalising values that thoroughly benefit the patriarchy and the state at the expense of the marginalised population. The novel explicates how women are at the receiving end, battered and violated through rape and other modes of control and yet are strictly expected to maintain purity of body. The Haitian stress on virginity and the reckless imposition of the norms is a major concern in the novel. The embedded tale Sophie narrates about a rich man who marries a poor black girl stands testimony to the sanctioned violence that the female body is bound to tolerate. The weight of family honour is placed on the woman's body, often at the cost of her life. The female body is reduced to a mere commodity traded among men, a vessel of honour that must be vigilantly protected to preserve its value. These beliefs and the strict adherence to the patriarchal codes suffocates all women and stifles their individuality. To quote:

> When I was a girl, my mother used to test us to see if we were virgins. She would put her finger in our very private parts and see if it would go inside. Your Tante Atie hated it. She used to scream like a pig in a slaughterhouse. The way my mother was raised, a mother is supposed to do that to her daughter until the daughter is married. It is her responsibility to keep her pure. (Danticat 61)

The obsession with female purity stems from a fixation on the woman's body, which is elevated to the status of a sacred object. It ceases to belong to the woman herself, becoming instead a symbolic vessel of honour, with its utility and purpose determined by others. The woman is thus alienated from her body and trapped by the burden of impossible gender role expectations. Martine's rape causes her to battle persisting trauma throughout her life. The violence done to her body makes her feel ashamed and alone as she is fed upon the notion that purity of the body is pivotal to the honour of the family and society.

The testing Martine’s mother subjects her to and the rape makes her forfeit all control over her body and she literally starts hating her own body. The paradox here is that it is the women in the families who serve as the agent of patriarchy and inflict lasting damage to other women /girls in order that the male ego is satisfied. The female is associated with her body and her worth lies in her chastity.

Gerda Lerner, in her *The Creation of Patriachy,* contends that the system of patriarchy functions smoothly through ensuring female docility and acceptance through methods of “gender indoctrination; educational deprivation; the denial of women of knowledge of their history; the dividing of women, one from another, by defining “respectability” and “deviance” according to women's sexual activities” (217). Feminists have highlighted how, in different cultural and historical contexts, women’s bodies have been seen as unclean and deviant. This idea of the unclean female body has served as a way to control women for generations and in the novel also women live under constant threat of being labelled sexually impure, or ‘deviant.’ If a young girl is labelled as impure/defiled, it would be impossible for her to get married, because the society would ostracize her. The thrust thus on control of female sexuality to maintain the order in the society is internalised and followed by the women of the community who reason that, “If I give a soiled daughter to her husband, he can shame my family, speak evil of me, even bring her back to me, Grandma Ife says to Sophie in an attempt to justify the testing” (Danticat 156).

Silencing the voice of the oppressed through internalising fear and terror or guilt and shame has been the tactic that the oppressor has for generations universally adopted for the continued oppression of masses. The characters in the novel or the author herself are trying to narrate the unheard sagas of suffering and revolt. Martine was incapable of calling out for help as the rapist “kept pounding her until she was too stunned to make a sound” (Danticat 139). Later, the society and her family silence her since publicly voicing the atrocity would have risked severe damage to herself and her family. Nevertheless, Martine who is unwilling to narrate the haunting memories of her rape finds herself subjected to rape every day since. Her silent exit to the US only manages to traumatise her further. However, when she narrates the episode to Sophie for the first time trying to face it squarely, she seems to gather control over her own life. Martine's suicide also can be read as an attempt to destroy the “unclean’ body and as a symbolic victory over the rapist who defiled her body – a process of liberating herself. Sophie says “she is going to be a star. She’s going to be a butterfly or a lark in a tree. She’s going to be free” (Danticat 228). The abject -other status that New York accords to Sophie frustrates her at a point and she decides to resist the control of her life and the manipulation of her body. She therefore plans a return to her native culture in order to redress her pains and also to claim her identity. She affirms:

> I come from a place where *Breath, Eyes, Memory* are one, a place where you carry your past like the hair on your head... My mother

> was as brave as stars at dawn. She too was from this place. My mother was like that woman who could never bleed and then could never stop bleeding, the one who gave in to her pain, to live as a butterfly. Yes, my mother was like me. (Danticat 234)

Sophie's conscious attempts to address the control and manipulation of her life and identity helps her recover and regain her strength. As she manages strong resistance to the suffocating dictates of patriarchy, the violence of the state and the abjection by the West through therapy and breaking the silence, she is able to transcend the tragedy of her mother's and aunt's experience. Sophie ventures to question the practices and traditions imposed by the patriarchal regimen and pledges that she wouldn't let such physical and psychological violation affect her daughter Briggete thereby subverting the age-old tradition of violation and abjection.

Though it is initially only Sophie who seems to be rationalising the claims of abjection of the black women through an analysis of the apparatuses of power, Atie, Martine and Grandma Ife also try to devise methods to free themselves from the oppressive regimes of patriarchy and the state. Towards the end of the novel, we realise that there emerges a camaraderie in suffering and a need to revolt that is experienced by all women at a point when they realise that the oppressive strategy stifles their very existence. While Martine who is traumatised both physically and emotionally by the rape that she was subjected to at a very tender age seeks freedom through death, Sophie hopes to encounter her fears and trauma by narrating and through subverting the norms. Sophie wants her mother to be adorned like Erzulie in red when she goes to her grave. Her desire to be powerful and strong reverberates in her words "She would look like a Jezebel, hot blooded Erzulie who feared no men, but rather made them her slaves, raped them and killed them. She was the only woman with that power" (Danticat 227). Tante Atie displays a different mode of resistance as she ventures to attain education and decides to live alone which is considered taboo in the Haitian culture.

While the novel depicts the case of violation and abjection through the apparatuses of the state and patriarchy at different levels in the lives of the women characters, it also explores the possibility of a counter-discourse. When women characters use their abused and appropriated bodies as weapons to wage a battle against the hegemonic powers, they aim at asserting their agency and identity. “Only a mountain can crush a Haitian woman” (Danticat 198) reverberates the resilience that the Haitian women exhibit even amid the trying circumstances that they have been subjected to. Danticat’s effort in her writing is to affirm the fact that while deeming somebody or a community abject, the hegemonic state and patriarchy precariously maintains its power. This act of abjection also is indicative of the fear and threat of the abject that the “subject” harbours. The abject therefore has in it the capacity to deconstruct or endanger the clean zone that the subject inhibits only when it questions the boundaries, upturn the theories of subordination and resist the abjection. Resistance to the seemingly natural divisions and power equations is manifested in Danticat’s novel as her characters wage a concerted battle against the physical and psychological disciplining, control and violence perpetrated against them. The concluding statement in the novel “God grant us the courage to change those things we can, the serenity to accept the things we can’t, and the wisdom to know the difference…We are beautiful women with strong bodies…Since I have survived this, I can survive anything” (Danticat 202) resonates a strong will to survive and not to yield under pressures which holds a beacon of light and hope.

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Equitable Access to End-of-Life Care: Addressing Socio-Economic, Cultural and Systemic Barriers

[1*] C.S. Prabha, [2] Dr. Minu Mary Mathew

1. Assistant Professor, Department of English, The Cochin College, Kochi, Kerala

2. Associate Professor, Department of English, Assumption College, Changanassery, Kerala

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ABSTRACT

Access to end-of-life care is shaped by cultural, social, and economic factors that often marginalise vulnerable communities. An intersectional approach reveals how race, socio-economic status, religion, and gender contribute to disparities in palliative care. These raise ethical concerns about justice, autonomy, and equity in healthcare. This article examines the cultural and ethical barriers to palliative care, focusing on how intersecting identities affect access and quality. Using case studies and global data, it highlights systemic biases and policy gaps. The role of cultural competence in palliative care delivery is explored, underscoring the need for inclusive, patient-centred practices. Drawing from bioethics and cultural studies, the research calls for reforms to ensure equitable and culturally sensitive end-of-life care for all individuals.

Corresponding Author:

C.S. Prabha

Assistant Professor, Department of English

The Cochin College, Kochi, Kerala

End-of-life care (EoLC) refers to the comprehensive support provided to individuals in the final stages of life, typically when curative treatments are no longer effective or desired. Its primary focus is on ensuring comfort, managing pain and symptoms, and upholding the psychological, emotional, and spiritual well-being of the patient and their loved ones. Unlike geriatric care, which encompasses the broader healthcare needs of older adults regardless of prognosis, EoLC specifically addresses the needs of those nearing the end of life, regardless of age. While palliative care overlaps with EoLC in its focus on relief from suffering, palliative care can be administered alongside curative treatments at any stage of a serious illness, whereas EoLC is more distinctly centred on the final phase of life when the goal shifts entirely to quality of life rather than prolongation. EoLC holds significant relevance in literary and cultural studies, as portrayals of dying, mortality, and human dignity permeate literary narratives and cultural expressions across societies. Such representations shape societal attitudes toward death and dying, influencing how care at the end of life is perceived, discussed, and experienced. This intersection reveals how societies understand mortality, frame ethical dilemmas, and negotiate the meanings of care, dignity, and human vulnerability in the face of death.

Marginalised populations, including those defined by socio-economic disadvantage, racial or ethnic identity, gender, and cultural affiliation, often encounter significant obstacles in accessing adequate palliative care. Economic disparities limit their ability to afford comprehensive services, while cultural beliefs and societal taboos surrounding death may discourage the utilisation of available care options. Furthermore, healthcare systems are frequently ill-equipped to address the specific needs of these groups, leading to disparities in the quality and scope of end-of-life services. The cumulative effect of these factors contributes to a persistent inequity in access to palliative care, ultimately impeding the dignity and comfort of individuals from marginalised communities.

A central and prominent barrier to equitable end-of-life care is economic disparity. Individuals from lower socio-economic backgrounds often face financial obstacles that prevent them from accessing the necessary services for a dignified death. Palliative care services, which include medications, specialised healthcare professionals, and hospice facilities, can be prohibitively expensive. In many countries, the divide between public and private healthcare systems exacerbates this issue. Private systems often prioritise individuals who can afford to pay, leaving economically disadvantaged populations with inadequate care or no options at all. As noted by the World Health Organization (WHO), “Approximately 80% of people in low- and middle-income countries do not have access to palliative care,” a situation that underscores the stark inequalities in care availability (WHO and World Palliative Care Alliance). Without universal health coverage, even basic pain management and comfort care become luxuries for many, exacerbating the divide between those who can afford care and those who cannot.

In rural and underserved regions, economic barriers to palliative care are especially pronounced, with the availability of such services often limited or non-existent. In these settings, patients are forced to rely on general healthcare facilities, which frequently lack the expertise necessary to provide adequate end-of-life care. The scarcity of resources and specialised knowledge deepens existing healthcare disparities, exacerbating the inequities faced by marginalized populations. “In many remote areas, the dearth of specialized palliative care services leaves patients to face terminal illness without the necessary support or comfort” (Smith and Jones 213). The observation highlights the profound role that economic disparities play in obstructing access to essential palliative care, ultimately denying marginalised individuals the dignity they deserve in the final stages of life. Beyond economic constraints, cultural factors also play a pivotal role in shaping both access to and the experience of end-of-life care. Cultural taboos surrounding death often hinder open discussions about dying, leading to inadequate preparation for palliative care. In numerous societies, death remains a subject imbued with fear, avoidance, or denial, and this reluctance to confront the realities of death can obstruct the utilisation of necessary palliative services. “Cultural attitudes towards death and dying have a profound impact on how individuals approach and engage with end-of-life care,” emphasising the considerable influence of cultural perspectives on healthcare decisions. (Thompson 112)

In many marginalised communities, particularly within immigrant populations or ethnic minorities, there is often a strong preference for family-centred care, where the responsibility for the care of the dying falls upon the family rather than professionals. This cultural expectation can discourage the utilisation of palliative care services, which are frequently perceived as impersonal or as intrusions on the familial role. Furthermore, a lack of awareness or understanding of palliative care in specific cultural contexts may lead patients and their families to reject services that could significantly improve their quality of life during the final stages. “Cultural misunderstandings, often rooted in a lack of awareness, can prevent families from engaging with palliative care services that could provide much-needed support” (Kelleher 98). The role of family in palliative care is particularly significant in cultures where caregiving is primarily seen as a familial responsibility. In many marginalised communities, family members are expected to assume the burden of providing care for a terminally ill relative, often at the expense of their own well-being. This familial care model, while deeply rooted in cultural values, can present challenges in the context of professional palliative care. The reluctance to seek external assistance may stem from a sense of duty, cultural expectations, or fear of undermining traditional practices. However, relying solely on family care can lead to issues such as caregiver burnout, a lack of specialised knowledge, and the failure to address complex medical needs. This is particularly evident in marginalised groups, where limited access to formal healthcare services compounds the strain on families. A collaborative approach, in which professional palliative care teams work alongside family caregivers, is crucial in ensuring that patients receive comprehensive and culturally sensitive care. By respecting familial values and integrating professional expertise, this partnership can help alleviate the burden on families while ensuring that the patient’s needs are met with dignity and compassion.

Religious beliefs play a significant role in shaping individuals’ views on end-of-life care, often influencing decisions regarding treatment options, palliative care, and the acceptance of death itself. In many marginalised communities, religious doctrines provide comfort and guidance during the dying process, shaping the expectations surrounding death and the afterlife. For instance, certain religious groups may prioritise spiritual practices or rituals, such as prayer, over medical interventions, while others may reject the use of life-sustaining technologies, seeing them as contrary to divine will. These religious perspectives can complicate the integration of conventional palliative care services, particularly when medical professionals and patients' families have differing beliefs regarding the appropriateness of certain treatments. The challenge lies in respecting these deeply held religious values while ensuring that the patient receives appropriate care. Cultural competence within healthcare systems is essential in addressing these complexities, with professionals needing to be aware of religious perspectives to offer care that is both ethically sound and aligned with the patient's beliefs. When religion is integrated thoughtfully into the care process, it can serve as a source of comfort and dignity for the patient, ensuring that end-of-life care is not only medically effective but also spiritually fulfilling.

Educational barriers for healthcare professionals play a crucial role in limiting the effectiveness and accessibility of palliative care, particularly in marginalised communities. While palliative care is an essential component of healthcare, many healthcare providers, including doctors, nurses, and social workers, receive inadequate training in this field during their professional education. The absence of comprehensive palliative care education can result in a lack of understanding of its principles, such as pain management, symptom relief, and the importance of emotional and psychological support for patients and families. In many cases, healthcare professionals are unprepared to address the unique needs of diverse patient populations, particularly those from culturally or socially marginalised backgrounds. This lack of cultural competence can lead to ineffective communication, misunderstandings, and ultimately a failure to provide the most appropriate care. Furthermore, limited exposure to end-of-life care during medical training often leads to discomfort among healthcare providers when confronted with death, causing them to avoid difficult conversations or fail to offer adequate support. To improve palliative care services, it is essential to integrate palliative care education into medical curricula, providing healthcare professionals with the skills and knowledge necessary to deliver compassionate, culturally sensitive, and comprehensive care to all patients. This would ensure that end-of-life care is not only medically effective but also aligned with the needs and values of patients, fostering a more equitable and compassionate healthcare environment.

Advance care planning (ACP) plays a crucial role in ensuring that individuals receive the end-of-life care that aligns with their values, preferences, and needs. It involves the process of making decisions about the types of care a person would want to receive if they become unable to communicate their wishes due to illness or incapacity. “Advance care planning gives you time to consider and reflect on the kind of health and medical care you would consent to, or refuse, in a crisis” (Canadian Family Physician). The importance of ACP is particularly pronounced in marginalised communities, where cultural, socio-economic, and systemic barriers often complicate access to appropriate palliative care. By engaging in ACP, individuals can articulate their desires for treatment, including decisions on life-sustaining interventions, pain management, and end-of-life care preferences, thus ensuring that their dignity and autonomy are maintained. In addition, ACP can help alleviate the burden on families and healthcare providers by reducing uncertainty and conflict about care decisions during emotionally distressing times. However, the uptake of ACP remains inconsistent, with many individuals from marginalised groups less likely to engage in these discussions due to factors such as lack of awareness, mistrust of healthcare systems, and cultural taboos surrounding death. Healthcare providers must prioritise promoting ACP as a tool for empowerment, particularly within these communities, by offering clear, culturally sensitive information and ensuring that individuals feel supported in making informed decisions about their care. Ultimately, effective advance care planning is essential for improving the quality of end-of-life care, helping individuals and their families feel more in control and confident in the decisions being made on their behalf.

The intersection of gender and end-of-life care is an important yet often overlooked dimension of palliative care, as gendered experiences and societal roles can significantly influence an individual’s access to and experience of care at the end of life. In many cultures, gender roles dictate the responsibility for caregiving, with women disproportionately shouldering the emotional and physical burdens of caring for dying family members. This often results in women, particularly from marginalised communities, facing compounded stressors, as they may simultaneously be managing their own health needs while fulfilling caregiving duties. Furthermore, gender-specific healthcare needs, such as those related to reproductive health, breast cancer, or prostate issues, require tailored end-of-life care that is often inadequately addressed in palliative settings. For men, particularly in certain cultural contexts, expressing vulnerability or seeking palliative care may be seen as a sign of weakness, which can discourage them from pursuing available services. Moreover, gender biases within the healthcare system can lead to disparities in care provision, with women sometimes receiving less aggressive treatment or being perceived as less deserving of certain types of care. In contrast, men may experience difficulty in accessing care that attends to emotional or psychological needs, as they are less likely to be encouraged to voice these concerns. The intersection of gender with other factors such as socio-economic status, ethnicity, and cultural background compounds these challenges, necessitating a more nuanced and inclusive approach to end-of-life care that recognises the diverse needs and preferences of all individuals, regardless of their gender.

The lack of cultural competence within healthcare systems exacerbates the difficulties that marginalised groups encounter in accessing end-of-life care. Cultural competence, defined as the ability of healthcare providers to understand, respect, and appropriately respond to the cultural needs of diverse populations, is often insufficient. The absence of cultural competence can lead to the inadvertent perpetuation of stigma, misunderstandings, or a failure to address the unique needs of patients from varying cultural backgrounds. "The lack of cultural awareness and competency in healthcare systems often results in care that is not aligned with the values and needs of diverse patient populations" (Williams 213). This illustrates how both implicit and explicit biases within healthcare systems can further marginalise certain groups, particularly when healthcare providers lack the necessary training to recognise and address these cultural dynamics. To overcome these barriers, healthcare systems must prioritise cultural competence training for healthcare professionals, ensuring that care is respectful and aligned with the cultural values and preferences of patients. Such training should be an integral part of medical education, accompanied by a strengthened focus on patient-centred care that considers the broader socio-cultural context of each individual's healthcare requirements.

In addition to economic and cultural barriers, systemic issues within healthcare systems play a pivotal role in limiting access to palliative care. Marginalised communities, particularly those in rural areas or low-income countries, often face a severe lack of palliative care infrastructure. The absence of specialised palliative care teams or services means that even when palliative care is available, it is often insufficient or ineffectively delivered. As the International Association for Hospice and Palliative Care (IAHPC) reports, "Over 100 countries around the world lack a sufficient palliative care infrastructure," which reflects the global disparities in care (2016). This lack of infrastructure, combined with the scarcity of healthcare professionals trained in palliative care, exacerbates the inequities in end-of-life services.

Healthcare systems themselves often disproportionately allocate resources to higher-income individuals or urban areas, further deepening the divide. Marginalised groups, especially those from racial or ethnic minorities, are frequently subject to discrimination, both overt and subtle, within healthcare settings. Studies have shown that individuals from these communities are less likely to receive appropriate care, even when palliative services are available, due to systemic biases. Discriminatory practices within healthcare settings contribute to unequal access to care, including palliative services, for racial and ethnic minorities. These structural issues in healthcare, coupled with biases based on race, socio-economic status, and cultural identity, significantly undermine the provision of equitable end-of-life care.

Mental health is an often-overlooked aspect of palliative care, yet it is critical to ensuring comprehensive end-of-life support for patients. Individuals facing terminal illnesses frequently experience emotional and psychological distress, including anxiety, depression, and existential fear, which can significantly impact their quality of life. For marginalised communities, these mental health challenges may be compounded by socio-economic stressors, cultural stigma surrounding mental health, and limited access to mental health services. While palliative care traditionally focuses on physical symptoms, it is equally essential to address the emotional and psychological well-being of patients. Effective palliative care requires a holistic approach that integrates mental health support alongside physical care, ensuring that patients can cope with the emotional and psychological burdens of terminal illness. However, access to mental health services within palliative care is often inadequate, especially in underserved areas or among those from lower socio-economic backgrounds. Therefore, healthcare providers must adopt a multidisciplinary approach, involving mental health professionals within palliative care teams, to offer a more complete form of support that addresses both the physical and psychological aspects of dying. This integrated care model helps to alleviate suffering and promote dignity, ensuring that patients experience not only physical comfort but also emotional peace in their final days.

While the focus on barriers to palliative care often centres on developing countries, even in developed nations, significant obstacles persist, preventing equitable access to end-of-life care. In these countries, socio-economic disparities, cultural perceptions, and systemic inefficiencies continue to hinder many individuals, particularly those from marginalised groups, from receiving the care they need. Despite the availability of advanced healthcare systems, economic barriers remain, with many patients facing high out-of-pocket costs for palliative services, especially in private healthcare settings. Additionally, the growing ageing population and the increasing prevalence of chronic diseases place tremendous strain on healthcare resources, leading to an unequal distribution of services. Furthermore, cultural factors such as the reluctance to discuss death openly or the preference for home-based care over institutional settings may deter individuals from seeking professional palliative care. In many developed countries, healthcare providers may lack the necessary cultural competence to cater to diverse populations, leading to misunderstandings and mistrust, particularly among immigrant and minority groups. These barriers, when compounded by issues such as limited insurance coverage or inadequate training of healthcare professionals in palliative care, result in a situation where even those in wealthier nations are not guaranteed access to high-quality end-of-life care. As such, addressing these challenges requires a multi-faceted approach, including policy reforms, financial support for vulnerable populations, and the promotion of cultural competence within healthcare systems.

In developed nations, access to end-of-life care for marginalised groups is often hindered by a complex interplay of systemic, economic, and cultural barriers. While these nations generally have more developed healthcare systems and resources for palliative care, significant disparities persist, particularly for ethnic minorities, immigrants, low-income populations, and individuals with disabilities. Despite the availability of advanced medical technologies and services, marginalised groups frequently face challenges in accessing palliative care due to factors such as language barriers, lack of cultural competence within healthcare settings, and discriminatory practices that exacerbate healthcare inequalities. For instance, racial and ethnic minorities in developed countries have been shown to experience lower levels of access to palliative care services, which can be attributed to both explicit biases within the healthcare system and historical mistrust of medical institutions. Furthermore, socio-economic disparities often lead to an unequal distribution of palliative care resources, with economically disadvantaged individuals having limited access to high-quality services, even in nations with universal healthcare coverage. The failure to address these issues often results in marginalised groups being subjected to inadequate end-of-life care, where their preferences and cultural values are not fully respected, and their suffering is not adequately managed. Addressing these inequalities requires a multi-faceted approach, including policy reforms aimed at ensuring equitable distribution of resources, cultural competence training for healthcare providers, and targeted advocacy for the rights of these vulnerable groups. Only by confronting these challenges can developed nations ensure that all individuals, regardless of their background, receive the compassionate and dignified end-of-life care they deserve.

The ethical ramifications of these systemic barriers to palliative care are profound. From a bioethical standpoint, the denial of adequate end-of-life care constitutes a violation of principles of justice, autonomy, and beneficence. The failure to provide equitable care to marginalised populations directly undermines their right to a dignified death, violating the ethical tenet of justice. Furthermore, the inability of individuals from marginalised groups to make informed decisions about their end-of-life care, due to financial, cultural, or systemic barriers, undermines their autonomy. As noted by Connor et al. (2014), “Access to palliative care is not just a matter of healthcare—it is a matter of human rights.” The ethical imperative is this clear: healthcare systems must reform to ensure that all individuals, regardless of background, can access compassionate and appropriate care in the final stages of life.

Comprehensive policy reforms are essential to overcoming these challenges. Governments must acknowledge the necessity of universal access to palliative care, allocating resources to both infrastructure and human capital to guarantee that these services are accessible to all, regardless of socio-economic status. In addition, cultural competence training for healthcare professionals should be institutionalised, ensuring that end-of-life care is provided in a culturally sensitive and respectful manner. Moreover, advocacy for universal health coverage that encompasses palliative care is crucial to alleviate the economic barriers encountered by marginalised communities. It is also essential to develop comprehensive policies that prioritise the integration of palliative care within national health systems to achieve long-term sustainability.

Technological advances have the potential to significantly improve palliative care by enhancing both the accessibility and quality of services. In recent years, innovations such as telemedicine, electronic health records, and artificial intelligence (AI)-powered symptom management tools have made it easier for healthcare providers to offer timely and efficient care, particularly in underserved or rural areas where access to specialised services may be limited. Telemedicine, for instance, enables patients to consult with palliative care specialists remotely, overcoming geographical and logistical barriers. Similarly, electronic health records allow for better coordination of care, ensuring that all members of the healthcare team have access to the most up-to-date patient information, which is essential for effective decision-making. AI-driven tools can assist in predicting and managing symptoms, providing healthcare professionals with insights into pain levels or the progression of terminal conditions, which can lead to more personalised care plans. Issues related to data privacy, digital literacy, and the need for adequate training in new technologies for healthcare professionals must be addressed to ensure that these innovations benefit all patients, particularly those from marginalised communities. Additionally, while technology can enhance care delivery, it should never replace the human element of palliative care, as compassionate communication and emotional support remain fundamental to providing a dignified end-of-life experience. The careful implementation of technological solutions, with attention to equity and cultural sensitivity, holds the promise of bridging gaps in care, ensuring that palliative services are more widely accessible and responsive to the needs of diverse populations.

Global advocacy for palliative care has become an essential element in addressing the disparities in end-of-life care, particularly for those in marginalised communities. Organisations such as the World Health Organization (WHO) and the International Association for Hospice and Palliative Care (IAHPC) have been at the forefront of promoting palliative care as a fundamental human right, advocating for the integration of palliative services into national healthcare systems worldwide. These efforts have highlighted the importance of palliative care in providing comprehensive support to individuals with terminal illnesses, focusing not only on pain management but also on improving the quality of life and maintaining dignity at the end of life. Despite the growing recognition of its value, palliative care remains underfunded and underdeveloped in many parts of the world, especially in low and middle-income countries, where access to essential pain relief medications and specialised care services is often limited or non-existent. Through international collaborations, policy initiatives, and public awareness campaigns, global advocacy is working to ensure that palliative care becomes an integral part of health systems worldwide, promoting a more equitable approach to end-of-life care for all individuals, regardless of their socio-economic or cultural background.

The intersection of socio-economic, cultural, and systemic factors creates significant barriers to accessing end-of-life care for marginalised communities. Economic disparities, cultural stigma, and a lack of healthcare infrastructure and cultural competence in healthcare systems contribute to a landscape of unequal access to palliative care. Addressing these inequities requires comprehensive policy reforms, cultural competence training, and the expansion of healthcare infrastructure. Only by confronting these challenges can we ensure that all individuals, regardless of socio-economic or cultural background, are able to access dignified and compassionate end-of-life care. "The greatest dignity to be found in death is the dignity of the life that preceded it" (Nuland 258). The sentiment underscores the profound connection between a life well-lived and the dignity experienced at life's end. It serves as a poignant reminder of our ethical obligation to ensure that every individual is afforded the opportunity to conclude their journey with respect and honour.

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Decoding *Arcane*'s Subalternity through the Lens of Agamben's State of Exception

Arunthathi T.S.

Assistant Professor, Siena College of Professional Studies, Edakochi, Kerala

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ABSTRACT

This study attempts to break down the ways in which *Arcane* presents its subaltern themes with the help of Agamben's concept of "State of Exception". The series portrays the blatant power imbalance between two cities through a clear juxtaposition of the cityscapes where one is depicted as pure and pristine whereas the other, is contaminated and filthy. This condition of existence stemmed from the overt exclusion of the Undercity and the people belonging to it is identical to this theorization of Agamben specified in his Homo Sacer book series. This excluded and neglected territory functions as a zone of exception where laws are suspended, rendering its citizens politically castrated and marginalized while the topside basks in the glory of progress. Through Agamben's theoretical framework, this research aims to unveil the strategies of exclusion and the resultant resistance that presents itself in *Arcane* and discuss how this series demonstrates how power operates in the contemporary political setting.

[*]***Corresponding Author:***

Arunthathi T.S.

Assistant Professor, Department of English

Siena College of Professional Studies, Edakochi, Kerala

Arcane, based on the hugely popular game League of Legends, carries subaltern themes within its narrative brilliantly. The political theories that are relevant to the current epoch are embedded in this cinematic rendering of the beloved game inviting the viewer's attention to real-world parallels. This adaptation is charting a new course in cinematic history where refreshing elements that question the established norms whether it is, queer representation or breaking gender stereotypes, is portrayed with extreme care. *Arcane* makes use of unparallelled social commentary through its visual language on matters that are reminiscent of issues plaguing the current world politics.

The famous Italian Philosopher Giorgio Agamben's theories which are mostly known for their intricate analysis of human rights and subjectivity becomes relevant in the discussion of *Arcane*. *Arcane*'s characters belong to every realm of society and are caught up in the workings of the system, some consciously participating in the marginalization of a set of people while some others unknowingly getting caught between the whirlpool of violence perpetrated by the State and others who are the actual victims of the said violent tendencies. The two sisters Violet and Powder (later, Jinx) belong to the undercity which is an excluded territory constantly prone to severe human rights violations. They both share a traumatic past where they were orphaned due to the brutal killing of their parents by the law enforcement agency belonging to Piltover in a failed rebellion, known as Enforcers during a rebellion. They were both taken into the protection of their father-like figure, Vander, who being an important person of the Undercity, is regularly involved in secretive peace settlements with the Enforcers. He becomes the protector of the lives of people belonging to the undercity and is against the idea of armed, violent resistance which Silco (Vander's brother) is thoroughly invested in. The girls grow up under the care of Vander without the knowledge that he has been negotiating things with Enforcers behind the scenes. (*Arcane*)

Agamben traces the history of his concept of the "State of exception" to the days of the French Revolution when authorities threatened the citizens with the suspension of the constitution in the face of insurgency. He further states that Nazi Germany never acted in violation of the Weimar Constitution but their decisions to suspend human rights during extraordinary situations were well within the framework of it. According to him, “From a juridical perspective, the entire Third Reich can be considered a state of exception that lasted twelve years” (Agamben, State of Exception 2). Agamben goes on to say that in modern totalitarianism, there exists a “voluntary creation of a permanent state of emergency”. (2) This new technique is being adopted by current governments which involves blatant discrimination against a particular set of people who cannot be “integrated into the political system”. (2) In the context of *Arcane*, the people who exist outside of the political system are the ones belonging to the undercity and many of them are branded as rogues and criminals, which in turn affects the innocent population who just wants to live. There are instances where these people who live without rights are dehumanized by being likened to “sump-rats” (Some Mysteries Are Better Left Unsolved 00:25:24-00:25:27). The strong parallels such examples evoke can be found in the world of *Arcane*, notably in how Piltover, the powerful city, exercises its authority over the citizens of the undercity. The world of *Arcane* is incessantly caught between a cycle of violence, mostly perpetuated by the city of Piltover, and the gradually budding resistance under the kingpin, Silco, who is motivated by his daunting megalomania. The innocent citizens of the underbelly are always the ones to pay the price whenever Silco, who sits at his cozy throne well-protected and secure, attempts to undertake his mission to shake the foundations of the powerful elites of Piltover. Although he calls it resistance, his thinly veiled longing for absolute power over the citizens of the undercity whom he treats as pawns of his game becomes exceedingly clear.

The world of *Arcane* brings forth wonderful parallelisms of the real world through its portrayal of the advanced, flourishing city of Piltover which is known as “the city of progress” (Some Mysteries are Better Left Unsolved 00:16:51 - 00:16:53) and its underbelly known as Zaun where its citizens are forced to survive in highly polluted and depraved settings. The visual language of the series is enough proof pointing at the problematic power dynamics existing between both regions. The horrors inside Zaun are the type of stuff you brush under a rug. *Arcane* could be read as a perfect analogy of how an imperfect world that thrives on the marginalization of a group of people is doomed to fail. How long will you bask in the artificially created glory of your perfect city as its marginalized, defenseless citizens are thrown into a wasteland? The smoke and industrial waste fogs the landscape of Zaun where the citizens living in constant fear and vulnerability are forced into a life of crime and immorality. In Agamben's text Homo Sacer: Sovereign Power and Bare Life, Agamben states that "the status of homo sacer is therefore not the original ambivalence of the sacredness that is assumed to belong to him, but rather both the particular character of the double exclusion into which he is taken and the violence to which he finds himself exposed." (Agamben, Homo Sacer: Sovereign Power and Bare Life 82) The body of Homo Sacer become a site of violence and they are a vulnerable population constantly exposed to the threat of destruction, especially in the context of Arcane where the lives inside Zaun are plunged into misery and a threat of extermination looms over them. They are victims of "unsanctionable killing" (82). The very obvious dichotomy between the two cities is further aggravated by the never-ending violence and systemic neglect unleashed on the impoverished citizens by the topside enforcers making the conditions of their existence even more miserable.

The Subaltern in the context of *Arcane* are the citizens of Zaun, who face constant discrimination, exploitation, and violence from the topsiders. This underprivileged demographic is entirely cut off from the socio-economic sphere and victimized through the hegemony exercised by the politicians of Piltover. Their hopeless existence could be seen to be the driving force behind the life of violence that they have chosen in their spaces to enjoy an ephemeral sense of power. The frames showing the polarity between both landscapes are an important tool of storytelling. Whenever the action is happening in Piltover, the atmosphere is magnificent and the air is clean and fresh, the architecture pristine and marvelous. The urban landscape of both these cities is symbolic of the lifestyle of the people living in them. The people living in the undercity are constantly prone to the violence enforced by the cops belonging to Piltover. Their labor is exploited and they are deemed insignificant, reduced to just living bodies who have no rights in this system. They live in tight, contaminated spaces without access to fresh air and are even deprived of the life-affirming sunlight and other simple joys of life. The people of the undercity are regularly caught up in the tensions and brawls between the upper and lower cities. They are forced to live a life of endless toil making the elites in Piltover rich, barely surviving in the toxic and inhumane conditions that they are subjected to work in. The citizens of the underbelly are necessary for the smooth functioning of the topsiders and their role ends there. They are not needed at the sites of decision-making and they are denied the fundamental and inalienable rights of a human being. As you move further into the inner-most parts of the undercity where even the sunlight does not reach, homelessness is rampant and the population is suffering from constant violence.

Agamben's concept of a "State of exception" can be applied to the political relationships existing between Piltover and Zaun. In other words, we could argue that the "state of exception" is the norm since the conflict arose between both cities. Although the undercity is strictly under the authorial structure of Piltover, the citizens do not belong to the city. Hence, they are a marginalized demographic, away from the protection of law and order enjoyed by the citizens of Piltover. Their needs are not met, and they are subjected to never-ending atrocities orchestrated by the topside. They simply exist in this state of exception to be tortured and exploited. A state of exception is a special state of affairs "in which the juridical order is actually suspended due to an emergency or a serious crisis threatening the state." (Giordanengo) Arbitrary violence is one of the characteristics of such a scenario and the law enforcement agencies have the right to suppress any form of insurgency to maintain peace in the land. From the context of *Arcane*, we are able to find that this atmosphere is incessant since the tensions between the two cities are heightening as the story progresses. The disempowered citizens of Zaun have no say in the political matters of the state leading to the budding resistance attempts under the leadership of Silco. When Vander was the foreman, he handled the situation by negotiating peace with the enforcers behind the scenes. As soon as Silco took over as the kingpin, the situation escalated as he had his own selfish goals to be attained under the guise of an armed resistance meant to create a sovereign state.

The concept of "bare life" too is important in the setting of *Arcane*, as the individuals are reduced to living, breathing life forms with no agency or control over their lives, and their existence is exposed to the whims of authority. The Jew in Nazi Germany was treated as "Lice" by Hitler (Agamben, *Homo Sacer: Sovereign Power and Bare Life* 114) which exemplifies the concept of bare life.

The Jew, hence is homo sacer whose inherent state of life is its “capacity to be killed” and his killing will never entail the risk of any kind of punishment. (114) It is through the process of exclusion, that bare life gets included in politics. It is solely through this mechanism of exclusion that bare life finds its existence in this sphere. (11) When the law is suspended during an emergency or as in the case of *Arcane*, the suspension of law becomes the norm, it results in the creation of bare life. These beings are deprived of all legal protections and hence they become the most vulnerable and exploited people who are relegated to the status of beings who are just living or existing. Agamben calls them, “legally unnamable and unclassifiable” beings. (Agamben, State of Exception 3) The Guantanamo Bay Detainees, who are outside of both American and International law, clearly epitomize absolute neglect in legal terms according to Judith Butler (4). In the world of *Arcane*, the people belonging to the undercity could be seen as representing the concept of bare life. They have no legal protection and due to this, they have been facing mistreatment from the authorities. Ever since childhood, Vi and her gang have witnessed the ruthlessness of the Enforcers and they try to fight back in their own way.

“Law is made of nothing but what it manages to capture inside itself through the inclusive exclusion of the exception: it nourishes itself on this exception and is a dead letter without it”, says Agamben (Agamben, Homo Sacer: Sovereign Power and Bare Life 27). Law works differently and often times mysteriously. Who comes under the law or who is protected under it is a vexed question as it incorporates within itself a troubled definition of exception. Exception is essential, and the sovereign power dictates who is excluded from the law. In the world of Arcane, there is a lot of proof regarding this dictum as the people belonging to Zaun faces exclusion everywhere.

Agamben adds that during a state of emergency, the authority has the upper hand allowing them to act freely without any legal constraints while feigning an illusion of complete legitimacy. He makes a clear distinction regarding the concepts of *auctoritas* which could mean authority and *potestas* meaning legal power in their simplest sense (Agamben, State of Exception 75-81). The enforcers belonging to the upper city exert their power over the people in the under city allowing them to commit acts of violence without legal consequences as they are protected and employed by the state. In several instances from the series, we see them inflicting pain on the people from the lower city who have no one to address these acts of violence to. Hence, they are forced to bear it without resisting. The authority here who is the state of Piltover, can bend the legal laws and appropriate them without any constrictions. They have the ultimate authority and enjoy unchecked power over the people belonging to the under city.

It has been already established that Zaun is under the control of the city of Piltover and they are exploited for their cheap labor. Their workforce is the only resource that the upper city deems as worthy but their labor is taken for granted which has led to the creation of a permanent state of inequality where they have to depend on the bare minimum assistance which they get from the wealthy elite of Piltover. In the Nazi Germany concentration camps, the Jews were made to work until their bones collapsed without gaining anything from the regime. They worked non-stop under degrading conditions even when their health was deteriorating. (*Forced Labour Camps – the Holocaust Explained: Designed for Schools*, sec.Forced Labour Camps). Just as how the Jews were annihilated and dehumanized, the people in Zaun face the threat of violence constantly. The holocaust is a brutal and dark chapter in history and it is not to be compared with this fictional setting but understanding how they were persecuted in Nazi Germany is key in this study because Agamben himself have drawn examples from how Nazis treated Jews.

Arcane is full of such instances where the exploitative tendencies of the elites are shown directly and this conflict makes up a huge part of the central narrative of the series. Vi tells Vander in one scene, “They've got plenty, while we're down here scraping together coins” (Welcome to the Playground 00:24:54 - 00:24:57), and asks him, “When did you get so comfortable living in someone else's shadow?” (Welcome to the Playground 00:25:07 - 00:25:10) Here again, the series sheds light into the exploitative conditions to which the Zaunites are forced into by the topsiders. The severe economic imbalance between these cities comes into the spotlight during this exchange taking place between Vi and Vander. Viktor, who is Jayce’s partner in his research is another character that has experienced what life was like in Zaun and we can also find that Viktor is highly loyal to the Zaunites and wants to put an end to their sufferings since he was also brought up in the undercity. Viktor recalls the time he came to Piltover. He says to Jayce: “Nobody's ever believed in me. A poor cripple from the undercity. I was an outsider the moment I stepped foot in Piltover” (Some Mysteries are Better Left Unsolved 00:32:50-00:33:10). Caitlyn also bursts out against her mother in a scene saying that Zaun’s citizens are “living on the streets. Being poisoned. Having to choose between a kingpin who wants to exploit them and a government that doesn't give a shit” (Oil and Water 00:07:30-00:07:40). All such instances point to struggles of the citizens who tirelessly work to survive under the harsh conditions of Zaun.

Ekko, a kid from Zaun says in one episode to Heimerdinger, “It’s not enough to give people what they need to survive, you have to give them what they need to live” (The Monster you Created 00:17:04- 00:17:15). Here he talks about how they are barred from experiencing the grandeur and the will to live which is essential for any citizen and the only way to cultivate it is to provide them peace and a space to thrive. The people of Zaun barely survive while their counterparts from the topside thrive. They are treated as expendable workers who are deemed worthy only for their manual labor which powers the city of Piltover. Silco’s words highlight the disposable way the Zaunite workers are treated by Piltover, “Have you forgotten where we came from? The mines they had us in? Air so thick it clogged your throat. Stuck in your eyes” (The Boy Saviour 00:16:05-00:16:20). It is through perpetuating a cycle of poverty and oppression that the elites remain in power.

The powerful weaponizes the aspect of violence, and this is especially notable in Zaun which is under the control of Piltover, but power operates differently here. The people of Zaun are trapped in an endless cycle of violence perpetuated by the Piltover elites. The enforcers who can act without legal constraints make full use of the state of exception enforced by the state. Vi and Powder’s life has been deeply affected by the violence perpetuated by the enforcers who ruthlessly murdered their family. The resistance that the state of Zaun puts up against the savagery of Piltover has started to shake the foundations of the city, scaring the elites. “People are starving, sick, ravaged by Shimmer” (Oil and Water 00:21:42 - 00:21:50), Caitlyn is explaining the rationale behind the resistance put up by the people in Zaun who were brutally treated by the cruel wielders of power.

Starvation or poverty here could be seen as a political tactic employed by the powerful to seamlessly exert their power over the vulnerable people of Zaun. Every attempt to fight back is always met with more violence from the other side as explained by Vander in one scene, “We make ourselves a problem for Piltover, and they will send the enforcers” (Welcome to the Playground 00:25:55-00:26:05). Similarly, Vi’s defense of her homeland where she says, “So? Why answer to them? These are our streets” (Welcome to the Playground 00:26:05-00:26:15) originates from a place of deep trauma triggered by the horrific murder of her family. The inhabitants of Zaun can be regarded as Homo Sacers too, due to their existence under the threat of incessant violence.

Piltover does not care about the people of Zaun which is evident from their apathy towards their struggles. The powerful elite let crime and vices fester in the undercity. The unchecked use of drugs like shimmer which is highly destructive and addictive is another example of how Piltover allows the crime-ridden and decaying environment to flourish. Zaun is a marginalized territory and the dichotomy between Piltover and Zaun can be read through the frames used in *Arcane* where Zaun is a polluted city marked by its moral deterioration which is a product of years of systemic neglect. The atmosphere of Zaun is ridden with corruption and crime which Piltover let fester for too long which made it a fertile ground for Silco, the industrialist, to manipulate the people of Zaun for his own egotistical ends. The people of Zaun now need to be liberated from the oppression and exploitation they are facing from both sides. Caitlyn introduces Vi to the council “Councilors, this is Vi. She was born in the undercity. Even though we failed her in countless ways, she risked everything to show me what life is really like down there. People are starving, sick, ravaged by Shimmer. They live in constant fear of the coordinated efforts of violent crime lords” (Oil and Water 00:21:31-00:22:00). Keeping his selfishness aside, his rebellion is clearly against Piltover and for the establishment of the sovereign state of Zaun which is no longer under the control of Piltover. This dialogue gives more clarity to the relationship dynamic between both cities. It appropriately places Zaun under the authority of Piltover and any attempt they make to assert their independence, they are punished by the system and labeled as criminals. Silco also understands the complexity of the oppression that Zaun is under which evident in this comment is made by Silco:

"The only way to defeat a superior enemy is to stop at nothing. To become what they fear" (Base Violence Necessary for Change 00:11:35-00:11:55).

Piltover has created a state of exception that directly oppresses the Zaun population under the guise of countering the insurgent activities while the elites continue to get the most out of the situation by making their lives insufferable. The theoretical framework provided by Agamben is key in analyzing the power structures located in the narrative of *Arcane*. The series *Arcane* becomes a seminal work of fiction that challenges the dominant political structures that are indifferent towards the plight of those who inhabit the area which is rendered a zone of exception. The systemic neglect and violence suffered by Zaun can be explored through a subaltern viewpoint. Their sufferings are erased and their lives are made unbearable. They are even deprived of the simple joys of life. Their land, inhospitable and their existence, painful; Zaun continues to fight the upper city with everything it has.

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Enhancement of Teaching Competency

Dr. Chandigy Xavier

Aquinas College, Edacochin

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ABSTRACT

Globalisation and the introduction of new curriculum have brought about numerous changes in the English teaching profession. English is no longer the language of the white man. It's become the universal language. Nowadays, those who use English are seen as meaning producers rather than language learners. As a worldwide language, English is getting more and more diverse depending on elements like accent and place of origin. As trends in the status of the English language have changed, so too have instructional practices. Managing computer-literate pupils is getting harder and harder. Teachers place a significant emphasis on implementing innovative teaching strategies in the classroom, and they must teach English in a way that makes it easy for pupils to understand. Teachers are also aware that innovative methods can help them become more proficient language teachers. It is the teacher's job to get the pupils' attention in class. Teachers should use audio-visual aids and computer-based instruction instead of more conventional methods. In order to make learning enjoyable, English teachers must incorporate humour and enjoyment into their lessons and give a thorough explanations of instructional tactics and activities.

****Corresponding Author***

Dr. Chandigy Xavier

Aquinas College, Edacochin, Kerala.

Introduction

Language is a set of human behaviours employed to convey feelings and ideas, as stated by O. Jesperson. The Anglo-Saxon kingdoms of England produced the West Germanic language called English. To be able to sound educated and informed is the main reason for learning English. Correctly speaking English and speaking well are crucial in order to progress in one's career. There are many explanations for why studying English is essential. Firstly, to make ourselves appear brighter and more educated, and secondly, effective communication with people, which is very important to be respected in every sphere of life and in career advancement.

The English teaching field has experienced many changes due to globalisation and also due to new curriculum implementation. The language of the white man is no longer English. It has become the global language. English language users today are regarded as meaning creators and not language learners. English is becoming increasingly different based on factors such as country of origin and accent as a global language. Instructional strategies have evolved alongside the changing trends in the English language's status. Technology and the use of AI has added a new level of meaning to the techniques employed. It is becoming increasingly difficult to handle students who are computer literate if the teacher is not.

The role of the teacher is more like a facilitator than a teacher since the learner-centred system is accorded such importance. Teachers should implement pragmatic method of teaching. "Pragmatic competence is not just a matter of knowing the rules, but also of knowing how to use them appropriately in context" (Crandall 15).

People speak varieties of English all around the globe. English is now the language of global communication. Perhaps, the most incredible fact behind this growing usage of English is that most English speakers are now multi-linguals who have learned English and who communicate in English to other multi-linguals. "Effective pragmatics-focused materials should provide opportunities for learners to engage in authentic communication and to develop their ability to negotiate meaning" (Crandall 18). Teachers should implement pragmatic method of teaching. The chief function of a pragmatic teacher is to suggest problems to his pupil and to stimulate them to find by themselves the solution which will work. "Pragmatic competence is not just a matter of knowing the rules, but also of knowing how to use them appropriately in context" (Crandall 15).

The four skills - listening, speaking, reading, and writing need to be integrated in language learning. It can be difficult to enable effective language teaching and learning if these are not connected. But both the teachers and the students struggle to integrate these skills. In all levels—primary, secondary, and tertiary—we need an effective and comprehensive approach to learning and teaching English. With the application of a number of instructional resources, this might be possible. Most scholars argue that instructional materials play a larger role in promoting effective language teaching and learning. If teaching aids are applied in class, the outcome is much improved compared to if they are not. "One of the major challenges facing EFL learners is the lack of opportunities for authentic language use outside the classroom" (Akbari 2048).

An internet-based public library and the web enhances both learning and teaching English as a second language. The web can instruct the students on how to infer meanings that are not literal. Also, it facilitates their description of how their language and style selections affect both implied and explicit meaning. The students may be given an opportunity to write and talk about any number of real-life topics. They should be motivated to respond to what they have read in a thoughtful and creative manner. "The evaluation of language teaching materials is a complex process that involves not only assessing the content and design of the materials but also considering the context in which they will be used" (Ellis 38).

English must be taught to students in such a manner that they are able to understand it easily, and teachers strongly emphasize using new techniques in the classroom. Teachers also understand how new techniques can enhance their proficiency in teaching languages. The teacher is responsible for grabbing students' attention in the classroom. Computer-based instruction and audio-visual devices should be used by teachers instead of more traditional teaching techniques. Consequently, English teachers need to integrate humour and enjoyment into their teaching and provide detailed descriptions of instructional strategies and activities that make learning fun. “The traditional grammar-translation method, which is still widely used in many EFL contexts, can hinder learners’ ability to communicate effectively in English” (Akbari 2051).

Although the previous generations could have thought that English was necessary for character-building or building sense of aesthetics, Macaulay could have felt that knowledge of English was a must for the civilisation of Indians. Nevertheless, the generation today is absolutely sure that economic, social progress and mobility call for English. Since it allows individuals to travel away from their local region to destinations with better prospects for professional and financial advancement, English is referred to as the language of opportunity. While it’s true that English does have a lot of “surrender value,” students are understandably eager to take advantage of it. English is thus in demand. “The development of language teaching materials should be based on a clear understanding of language learning principles and processes” (Ellis 44).

English is increasingly the language of modernisation, not Westernisation. While our teachers and authors of the curriculum do not know this, our students do know it well enough and would prefer to speed up the “lab to land” process. If English has to be an agent of modernisation and transformation, the latter must be transformed first. English language learners in India have reached the conclusion that in order for the world outside to comprehend them, they need to be able to communicate in English when talking about their identity, languages, literature, science, technology, society, economy, values, and culture. For example, we have to talk about Panini and Nagarjuna in English so that the world outside may know that there is a rich tradition of language philosophy in India that can engage the latest in modern thought.

Also, we need to translate because there is a large market for good English translations and adaptations of Indian literature, both old and new. A productive interface between Indian languages and English needs to be encouraged, and

English departments in India should attempt to translate well with the help and support of other language departments.

Neither critical thinking nor even effort towards original writing is fostered by the present English teaching system in India. Therefore, there should be an alternative strategy that goes beyond the classroom, textbooks, and exams on recommended readings. A specific kind of textbook that is less a text and more a pretext—a book that can allow students to drive with confidence beyond the safety perimeter and learn how to navigate traffic and congested areas.

In addition, in order to encourage students to read critically, write imaginatively, and answer thoughtfully, the texts selected or composed for the purpose should be so open-ended that no crib-writer can anticipate probable questions and answers. This will provide scope for a genuine test of the students' capacity to employ the language in situations other than those in which they acquired it.

All aspects of human life are bound to be affected by the internet, such as marketing, business, entertainment, social networking, browsing, leisure activities, and education. This illustrates how the internet came to play an important role in the lives of ordinary individuals. The actual usage of English has a tendency to separate individuals into internet-literate and non-internet-literate people. English has turned out to be the global language of the world due to the internet.

Students are able to go to places and experience things that they would not have been able to in a normal classroom environment due to the application of the Internet in learning and instruction. It also enables students to relate what they are studying in the classroom to their daily experiences and can even instruct them how to take what they have learned in one environment and apply it in another. As many teachers have been applying the web resources in English language classrooms, they should focus on a handful of basic pedagogical needs if they are to utilize new technologies properly. These needs involve integration thinking, recognizing complexity, student involvement in decision-making, assessing objectives, and offering the right support.

With the advent of a new informational society, teachers have to provide their students with specialized knowledge in order to help them succeed in this new world. In our country, English is gaining increasing popularity in public life and education. As the language is used as a means of instruction, teachers have to help students master it. Consequently, lectures and discussion in English classes need to be supplemented with seminars, debates, group discussions, and other exercises. Thus, one of the tools that can enhance the learning and teaching of English as a foreign language is the internet.

English is the universal language today, and the internet is the primary tool of communication and accessing information globally. English is the global language that is spoken most in the world due to globalisation. English's economic and political acceptance by English-speaking countries is the reason behind its ranking. English is employed in linguistics for international communication beyond national borders through the internet.

English is now the primary language for work and career progress, and it is linked to economic growth. English language proficiency provides a broad array of educational and employment opportunities in India and the world. To survive in this world, possessing a good standard of English language proficiency is imperative. If applied as an instructional aid, the Internet can help teachers in: creating effective instructional methods, like provoking the classroom; broadening and enhancing the material; providing a range of topics so that students may choose what they require; and using as many authentic resources as possible.

The classic functions of the English language will necessarily change in a globalised world. To express its thoughts in the fastest, easiest, most efficient, and most convenient way, it has to make itself a convenient and versatile medium. Headlines of newspapers, emails, and advertisements or slogans/messages are just some of the things that act as appetizers prior to the student proceeding to the main dish, which is the prescribed book. Educators need to compel students to read and understand headline language of newspapers and educate them on writing and understanding it so that enough interest is piqued among the students.

A slogan from an advertisement is another source which can spark interest among students when a class is beginning. It is the obligation of educators as well as students to integrate the skills into learning development process. Teachers and students are the most important parts of a learning process. Abilities and traits of teachers, student development and behavioural trends, etc. are the other elements facilitating the learning process.

The four learning abilities are the building blocks of learning traditions. Both students and instructors are seen as learners in the progressive school of education philosophy, unlike the social efficiency and critical traditions, where teachers are either the learners or the generators of learning. Based on these traditions, a teacher must be well qualified, innovative, and able to guide. They also think that teachers should instruct their students how to struggle for justice and change social norms.

The central concern of educational regulations to safeguard the calibre of teaching is currently assessing teaching competence. Teachers are expected to meet their duties by providing their students with the best possible teaching in an effort to satisfy their needs and objectives. They need to create favorable learning environments. Besides possessing adequate knowledge of the subject they teach, they ought to be in a position to convey that knowledge effectively. In essence, there are three competence elements required for effective pedagogy. They are knowledge competence, skill competence, and attitude competence.

Language learning should be accompanied with the science and art of intellectual self-control, critical thinking, and reasoning ability as part of our future preparation. The four language skills of listening, speaking, reading, and writing are not the sole purposes of language learning. In order to depict the synergistic processes of language acquisition, we must create a model on the basis of recitation and revelation, which are the intrinsic qualities of texts, thought and questioning, quietness and reflection. We must also examine the myth. A native approach to English teaching in India can be arrived at to reach a conclusion with proper professionalism and enhanced perceptions.

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The Influence of CRM on Customer Loyalty: An Empirical Study among SBI Customers

[1 *]**Dr. Vishnu P.M.**, [2] **Dr. Shiny V.N.**

[1] *Assistant Professor, P.G Department of Commerce, DB Pampa College, Pampa, Pathanamthitta.*

[2] *Assistant Professor, P.G Department of Commerce, DB Pampa College, Pampa, Pathanamthitta.*

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ABSTRACT

The banking sector in India is a dynamic industry, boasting growth and strength of the economy through financial inclusion as well as credit control, yet concurrently grappling with significant customer-related challenges. This comprehensive study delves into the impact of CRM on enhancing customer loyalty within the State Bank of India (SBI), a premier banking institution. The study aims to identify the key factors that most profoundly influence customers' perceptions of CRM in the banking sector and their subsequent loyalty. Emphasizing social and ethical responsibility, and implement effective CRM programs to increase customer satisfaction and loyalty. This study demonstrates the positive impact of CRM on customer loyalty in the banking sector, particularly in the State Bank of India.

[*]***Corresponding Author:***

Dr. Vishnu P.M.

Assistant Professor, Post Graduate Department of Commerce

DB Pampa College, Pampa, Pathanamthitta

Introduction

Customer Relationship Management (CRM) is a strategic approach that enables organizations to build long-term connections with customers by gathering and analysing customer data to tailor products and services to individual preferences. Effective CRM requires a customer-centric approach, integrating technology, processes, and people to build strong relationships, increase market share, and drive profitability. The primary goal of CRM is to maintain and satisfy customers, leading to increased loyalty and retention.

In today's competitive landscape, prioritizing customer satisfaction is crucial for organizations to gain a competitive edge. Achieving loyalty demands a profound understanding of customer needs, expectations, and preferences, which can be accomplished through effective CRM. By implementing CRM strategies, businesses can increase customer retention, loyalty, and profitability, gain a deeper understanding of customer needs, align organizational behaviour with individual customer needs, and maximize the value of customer life cycles.

The banking sector in India is a vital and dynamic industry, boasting immense potential and strength, yet concurrently grappling with significant customer-related challenges. This comprehensive study delves into the impact of CRM on enhancing customer loyalty within the State Bank of India (SBI), a premier banking institution. The study aims to identify the key factors that most profoundly influence customers' perceptions of CRM in the banking sector and their subsequent loyalty. By examining the intricate relationships between CRM strategies and customer loyalty, this study provides invaluable insights for policymakers and managers to refine their approach, foster a customer-centric culture, and cultivate a loyal customer base.

Literature Review

Research on CRM in banking highlights its significance in enhancing customer satisfaction and loyalty. Lalitha et al. (2022) identified key CRM factors, while Agrawal (2019) compared CRM practices in SBI and ICICI banks, showing its impact on customer satisfaction and loyalty. Hafeez and Abbas (2017) found employee knowledge and customer-centric attitudes enhance service quality. Narayan Baser (2015) emphasized CRM's role in delivering personalized experiences and building relationships. Baser and Thakar (2015) examined CRM's rise in India's competitive market, while Anbuoli and Thiruvenkatraj (2013) stressed customer retention and effective CRM. However, a research gap exists in understanding CRM's impact in underserved areas with limited banking services, necessitating further study to explore CRM effectiveness in these areas and provide insights for banking managers. In Kerala, there were limited studies carried out by the researchers on the influence of CRM practices on the customer loyalty among SBI customers in the digitalized banking environment.

Problem Definition

The study seeks to investigate the impact of CRM on enhancing customer loyalty in the banking sector, focusing on SBI. The research addresses the following questions. What factors contribute to the influence of CRM on customer loyalty in the banking sector, how effective CRM practices impact customer retention, satisfaction, and loyalty in SBI, and what strategies can SBI adopt to leverage CRM and enhance customer loyalty. By exploring these questions, this study aims to provide insights into the role of CRM in driving customer loyalty in the banking industry, using SBI as a case study.

Objectives of the Study

The study aims to determine the factors that influence customers' decisions for choosing a bank, identify the factors that influence customers' perceptions of CRM and to explore the impact of CRM on customer loyalty within the SBI.

Hypotheses of the Study

Following are the hypotheses of the study,

H0: There is no significant relationship between CRM and customer loyalty.

H1: There is a significant relationship between CRM and customer loyalty.

Methodology of the Study

This study is descriptive and analytical in nature, since it aimed to assess and analyse the factors influencing customer loyalty enhancement through customer relationship management (CRM). A sample of 100 account holders from State Bank of India in Kerala was selected using snowball sampling method. A structured questionnaire was designed to collect primary data. Data used for the purpose of this study includes both primary data, gathered through structured questionnaire, and secondary data; collected from banks annual reports, journals, research reports, newspapers, magazines, and company websites. The questionnaire method was employed for data collection. The analysis involved calculating percentages, creating charts and graphs to present the data visually, and utilizing different scales to draw meaningful insights. Specifically, the data was analysed using SPSS, Microsoft Word, and Excel, with statistical measures such as mean, standard deviation, and multiple regression employed to extract valuable information from the collected data.

Data Analysis and Results

Table: 1 Profile of the sample

Traits		**Percent**
Gender	Male	54.0
	Female	46.0
Age	Below 20	8.0
	20-30	55.0
	30-40	12.0
	40-60	20.0
	Above 60	5.0
Education	SSLC	5.0
	Plus two	10.0

	Degree	45.0
	Post Graduate	36.0
	ITI	4.0
Income	Below 3 lakhs	28.0
	3-4 lakhs	14.0
	4-5 lakhs	10.0
	Above 5 lakhs	48.0

(Source: Survey Data)

The survey reveals a predominantly male respondent base (54 percent) with a significant presence of young adults (55 percent aged 20-30) and a well-educated customer base (45 percent degree holders and 36 percent postgraduates). The respondents have a moderate to high annual income, with 48 percent earning above 5 lakhs and 28 percent earning below 3 lakhs. The age distribution shows a limited presence of young and senior customers, while middle-aged customers make up 20 percent of the respondents. Overall, the survey indicates a highly educated, moderately affluent, and young adult-dominated customer base.

Table: 2 Mean scores of influential factors in bank choice

Factors	Mean score
Mass communication	3.09
Customer friendly environment	3.34
Working hours	3.46
Easily accessible	3.54
Product and services offered	3.43
Modernization and infrastructural facilities	3.41
Secure transactions	3.68
Overall mean score	3.42

(Source: Survey Data)

As illustrated in the figure above, the factors influencing the choice of bank reveal that secure transactions have the highest mean score of 3.68, followed closely by easily accessible and working hours. Conversely, mass communication has the lowest mean score, indicating it's relatively lesser influence on the decision-making process.

Table: 3 Mean scores of customer perceptions towards CRM

Factors	Mean score
Reliability and safety	3.23
Personalization and relatedness	3.22
Transaction comfort and problem handling mechanism	3.21
Responsiveness	3.21
Privacy	3.37
Modern facility	3.36
Transparency	3.29
Communication system	3.32
Tangibility	3.27
Credibility and competence	3.39
Overall mean score	3.28

(Source: Survey Data)

As depicted in the figure above, the factors shaping customers' perceptions of CRM in their bank reveal that credibility and competence rank highest with a mean score of 3.39, closely followed by privacy and modern facilities. Conversely, transaction comfort and responsiveness receive the lowest mean scores, indicating areas for improvement.

Table: 4 Mean scores of customer loyalty improvement in bank

Factors	Mean score
Core banking operations	3.36
Trust created by bank	3.57
Communication system	3.49
Technological advancement	3.61
Charges and interest levied	3.48
Care for customers	3.46
Grievance redresses mechanism	3.37
Overall mean score	3.47

(Source: Survey Data)

The data indicates that technological advancement is the primary driver of customer loyalty enhancement in bank, with a mean score of 3.61. Trust created by the bank and competitive charges and interest rates are also significant factors, ranking second and third respectively. In contrast, core banking operations have the lowest mean score, implying that customers may view these as basic expectations rather than loyalty-enhancing factors.

The table below shows the mean score and standard deviation of factors influencing customer loyalty in banking, highlighting the relative importance of each factor in shaping customer relationships and loyalty.

Table: 5 Descriptive statistics of perception towards CRM in bank

Factors	Number	Mean	Std. Deviation
Core banking operations	100	3.40	1.119
Trust	100	3.62	1.162
Communication	100	3.52	1.010
Technology	100	3.66	1.075

Bank Charges	100	3.51	1.159
Care	100	3.50	1.124
Grievances	100	3.42	1.156
Valid N (list wise)	100		

(Source: Survey Data)

The table reveals that technology is the most significant factor in enhancing customer loyalty, with the highest mean score (3.66). Trust, bank charges, and communication follow in importance, while core banking operations and grievance redress mechanisms have the least impact. Standard deviation analysis shows that communication has the most consistent data, while trust has the most variability.

Table: 6 Descriptive statistics of customer loyalty enhancement in bank

Factors	Number	Mean	Std. Deviation
Core banking operations	100	3.40	1.119
Trust	100	3.62	1.162
Communication	100	3.52	1.010
Technology	100	3.66	1.075
Bank Charges	100	3.51	1.159
Care	100	3.50	1.124
Grievances	100	3.42	1.156
Valid N (list wise)	100		

(Source: Survey Data)

Technology is the key driver of customer loyalty enhancement in importance, while core banking operations have the least impact. Standard deviation analysis reveals that communication is the most consistent factor, while trust has the most variability. The regression analysis examines the relationship between Customer Loyalty (dependent variable) and Customer Relationship

Management (independent variable). The variables used in the analysis are specified in the table below.

Table: 7 Variables Entered/Removed

Model	Variables Entered	Variables Removed	Method
1	CRM[b]	-	Enter

(Source: Survey Data)

Dependent Variable: Customer Loyalty

Table: 8 Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.734[a]	.539	.534	4.26696	.539	114.408	1	98	.000

(Source: Survey Data)

a. Predictors: (Constant), Customer Relationship Management.
b. Dependent Variable: Customer Loyalty

Table: 9 ANOVA

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	2083.029	1	2083.029	114.408	.000[b]
	Residual	1784.281	98	18.207		
	Total	3867.310	99			

(Source: Survey Data)

The regression analysis reveals that CRM significantly enhances customer loyalty in the banking sector, specifically at SBI. The null hypothesis is rejected at a 5%

significance level, indicating a strong positive relationship between CRM and customer loyalty.

Discussion and Practical Implication

The study found that respondents, predominantly female (63 percent), middle-aged, educated, and with an annual income above 5 lakhs, prioritize secure transactions, accessibility, modernization, and customer-friendly environment when choosing a bank. They have a positive perception of CRM, particularly regarding responsiveness, privacy, credibility, and competence. Factors enhancing customer loyalty include core banking operations, trust, communication, technological advancement, and care for customers, with technological advancement having the highest mean score. To leverage this, banks should prioritize employee training and orientation on CRM practices, emphasizing social and ethical responsibility, and implement effective CRM programs to increase customer satisfaction and loyalty. With this, banks can maintain strong relationships with loyal customers, develop socially evolved employees, and stay competitive in meeting increasing customer expectations. This study demonstrates the positive impact of CRM on customer loyalty in the banking sector, particularly in the State Bank of India.

Limitations and Future Scope of Study

The study fundamentally focused on the perceptions of customers of SBI only. The perceptions on CRM practices and influence on customer loyalty studied only based on the data collected from Kerala. Other outcomes of CRM like customer satisfaction and customer experience etc. were not covered under this study. Based on these above limitations the researchers suggest following extension of the current study. Exploring the impact of CRM on customer loyalty in other banking sectors, such as private or rural banks, Comparing the CRM practices and customer loyalty between SBI and other banks and exploring the influence of CRM on customer loyalty in specific services, such as online banking or mobile banking.

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Breaking the Glass Ceiling: Exploring Financial Well-Being and Gender Equality among Teachers in Kerala in the Context of SDG 5

[1*]Dr. Fiona Sheenu Francis, [2]Varsha.N.S.

[1]Assistant Professor, P.G. Department of Commerce, Aquinas College, Edacochin, Kerala
[2]P.G. Student, P.G. Department of Commerce, Aquinas College, Edacochin, Kerala

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ABSTRACT

Gender equality is a fundamental pillar of sustainable development, emphasized in Sustainable Development Goal 5 (SDG 5). This study explores financial well-being and gender equality among teachers in Kerala. Using a mixed-methods approach, this research examines income levels, savings behavior, investment patterns, job satisfaction, and work-life balance among male and female teachers. The findings reveal significant gender-based differences in financial independence, access to career opportunities, and perceptions of job security. The study highlights the need for targeted policy interventions, such as financial literacy programs, workplace reforms, and equitable promotion policies, to bridge gender disparities in the teaching profession. Addressing these challenges is essential for achieving SDG 5 and fostering an inclusive, financially empowered workforce.

Corresponding Author:
Dr. Fiona Sheenu Francis
Assistant Professor, P.G. Department of Commerce
Aquinas College, Edacochin

INTRODUCTION

Breaking the glass ceiling refers to overcoming invisible barriers that prevent individuals, particularly women, from advancing to leadership roles and achieving equal opportunities in their professional lives. These barriers, deeply rooted in societal norms and systemic biases, are especially significant in fields like education, where gender imbalances persist. Overcoming these challenges is vital for achieving gender equality, financial resilience, and societal well-being.

Kerala, known for its high literacy rates and progressive social indicators, provides a unique context for exploring gender equality in education. Despite advancements in healthcare and human development, gender disparities remain, in the professional world, which is predominantly female. Addressing these inequalities is essential not only for individual empowerment but also for Kerala's broader socio-economic progress.

Teachers play a pivotal role in shaping society by influencing future generations. However, do women educators in Kerala face challenges such as unequal pay, limited leadership opportunities, and systemic biases in their institutions? Do these barriers hinder their professional growth, financial stability, and ability to serve as role models for students? Breaking the glass ceiling in the teaching profession is critical to advancing Sustainable Development Goal 5 (SDG5), which advocates for women's empowerment and the elimination of gender-based discrimination.

Financial well-being, defined as having a stable income and financial security, is essential for a fulfilling life. Many women in Kerala, however, face pay disparities and limited career advancement opportunities, undermining their financial resilience—the ability to withstand and recover from economic challenges. Promoting gender equality in teaching by addressing these inequities can enhance women's financial independence, enabling them to invest in their personal and professional growth.

Empowering women educators benefits not only individuals but also the larger community. Women in leadership roles bring unique perspectives that drive institutional growth, innovation, and inclusivity. They inspire future generations by demonstrating that gender equality is both achievable and necessary for progress. Kerala, with its focus on education and social development, is well-positioned to address systemic challenges like income inequality and restricted access to leadership roles.

Breaking the glass ceiling in teaching is not merely about removing barriers but about unlocking potential for transformative change. Achieving gender equality in this profession enriches the quality of education, strengthens institutions, and fosters a culture of meritocracy. Empowered educators contribute to the socio-economic development of their communities and inspire younger generations to pursue equality and excellence.

By focusing on reducing systemic biases, providing equitable career opportunities, and ensuring fair wages, Kerala can pave the way for a more inclusive society. These efforts align with sustainable development principles, creating long-term benefits for individuals and communities. Gender equality in teaching is thus a powerful driver of progress, enabling women to thrive professionally while contributing to Kerala's overall development. Kerala's success in addressing these challenges can serve as a model for other regions, demonstrating how gender equality in education fosters sustainable development and societal well-being.

THEORETICAL FRAMEWORK

The research, "Breaking the Glass Ceiling: Exploring Financial Well-Being and Gender Equality among Teachers in Kerala in the Context of SDG 5," is grounded in Social Role Theory and Perceived Financial Well-Being Theory. These theories provide a robust foundation for analyzing the interplay between social roles, financial perceptions, and career advancement in the context of gender equality and financial well-being. The study also emphasizes the progressive efforts of Kerala's educational institutions in fostering an environment of equity and empowerment, aligned with the principles of Sustainable Development Goal.

Social Role Theory

Social Role Theory is a psychological and sociological theory that explains how gender differences in behaviour, attitudes, and expectations arise from societal roles and cultural norms. Developed by Alice Eagly in the 1980s, this theory emphasizes that gender roles are shaped by social structures and expectations, rather than inherent biological differences.It asserts that individuals' behaviours, attitudes, and opportunities are shaped by the social roles they occupy, which come with specific societal expectations.

Social Roles: Defined roles individuals play in society, such as teacher, spouse, or parent.

Role Expectations: Norms dictating behaviours based on these roles, are often influenced by gender.

Role Conflict: Tension arises when professional responsibilities clash with personal or familial expectations.

Role Negotiation: Strategies to balance or redefine roles to achieve harmony and progress.

In this study, Social Role Theory examines how the multiple roles of women teachers (e.g., educator, mother, and wife) influence their financial well-being and professional growth. It also explores how role conflict can create barriers to career advancement and financial independence. The research highlights the efforts of Kerala's institutions to reduce such conflicts by implementing gender-sensitive policies, offering flexible work environments, and fostering inclusive practices that empower women teachers.

Social Role Theory is particularly important in understanding and addressing gender inequality. By recognizing that these roles are socially constructed, it becomes possible to challenge and change them, fostering a more equitable society.

The institutions in Kerala are actively addressing traditional role conflicts through initiatives such as mentoring programs, leadership opportunities for women, and support for work-life balance. These measures enable women teachers to overcome societal expectations and achieve financial and professional growth.

Perceived Financial Well-Being Theory

Perceived Financial Well-Being Theory is a conceptual framework that focuses on how individuals subjectively evaluate their financial situation, encompassing both their current financial condition and their expectations for future financial security. Unlike objective measures of financial health, such as income or savings, this theory emphasizes personal perceptions and feelings about financial stability and satisfaction. This focuses on how individuals' subjective evaluations of their financial circumstances influence their overall financial health, behaviour, and decision-making

Perceived Financial Well-Being: Personal assessment of financial security and stability.

Financial Stress: Anxiety about financial responsibilities or uncertainty.

Financial Satisfaction: Contentment with one's financial condition.

Financial Resilience: Ability to adapt to and recover from financial challenges.

This theory examines how women teachers in Kerala perceive their financial well-being and how these perceptions influence their career advancement and decision-making. It considers factors like income stability, job satisfaction, and access to resources. The study underscores the role of Kerala's educational institutions in enhancing financial well-being through equitable pay structures, professional development programs, and financial literacy initiatives.

Perceived Financial Well-Being Theory helps to capture the nuanced and subjective nature of financial health, making it a powerful tool for research and policy design. Kerala's institutions are taking significant steps to alleviate financial stress and improve financial satisfaction among teachers. By promoting fair wages, offering career growth opportunities, and fostering financial independence, these institutions empower teachers to break the glass ceiling and achieve financial resilience and satisfaction

By integrating Social Role Theory and Perceived Financial Well-Being Theory, this study provides a comprehensive framework for understanding how gender roles and financial perceptions influence the experiences of teachers in Kerala. The theoretical foundation also highlights the transformative actions of Kerala's educational institutions in eliminating barriers, promoting gender equality, and fostering financial well-being. These efforts not only contribute to empowering women but also serve as a model for achieving SDG 5 in the education sector.

REVIEW OF LITERATURE

Premamalini and **Rani** (2018) conducted a study that investigates how women executives perceive the glass ceiling in their professional careers, specifically examining the roles of self-esteem and role efficacy in shaping these perceptions. The research highlights the impact of internal factors like self-esteem on how women perceive and navigate the barriers that hinder their career progression. By focusing on women in leadership positions, the study aims to understand the relationship between their confidence and their effectiveness in roles, as well as how these elements influence their career growth and opportunities. The findings provide valuable insights into addressing the challenges women face in overcoming the glass ceiling. **Joy** and **Simon** (2008) examine the motivation levels of school teachers in Kerala, particularly in the context of education reforms. It focuses on how these reforms have influenced the quality dimensions of teaching and learning, and assesses the impact on teachers' motivation. The research seeks to identify the factors contributing to teachers' professional satisfaction and their response to the changes in the education system. By evaluating the quality of education and the role of motivated teachers in achieving higher standards, the paper provides insights into improving teaching practices and school performance.

Claramma and **Ramola** (2007) explore the work-life balance of women professionals in Kerala, focusing on work-family conflicts and the coping strategies used to achieve equilibrium between career and personal life. The study includes 350 women professionals from three cities (Thiruvananthapuram, Kochi, and Kozhikode) and four professional fields: doctors, engineers, lawyers, and chartered accountants. The study examines the prevalence of the glass ceiling and its negative impact on career progression for women. The results show that although women employ various coping strategies to manage their work and family roles, work-related conflicts are more dominant than family conflicts. The glass ceiling remains a significant barrier, hindering the professional growth of women. The theoretical frameworks of Symbolic Interactionism and Gender Inequality were applied to analyze the findings.**Verma and Paul**, (2017) conducted a study focusing on the effectiveness of teacher education programs and their impact on job satisfaction, well-being, and the institutional climate. It aims to explore how these factors are interconnected and influence the overall effectiveness of teacher training. By examining the experiences and perceptions of educators, the research sheds light on the factors that contribute to a positive or negative institutional environment. The study also explores how the well-being of educators correlates with their job satisfaction, ultimately influencing their teaching effectiveness. The paper emphasizes the importance of creating a conducive institutional climate to enhance the professional and personal well-being of educators.

Verma and **Paul**, (2014) investigate the effectiveness of teacher education concerning job satisfaction, well-being, and institutional climate. Conducted at Himachal Pradesh University, the study explores how these factors interact to influence the professional development and effectiveness of educators. The findings aim to provide valuable insights into creating supportive institutional environments that enhance teacher satisfaction and overall well-being. **Sen** and **Sood** (2016), examine the relationship between professional commitment, role conflict, self-efficacy, and change proneness among secondary school teachers. Conducted at Himachal Pradesh University, the study delves into how these factors influence teachers' openness to change in educational environments. By analyzing the interplay between professional attitudes and challenges like role conflict and self-efficacy, the study provides insights into how teachers' commitment to their profession affects their adaptability to change.**Singh** and **Singhal**, (2001) explore the role of gender stereotypes in the workplace, particularly within the education sector, focusing on the dynamics between leaders and subordinates. It examines how these stereotypes contribute to the "glass ceiling" phenomenon, which limits the career advancement of women, specifically educational administrators and teachers. The research sheds light on the barriers that women face in leadership positions due to perceived gender roles, affecting both their professional growth and relationships in hierarchical structures. The study provides valuable insights into gender-based discrimination and leadership behaviour in educational environments.

Bino and Gabriel Simon, investigate the intricate relationship between educational reforms and teacher motivation in Kerala. The study draws upon various aspects of motivation theory and its application within the context of the education sector, focusing on quality assessment and its influence on school teachers.Reforms often aim to improve educational outcomes but can also place additional pressure on teachers. Studies by authors like Darling-Hammond (1997) explore how policy changes affect teacher autonomy, workload, and job satisfaction. Joy’s research likely builds on these insights to assess Kerala's unique context.

Rani and **Gupta** (2017) explore burnout and psychological well-being among secondary school teachers about organizational commitment, occupational self-efficacy, and personal stress. Conducted under Maharshi Dayanand University, the study examines how these factors interact to influence teachers' mental health and professional effectiveness. The findings aim to provide insights into improving teacher well-being and fostering a supportive work environment in educational institutions. **Claramma** explores work-life balance among women professionals in Kerala, analyzing work-family conflicts, coping strategies, and the impact of the glass ceiling on career growth. The research was conducted on 350 professionals across Thiruvananthapuram, Kochi, and Kozhikode, it uses Symbolic Interaction and Gender Inequality theories. Findings reveal pervasive role conflicts, with work being a slightly greater source of stress, and confirm the prevalence of the glass ceiling, hindering career prospects and recognition.**Peshave** and **Gupta**, examines the challenges faced by women employees in advancing their careers within the hospitality industry. Conducted under Bharati Vidyapeeth Deemed University, the study likely explores factors such as workplace barriers, gender bias, and industry-specific hurdles affecting women's professional growth. By identifying these challenges, the research contributes to understanding the career progression dynamics in the hospitality sector, offering insights for improving inclusivity and opportunities for women.

SIGNIFICANCE OF THE STUDY

This study, "Breaking the Glass Ceiling: Exploring Financial Well-Being and Gender Equality among Teachers in Kerala in the Context of SDG 5," is a crucial exploration of the strides being made by educational institutions in Kerala to promote gender equality and financial well-being. It recognizes the proactive efforts of these institutions in addressing the challenges of the glass ceiling and aligning with Sustainable Development Goal 5 (SDG 5). By examining the intersection of gender, finance, and education, this research aims to offer actionable insights that empower teachers and foster equity in the education sector.

The findings of this research will provide policymakers with data-driven insights to craft and implement effective policies that promote financial stability and gender equality among teachers. This will support Kerala's efforts to create a more inclusive and equitable education system that aligns with the objectives of SDG 5.

By identifying key challenges faced by teachers, the study will enable educational institutions to design targeted interventions aimed at enhancing teacher welfare. Such initiatives will contribute to financial security, improved work environments, and overall professional satisfaction for educators in Kerala. This research will highlight the experiences of women teachers, addressing the barriers they face in achieving equity. It will contribute to empowering women in the education sector by dismantling the glass ceiling and promoting a culture of gender equality and inclusivity.

This study will enrich the body of literature on SDG 5 by providing new perspectives on the interplay between financial well-being, gender equality, and education. It will serve as a valuable resource for understanding how global sustainability goals can be implemented locally.By exploring the intersection of gender, finance, and education, the study will provide a nuanced understanding of how these factors collectively shape the experiences of teachers in Kerala. This will shed light on systemic challenges and areas for improvement.

The study will examine the unique context of Kerala in implementing SDG 5, offering a localized understanding of the challenges and opportunities involved in achieving global gender equality and financial equity.

The research employs a mixed-methods approach, combining quantitative and qualitative data to present a comprehensive analysis. This approach ensures a balanced understanding of statistical trends and personal experiences, making the findings robust and practical.

By focusing on Kerala's specific socio-cultural and educational landscape, the study will provide valuable insights that emphasize the importance of localized strategies when designing and implementing education policies and programs.This research will not only address gaps in financial well-being and gender equality among teachers but also demonstrate Kerala's progress in achieving SDG 5. By showcasing the efforts of Kerala's teaching institutions, it aims to inspire similar advancements across other regions, contributing to a more inclusive and equitable education sector worldwide.

STATEMENT OF THE PROBLEM

Kerala, renowned for its progressive approach to education and social equality, has been making strides toward fostering gender equality within its teaching institutions. With a substantial number of women in the teaching workforce, the state provides an opportunity to examine how efforts to eliminate gender-based barriers contribute to achieving Sustainable Development Goal 5 (SDG 5), which emphasizes gender equality and the empowerment of women and girls. This research aims to explore the progress being made in promoting financial well-being and dismantling the glass ceiling for teachers in Kerala while identifying areas for further improvement to ensure a truly equitable environment.

1. What are the current levels of financial well-being among women teachers in Kerala, and how do they compare to their male counterparts?

2. What are the key factors influencing financial resilience and financial well-being among teachers in Kerala?

3. How can policies and interventions be designed to achieve gender equality and break the glass ceiling to promote financial well-being among teachers in Kerala, aligning with the goals of SDG 5?

4. Do female teachers experience invisible barriers in their institutions? Do these invisible barriers or glass ceilings restrict their growth to achieve financial well-being?

Advancing Financial Well-Being among Teachers

Teaching institutions in Kerala have taken significant steps to promote financial well-being among educators, with a particular focus on empowering women teachers. Policies aimed at equitable pay, access to professional development opportunities, and enhanced workplace support are being implemented to ensure financial stability and growth for all teachers. Understanding the current levels of financial well-being among women teachers compared to their male counterparts will highlight the effectiveness of these initiatives and provide insights into areas where further efforts are needed.

Key Factors Enhancing Financial Resilience and Equality

Efforts to boost financial resilience among teachers in Kerala have included measures such as improving job security, promoting financial literacy, and supporting work-life balance. By addressing challenges such as gender bias and unequal access to resources, institutions are creating a more inclusive environment that supports the financial and professional growth of women teachers. Identifying the factors contributing to these positive changes is essential for scaling successful interventions and ensuring sustainable progress toward gender equality.

Addressing and Breaking Invisible Barriers

While progress has been made, subtle challenges like the "glass ceiling" remain a concern in some institutions. These invisible barriers often restrict women from accessing leadership roles or decision-making positions. However, increasing awareness and proactive measures within teaching institutions are breaking these barriers, fostering an environment where women can achieve their full potential. By focusing on success stories and identifying remaining obstacles, this research seeks to highlight the transformative impact of such efforts on financial well-being and career advancement.

Policy Implications and Alignment with SDG 5

Kerala's teaching institutions are actively aligning their policies and practices with the principles of SDG 5. Initiatives promoting gender-sensitive workplaces, equitable career progression, and financial empowerment for women teachers are creating a foundation for long-term gender equality. By evaluating these efforts and suggesting enhancements, this research aims to provide actionable recommendations that strengthen ongoing progress, ensuring that both women and men thrive equally in the teaching profession.

RESEARCH QUESTIONS

The present study tries to address the following research question - Does achieving financial resilience among female teachers contribute to their financial well-being, promote gender equality, and help eliminate the glass ceiling in the workplace?

RESEARCH OBJECTIVES

The study examines the following objectives:

- To determine the level of financial resilience, financial well-being, gender equality and glass ceiling.
- To analyse the relationship between financial resilience, financial well-being, gender equality and glass ceiling
- To analyse the difference in the level of financial resilience, financial well-being, gender equality and glass ceiling among the different categories of demographic variables.

RESEARCH HYPOTHESIS

The study examines the following hypothesis:

Achieving financial resilience among female teachers positively correlates with enhanced financial well-being, promotes gender equality, and helps reduce the effects of the glass ceiling in the workplace.

METHODOLOGY

This study seeks to examine the role of financial resilience, financial well-being, gender equality and their contribution towards eliminating the glass ceilings in the workplace and achieving United Nations Sustainable Development Goals (SDGs). The study is descriptive in nature and is conducted in Kochi City. Both primary and secondary data sources were used for the study. Primary data is collected from the people who with the help of the questionnaire for the first time are original in nature. Secondary data for the study was collected from various sources including Journals, the internet, newspapers etc. The sample size of the study is 50 respondents and the population consists of teachers in various colleges. Samples were selected using convenient sampling and data was analysed using statistical tools like Correlations, ANOVA etc.

RESULTS AND DISCUSSION

This section deals with the analysis and interpretation of data collected from respondents through Google forms.

Table 1 - Demographic Profile of the Respondent.

Variables		Frequency	Percentage
Gender	Female	41	82
	Male	9	18
Type of institutions	aided college	31	62
	government college	12	26
	private college	5	10
	self-finance	1	2
Residential area of the institution	urban	21	42
	Semi-Urban	18	36
	rural	11	22
Experience	less than a year	7	14
	more than a year	12	24
	more than 5 years	10	20
	more than 10 years	21	42

Source: primary data

Interpretation

This table provides a demographic profile of the respondents in a survey, breaking down the data based on various variables. Here's an interpretation of the findings:

Gender:

82% of the respondents are female (41 out of 50). 18% of the respondents are male (9 out of 50).

Type of Institutions:

The majority of the respondents are from aided colleges (62%, or 31 out of 50).26% are from government colleges (12 out of 50).10% are from private colleges (5 out of 50).Only 2% are from self-financed institutions (1 out of 50).

Residential Area of the Institution:

42% of the institutions are located in urban areas (21 out of 50).36% are in semi-urban areas (18 out of 50).22% are in rural areas (11 out of 50).

Experience:

14% of respondents have less than a year of experience (7 out of 50).24% have more than a year of experience (12 out of 50).

20% have more than 5 years of experience (10 out of 50).The highest percentage, 42%, have more than 10 years of experience (21 out of 50).

Table 2 – Grouping in respondents on the basis of financial resilience, financial well-being, gender equality and glass ceiling.

Variables	Classification	Frequency	Percentage
Financial resilience	Low	13	26
	High	37	74
Financial well-being	Low	14	28
	High	36	72
Gender equality	Low	5	10
	High	45	90
Glass ceiling	Low	48	96
	High	2	4

Source: primary data

Interpretation

Financial Resilience: 26% of the respondents perceive their financial resilience as low (13 out of 50).74% perceive it as high (37 out of 50). A large majority (74%) of respondents feel financially resilient, suggesting they are confident in their ability to withstand economic shocks or challenges. However, a notable minority (26%) still feel their financial resilience is low, possibly indicating some vulnerability or uncertainty among certain respondents.

Financial Well-being: 28% report their financial well-being as low (14 out of 50).72% report their financial well-being as high (36 out of 50).
The majority of respondents (72%) feel they have a strong sense of financial well-being, implying they are satisfied with their financial situation. However, 28%

report low financial well-being, which may indicate concerns about financial security or challenges among that group.

Gender Equality: Only 10% of respondents perceive gender equality as low (5 out of 50).90% perceive gender equality as high (45 out of 50). The overwhelming majority of respondents (90%) believe that gender equality is high, indicating a strong sense of fairness and balance in terms of gender issues within the environment surveyed. The 10% reporting low gender equality suggests there are some areas or perceptions where gender issues may still be a concern.

Glass Ceiling:A vast majority, 96%, believe the glass ceiling is low or not a significant issue (48 out of 50).Only 4% perceive the glass ceiling as high (2 out of 50). The data suggests that the glass ceiling—barriers that prevent individuals, especially women, from advancing to higher levels in their careers—does not appear to be a significant issue for the respondents, with 96% perceiving it as low. However, the 4% who feel it is high could indicate that a small group still faces barriers in career advancement due to gender or other factors.

Table 3 - Correlation

Variables	Correlation	Sig.	Remarks
Financial resilience*Financial well-being	0.705**	0.000	High Positive correlation
Financial resilience*Gender equality	0.378**	0.006	Moderate Positive correlation
Financial resilience*glass ceiling	-0.258	0.070	Not significant Negative correlation

Financial well-being* gender equality	0.351	0.012	Moderate Positive correlation
Financial well-being*glass ceiling	-0.375**	0.007	Not significant Negative correlation
Gender equality*glass ceiling	-0.416**	0.003	Not significant Negative correlation

Source: primary data

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Interpretation

Financial Resilience * Financial Well-being: A strong positive correlation (p = 0.000) shows that individuals who feel financially resilient also report high financial well-being, indicating that financial resilience is key to financial satisfaction.

Financial Resilience * Gender Equality: A moderate positive correlation (p = 0.006) suggests that those who perceive themselves as financially resilient tend to report higher gender equality, highlighting a meaningful but weaker relationship than financial resilience and well-being.

Financial Resilience * Glass Ceiling: A weak negative correlation (p = 0.070) indicates a slight tendency for greater financial resilience to be associated with lower perception of the glass ceiling, though not statistically significant at the 0.05 level.

Financial Well-being * Gender Equality: A moderate positive correlation (p = 0.012) shows that higher financial well-being is associated with higher perceptions of gender equality, suggesting financial well-being influences views on gender fairness.

Financial Well-being * Glass Ceiling: A moderate negative correlation (p = 0.007) shows that individuals with higher financial well-being perceive a lower glass ceiling, indicating that financial well-being may reduce perceived career barriers.

Gender Equality * Glass Ceiling: A moderate negative correlation (p = 0.003) indicates that greater gender equality is associated with lower perceptions of the glass ceiling, suggesting that higher gender equality leads to fewer career advancement barriers.

Table 4 - ANOVA one-way analysis by gender

Variables	F	Sig.
Financial resilience	0.650	0.424
Financial well-being	0.468	0.497
Gender equality	0.170	0.682
Glass ceiling	0.905	0.346

Source: primary data

Interpretation

Financial resilience: There is no statistically significant difference between males and females in terms of their financial resilience. This implies that both genders likely exhibit similar levels of capacity to withstand financial shocks or unexpected events.

Financial Well-being: Similar to financial resilience, the results indicate no significant difference in financial well-being between males and females. This suggests that both groups likely experience comparable levels of financial satisfaction and security.

Gender Equality: There is no statistically significant difference in the perception of gender equality between males and females. This could imply that both groups hold relatively similar views on the extent of gender equality in the society or workplace under study.

Glass Ceiling: There is no statistically significant difference between males and females in their perception of the existence or impact of the "glass ceiling." This might suggest that both genders have similar views on the presence of barriers that hinder women's career advancement.

Table 5 - ANOVA one-way analysis by type of institutions.

Variables	F	Sig.
Financial resilience	4.122	0.011
Financial well-being	2.170	0.104
Gender equality	1.486	0.231
Glass ceiling	1.098	0.360

Source: primary data

Interpretation

Financial resilience: The F-value is 4.122, and the p-value (Sig.) is 0.011, which is less than the typical significance level of 0.05. This means that there is a statistically significant difference in financial resilience between the different types of institutions. The null hypothesis that the means are equal across institutions is rejected.

Financial well-being: There is no statistically significant difference in financial well-being across the different types of institutions. Therefore, the null hypothesis cannot be rejected.

Gender equality: The differences in gender equality between the types of institutions are not statistically significant, so we fail to reject the null hypothesis.

Glass ceiling: This suggests that there is no significant difference in the perceived glass ceiling across the institutions, and the null hypothesis stands. Financial resilience shows a significant difference between institutions (p = 0.011). Financial well-being, gender equality, and glass ceiling do not show significant differences (p-values are greater than 0.05).

Table 6 - ANOVA one-way analysis by residents of institutions.

Variables	F	Sig.
Financial resilience	0.134	0.875
Financial well-being	0.106	0.900
Gender equality	1.315	0.278
Glass ceiling	1.151	0.325

Source: primary data

Interpretation

Financial Resilience: There is no significant difference in financial resilience across groups of residents in the institutions.
Financial Well-being: No significant difference in financial well-being across the groups.
Gender Equality: There is no significant difference in perceptions of gender equality across the groups
Glass Ceiling: No significant difference in the perception of the glass ceiling across the groups. All variables—financial resilience, financial well-being, gender equality, and the glass ceiling—show no significant differences between the groups based on the test.

Table 7- ANOVA one-way analysis by experience.

Variables	F	Sig.
Financial resilience	4.691	0.006
Financial well-being	2.150	0.107
Gender equality	2.937	0.043
Glass ceiling	1.190	0.324

Source: primary data

Interpretation

Financial resilience: The result is statistically significant ($p < 0.05$), suggesting that experience has a significant impact on financial resilience.

Financial well-being: The result is not statistically significant ($p > 0.05$), indicating that experience does not have a significant impact on financial well-being.

Gender equality: The result is statistically significant ($p < 0.05$), meaning experience has a significant impact on gender equality.

Glass ceiling: The result is not statistically significant ($p > 0.05$), suggesting that experience does not significantly affect the perception of the glass ceiling.

Experience significantly affects financial resilience and gender equality but does not significantly impact financial well-being or the glass ceiling.

FINDINGS

- The majority of respondents are female and from aided colleges.
- A large proportion of institutions are located in urban or semi-urban areas, with a small number in rural locations.

- Respondents have significant work experience, with 42% having more than 10 years of experience, and 24% having between 1 and 5 years of experience.

- These demographic insights could help in understanding the perspectives of the respondents based on their background

- Financial Resilience and Well-being(table 2): A significant portion of the respondents (74% and 72%, respectively) perceive themselves as financially resilient and having high financial well-being, indicating that most individuals in this group feel confident and secure in their financial situation. However, a small but notable proportion (26% and 28%, respectively) are struggling or feeling insecure, which could signal areas for improvement or intervention.

- Gender Equality (table 2): A large majority perceive gender equality as high, suggesting that, overall, there is a strong sense of fairness in gender-related issues. The 10% who perceive gender equality as low could point to areas where further work may be needed to address disparities.

- Glass Ceiling (table 2): Most respondents do not feel that the glass ceiling is a barrier in their careers, which might indicate that the environment is relatively supportive of career advancement. However, the 4% who perceive it as high could reflect the experiences of a small but possibly significant minority.

- The data suggests a generally positive outlook on financial resilience, well-being, gender equality, and the absence of the glass ceiling among respondents, with a few areas that could benefit from targeted attention or support for those facing challenges.

- Financial Resilience and Well-being (table 3): A strong positive correlation shows that financially resilient individuals tend to have higher financial well-being, suggesting improving resilience could boost financial satisfaction.

- Gender Equality and Financial Resilience (table 3): A moderate positive correlation indicates that those who feel financially secure also perceive more gender equality, implying financial stability may improve views on gender fairness.

- Financial Well-being and Gender Equality (table 3): A moderate positive correlation shows that individuals with better financial well-being tend to view gender equality more positively, suggesting financial stability is linked to more gender equality.

- Glass Ceiling Perceptions (table 3): Negative correlations with financial well-being and gender equality suggest that better financial well-being and higher gender equality are linked to lower perceptions of the glass ceiling. However, no significant relationship was found between financial resilience and the glass ceiling.

- The findings indicate that improving financial resilience and well-being could lead to better perceptions of equality and less perceived hindrance to career advancement.

- Within this dataset, gender does not appear to be a major factor influencing these factors.

- Financial resilience is the only variable that is significantly influenced by the type of institution, suggesting that different types of institutions may have different impacts on individuals' financial resilience.

- Financial well-being, gender equality, and the glass ceiling do not show significant differences across types of institutions, implying that these factors are largely independent of the institution type in this dataset.

- Financial resilience and gender equality are significantly influenced by experience, meaning that individuals' perceptions of these factors vary based on their work or life experience.
- Financial well-being and the glass ceiling are not significantly influenced by experience, suggesting that these factors are less dependent on the amount of experience individuals have.

SUGGESTIONS

- **Develop Financial Literacy Programs**: Introduce targeted financial literacy initiatives for teachers, particularly in rural areas, to enhance financial resilience and well-being.
- **Institutional Support for Financial Security**: Encourage educational institutions to provide resources like pension plans, savings schemes, and workshops to strengthen financial security among teachers.
- **Promote Gender Equality Awareness Campaigns**: Conduct regular sensitization programs and workshops to address unconscious biases and promote a culture of gender equality in schools and colleges.
- **Mentorship Programs for Women Teachers**: Establish mentorship and leadership development programs to support women in navigating career challenges and breaking perceived barriers.
- **Inclusive Policies in Educational Institutions**: Advocate for policies ensuring equitable opportunities for promotions, leadership roles, and salary parity among male and female teachers.
- **Address Perceptions of the Glass Ceiling**: Identify and address specific factors contributing to the perception of a glass ceiling among the 4% of respondents who experience it as a significant barrier.

- **Encourage Collaboration Between Institutions**: Foster partnerships between urban, semi-urban, and rural institutions to share best practices in improving financial well-being and promoting gender equality.
- **Regular Monitoring and Evaluation**: Implement regular surveys and audits in educational institutions to assess progress on financial resilience, gender equality, and perceived career barriers.
- **Special Focus on Experienced Teachers**: Leverage the insights of teachers with more than 10 years of experience to mentor younger colleagues and promote resilience-building strategies.
- **Create Networking Platforms**: Develop platforms for teachers to network, share experiences, and advocate for gender-sensitive practices and policies.
- **Financial Incentives for Rural Teachers**: Provide additional financial incentives or allowances for teachers in rural institutions to improve their financial resilience and motivation.
- **Encourage Research on Gender Equality**: Promote research on gender dynamics in education and the specific challenges faced by teachers in Kerala to inform evidence-based interventions.
- **Build Awareness of SDG 5 Goals**: Integrate discussions of Sustainable Development Goal 5 (SDG 5) into professional development programs to raise awareness and commitment to gender equality.
- **Enhance Professional Development Opportunities**: Provide equal access to training and professional development programs to empower teachers and eliminate perceived career hindrances.
- **Community Engagement for Equity**: Engage with the local community to create awareness about gender equality and financial resilience, fostering a supportive ecosystem for teachers' personal and professional growth.

CONCLUSION

The study highlights a generally positive outlook among respondents regarding financial resilience, well-being, and gender equality, with minimal concerns about the glass ceiling. A significant majority feel financially secure and perceive gender fairness, though small groups face challenges in these areas, suggesting targeted interventions may be beneficial. Correlations reveal that financial resilience enhances well-being, while financial stability improves perceptions of gender equality. Higher well-being and equality perceptions also correlate with reduced reduced glass-ceiling concerns. Institutional type impacts financial resilience but not well-being, gender equality, or the glass ceiling. Experience significantly influences perceptions of financial resilience and gender equality, but not financial well-being or career barriers. These insights underscore the importance of addressing financial and equality-related challenges while leveraging institutional and experiential factors to foster a supportive environment.

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Emerging Economy Mergers and Acquisitions: A Review and Research Agenda

[1*]Lakshmi Priya K.S., [2]Prof. (Dr.) Suresh V N

[1]Research scholar, PG and Research Department of Commerce, Maharaja's College, Ernakulam

[2]Research supervisor, PG and Research Department of Commerce, Maharaja's College, Ernakulam

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ABSTRACT

Survival of the fittest is the norm of nature, and the rule also applies to the corporate world. Mergers and acquisitions are essential measures companies use to ensure their survival and success. In recent times, studies on mergers and acquisitions by emerging economies have increased exponentially, and this motivated a bibliometric analysis of research on mergers and acquisitions made by emerging economy firms. From a total of 612 documents, 155 articles were selected for analysis, and the study found that most research on mergers and acquisitions by emerging economy firms focuses on China. Studies focusing on India and BRICS countries are also on the rise.

[*]Corresponding Author:

Lakshmi Priya K.S.

Research scholar, PG and Research Department of Commerce

Maharaja's College, Ernakulam, Kerala

Introduction

In this ever-changing world of uncertainties, companies seek innovative ways to survive the competition and reap profits. Mergers and acquisitions have always been essential measures used by companies to ensure their survival and continued success. After a slight slowdown due to COVID-19, the number of mergers and acquisitions has spurred again (Chiaramonte et al., 2023).

Research on mergers and acquisitions has mainly focused on the drivers of mergers and acquisitions, the post-merger performance of mergers and acquisitions, and the effect of cross-border mergers and acquisitions. Reviews on mergers and acquisitions have mainly focused on mergers and acquisitions happening in the financial sector (Cumming et al., 2023) or cross-border mergers and acquisitions (Xie et al., 2017).

Corporates from emerging economies increasingly use mergers and acquisitions to expand their operations overseas and ensure their survival and growth. According to Madhok & Keyhani, (2012), the most cited paper included in this review, mergers and acquisitions made by emerging economy multinationals benefits the international business and has introduced new dimensions to international strategy research. In this study, the researcher conducts a bibliometric analysis of the studies on mergers and acquisitions happening in emerging economies. The researcher mainly focuses on mergers and acquisitions in India, China, and the BRICS countries. Combining bibliometric analysis with content analysis, the researcher aims to answer the following research questions:

- What are the significant research areas on mergers and acquisitions in emerging economies?
- What are the avenues for future research on mergers and acquisitions in emerging economies?

The literature review is structured as follows. The first part introduces the research methodology and search protocol, the second part presents the overview of the selected publications and bibliometric analysis, and the final part provides a conclusion and states the avenues for future research.

Methodology

Web of Science database is used to identify studies conducted on mergers and acquisitions in emerging economies. The query used to identify documents is: ((merger) or (acquisition) or (takeover)) and ((emerging economy) or (emerging economies) or (India) or (China) or (BRIC) or (BRICS))

The query searched in the title field of the Web of Science database yielded 612 documents. From this, only English research and review articles published till December 2024 in the business economics field were considered for review. From this, 155 research and review articles on mergers and acquisitions in emerging economies were selected for review. To be included in the bibliometric analysis, the study should focus either on mergers and acquisitions happening in an emerging economy or a cross-border merger and acquisition study with at least one party belonging to an emerging economy. Fig. 1 depicts the article selection process used in the study. The analytical packages used in the study are Biblioshiny and VoS Viewer.

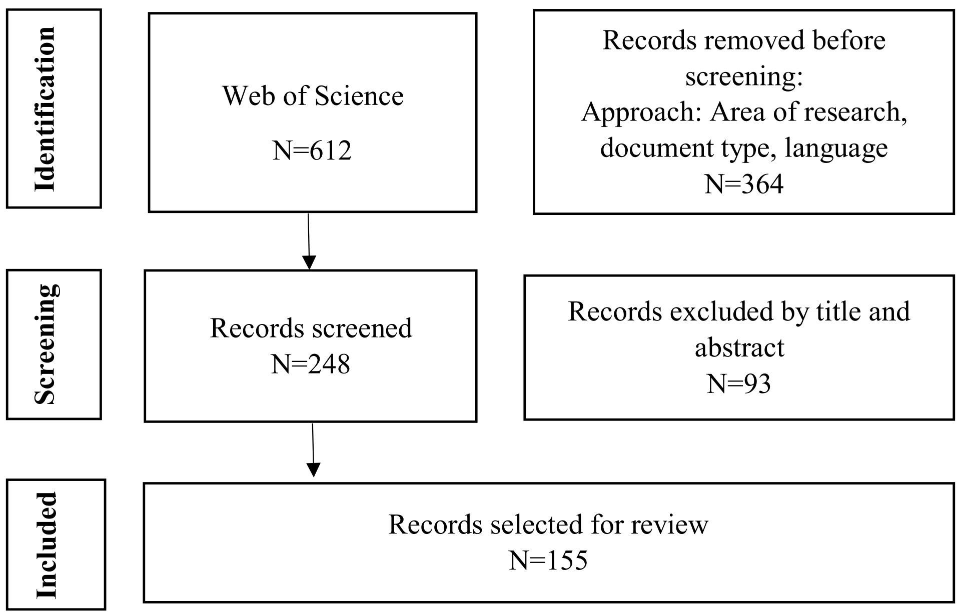

Fig. 1: Flow diagram for article selection

Findings

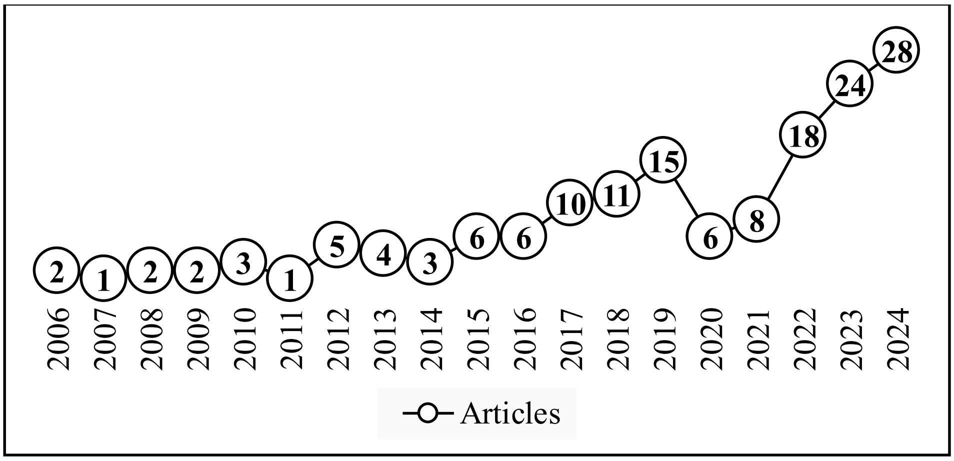

Fig. 2: Article production

Fig. 2 depicts that studies on mergers and acquisitions focusing on emerging economies are on the rise, and article production has exponentially increased since 2021. This reveals that mergers and acquisitions in emerging economies is a promising area for further research. The studies so far have mainly focused on China and there is scope for analysing the multifaceted effect of mergers and acquisitions on other emerging economies as well.

General information

155 articles on mergers and acquisitions in emerging economies were selected for bibliometric analysis. This includes 153 research articles and 2 review articles published in 93 journals. Articles published from 2006 to 2024 were included in the study. General information about the articles selected for the study is presented in Table 1.

Table 1: General information of selected articles

Description	**Results**
MAIN INFORMATION ABOUT DATA	
Timespan	2006:2024
Sources	93
Documents	155
Average citations per doc	23.59
References	7478
DOCUMENT CONTENTS	
Keywords Plus (ID)	484
Author's Keywords (DE)	554
AUTHORS	
Authors	367
Authors of single-authored docs	11
AUTHORS COLLABORATION	
Single-authored docs	11
Co-Authors per Doc	2.97
International co-authorships %	39.35
DOCUMENT TYPES	
Article	147
Article: early access	6
Review	2

Source: Biblioshiny

Most Cited Articles

Four of the 155 articles selected for review have more than 100 citations. With 429 citations (Madhok & Keyhani, 2012) is the article with the most citations. This article focuses on the mergers and acquisitions made by emerging economy companies in advanced economies. (Gubbi et al., 2010) which focuses on the value creation of cross-border mergers to emerging economy acquirers, stands closely behind with 417 citations. Gubbi et al., (2010) found out that shareholders of acquiring companies gained positive abnormal returns in the post-acquisition period. Fig. 3 presents the highly cited articles on mergers and acquisitions in emerging economies.

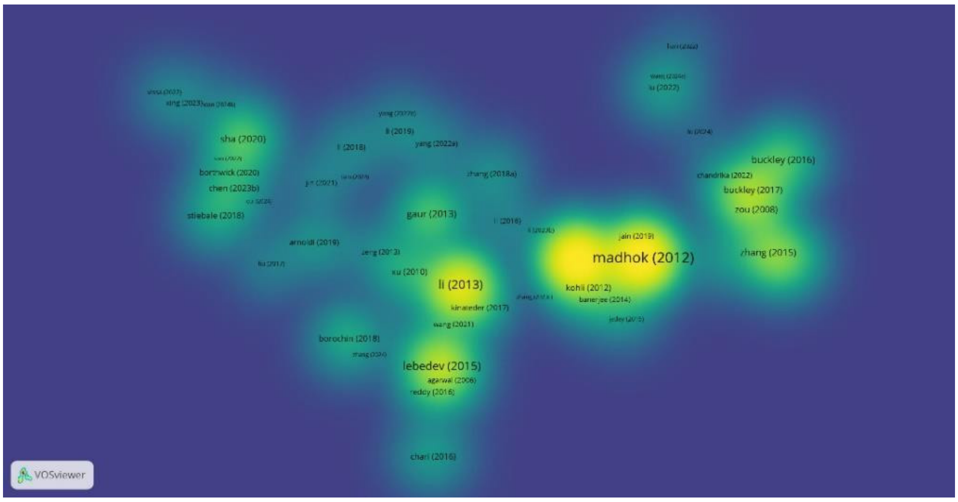

Fig. 3: Most cited articles

Research themes

Fig. 4 depicts the highly researched themes of mergers and acquisitions in emerging economies. Most studies on mergers and acquisitions by emerging economies are focused on China. Among these, studies on cross-border mergers and acquisitions by emerging economy firms and post-merger performance are extensive.

Fig. 4: Word cloud

Cross-border mergers and acquisitions by emerging economy firms

In this era of globalization, companies worldwide are looking to expand operations and explore foreign markets. Companies from emerging market economies are also joining the trend, and several studies have analysed the effect of cross-border mergers on the post-merger performance of emerging economy acquirers, the stock market reactions to cross-border merger announcements, and the motives prompting emerging economy acquirers to go for cross-border mergers.

(Valiya Purayil & Lukose P. J., 2022) studied the effect of cross-border acquisitions on earnings management by emerging economy acquirers. The study considered the acquirers from India between 2000 and 2015 and found that cross-border mergers and acquisitions promoted Indian acquirers to adopt better accounting practices. A comparison of mergers and acquisition strategies and green field investments of Chinese companies was conducted by(Ahmed et al., 2022).

Green mergers

Climate change is a real problem, and life all over is affected by it. It is a known fact that pollution levels in developing countries are higher compared to developed countries. Corporates in emerging countries have a vital role in mitigating the adverse effects of climate change, and the concept of green mergers and acquisitions is gaining momentum. Green mergers and acquisitions are cases in which acquisitions or mergers are made to acquire green technology, reduce emission levels, and improve energy efficiency (Xu et al., 2024). Wang et al., (2024) studied the effect of green mergers on corporate financialization and found out that green mergers and acquisitions inhibit corporate financialisation. The relationship between environmental regulation and green mergers was studied by Han et al., (2022). The study found out that implementation of environmental protection laws accelerated green mergers and acquisition practices of firms.

Post-merger performance

Companies spend enormous amounts of resources in finalizing each merger, and numerous studies have been conducted to analyse the post-merger performance of companies. (Chu et al., 2024) studies the effect of gender diversity on the post-merger performance of acquirer companies. The study on mergers and acquisitions by Chinese acquirers found that acquirers with more female representation on the board paid lesser acquisition premiums and performed better in both short-term and long-term post-merger. The influence of host country governance practices on post-merger performance was studied by (Liu et al., 2021). The study concluded that governing conditions in the host country had a negative effect on merger performance in the short run, but had positive effects in the long run.

Directions for future research

The studies on mergers and acquisitions by emerging economies have mainly focused on China and India. The studies focusing on other emerging economies are minimal. There is considerable scope for expanding research to mergers and acquisitions made by other emerging economies. Cross-country analysis and analysis of blocks of countries like BRICS would help the researcher to analyse the comparative performance of mergers and acquisitions in emerging economies. Green merger is an emerging research concept on mergers and acquisitions in emerging economies. The studies on green mergers are mainly confined to China, and there is scope for further research on green merger practices in India and other emerging economies.

Conclusion

Emerging economy firms are increasingly engaged in mergers and acquisitions these days. Researchers have studied mergers and acquisitions in emerging economies from multiple fronts. This study conducted a bibliometric analysis of 155 articles related to mergers and acquisitions in emerging economies to identify significant research themes and avenues for future research. The study identified the seminal papers in the area and the most researched themes and, using content analysis, identified avenues for further research. The study found that most studies on mergers and acquisitions in emerging economies focus on China, and there is scope for extending the research to other emerging countries as well. Emerging themes like green mergers and monopoly effects of mergers and acquisitions by emerging economy firms provide further avenues for future research.

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Theoretical Perspective on the Glass Ceiling and Professional Growth

[1*]Cilla Joseph K., [2]Dr.Swapna R, [3]Vineetha Shibu

[1]Research Scholar, PG and Research Dept. of commerce, Maharaja's College Ernakulam.

[2]Associate Professor, PG and Research Dept. of commerce, Maharaja's College Ernakulam.

[3]Research Scholar, PG and Research Dept. of commerce, Maharaja's College Ernakulam.

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ABSTRACT

Workplace inequality remains a persistent challenge affecting various dimensions of professional life, such as pay gaps, career progression, and organizational inclusion. Gender equalization is considered as an important goal of sustainable development. But in the current scenario representation of women in decision making is nominal which is evident from the statistical data published by reliable sources. This paper tries to present a theoretical framework for understanding workplace inequality by analyzing its causes, manifestations, and changes on employees and their professional growth. The study synthesizes existing literature, identifies key factors contributing to glass ceiling and professional growth, and suggests avenues for addressing these disparities.

Corresponding Author:

Cilla Joseph K.

PG and Research Department of Commerce

Maharaja's College Ernakulam.

Introduction

The “glass ceiling” refers to a hidden yet impassable barrier that impede certain groups, particularly women, racial minorities, and other marginalized individuals, from reaching the high level management within organizations (Morrison & Von Glinow, 1990; Sashi& Rajiv, 2019).This term was first conceived by Ann Morrison in the 1980s later on attained importance through The Wall Street journal’s corporate women–a column1983, still the situation remains the same in many areas. According to the report of the International labour organisation in 2021-22, 32.8% of women of working age (15 years and above) were in the labour force in India, which was a 9.5% increase from 2017-18, but the women representation remains imbalanced against total women labour in force. Recent global gender gap report 2024 by the World economic forum states that women’s participation in the total labour force is 42% and only 31.7% in leadership roles, termed it as “drop to the top”. India falls at 129th position among 146 countries, in which the women participation in the labour force is only 37 percent .The report also states that it will take another 134 years to build a complete gender equality (world economic forum 2024). Even though companies continuously strive to support diversity and inclusion, the glass ceiling still exists based on gender, race, income level, and other factors. Employees face barriers in career advancement, wage disparities, and limited access to leadership roles. This study point out the root causes and effects of glass ceiling on professional growth.

Objectives

- To explore the theoretical perspective of glass ceiling.
- To identify key factors contributing to glass ceiling.
- To propose a model for the relationship of glass ceiling and professional growth by identifying organisational justice as a moderating variable.

Methodology

In this study an extensive literature synthesis is conducted through reviewing the existing literature which helps to identify the common variables, factors and consequences. Theoretical analysis helps to get an insight into the key theories relevant to the topic, which motivates to develop relations between variables in the proposed conceptual model.

Review of literature

According to Thushar Agarwal (2013), Delrose Noronha (2019), Bombuwela P.M and De Alwis (2012), P V Nilufer (2018), Dr.Jojo K Joseph, Jikky P Shaji (2021) individual factors, family factors, cultural factors, gender stereotype, organisational factors play important role to decide the existence of glass ceiling and all these antecedents have negative influence on the professional growth of women employees. Rajvirkaur (2019), María Paz Espinosa & Eva Ferreira (2022), Sewon Min & Borham Yoon (2021) these studies find that the major consequences of glass ceiling on women employees are turn over intention, job dissatisfaction, increase in job stress which lead to health issues, reduction in work engagement and performance. In the current scenario women employability increased a lot but their representation in the decision making role is limited (Sharjeel et.al 2017, Kiaye and Singh, 2013), this mismatch in career occurs mainly because of the discrimination based on gender along with other factors. According to the data published by fortune 500 as of June 2024 only 10.4% of companies are led by women CEOs, where women participation in the US workforce is having an average of 46.1%.

Many women succeed to start a career for themself but their career progression is too slow or remains as a dream for them. The barriers they need to cross to reach at key position in an organisation still exist, in spite of the fact that many gender equity norms and policies formulated by different authorities'(Davidson & Burke, 2012;Sashi & Rajiv,2019).This invisible barrier that act as an obstacle for women and minorities to climb the professional career is termed as glass ceiling. In his research, Brenda J. Wrigley (2002) developed an innovative theoretical concept for negotiated resignation, in which he used to analyse the psychological consequences of encountering a glass ceiling. The study's findings include the development of techniques and initiatives to mitigate the impact of these invisible barriers and point-out the respondents' attitudes towards glass ceiling. Rajvir Kaur (2019) unequal treatment, a hostile work environment, gender discrimination, biased company policies, family obligations, and an unbalanced work-family schedule are the main obstacles to the success of women managers. Women and minorities are prevented from attaining executive roles by an invisible barrier. Since she teaches material engineering, the paper explains how the term "glass ceiling" might be applied to metaphorically represent this invisible barrier. In all of these fields, the ratio of men to women was not justified, indicating that discrimination was present Valerie Randle (1999).

Women and minorities in the workforce suffer a critical issue known as the “glass ceiling” in their corporate ladder. Fapohunda, Tinuke, M. (2018). Samuel Amakye, Victor Chimhutu& Ernest Darkwah (2022) analysed how some women break the glass ceiling and attain their current position as organizational heads. The study followed a phenomenological design to analyse the data. Sharjeel Saleem, Asia Rafiq, SaquibYusaf, (2017) in their study found that the antecedents for glass ceiling were the gender of the board of directors, training and development, and stereotype attitudes towards women and all these factors have an effect on the promotion and selection of female employees as well as their effectiveness. The data analysed using correlation and regression projected a negative correlation between the glass ceiling's antecedents, selection and promotion and female effectiveness. A positive attitude towards women's employment but there is exiting gender bias that limits the females from reaching executive posts (RabiaNaguib, MuznahMadeeha, 2023).

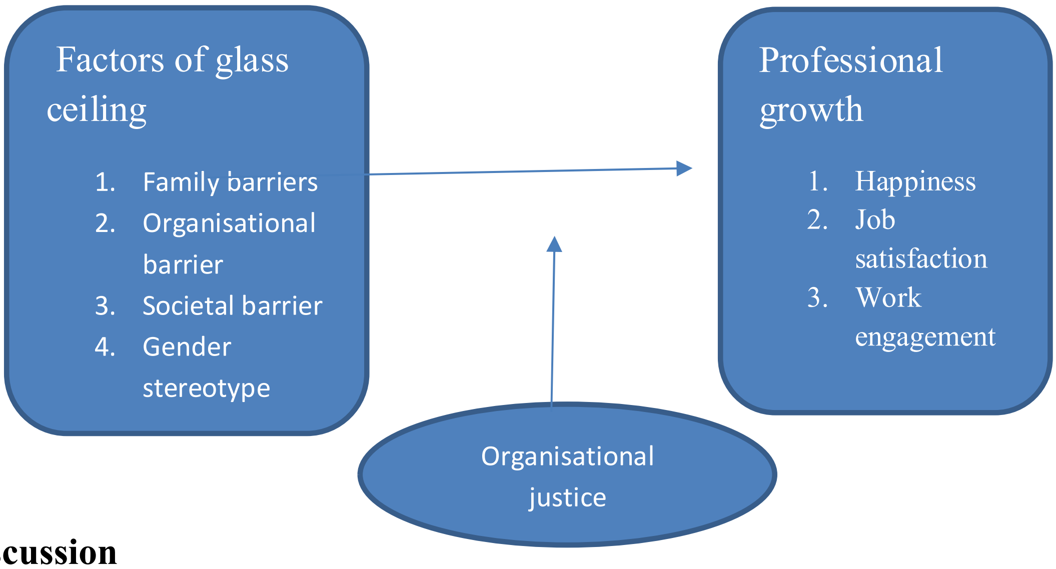
Background theories

According to Social Role Theory, men and women in the society are assigned different spaces to perform and how these role plays affect the organizational structure (Eagly et al., 1981). The theory suggests that all human beings are believed to have natural qualities that make them better suited for specific roles. Eagly (1997) explain how gender differences shape their roles in society and influence their behavior. This theory states that, these gender-based expectations lead to men being seen as the primary providers, making it more acceptable for them to hold higher positions in organizations, which act as an obstacle for women when trying to advance in their careers (Schneider &Bos, 2019).Women's performance is negatively affected by gender stereotype. They are often considered as less competent, which results in them receiving fewer opportunities, resources, and support for professional growth (Scalambrino& Lowery, 2017). Person centered theory suggested that the men and women have different in their behavioural characteristics and traits. And also argued that women's value and way of thinking are different from men. (Schein 1973, Lamsa et al 2000).Bias centered theory exhibit the unfair treatment of women due to stereotypes and past experience. And also suggested that they are less suitable for the leadership roles and they discriminated against because of this thought (Schein 1973, 1975).

Equity theory deals with fairness in social exchange relationships. It suggested that individuals compare their own efforts and rewards with others to assess whether they are treated fairly or not. Structure centered theory deals with how the social structures like, institutions, policies, cultural norms influences the behaviour and opportunities of the individuals. Inequalities such as gender disparities are shaped by these structures. Theory of Justice formulated by Rawlsian (1958), was to this study adopts because of its relevance in selecting moderating variable as organizational justice this theory put forward the three main aspects such as procedural justice, distributive justice, and interactive justice all this helps in maintaining ethical considerations in an institution. According to Rawls (1973), the nutshell principle of this theory is that all should be treated fairly and ensures them equal opportunities. So the institution is required adopt anti-discriminant strategies for all. It also emphasizes women's representation in leadership; they should be empowered to key decision-making processes. The taxonomy of organizational justice theory proposed by Greenberg's (1987) is also relevant in this context of this study. Organizations often focus on procedural justice while overlooking distributive and interactive justice (Fia & Sacconi, 2019).

Organizations that implement all three aspects of justice are more likely to reduce barriers such as the glass ceiling (Nesarat & Mathew, 2017). Therefore, this theory played an important role in selecting organizational justice as the moderating factor in this study.

Proposed Model



Discussion

Women and minorities in various fields continues to face a major barrier to their professional growth is termed the glass ceiling. Even though women in workforce increase, their representation in executive and executive roles remains limited (Sharjeel et al., 2017; Kiaye & Singh, 2013). Rajvir Kaur (2019) identified key obstacles such as unequal treatment, a hostile work environment, and discrimination on the basis of gender, biased company policies, family obligations, and an imbalanced work-family schedule as factors preventing women from reaching leadership roles. Further studies (Agarwal, 2013; Noronha, 2019; Bombuwela & De Alwis, 2012; Nilufer, 2018; Joseph & Shaji, 2021) highlighted multiple factors contributing to glass ceiling. It includes individual limitations, family responsibilities, cultural expectations, gender stereotypes, and organizational biases, all of which negatively impact the career prospects of women employees. Family responsibilities, challenges in work-life balance, and traditional gender roles are the major societal barriers that lead to glass ceiling. Women always continue to bear the primary responsibility for childcare and household duties, it result limitations in the career progression. Therefore family commitments act a significant obstacle to their professional growth (Eghlidi & Karimi, 2020; Da Silva et al., 2022). The primary bread winners of the family is perceived as men and fewer family related roles, focused skill development and advanced leadership make them prefer for the higher levels. (Mkhatshwa & Genc, 2022; Wolfgram et al., 2020). Organizational barriers arise as a results of unfair workplace policies, hiring, promotion practices, performance assessments, and training programs (Ramos et al., 2022). Lack of understanding of women's experiences, biases in promotion criteria contributes to the "glass ceiling," and which is preventing women from reaching in executive positions (Mahal, 2014). The effect of the glass ceiling have been extensively studied, by the researchers like Kaur (2019), Espinosa & Ferreira (2022), and Min & Yoon (2021) linking it to higher turnover intentions, job dissatisfaction, increased work stress, health issues, and lower work engagement and the performance.

All these key factors contributing to glass ceiling (societal, organisational, family and cultural) lead to negative professional growth which can be decreased by moderator: organisational justice, which contribute positively to career advancement (Greenberg's 1987, Colquitt 2001, Watanabe, K. S., & Kwarteng, A. H. 2024). Organizational justice can be classified in to Distributive Justice, Procedural Justice Interactional Justice. Distributive justice is deals with the fair allocation of organizational resources, outcomes, and career opportunities. Equal distribution and fairness in dealings results have equal access to women in resources, empowering them to enhance their skills and professional growth (Wesarat & Mathew, 2017). When organizations adopt the equitable resource distribution, both men and women got equal treatment, thereby it reducing societal barriers to professional growth (Foley et al., 2002). Distributive justice applies in financial and non-financial rewards, such as bonuses linked to performance goals. Equitable distribution ensures that the women receive fair recognition and opportunities for development (Qu et al., 2020). In addition, distributive justice can helps in minimize organizational barriers, including gender-biased policies and the lack of institutional support for women's leadership progression (Akpebuadjah & Van der Walt, 2019). Procedural justice indicate fairness in decision-making processes within every organization. It ensures that all employees have equal access to promotions, training, and leadership opportunities without any kind of discrimination (Brown et al., 2010).

True application of procedural justice ensured, the women to acquire the skills, resources, and knowledge necessary to progress into top management positions. So every organization must implement six key principles to maintain fairness in both decision-making procedures (Yunita & Darma, 2020). Fairness in interpersonal treatment and communication between employees and management results interactional justice and it consists of two main aspects such as Interpersonal justice and Informational justice. To respect and courtesy in workplace interactions is known as the interpersonal justice. Informational justice, which means the adequacy and timeliness of information provided by management (Colquitt, 2001). The phenomenological study by Fapohunda, Tinuke, M. (2018), and Amakye, Chimhutu & Darkwah (2022) covered the understanding about glass ceiling of women who cracked the same. Their findings suggested that age, workplace perceptions, discrimination, sexism, and prejudices influenced career advancement. In addition, gender composition in boardrooms, training and development opportunities, and stereotypical attitudes were identified as critical factors affecting women's selection, promotion, and effectiveness in leadership roles (Sharjeel Saleem, Asia Rafiq, & Saquib Yusaf, 2017).

CONCLUSION

Even though women's workforce participation has increased, their professional growth remains disproportionately slow, and even much lower in leadership roles (Davidson & Burke, 2012; Sashi & Rajiv, 2019). According to the data published by Fortune 500 (June 2024) revealed that only 10.4% of companies are led by women CEOs, despite women constituting 46.1% of the U.S. workforce. This significant gap underscores the existence of the glass ceiling despite gender equity policies and diversity initiatives.The study provides critical insights into the factors contributing to the glass ceiling and its consequences on the professional growth based on the theoretical frameworks. Which provides a basis for understanding its complexities, and empirical evidence underscores the need for systemic change.

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