ISSN: 3009-0016

International Journal of Management Thinking (IJMT) is an open access, peer-reviewed international journal that deals with both applied and theoretical issues in the field of Management.

To be included in the journal, a manuscript must make empirical, theoretical, and methodological contributions in the field of management science.

Generally, accepted papers will appear online within 2-3 weeks. The journal publishes original papers including but not limited to the following fields:

- Management Thinking
- Leadership and Management
- Project Management
- Operations Management
- Supply chain Management
- Organizational management
- Education Management
- Economic Thinking
- Environmental management
- Construction management
- Tourism management
- Human resource management
- Natural resource management
- Waste management
- Water Management
- Flood Management
- Information Management
- Learning management
- Data Management

International Journal of Management Thinking (IJMT) operates through the peer-review process and is associated with United Frontiers Publisher. It is not associated with or does not represent any governmental, non-governmental organization, or any public or private university.

Editorial Board

Table of Contents

Vol.2, Issue.1, (2024)

International Journal of Management Thinking
https://doi.org/10.56868/ijmt.v2i1.53

Optimizing Ecotourism in North Taihu Lake, Wuxi City, China: Integrating Back Propagation Neural Networks and Ant-Colony Algorithm for Sustainable Route Planning

Na Li[1], Siti Zubaidah Binti Mohd Ariffin[2*], Heng Gao[3]

1-2. Faculty of Management and Economics, Universiti Pendidikan Sultan Idris, Perak, 35900. Malaysia
1. International Business School, *Xi'an* FanYi University, *Xi'an*, 710105 China
3. School of Marketing and Management, Asia Pacific University of Technology & Innovation, Kuala Lumpur, 57000, Malaysia

Article Information

Article Type: Research Article

Dates:
Received: January 14, 2024
Revised: March 21, 2024
Accepted: March 28, 2024
Available online: April 05, 2024

Corresponding Author:
Na Li
540967275@qq.com
https://orcid.org/0009-0005-36362665

ABSTRACT

Urbanization's rapid pace has sparked a growing interest in nature-based travel experiences, highlighting the growing importance of ecotourism. This study presents an innovative algorithm for ecotourism route planning, focusing on aligning tourists with picturesque attractions of nature to enhance growth and appeal. The research utilizes ecological attractions in the Taihu Lake scenic area as an experimental dataset, incorporating historical travel data to examine the relationship between user characteristics and ecotourism attractions. Backpropagation neural networks and one-hot encoding are employed to predict visitor experiences. At the same time, a new ecotourism route design method combining deep learning and an ant colony algorithm based on average distance is applied to formulate an optimal ecotourism route. Results indicate Yuan Tou Zhu and Ling Shan as the top recommended destinations, with the optimal path identified as 1, 2, 3, 6, 4, 5, 7. This suggests that considering individual tourist preferences significantly elevates visitor satisfaction in ecotourism route planning, and it reveals the positive impact of aligning tourist attributes with attraction features. The findings underscore the importance of integrating user preferences into ecotourism planning strategies. Prioritizing personalized tourist experiences significantly enhances the effectiveness of ecotourism route planning initiatives. The research contributes a comprehensive framework for revitalizing ecotourism in the digital age, recommending the prioritization of individual tourist inclinations and attraction compatibility. Furthermore, adopting deep learning techniques and one-hot encoding is suggested to enhance the accuracy and efficacy of ecotourism planning.

Keywords: Ecotourism; Ant-colony Algorithm; Deep Learning; One-hot Encoding; Visitor Satisfaction

1. INTRODUCTION

The International Ecotourism Association Society (TIES) defined ecotourism in 1991, describing it as a form of responsible travel to natural regions that aims to safeguard the environment and enhance the well-being of local communities (Pathak et al., 2023). The main idea of ecotourism encompasses several vital principles (Pathak et al., 2023). Firstly, there is an emphasis on mitigating adverse effects on the environment. Secondly, ecotourism seeks to foster an understanding and appreciation of a destination's natural and cultural aspects.

Furthermore, it aims to create a positive and enriching experience for visitors and residents. Additionally, ecotourism endeavors to generate direct economic gains by contributing to conservation efforts. Moreover, it strives to provide economic benefits and empower local communities (Hatma et al., 2022). Ecotourism aims to cultivate a heightened awareness and sensitivity towards the host country's political, environmental, and social dynamics. The Quebec Ecotourism Declaration, established in 2002, acknowledges the fundamental tenets of sustainable tourism regarding the economic, social, and environmental ramifications associated with tourism (Baloch et al., 2022). The proclamation stipulates that ecotourism should actively contribute to preserving both natural and cultural heritage. This entails the inclusion of local and indigenous populations in planning, developing, and operating ecotourism activities, aiming to enhance their overall welfare (Quintana, 2020).

The study on ecotourism in China was commenced in 1992. It has demonstrated significant advancements over the past three decades, including the conceptual understanding of ecotourism, its environmental implications, community involvement, and educational contributions (Rahman et al., 2022). The concept of ecological civilization, proposed and further developed at the 18th National Congress of the Communist Party of China, has led to a growing interest in ecotourism. Ecotourism, characterized by its environmentally friendly approach, minimizes resource consumption and emphasizes on ecological sharing, and aligns well with the principles of ecological civilization (Lin et al., 2022). As a result, the ecotourism market has experienced significant growth, leading to increased research and exploration of ecotourism theory and practice.

The eco-cultural tourism circuit in this study about Taihu Lake primarily comprises four towns: Suzhou, Wuxi, Changzhou, and Huzhou. These cities are intricately linked with other major urban centres such as Shanghai, Nanjing, Zhenjiang, Jiaxing, Hangzhou, and Ningbo. In recent years, these four cities have collaboratively organized the inaugural International Tourism Festival around Taihu Lake, the Yangtze River Delta Integrated Cultural Tourism Summit and the Cultural Tourism Industry Forum around Taihu Lake. Additionally, they have collectively introduced the cultural tourism brand "Ten Sights around Taihu Lake" and curated boutique routes featuring attractions such as Huzhou Taihu Dragon Dream, Nanxun Ancient Town, Changzhou Dinosaur Park, Yancheng in spring and autumn, Wuxi Nianhuawan Town, and Suzhou Taihu Lake.

The objective is to collaboratively safeguard the advancement and establishment of Taihu Lake while concurrently fostering the growth of ecotourism in the surrounding area. Sustainable tourism encounters challenges related to a singular development model, limited product diversity, and a lack of core competitiveness (Rahman et al., 2022). Consequently, there is a need to boost customer satisfaction and service quality and strengthen the potential to drive economic growth in surrounding areas. Meanwhile, with the advancement of information technology, there has been a growing trend among individuals to utilize online tourism platforms to plan their trip routes. This facilitates the ability of online platforms to further promote ecotourism. However, suggesting tourist sites based on user preferences necessitates analyzing and manipulating a substantial volume of user feature data. When developing travel itineraries for consumers, it is imperative to carefully curate a selection of acceptable attractions from a vast array of options and construct a well-suited path. Many methodologies, including multiple linear regression, collaborative filtering, deep learning, matrix decomposition, and association rule learning, examine user characteristics and recommend attractions. The travel route planning problem here is an NP (Non-deterministic Polynomial)-complex problem (Yahi et al., 2015). Utilizing a heuristic algorithm is a practical approach to resolving this challenge (Gavalas et al., 2015).

Liang et al. (2021) use an ant colony algorithm to solve the trip planning problem considering distance and scenic spot comfort ratio. However, only some distinctive data analysis methodologies are available to develop a tourism recommendation system. Meanwhile, the travel planning algorithm needs to consider the degree of compatibility between attractions and travelers. This study presents a novel approach for ecotourism route planning by integrating deep learning and an ant colony algorithm. This study aims to enhance the competitive edge of the Taihu Lake scenic area in ecotourism by proposing a novel ecotourism route design method that integrates deep learning and an ant colony algorithm. The effectiveness of this method is tested through its application in the tourism planning of the North Taihu Lake Scenic area. Integrating the recommendation factor, derived from the back propagation (BP) neural network algorithm, into the iterative process of the ant colony algorithm is a crucial focus of this research.

This integration underscores the inherent connection between visitors and attractions in Wuxi, fostering a tailored experience that heightens visitor satisfaction and reinforces the principles of ecotourism and sustainability. Combining these advanced techniques, the study seeks to provide a comprehensive approach to ecotourism route planning, prioritizing individual preferences and attraction compatibility. This contributes to the scenic area's attractiveness and aligns with the broader goals of promoting responsible and sustainable tourism practices. The validation of this methodology in the North Taihu Lake Scenic area emphasizes its potential applicability in real-world ecotourism planning scenarios.

2. LITERATURE REVIEW

The rising ecotourism sector has gained significant recognition within the tourism industry due to its capacity to promote sustainable economic development while preserving natural resources (Kiper, 2013). Nevertheless, despite its optimistic trajectory, ecotourism encounters numerous hurdles, particularly in the era of digital technology (Mileti et al., 2022). Route planning is a crucial element within the realm of ecotourism, attracting considerable interest from scholars on a global scale. Various studies have proposed different models and algorithms to address the challenges of personalized route planning in ecotourism.

Lv (2022) designed an ecotourism personalized route planning system based on the ecological footprint model, considering the popularity of scenic spots and user preferences. Xie (2018) emphasized the importance of scientifically and rationally designed tourist routes to improve tourist satisfaction and promote the long-term development of tourist destinations, particularly in rural ecotourism. Yan (2022) proposed an improved interest field travel route planning model to enhance the personalization of tourism route planning by considering tourists' interests and using an intelligent interest field extraction model. These studies highlight the significance of route planning in ecotourism and provide valuable insights into optimizing tourist routes based on various factors and preferences.

This research aims to comprehensively examine the current body of literature on the challenges encountered in ecotourism, with a specific focus on the importance of route planning in its progression. This review will underscore the research deficiencies in the Wuxi tourist region, highlighting the relevance and urgency of the present study. A multitude of academics have extensively examined many obstacles encountered within the realm of ecotourism. Some researchers emphasize the inherent contradiction of increased tourism and the imperative to preserve the ecosystem (Zeng et al., 2022).

The growing need for genuine experiences threatens the fragile equilibrium of indigenous ecosystems. Another viewpoint pertains to the amalgamation of information technology and ecotourism. The advent of the information age has provided various technological advancements that can enhance the overall tourist experience. The amalgamation of information technology and ecotourism has the potential to enhance the overall tourist experience. The information age has brought about technological advancements that can be utilized in the tourism industry (Zainol et al., 2023). Information and communication technologies (ICTs) facilitate global communication between the travel industry's suppliers, consumers, and intermediaries (Li et al., 2023).

Digital marketing strategies enabled by ICTs can be used to connect with tourists and provide them with diverse tour information and destination images (Khan et al., 2022). The use of ICT in tourism has revolutionized operations within the tourism distribution channel and has stimulated tourism in some countries, leading to further advancements in ICT (Bayrakci & Özcan, 2022). The use of ICTs, such as information and communication technologies, has significantly changed the dynamic nature of the tourist experience, allowing for increased consumer involvement and co-creation (Yetimoğlu, 2022).

Alharbe et al. (2023) present an algorithm for collaborative filtering that uses embeddings to recommend content to users by assessing similarity. The efficacy of the approach has been demonstrated. Oukawa et al. (2022) conducted a comparative analysis of multiple linear regression and random forest techniques for fine-scale modelling of urban heat islands. Nevertheless, these two approaches are better suited for scenarios involving a limited number of qualities. When the number of attributes exceeds a certain threshold, the accuracy of multiple linear regression fails to fulfil the desired criteria. Law et al. (2019) summarise the utilization of deep learning techniques in the context of travel demand forecasting. Subsequently, the researchers substantiate the efficacy of their proposed approach by presenting a case study involving travel to Macau. Association rule learning approaches are employed for pattern mining in tourism attraction (Versichele et al., 2014). During 15 days, 14 tourist sites and 14 hotels were monitored and recorded. The resulting data was then analyzed and visualized through visit pattern maps, effectively displaying the identified trends. Subsequently, the techniques for building a travel itinerary are presented.

The methods can be categorized into Exact Algorithms and Heuristic Algorithms. A summary of using the Dijkstra algorithm in the context of trip plan suggestions has been provided (Gunawan & Tho, 2021). The Dijkstra algorithm is a well-known and widely used precise method commonly employed to solve the travelling salesperson issue. However, the travel route planning is a (Non-deterministic Polynomial) NP-hard problem (Yahi et al., 2015). Utilizing a heuristic algorithm is a practical approach to resolving this challenge (Gavalas et al., 2015). Liang et al. (2021) use an ant colony algorithm to solve the trip planning problem considering distance and scenic spot comfort ratio. However, it is essential to acknowledge the potential problems of these advancements, as they may inadvertently dilute the fundamental principles of ecotourism, particularly the intimate connection with the natural environment.

2.1 Deep Learning on Scenic Spot

Neural networks, particularly back propagation networks, have been widely utilized in many recommendation systems (Ding et al., 2022). Forouzandeh et al. (2022) suggest a novel approach integrating an evolutionary algorithm with the Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS) model.

The individuals recommend tourist destinations based on their tastes and experiences. An & Moon (2022) employ sentiment analysis with the Convolutional neural networks-long-short term memory (CNN-LSTM) approach to provide recommendations for tourist destinations. Nevertheless, managing high concurrency scenarios poses a significant challenge. Nuanmeesri (2022) hopes to enhance community tourism in emerging cities by employing gamification techniques to enhance the quality of tourist products and services in offline and online operations, presenting a comprehensive framework for community recommendations. Our study employs targeted and suitable methodologies within our suggestion framework to advance the cause of sustainable tourism and ecotourism.

2.2 Route Planning

The area of ecotourism encompasses two distinct sorts of route planning methods: automatic planning and interactive planning. Automatic planning is concerned with applying path optimization algorithms to autonomously choose the most efficient route for a user based on predefined objectives. On the other hand, interactive planning utilizes interactive features, allowing users to carefully devise a comprehensive itinerary by choosing preferred destinations and waypoints. The methodology described in this passage pertains to automatic planning algorithms.

The problem of automatic route planning falls within the category of NP (Non-deterministic Polynomial)-hard problems within the field of path optimization (Tong et al., 2022). In order to address NP-hard issues, it is customary to employ optimization methods with a strong focus on heuristic algorithms. Heuristic algorithms can be classified into constructive and meta-heuristics (Pan et al., 2019). Constructive heuristics utilize iterative methods to incorporate nodes until a thorough solution is achieved gradually. This comprises methods that are based on greedy approaches (Chvatal, 1979), graph creation methods (Phillips et al., 2015) and methods that involve region partitioning (Horn, 1995). Such algorithms are characteristically efficient.

Nevertheless, owing to structural constraints, they are susceptible to landing in local optima, rendering the solution quality often suboptimal. Meta-heuristic algorithms expand the search spectrum and continuously employ iterative mechanisms to refine and derive superior solutions. However, the temporal and spatial overheads they incur are frequently prohibitive. Prevalent meta-heuristic algorithms include Genetic Algorithms (GA) (Baker & Ayechew, 2003), ant colony algorithms (Li et al., 2022) and water drop algorithms. Because of the small scale of the problem described in this paper, meta-heuristic can better solve the problem.

Building upon the existing literature, this study identifies a research gap in ecotourism, specifically in integrating route planning methodologies with sustainable practices, community engagement, and tourist satisfaction. Existing studies often focus on algorithmic efficiency or optimizing the tourist experience but tend to overlook the fundamental objectives of ecotourism, such as environmental conservation and local community welfare. Furthermore, there needs to be more connection between ecotourism route planning and tourist satisfaction, which is crucial for enhancing the overall quality of the ecotourism experience and ensuring long-term success in sustainable tourism practices. This research aims to bridge these gaps by developing a comprehensive route planning approach that utilizes advanced algorithms and upholds principles of ecological preservation, community development, and visitor contentment.

3. METHODOLOGY

The approach described in this article can be divided into two components: employing a deep learning methodology for suggesting points of interest and formulating an ecotourism route by utilizing an ant colony algorithm. This paper proposes a recommended method that utilizes Back Propagation Neural Networks (BPNN) as its underlying framework. The encoding approach utilized in this study is the one-hot method. It is imperative to adequately format and structure the data before training the neural network. Before analysis, the data must undergo a cleansing procedure to remove any irregularities and extreme values. Subsequently, encoding categorical features is necessary to make them comprehensible for the BP Neural Network. The One-Hot Encoding technique is widely employed in machine learning to manage categorical data. This technique is beneficial when dealing with categorical data, such as tourist preferences for specific types of destinations and past travel records, which cannot be directly fed into a neural network.

No mathematical link can be observed between various categories, such that the summing of Category 1 and 2 does not yield Category 3. To effectively tackle the matter under consideration, the technique of One-Hot Encoding is employed. This methodology transforms categorical variables into a binary representation, including 0s and 1s. Using this methodology, neural networks can significantly augment their predictive capacities. To provide an example, consider a characteristic referred to as "preferred type of destination" that includes three separate classifications: "beaches," "mountains," and "forests." To characterize this attribute, it can be encoded into three binary columns, each corresponding to a distinct category.

3.1 BP Neural Network

BP Neural Networks are one of the primary neural networks in deep learning. The BP neural network is trained using historical data of tourists, including their preferences, travel history, feedback on visited places, and more. It includes input layers, hidden layers and output layers.

- **Input Layer:** This consists of neurons equal to the number of features in our dataset. After being one-hot encoded, each feature represents an individual neuron.
- **Hidden Layers:** Depending on the complexity of the data, we have one or more hidden layers. These layers capture intricate patterns in the data which might not be visible at the higher level.
- **Output Layer**: It provides the list of recommended places of interest. The number of neurons here corresponds to the total number of tourist spots under consideration. Each neuron's activation level represents the recommendation score for a specific spot.

The distances between attractions are modified based on the recommendation ratings generated from the neural network as we integrate them into the Ant Colony Algorithm. Specifically, a high recommendation score can decrease the perceived distance, whilst a low recommendation score can magnify it. Making appropriate modifications guarantees that the recommended destinations will become more appealing to potential visitors, akin to ants in our analogy results and analysis.

4. RESULTS AND DISCUSSION

4.1 Ant Colony Algorithm

Step1: Initialization:

At the start, each ant is placed in a randomly chosen place of interest. Pheromone levels on all paths are initialized to a constant value.

Step2: Pheromone Update and Path Selection:

As ants travel on the paths, they leave pheromones proportional to the recommendation score and inversely proportional to the distance. It means a shorter path between higher recommended places will accumulate pheromones faster. The probability Pij of ant k moving from place i to place j is calculated and shown in Equation 1 (Lalbakhsh et al., 2013).

$$P_{ij}^{k} = \frac{\tau_{ij}^{\alpha} \times \eta_{ij}^{\beta}}{\sum \tau_{ik}^{\alpha} \times \eta_{ik}^{\beta}} \quad (1)$$

Where:

τ_{ij}^{α} Represents the pheromone on the path between places i and j.

η_{ij}^{β} Represents the desirability of the move, which is calculated based on the effective distance.

α and β represent parameters that control the influence of pheromone and effective distance.

4.2 Pheromone Evaporation

Over time, pheromones on paths evaporate, simulating the volatile nature of pheromones in the real world. This ensures that the algorithm does not converge prematurely and that the solutions will not be trapped in local optimal solutions.

4.3 Experiment

Several ecological attractions within the Wuxi Taihu Lake Scenic Area have been chosen as the experimental dataset to ascertain the efficacy of the methods posited in this study. In the initial phase, data was collected about the following attractions: Yuan Tou Zhu, Ling Shan, Chang Guang Xi, Mei Yuan, Xi Hui Gong Yuan, Nian Hua Wan, and Li Yuan. Their latitudes and longitudes are shown in Table 1. Regarding tourist information, we assembled the following data points: historical travel data of tourists, demographics and preferences of the tourists, including age, salary, gender, educational background, commonly used modes of transportation, typical transportation costs, and preferred accommodations.

Additionally, we acquired the driving route distances between these attractions, shown in Table 2. This was facilitated by utilizing the driving navigation API provided by Baidu Maps. The BP Neural Network trained the model using visitor data to forecast their preference levels for different sites. Comparative studies were undertaken to ascertain the one-hot encoding approach's efficacy. In the absence of one-hot encoding, a decrease in accuracy was seen with the progression of network training, suggesting the presence of mistakes in the training procedure.

In contrast, following the implementation of one-hot encoding, the accuracy of predictions exhibited a progressive improvement during the training process, eventually reaching a notable degree of precision. Figure 1 illustrates the comparison between the two. Then, we introduce an additional analytical dimension that amalgamates the recommended level of each attraction with their respective distances, resulting in a composite metric termed the recommendation index weighted distance'. This metric is pivotal in modelling the tourist's itinerary choices, as it inherently gravitates towards attractions that are both highly recommended and in closer proximity.

This approach aligns with the psychological preferences of tourists, potentially augmenting their satisfaction with the ecological tourism experience. This outcome serves as evidence supporting the effectiveness of employing this particular strategy. Finally, the recommendation score of each place of interest is shown in Table 3. Solving with the ant colony algorithm, the optimal path is 1, 2, 3, 6, 4, 5, and 7, shown in Figure 2. In conclusion, implementing information technology and big data in ecotourism significantly alters the visitor experience and the operational framework of the industry.

The optimization is conducted based on the following aspects:

(1) Customized travel experience: Most tourists are subjected to standardized and generalized recommendations within the conventional travel paradigm. However, by implementing informatization and utilizing big data, it has become feasible to offer personalized recommendations to individual visitors by considering their interests, travel history, and other pertinent data. This implies that individuals with a strong interest in bird watching may be advised to visit a nature reserve characterized by a diverse avian population instead of an area primarily focused on trekking activities. This greatly facilitates the advancement of ecotourism.

(2) Conservation of the biological environment: Specific recommendations can also facilitate improved management and allocation of visitor flows, thereby mitigating the impact on vulnerable ecological areas. For instance, if a particular region is undergoing ecological restoration or maintenance, the system can temporarily decrease its recommendations for that place until it is again deemed suitable for accommodating tourists.

(3) Novel marketing strategies: By leveraging extensive data analysis, ecotourism destinations can discern emerging market trends and potential avenues for devising inventive and focused marketing approaches. For instance, if the data indicates an increasing market demand for a specific ecological experience, the attraction might promptly adapt its promotional plan to cater to this desire.

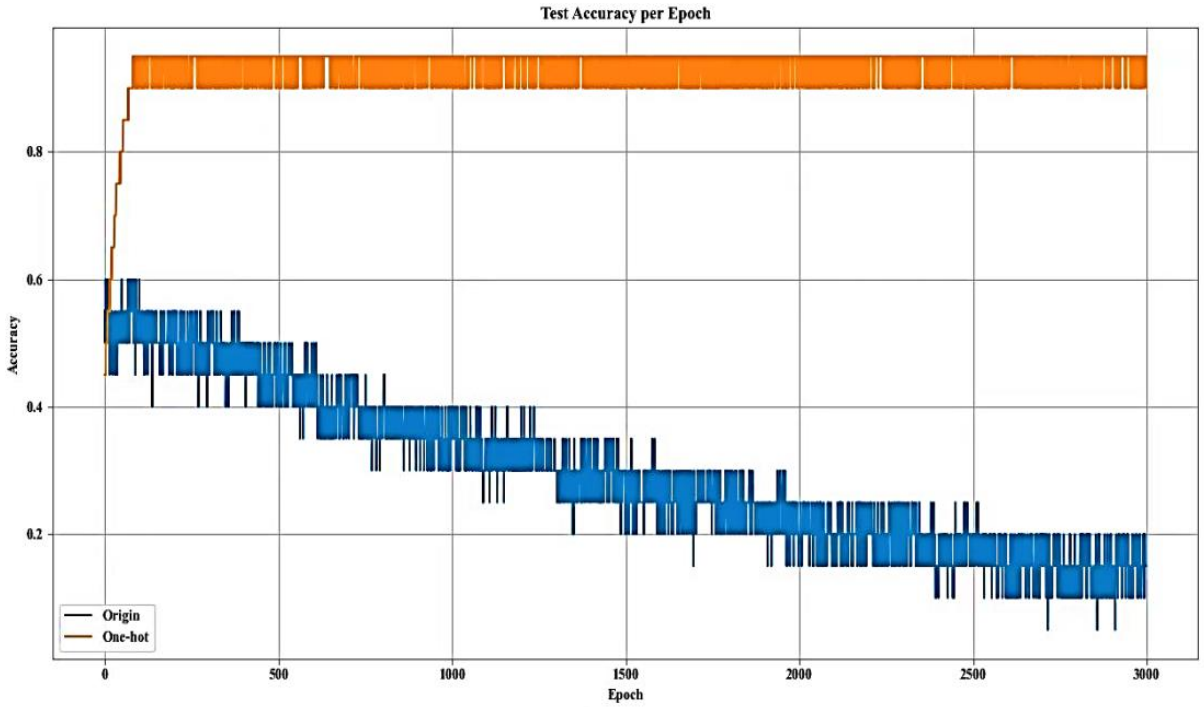

Figure 1. Compared Training

Table 1. Attractions List

No.	Attraction	Longitude	Latitude
1	Yuan to zhu	120.227995	31.517799
2	Chang guang xi	120. 268561	31. 470521
3	Ling shan	120. 31191	31. 491169
4	Mei yuan	120.226094	31.413655
5	Xi hui gong yuan	120.274968	31.556382
6	Nian hua wan	120.072299	31.577472
7	Li yuan	119.851	31.258125

Table 2. Details of Driving Distance Between Various Attractions

(km)	1	2	3	4	5	6	7
1	0	52.934	60.306	65.631	94.123	89.892	98.02
2	52.934	0	27.518	32.843	36.249	35.193	40.146
3	60.306	27.518	0	7.398	13.296	8.541	17.74
4	65.631	32.843	7.398	0	8.396	12.115	13.124
5	94.123	36.249	13.296	8.396	0	13.532	6.388
6	89.892	35.193	8.541	12.115	13.532	0	15.499
7	98.02	40.146	17.74	13.124	6.388	15.499	0

Table 3. Recommendation Score

No	Attraction	Score
1	Yuan tou zhu	0.95
2	Ling shan	0.95
3	Chang guang xi	0.4
4	Mei yuan	0.5
5	Xi hui gong yuan	0.8
6	Nian hua wan	0.6
7	Li yuan	0.4

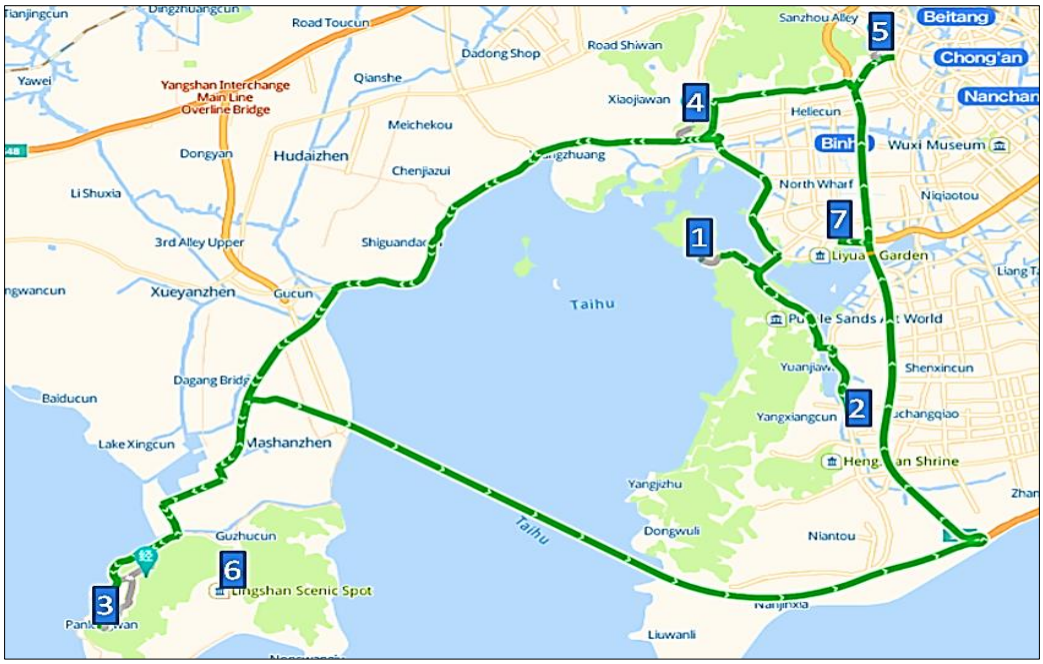

Figure 2. Travel Plan Result of North Taihu Lake

4.4 Discussion

Incorporating the comparative analysis with existing models and the synthesis of the proposed methodology into your original discussion enhances its depth and context. The simple shortest distance path planning scheme, without considering the satisfaction of tourists, may encounter unsatisfactory scenic spots at the beginning, and it is easier for tourists to directly terminate the trip, which is not conducive to the sustainable development of eco-tourism. In contrast, the path planning with recommendation index gives priority to the preference of tourists.

Under the algorithm model of ant colony algorithm and the recommendation method of back propagation neural network as the underlying framework, the recommendation of scenic spots and historic sites is completed, which improves the accuracy and effectiveness of path planning. In this paper, we propose a personalized travel route recommendation algorithm, which utilizes social scores and location scores of attractions based on crowd perception, as well as the driving distance between attractions, and the user's personal spatiotemporal accessibility value is integrated into this comprehensive score. This study tries to make the route planning of tourist attractions on the basis of tourist satisfaction. Previous studies have shown that tourists' preference for scenic spots has become an important factor in their choice of travel path and directly affects a pleasant travel experience. In this study, constraints such as location point, user movement trajectory, and user preference are taken as constraints, and constraints are taken as influencing factors for path planning, which is obviously superior in path planning and it is consistent with previous studies (Liang et al., 2021).

Comparative analyses with existing ecotourism models reveal that while many focus on individual aspects such as environmental conservation or economic development, few offer a holistic integration of these factors (Cabral & Dhar, 2020). The proposed methodology's comprehensive approach, leveraging deep learning and ant colony algorithms, demonstrates superior efficacy in addressing the multifaceted nature of sustainable tourism.

This study also uses deep learning technology and one-hot encoding to significantly improve the effectiveness and accuracy of the ecotourism route planning plan. Finally, it plans the optimal tourism path, providing a comprehensive framework for revitalizing ecotourism in the digital age, consistent with previous studies (Li et al., 2022). In addition, ecotourism conforms to the concept of sustainable development and has excellent market development potential. Integrating technological innovations with ecotourism principles presents a robust framework for the sector's revitalization in the digital era. Our study's emphasis on integrating technological innovations with ecotourism principles reflects a broader commitment to sustainable development and showcases the market's vast potential. By prioritizing tourist satisfaction and leveraging the capabilities of advanced computational techniques, this study offers insightful perspectives on the potential of technology to revolutionize ecotourism, underscoring the importance of sustainable practices and personalized experiences in fostering a deeper connection between tourists and the natural world.

5. CONCLUSION AND RECOMMENDATIONS

This study explores the interconnection between ecotourism, advanced information technology, and travel recommendation systems in the context of Wuxi, a prominent tourist destination in China. This study presents an innovative approach combining deep learning and the Ant Colony Algorithm to optimize ecotourism route designs. Integrating the ant colony algorithm with a recommendation factor based on the BP Neural Network facilitates a more profound synchronization between the tastes of tourists and the diverse range of attractions, particularly in locations such as Wuxi. This collaborative effort lays a significant emphasis on promoting the principles of sustainable tourism. In order to handle the non-numeric tourist data, the technique of One-Hot Encoding is employed, which improves the accuracy of recommendations. The primary focus of this study revolves around the experimental validation of the natural attractions inside the North Wuxi Taihu Lake Scenic Area.

The system collects a wide range of data about landscape attractions and tourist preferences, including various aspects such as demography, travel history, and other relevant factors. The driving distance for routes connecting these sites, particularly within Wuxi, are obtained from the driving navigation application programming interface (API) provided by Baidu Maps.

A significant discovery highlights the effectiveness of the one-hot encoding technique. Without its application, the model's training accuracy rapidly diminished. On the other hand, using this technique resulted in a consistent improvement in prediction accuracy. The study holistically presents an innovative approach for developing ecotourism trip plans using deep learning and heuristic algorithms and sheds light on Wuxi's potential and contributions in this field. The ultimate objective is to provide accurate and tailored advice for tourists, thereby emphasizing and conserving Wuxi's cultural and historical assets for future generations.

Finally, adopting advanced technologies within the ecotourism sector is an enhancement and a necessity for modernizing and elevating the overall tourist experience. Our recommendation focuses on harnessing technologies such as deep learning algorithms, the Ant Colony Algorithm, and One-Hot Encoding to significantly improve the precision of travel recommendations, thereby ensuring that each tourist's experience is as rewarding and personalized as possible. The core advantage of integrating advanced technologies is their ability to process and analyze vast datasets, capturing nuanced tourist preferences and behaviors.

By leveraging deep learning, stakeholders can develop systems that accurately predict individual preferences, offering recommendations that align with each visitor's unique interests and desires. For example, tourists interested in serene, nature-centric activities could receive suggestions for tranquil lakeside spots or secluded nature trails rather than bustling urban centers. Advanced technologies enable the creation of dynamic, personalized travel itineraries that adapt to real-time feedback and changes according to tourist preferences. This adaptability improves the tourist experience and boosts satisfaction by personally making tourists feel understood and valued. The application of algorithms like the Ant Colony Algorithm, which simulates decision-making like natural ant colonies, can optimize route planning in real time, ensuring that tourists can enjoy a seamless experience that maximizes their enjoyment and engagement with the destination.

6. LIMITATIONS AND FUTURE STUDIES

The dataset used in this study is limited to the Taihu Lake scenic area located in Wuxi, China. Due to geographical constraint, the suggested ecotourism route planning algorithm may have limited applicability to other regions with distinct eco-attractions and tourist profiles. Furthermore, it is essential to note that the historical travel data utilized for research may not comprehensively encompass evolving travel patterns and preferences. This limitation could impact the algorithm's capacity to adapt effectively to shifting visitor behaviour.

Moreover, the research mainly utilized quantitative data while neglecting to thoroughly investigate qualitative dimensions, such as cultural, social, and economic determinants that impact ecotourism. Implementing in-depth qualitative analytical methods, such as interviews and surveys, can achieve a more comprehensive understanding of the aspects that influence ecotourism experiences. In addition, integrating real-time data and monitoring visitor behavior will enhance the advancement of dynamic and adaptive algorithms. Investigating the incorporation of developing technologies, like artificial intelligence and augmented reality, can offer inventive solutions for customized ecotourism experiences, going beyond the scope of deep learning. Collaborative research across many fields, such as ecology, sociology, and technology, enhances our awareness of the various aspects of the changing digital era that affect the planning of ecotourism routes.

Acknowledgements: We sincerely thank the scenic spots and tourists who facilitated this research. Special thanks to Dr. Lei Jia for valuable writing suggestions and to Dr. Wang Yi for the thorough review and revision of the paper.

Author(s) Contributions: Conceptualization, Na Li; Methodology, Na Li; Software and Validation, Na Li and Heng Gao; Formal analysis, Na Li; Investigation, Siti Zubaidah Mohd Ariffin; Writing-original draft preparation, Na Li and Heng Gao; Writing Review and Editing, Siti Zubaidah Mohd Ariffin; Supervision, Siti Zubaidah Mohd Ariffin; Project administration, Siti Zubaidah Mohd Ariffin; Funding Acquisition, Na Li and Heng Gao. All authors have read and agreed to the published version of the manuscript.

Ethical Statement: The author(s) has obtained permission from the host department at Xi'an FanYi University. The researcher explained the study's objectives before interviewing the respondents. The respondents were assured that the information would only be used for research purposes. They were also told they could withdraw from the interview at any stage if they felt uneasy or did not want to continue.

Competing Interests: The author(s) declared that this work has no competing interests.

Consent to Participate: It is not applicable considering the nature of the study.

Grant/Funding Information: The author(s) declared that no grants supported this work.

Data Availability Statement: The associated data is available upon request from the corresponding author.

Declaration Statement of Generative AI: The author(s) of this work declared that they did not use any AI tools or program/software to draft this paper.

REFERENCES

Alharbe, N., Rakrouki, M. A., & Aljohani, A. (2023). A collaborative filtering recommendation algorithm based on embedding representation. *Expert Systems with Applications*, *215*, 119380. https://Doi.Org/10.1016/J.Eswa.2022.119380

An, H. W., & Moon, N. (2022). Design of recommendation system for tourist spots using sentiment analysis based on CNN-LSTM. *Journal of Ambient Intelligence and Humanized Computing*, 1-11. https://doi: 10.1007/S12652-019-01521-W

Baker, B. M., & Ayechew, M. (2003). A genetic algorithm for the vehicle routing problem. *Computers & Operations Research*, *30*(5), 787-800. https://doi.org/10.1016/S0305-0548(02)00051-5

Baloch, Q. B., Shah, S. N., Iqbal, N., Sheeraz, M., Asadullah, M., Mahar, S., & Khan, A. U. (2022). Impact of tourism development upon environmental sustainability: A suggested framework for sustainable ecotourism. *Environmental Science and Pollution Research*, *30*(3), 5917-5930. https://doi.org/10.1007/s11356-022-22496-w

Bayrakci, S., & Özcan, C. C. (2022). Relationship between ICT and tourism: The case of Mediterranean countries. In *ICT as Innovator Between Tourism and Culture* (pp. 138-154). IGI Global. https://doi.org/10.4018/978-1-7998-8165-0.ch009

Cabral, C., & Dhar, R. L. (2020). Ecotourism research in India: From an integrative literature review to a future research framework. *Journal of Ecotourism, 19*(1), 23-49. https://doi.org/10.1080/14724049.2019.1625359

Ding, J., Wang, G., Chu, Y., Dong, T., Cai, Y., & Chen, C. (2022, April). Advantages of BP neural network in sports tourism management system. In *International Conference on Multi-modal Information Analytics* (pp. 880-886). Cham: Springer International Publishing. https://doi.org/10.1007/978-3-031-05484-6_116

Forouzandeh, S., Rostami, M., & Berahmand, K. (2022). A hybrid method for recommendation systems based on tourism with an evolutionary algorithm and TOPSIS model. *Fuzzy Information and Engineering*, *14*(1), 26-50. https://doi.org/10.1080/16168658.2021.2019430

Gavalas, D., Konstantopoulos, C., Mastakas, K., Pantziou, G., & Vathis, N. (2015). Heuristics for the time-dependent team orienteering problem: Application to tourist route planning. *Computers & Operations Research*, *62*, 36-50. https://doi.org/10.1016/j.cor.2015.03.016

Gunawan, E. P., & Tho, C. (2021, August). Development of an application for tourism route recommendations with the Dijkstra algorithm. In *2021 International Conference on Information Management and Technology (ICIMTech)* (pp. 343-347), IEEE. https://doi.org/10.1109/ICIMTech53080.2021.9534998

Hatma Indra Jaya, P., Izudin, A., & Aditya, R. (2022). The role of ecotourism in developing local communities in Indonesia. *Journal of Ecotourism*, *23*(1), 20-37. https://doi.org/10.1080/14724049.2022.2117368

Horn, M. E. (1995). Solution techniques for large regional partitioning problems. *Geographical Analysis*, *27*(3), 230-248. https://doi.org/10.1111/j.1538-4632.1995.tb00907.x

Khan, M. M., Siddique, M., Yasir, M., Qureshi, M. I., Khan, N., & Safdar, M. Z. (2022). The significance of digital marketing in shaping ecotourism behaviour through destination image. *Sustainability*, *14*(12), 7395. https://doi.org/10.3390/su14127395

Kiper, T. (2013). *Role of ecotourism in sustainable development.* In M. Özyavuz (Ed.), Advances in Landscape Architecture. Intech Open. http://dx.doi.org/10.5772/55749

Lalbakhsh, P., Zaeri, B., & Lalbakhsh, A. (2013). An improved model of ant colony optimization using a novel pheromone update strategy. *IEICE TRANSACTIONS on Information and Systems*, *96*(11), 2309-2318. https://doi.org/10.1587/transinf.E96.D.2309

Law, R., Li, G., Fong, D. K. C., & Han, X. (2019). Tourism demand forecasting: A deep learning approach. *Annals of tourism research*, *75*, 410-423. https://doi.org/10.1016/j.annals.2019.01.014

Li, P., Zhou, Y., & Huang, S. (2023). Role of information technology in developing e-tourism marketing: A contextual suggestion. *Economic Analysis and Policy*, *78*, 307-318. https://doi.org/10.1016/j.eap.2023.03.010

Li, S., Luo, T., Wang, L., Xing, L., & Ren, T. (2022). Tourism route optimization is based on improved knowledge of the ant colony algorithm. *Complex & Intelligent Systems*, *8*(5), 3973-3988. https://doi.org/10.1007/s40747-021-00635-z

Liang, S., Jiao, T., Du, W., & Qu, S. (2021). An improved ant colony optimization algorithm based on context for tourism route planning. In D. Oliva (Ed.), *PLOS One*, *16*(9), e0257317. https://doi.org/10.1371/journal.pone.0257317

Lin, Y., Yang, Y., Li, P., Feng, C., Ding, J., Zhou, J., Jiang, Q., & Ye, G. (2022). Spatial-temporal evaluation of marine ecological civilization of Zhejiang Province, China. *Marine Policy*, *135*, 104835. https://doi.org/10.1016/j.marpol.2021.104835

Lv, H. (2022). [Retracted] A design of the ecotourism individualized route planning system based on the ecological footprint model. *Computational Intelligence and Neuroscience*, (15), 1-11 https://doi.org/10.1155/2022/6342696

Mileti, F. A., Miranda, P., Langella, G., Pacciarelli, M., De Michele, C., Manna, P., Bancheri, M., & Terribile, F. (2022). A geospatial decision support system for ecotourism: A case study in the Campania region of Italy. *Land Use Policy, 118*, 106131. https://doi.org/10.1016/j.landusepol.2022.106131

Nuanmeesri, S. (2022). Developing community tourism enhancement in emerging cities using gamification and adaptive tourism recommendations. *Journal of King Saud University-Computer and Information Sciences*, *34*(10), 8549-8563. https://doi.org/10.1016/j.jksuci.2021.04.007

Oukawa, G. Y., Krecl, P., & Targino, A. C. (2022). Fine-scale modelling of the urban heat island: A comparison of multiple linear regression and random forest approaches. *Science of the Total Environment*, *815*, 152836. https://doi.org/10.1016/j.scitotenv.2021.152836

Pan, Q. K., Gao, L., Xin-Yu, L., & Jose, F. M. (2019). Effective constructive heuristics and meta-heuristics for the distributed assembly permutation flow shop scheduling problem. *Applied Soft Computing*, *81*, 105492. https://doi.org/10.1016/j.asoc.2019.105492

Pathak, R., Bhadauria, A. S., Chaudhary, M., Verma, H., Mathur, P., Agrawal, M., & Singh, R. (2023). Role of ecotourism in conserving forest biomass: A mathematical model. *Computational and Mathematical Biophysics, 11(*1), https://doi.org/10.1515/cmb-2022-0153

Phillips, D. J., McGlaughlin, A., Ruth, D., Jager, L. R., Soldan, A., & Alzheimer's Disease Neuroimaging Initiative. (2015). Graph theoretic analysis of structural connectivity across the spectrum of Alzheimer's disease: The importance of graph creation methods. *NeuroImage: Clinical*, *7*, 377-390. https://doi.org/10.1016/j.nicl.2015.01.007

Quintana, V. M. (2020). *Eco-cultural tourism: Sustainable development and promotion of natural and cultural heritage.* In S. A. R. Khan (Ed.), Tourism (pp. 1- 17). Intech Open. https://doi.org/10.5772/intechopen.93897

Rahman, M. K., Masud, M. M., Akhtar, R., & Hossain, M. M. (2022). Impact of community participation on sustainable development of marine protected areas: Assessment of ecotourism development. *International Journal of Tourism Research*, *24*(1), 33-43.

https://doi.org/10.1002/jtr.2480
Tong, B., Wang, J., Wang, X., Zhou, F., Mao, X., & Zheng, W. (2022). Optimal route planning for truck–drone delivery using variable neighborhood tabu search algorithm. *Applied Sciences*, *12*(1), 529. https://doi.org/10.3390/app12010529
Versichele, M., De Groote, L., Bouuaert, M. C., Neutens, T., Moerman, I., & Van de Weghe, N. (2014). Pattern mining in tourist attraction visits through association rule learning on bluetooth tracking data: A Ghent, Belgium case study. *Tourism Management*, *44*, 67-81. https://doi.org/10.1016/j.tourman.2014.02.009
Xie, X. (2018). *Analysis of the sustainability of cultural tourism destinations in China from the tourist perspective: Case study of the ancient town of Wuzhen* [Master's thesis; Vancouver Island University]. www.leisurematterssviu.com/uploads/1/0/2/3/102377988/thesis-xiaosylviaxie.pdf
Yahi, A., Chassang, A., Raynaud, L., Duthil, H., Horng, D., & Aurigo, C. (2015). Auriga: An interactive tour planner for personalized itineraries. In *IUI '15: Proceedings of the 20th International Conference on Intelligent User Interfaces* (pp. 275 – 285). ACM Digital Library. https://doi.org/10.1145/2678025.2701366
Yan, L. (2022). Improved on-demand travel route planning model with interest fields. In Q. Li (Ed.), *Computational Intelligence and Neuroscience*, *Vol. 2022*, 1-12. Hindawi Limited. https://doi.org/10.1155/2022/6442441
Yetimoğlu, S. (2022). *The impact of technology applications on tourists' experiences.* In A. Hassan (Ed.), Handbook of Technology Application in Tourism in Asia (pp. 205-230). Springer Nature Singapore Pte Ltd. https://doi.org/10.1007/978-981-16-2210-6_10
Zainol, N. R., Abdullah, F. A., & Rahman, M. K. (2023). *I am exploring the digitalization-driven in innovative ecotourism sector.* In Social Entrepreneurship and Social Innovation in Ecotourism (pp. 61-84). Springer Nature Singapore. https://doi.org/10.1007/978-981-99-1827-05
Zeng, Y., Filimonau, V., Wang, L., & Zhong, L. (2022). The role of seasonality in assessments of conflict tendency between tourism development and ecological preservation in protected areas: The case of protected areas in China. *Journal of Environmental Management*, *304*(4), 114275. https://doi.org/10.1016/j.jenvman.2021.114275

Vol.2, Issue.1, (2024)
International Journal of Management Thinking
https://doi.org/10.56868/ijmt.v2i1.46

Financial Literacy's Moderating Effect on Project Selection with Heuristic-Driven Biases: SMEs' Entrepreneurial Market Development in Pakistan

Hira Asif[1*] and Mariam Mansoor[2]

1-2. Bahria Business School, Bahria University, Islamabad, 44000, Pakistan

Article Information

Article Type: Research Article

Dates:
Received: November 30, 2023
Revised: March 17, 2024
Accepted: April 11, 2024
Available online: May 08, 2024

Corresponding Author:
Hira Asif
hiraasifarsalan19@gmail.com
https://orcid.org/0000-0003-2232-5546

ABSTRACT

Certain biases on various project stages influence projects. Based on the moderating influence of financial literacy, the effect of heuristic-driven biases on project selection is evaluated in this research. The study aimed to evaluate how heuristics-driven biases affected the project management environment. A questionnaire with a five-point Likert scale is used to gather quantitative data. In this study, target's demographic comprises of project managers and other senior employees at Small and Medium Enterprises (SMEs) with more than five years of experience. This study involved 200 participants, but only 151 responses were deemed authentic. Convenience sampling is opted as the study's methodology. SPSS and Smart PLS3 are used for data analysis. The findings show that three behavioural biases, availability, representativeness, and under-confidence have a negligible influence on project selection; but two behavioural biases—overconfidence and anchoring have a favourable impact. The research asserts that individuals do not succumb to these biases in many SMEs. The findings indicate that financial literacy does not moderate the association between heuristic-driven biases and project selection. Entrepreneurs, managers, investors, and businesses will gain immensely. Business owners should detect heuristic-driven biases to make better judgements. Controlling heuristic biases helps entrepreneurs make better decisions and implement productive business strategies. This research will help business owners manage their heuristic biases and grab business opportunities without making costly mistakes. This study offers a unique opportunity and the potential to improve the knowledge of entrepreneurial managers about the impact of heuristic-driven biases in the context of project management.

Keywords: Financial Literacy; Cognitive Bias; Heuristic-Driven Bias; Entrepreneurial Decision-Making; Entrepreneurship and Project Management

1. INTRODUCTION

The decision-making process in project selection can be simple or complicated based on project size and type. Thus, the project manager's and entrepreneur's primary role is to judge which opportunities to pursue and how to capitalize on them (Shane & Venkataraman, 2000). Entrepreneurs often use heuristics in their business decisions (Pinto, 2014). As entrepreneurship has always been full of risks, good decision-making is crucial to succeed, no matter how much data and time you have. Moreover, limited time and money made it difficult for entrepreneurs to decide which opportunity is worth pursuing (Hjeij, 2022). On the other hand, adopting these heuristics with empirical study may result in better judgment and decision-making, severely affecting the organization's project management decisions (Adil et al., 2021; Simon, 1991).

Researchers concluded that investors like to operate rationally when deciding where to put their money (Kubilay & Bayrakdaroglu, 2016). People succumb to behavioural biases that have a detrimental influence on investment decisions and performance (Ahmad, 2020; Dangol & Manandhar, 2020; Khan et al., 2021). Facing time constraints, people tend to fall back on heuristics, which are defined as patterns, habits, or experiences they have had in the past (Goodie & Crooks, 2004). Available research in this regard suggests that the heuristics used by entrepreneurs and the effect that these heuristics have on project selection in developing countries need to be investigated (Ahmad, 2020).

Therefore, it is necessary to research how the qualities above impact the selection of projects and the behaviour of entrepreneurs. Similarly, it has been observed in practice and literature that the majority of business owners have a poor degree of financial literacy, and it is uncommon for them to evaluate the financial elements of the projects (Ahmad, 2020; Brundin & Gustafsson, 2013). As a result, financial literacy was chosen to function as a moderator in this study so that researchers could determine if heuristic-driven biases affected the project selection process (Ahmad et al., 2021; Hair Jr et al., 2021; Khan et al., 2021).

Due to a lack of relevant research in this area, behavioral finance has played only a minor role in managing decision-making processes in emerging markets; for instance, company owners are only sometimes aware of their own behavioural biases. Market fundamentals in emerging countries, such as Pakistan, vary from those in industrialized countries regarding investor psychology (Shah et al., 2018). Overconfidence affects a financier in a collectivistic society, leading to psychological biases in decision-making. reflects the collectivism prevalent in many Asian nations (Ranaweera & Kawshala, 2021).

Emerging economies like Pakistan have significant challenges, such as limited market access, data availability, funding, technology, bad laws, and a regulatory environment (Sherazi et al., 2013). As a result, small and medium-sized firms (SMEs) have a high failure rate, and business owners must make strategic decisions regarding their company. Different theoretical views characterize the link between heuristic-driven biases and decision-making. According to the bounded rationality theory, people's reason is restricted when making decisions.

The restrictions include the task's intricacy, the mind's cognitive ability, and the time available to decide. When decision-makers face perilous situations with great uncertainty, their reasoning suffers (Eisenhardt & Zbaracki, 1992; Pettigrew, 2014). Prospect theory states that people make decisions based on gains and losses, setting reference points and deciding whether or not to follow them (Kahneman & Tversky, 1979). People value gains and losses differently; some accept lower returns to prevent losing money, while others accept lower returns to avoid losing money in exchange for higher returns. Using heuristics to avoid losses in uncertain situations is a central concept of heuristics theory (Ritter, 2003).

Heuristics simplify the complexity of measuring probability and forecasting values. Heuristics is an effort-reduction method that employs one or more of the following: analysis of a few suggestions, integration of less information, or assessment of a few options (Shah & Oppenheimer, 2008). In light of the above, this research sought to assess the influence of heuristics on project selection, with financial literacy as a moderator. The study will focus on entrepreneurs, project directors, and project supervisors from Pakistani small and medium-sized enterprises (SMEs). The recent development of connections between China and Pakistan has spurred the negotiation of an agreement that will benefit all parties involved, not just these two. The cornerstone of China's $5 trillion One Belt, One Road (OBOR) investment strategy is the China-Pakistan Economic Corridor (CPEC) (Heydarian, 2020). The project was expected to give Pakistan's government a sizable economic incentive and attract more international investment (Hayat &Anwar, 2016).

Many academics agreed that CPEC could alter the course of history, as all international investors, including those from East Asia, the United States, and the European Union endorse (Ahmad et al., 2021; Akcam et al., 2019; Hayat & Anwar, 2016). Pakistanis have significant ownership and support for the CPEC project, especially when it comes to enhancing the region's tourist market, socioeconomic growth, eradicating poverty, and improving living conditions across various geographical regions (Menhas et al., 2019). Consequently, the local SME market would expand, positively affecting global economic cooperation. There will also be a greater need for future project selections, especially from emerging countries' perspectives, which might need additional studies in related field.

In context to Pakistan, completing this research's goal would provide the current literature with a more intriguing global perspective on developing countries, given that most of the literature in this field is produced in Western nations and developed countries. This study aims to identify heuristic biases that impact project selection. To identify impact levels of heuristic-driven biases on project selection, and to examine financial literacy as a moderator in the relationship between heuristic-driven biases and project selection, this research intends to investigate the following questions: Does heuristic-driven bias influence project selection? Does financial literacy moderate the relationship between heuristic-driven biases and project selection?

2. LITERATURE REVIEW

2.1 Project Selection

Project selection is a time-consuming procedure that considers the marketing environment and client wants. Most companies need more resources as well as a plethora of risks and possibilities. As a result, managers and entrepreneurs often cannot properly predict customer reactions, market potential, feasibility, and risks because they need crucial knowledge (Hammedi et al., 2011; Loch et al., 2008). Deciding which innovative projects to pursue directly influences a company's competitiveness and performance (Chao & Kavadias, 2008). Poorly assessed choices in terms of costs and benefits result in bad decisions. Decision-making traps may also cause decision-makers to make erroneous decisions based on heuristics and biases (Ahmad, 2020; Chao & Kavadias, 2008).

Strategic decisions are made when the resources and talents required to achieve strategic goals are committed to influencing organizational direction and structure and defining the destiny of a firm (Eisenhardt, 1999). They need both a reactive and proactive strategy. A variety of options impact individuals' strategic decisions. This category includes individual characteristics, prior experiences, and cognitive biases (West et al., 2008). These factors are important in strategic decision-making, as are intuition and emotional components (Fenton-O'Creevy et al., 2011).

2.2 Heuristics

Heuristics are efficient cognitive processes that intentionally or unintentionally dismiss specific information (Gigerenzer & Gaissmaier, 2011). Heuristics are the rules of thumb and mental shortcuts that govern management decisions during the start-up and management of a new business (Manimala, 1992). Entrepreneurs' heuristics are useful and favourable when decision-makers lack information and time (Waweru et al., 2008). They may, however, result in a sequence of errors in judgment (Ritter, 2003). Heuristics may be more accurate with minimal data than complex strategies (Gigerenzer & Gaissmaier, 2011).

Research suggests that in order to thrive in today's volatile environment, entrepreneurs must demonstrate the ability to function confidently and promptly under pressure (Bandura, 1997). As a consequence, entrepreneurs can only conduct business with the use of heuristics. Heuristics help entrepreneurs advance by implementing updated information and developing risk-averse strategies (Hackman & Wageman, 1995; Lyytinen et al., 1998). More often, relying on intuition and cognition, decision-making biases such as overconfidence attitudes are inherent in entrepreneurial characteristics (Baron, 1998). Small company owners lacking well-established decision-making styles are more susceptible to heuristics and biases than managers in large corporations (Busenitz & Barney, 1997). Entrepreneurs suffering from these biases are unaware of the risks of launching new enterprises. Consequently, they must be equipped to compete in the market (Simon et al., 2000).

Some of the most significant causes of heuristics and biases and their effects on new venture development have been studied. Although research in this field is sufficient, numerous unsolved problems remain like the exact nature of business heuristics and biases, the degree of relationship between heuristics and biases, the good and bad consequences, and how negative consequences can be mitigated. Even though past research has shown the relevance of cognitive biases in explaining entrepreneurial outcomes, further research is required (Gudmundsson & Lechner, 2013). Many behavioural biases may be observed among financial practitioners and corporate performers who use heuristics to make judgments. According to this research, overconfidence, representativeness, availability, anchoring and under confidence biases affect project selection.

2.3 Overconfidence Bias

Overconfidence is a cognitive heuristic bias characterized by unjustified reliance on one's intuition, reasoning, and cognitive abilities (Pompian, 2012). Investors are overconfident because initial investments are not sufficiently amended by investors after getting fresh facts (Simon et al., 2000). According to Gigerenzer et al. (2011), overconfidence favours the decision to start a firm. It may initially support entrepreneurs by assisting them in uncovering opportunities in difficult situations, providing them with energy and enthusiasm. According to some experts, overconfidence bias and decision-making are only sometimes favorable. Cognitive simplification processes, such as overconfidence, negatively impact choices and judgments (Nouri et al., 2018). Dangol and Manandhar (2020) show that the overconfidence bias has a detrimental influence on a capitalist's decision-making ability. The impact of overconfidence bias on Indian investors' choices was shown to be negligible in a study (Adil et al., 2021).

Overconfidence significantly impacts investment decisions (Adiputra, 2021). Investment decisions in the Indonesian stock market were found to be highly impacted by investors' overconfidence (Armansyah, 2021). It was found that millennial investors in Semarang City's stock market benefited from the influence of overconfidence (Adielyani & Mawardi, 2020). Overconfidence positively impacts investment decision-making (Nareswari et al., 2021). After examining past researches, we discovered the following relationship:

H1*: Overconfidence bias has a significant influence on project selection.*

2.4 Representativeness Biases

Representativeness is one of the most common decision-making biases. The cognitive heuristic bias known as 'representativeness' refers to mental shortcuts such as adopting mental stereotypes to make decisions (Shefrin, 2008). Because of their representativeness, people value current experiences more than long-term rates (Ritter, 2003). Preconceptions let Individuals make inappropriate predictions about current circumstances (Shefrin, 2008). The two types of representativeness bias are base-rate neglect and sample-size neglect. When making decisions on the outcome of an investment, the decision maker depends on faulty data (Pompian, 2012). This is referred to as base-rate neglect. Decision-makers commit sample-size neglect when they base their conclusions on small samples.

Due to the representativeness heuristic bias, project selection and performance suffer. Representativeness cognitive biases hurt the quality of entrepreneurs' strategic decisions (Kudratova et al., 2018). In emerging businesses, applying representative heuristics may impede quality management decisions (Brundin & Gustafsson, 2013). The representativeness heuristic is particularly important for entrepreneurs making initial choices as it allows fast discovery of interesting prospects (Busenitz & Barney, 1997). Similar research discovered a link between representativeness bias and investing choices (Irshad et al., 2016; Toma, 2015). The research has indicated that representativeness bias positively impacts investment choices (Hirshleifer, 2001; Islam, 2012; Merikas et al., 2004). Investment choices are influenced favourably by representativeness, overconfidence, and anchoring (Rehan & Umer, 2017).

Overconfidence and representational heuristics considerably influence investor decision-making and stock market trading activity (Parveen et al., 2020). Representativeness, anchoring and overconfidence significantly affect investors (Raut et al., 2020). Both patterns' cognitive biases (representative and availability) are positively associated with entrepreneurial activity and performance (Zhang et al., 2020). Several cognitive biases had a positive and significant relationship with the intuitive side of investment decision-making, including overconfidence, representativeness, availability, and anchoring and adjustment biases (Lim & Oo, 2022). According to the findings of the empirical investigation, the following relationship is predicted:

H2*: Representativeness bias has a significant influence on project selection.*

2.5 Availability Bias

People prefer information that is easily available while making decisions. This is known as an 'availability cognitive heuristic bias (Ahmad et al., 2021). As a result, entrepreneurs use availability as a judgmental foundation for estimating an event's possibility by seeking easily recallable instances. The availability cognitive heuristic has a detrimental impact on project selection and entrepreneur performance. People use the availability heuristic to assess the probability of an event based on how soon relevant information comes to mind (Tversky & Kahneman, 1973). It has a detrimental impact on the decision-making process. Researchers found that cognitive heuristics like anchoring and availability impact risk perception, causing a choice bias (Gigerenzer et al., 2011). Availability influences investment choices favorably (Ikram, 2016; Khan, 2017). Investment choices are positively linked with availability and representativeness bias (Khan et al., 2021). Unit trust investors' investment decisions were found to be negatively impacted by availability bias but not by a statistically significant amount (Kigen, 2020).

H3: *Availability bias has a significant influence on project selection.*

2.6 Anchoring and Adjustment Bias

Anchoring and adjustment bias is a cognitive heuristic bias that occurs while making decisions and relies on the first piece of information supplied (the "anchor") (Ahmad et al., 2021). Anchoring and adjustment influence risk perception, resulting in skewed decision-making. Entrepreneurs tend to overestimate their chances of success owing to anchoring and adjustment bias, which may negatively influence their decisions. Another study in Ghana showed that investors are susceptible to anchoring Bias (Owusu & Laryea, 2022). Similarly, multiple behavioural biases (overconfidence and anchoring) were discovered in the sample of investors in the study (Quaicoe & Eleke-Aboagye, 2021).

Some researchers believe that anchoring and adjustment biases impede entrepreneurs' ability to establish a firm, manage cash, and network (Bruch & Feinberg, 2017). In contrast, others argue that anchoring has a favorable impact on investing choices (Ishfaq & Anjum, 2015; Parveen & Siddiqui, 2018). Representativeness, overconfidence, anchoring, and availability biases favorably correlate with investment performance (Aziz & Khan, 2016).

According to the research conducted in the Zimbabwe stock market, the following psychological biases have a role in investment decisions: anchoring, availability, gambler's fallacy, overconfidence, herding, loss aversion, mental accounting, regret aversion, and representativeness (Hunguru et al., 2020). The study in Nepal indicated that heuristics (such as anchoring, representative, overconfidence, and availability bias) have little bearing on investment returns (Pokharel, 2020); according to the research, anchoring and adjustment bias impact project selection directly or indirectly.

H4*: Anchoring and adjustment bias have a significant influence on project selection.*

2.7 Under Confidence Bias

Individuals with under-confidence bias, a heuristic-driven prejudice, underestimate their talents and knowledge (Mitchell et al., 2002). When an investor's subjective knowledge is diminished, that investor is considered unconfident. When investors need more confidence, they may be more inclined to invest or trade extensively because they think they better understand financial literacy (Pikulina et al., 2017). Investors in emerging markets may need to be more protected by under confidence bias in both the short and long run (Ahmad, 2020).

Project selection has a negative connection with the under-confidence Bias, showing that this prejudice impairs entrepreneurs' ability to make informed decisions. As a result, insecure company owners tend to overestimate their downside risk, resulting in inefficient start-up planning and financial management decisions that eventually contribute to the firm's collapse. Under-confidence negatively influences individuals' choices (Gigerenzer et al., 2011). According to the empirical investigation, the following link exists:

H5*: Under-confidence bias has a significant influence on project selection.*

2.8 Moderating Role of Financial Literacy

Financial literacy is a person's ability to understand and apply financial principles. According to Bruch and Feinberg (2017), SMEs in underdeveloped nations fail due to a lack of business awareness and financial understanding. Financial literacy positively moderates the connection between access to financing and growth for small and medium-sized firms (SMEs) (Huston, 2010; Mitchell et al., 2002).

According to a study, financial literacy favours company growth when resources are readily available, and firm owners have simple access to funding (Adomako & Danso, 2014). Financial literacy improves the relationship between firm growth and access to funding (Adomako et al., 2016). Another research looked at the association between financial literacy and the success of Nigerian SMEs (Eniola & Entebang, 2016). Other findings indicate that financial literacy moderate's overconfidence bias in the context of investing choices (Hayat & Anwar, 2016). Another research found that financial knowledge influences investing choices favorably (Khalid et al., 2018).

Financial knowledge, financial power, and financial behaviour all increase company success, according to other evidence (Menike, 2018). Bandung's working-age population's investment choices are significantly impacted by their level of financial literacy. When deciding whether or not to invest, financial literacy is a strong and positive factor (Adil et al., 2021). Therefore, the following hypotheses are assumed:

***H6**: Financial literacy moderates the relationship between overconfidence and project selection.*
***H7**: Financial literacy moderates the relationship between representativeness and project selection.*
***H8**: Financial literacy moderates the relationship between availability and project selection.*
***H9**: Financial literacy moderates the relationship between anchoring and project selection.*
***H10**: Financial literacy moderates the relationship between under-confidence and project selection.*

Within the scope of this investigation, heuristic-driven biases are treated as independent variables (i.e. overconfidence, availability, anchoring, representativeness and under-confidence). The dependent variable is project selection. The conceptual framework of the investigation is shown in Figure 1. The study model demonstrates a moderating function that financial literacy plays as a linkage between heuristic-driven biases and the selection of projects.

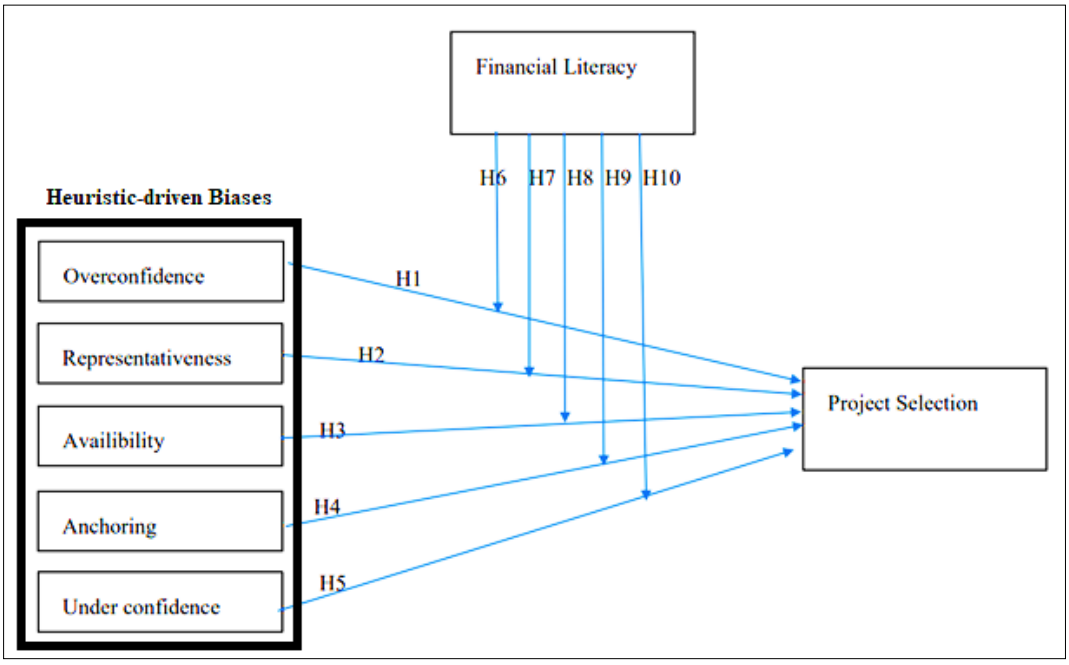

Figure 1. Theoretical Framework

3. RESEARCH METHODOLOGY

3.1 Research Design

In this study, data were quantified, using numerical values and statistical analysis rather than "qualitative" research techniques (Parylo, 2012). A survey was conducted to collect data quantitative data) from the respondents. The study used a questionnaire with a five-point Likert scale to gather quantitative data (from 1 [strongly disagree] to 5 [strongly agree]). Moreover, the study was based on cross-sectional data to empirically test the proposed hypothesis, model, and theories.

3.2 Data Instrumentation

Five questions from the research conducted by Qasim et al. (2019) were used to evaluate the overconfidence heuristic. Four items from Rasheed et al. (2018) were utilized to test the representativeness heuristics. The availability heuristic was tested using three items from Rasheed et al.'s (2018) study. The anchoring heuristic was measured using a scale adapted from Ul Abdin et al. (2017). Three questions from Sheldrake (2016) were used in the research to measure under-confidence. Eight distinct items were employed for the project selection dependent variable, taken from George's (2007) study. Four items from Kuria (2019) were utilized for the moderator which is financial literacy.

3.3 Data Collection and Sampling Techniques

The target group (SMEs in Pakistan) for our research comprises of business owners, project directors, and project supervisors from Rawalpindi and Islamabad due to their accessibility. Due to the diverse location, the target population was first divided into six (6) zones using cluster sampling techniques. In the second stage, systematic random sampling was applied to reduce the biases and reach the target population. Although a sample size of 200 was used in our study, only 151 authentic responses were acquired.

Given that it was more than the necessary minimum sample size (100, as recommended by Reinartz et al., 2009), the sample size was enough. Data were collected across 3.5 months at one point using a cross-sectional technique. Participants were given the questionnaires through social media (LinkedIn, WhatsApp) and email. Respondents were reassured of the confidentiality of the information. Furthermore, the data collection process followed all protocols to ensure data validity, authenticity, reliability, and meaningfulness.

4. RESULTS AND DISCUSSION

4.1 Demographics

Table 1 reveals the demographic information for the study. According to the statistics, over 33.8% of respondents worked as CEOs of businesses, followed by project directors (35.1%), project supervisors (29%), and others (just 2%). 78.1% of the population was male and 21.9% female. The age values show that 32.5% of respondents i.e., most of the respondents were between 26 and 30. A little over 29.8% of respondents were in the 31 to 35 age range. Additionally, 13.2% were between 36 and 40, and 15.2% were between 18 and 25. Only 9.3% of responders were in the age range of 46 to 50. Regarding education, 34.4% of respondents had a bachelor's degree, compared to 53.6% with a master. In addition, 1.3% had a Ph.D., 0.7% were internationally certified, and 0.7% had no formal education. 9.3% of the students also held an MBA.

Table 1. Demographics of the study

Gender		Frequency	Percent (%)
	Male	118	78.1
	Female	33	21.9
Age			
	18–25	23	15.2
	26–30	49	32.5
	31–35	45	29.8
	36–40	20	13.2
	46–50	14	9.3
Qualification			
	Masters	81	53.6
	Bachelors	52	34.4
	MBA	14	9.3
	Ph.D.	2	1.3
	NoFormal Education	1	0.7
Designation			
	CEO	51	33.8
	PD	53	35.1
	PS	44	29.1
	Others	3	2.0
	Total	151	100.0

Smart-PLS3 and SPSS were utilized to analyze the collected data. The structural equation modelling (SEM) approach was employed for hypothesis testing. Smart-PLS3 program was used for reflective measurements analysis. The structural model was used due to its numerous beneficial characteristics, including the heterotrait-monotrait (HTMT) criterion, bootstrap-based significance testing, Partial Least Square prediction, and goodness of fit. Moreover, Smart-PLS3 can manage normal and abnormal data and ensure consistency, reliability, and validity. Data was analyzed in two stages. First, the measuring model was used to investigate and construct validity, reliability, convergent validity, and discriminant validity. The second step created a structural model to test the idea (Hair et al., 2017).

4.2 Measurement Model Assessment

The model first measured instrument reliability and internal consistency using Cronbach's alpha (CA) and composite reliability (CR). These numbers fell between 0.550 and 0.831 for CA and 0.738 and 0.871 for CR. CA values between 0.5 and 0.7 were deemed as moderate (acceptable) dependability. According to the threshold, a CA of at least 0.8 indicates high dependability (Ekolu & Quainoo, 2019). Average Variance Extracted (AVE) must be more than 0.5 to prove convergent validity. However, convergent validity is sufficient and acceptable if AVE is less than 0.5 and CR is more than 0.6. (Fornell & Larcker, 1981). The values reveal that every CR number is higher than 0.6.

According to Table 2, only one AVE value is marginally below 0.5. A project selection item (P3) with an extremely low outer loading value was eliminated. After elimination, the outcomes could have improved. Items from outer loadings between 0.4 and 0.7 should only be removed if doing so raises the AVE value beyond the threshold value and values below 0.4 should be left alone (Hair Jr et al., 2017).

The research preserved these elements since removing them had no discernible impact on the AVE score. Another source claims that a loading value of 0.5 or greater is acceptable, whereas a value of less than 0.5 is deleted (Chin, 1998). As shown in Figure 2, all outside loading values are more than 0.5.

Table 2. Construct Validity and Reliability

Items		Factor Loadings	Cronbach's Alpha	Rho (ρ)	Composite Reliability	Average Variance Extracted (AVE)
ANC			0.550	0.570	0.735	0.415
	ANC1	0.726				
	ANC2	0.511				
	ANC3	0.741				
	ANC4	0.659				
AVB			0.831	0.809	0.871	0.696
	AVB1	0.809				
	AVB2	0.774				
	AVB3	0.631				
RP			0.641	0.668	0.797	0.569
	RP1	0.627				
	RP2	0.468				
	RP3	0.789				
	RP4	0.678				
OVC			0.777	0.840	0.839	0.516
	OVC1	0.790				
	OVC2	0.754				
	OVC3	0.524				
	OVC4	0.864				
	OVC5	0.803				
UCB			0.831	0.809	0.871	0.696
	UCB1	0.711				
	UCB 2	0.934				
	UCB 3	0.941				
FL			0.702	0.710	0.818	0.531
	FL1	0.726				
	FL2	0.817				
	FL3	0.666				
	FL4	0.696				
PS			0.787	0.792	0.845	0.539
	PS1	0.658				
	PS2	0.746				
	PS3	0.638				
	PS4	0.595				
	PS5	0.625				
	PS6	0.666				
	PS7	0.698				
	PS8	0.707				

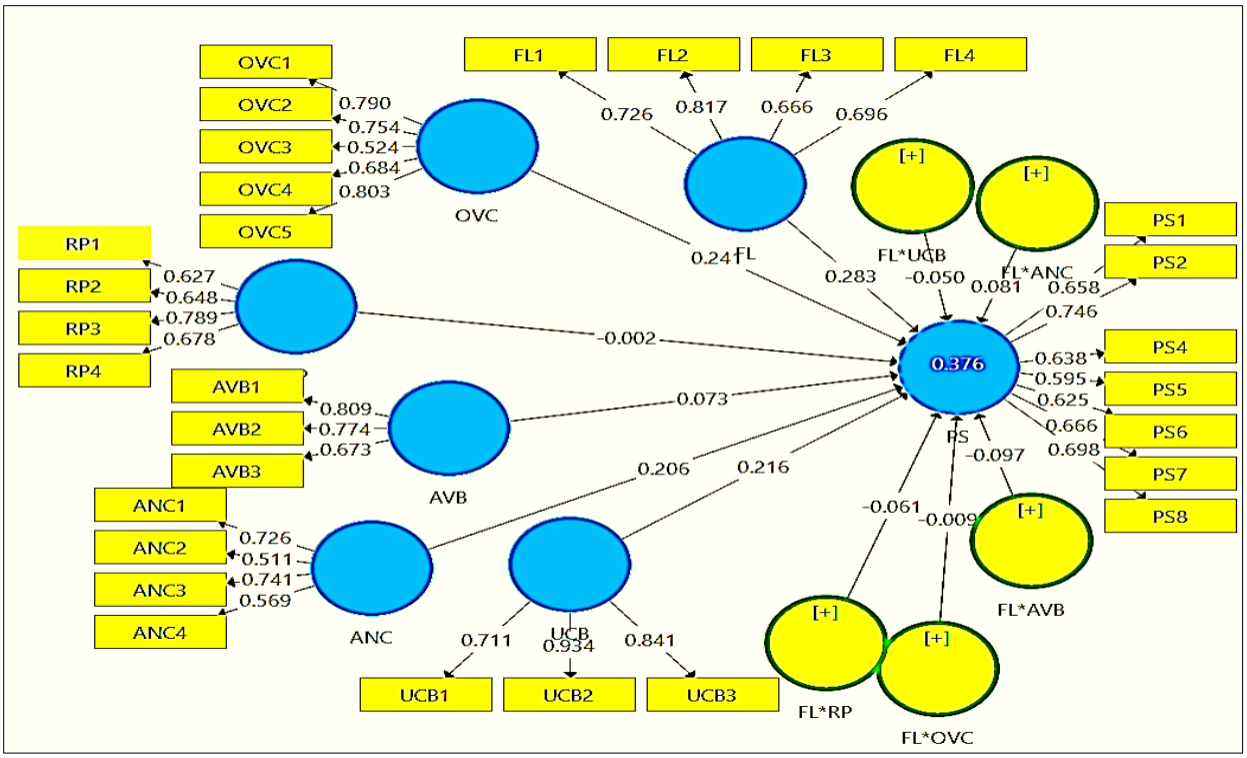

Figure 2. Measurement Model

The HTMT ratio approach was used to evaluate the constructs' discriminant validity. The discriminant validity of any pair of variables is established if the correlation values are less than 0.9. This approach was recommended by Henseler et al. (2015). Table 3 shows that both support values fall below the 0.9 cutoff.

Table 3. Discriminant Validity–HTMT

	ANC	AVB	FL	OVC	PS	RP	UCB
ANC							
AVB	**0.532**						
FL	0.590	**0.276**					
OVC	0.490	0.242	**0.403**				
PS	0.579	0.385	0.613	**0.402**			
RP	0.562	0.275	0.417	0.557	**0.341**		
UCB	0.253	0.480	0.156	0.388	0.208	**0.248**	

Fornell and Lacker (1981) are considered the initial criteria for discriminant validity. For this procedure to work, the square root of the construct's AVE must be greater than its inter-correlation values. As shown in Table 4, each construct's square root was greater than its corresponding inter-correlation value, supporting the model's discriminant validity. The values are given in Table 4.

Table 4. Fornell Lacker Values

Variables	ANC	AVB	FL	AVG	PS	RP	UCB
ANC	0.849						
AVB	0.636	0.839					
FL	0.717	0.738	0.803				
OVC	0.790	0.702	0.793	0.833			
PS	0.602	0.638	0.720	0.822	0.857		
RP	0.479	0.502	0.638	0.765	0.842	0.842	
UCB	0.738	0.692	0.730	0.788	0.762	0.790	0.816

4.3 Assessment of Structural Model

PLS-SEM uses six phases to evaluate the structural model's validity. First, it is crucial to evaluate the latent co-linearity problems, which were evaluated using the variance inflation factor (VIF). According to the protocols, VIF should be less than or equal to 5 (VIF = 5). R2 and F2 were also used to evaluate the structural model's importance and relevance. Moreover, Q2 evaluated the predictive relevance. Table 5 displays the values of the indicators above. The results are also supported by Figure 3.

Table 5. Assessment of Structural Model

R-Square	**Endogenous Variables**	**R Square**			**R Square Adjusted**	0.26: Substantial, 0.13: Moderate, 0.02: Weak
	PS	0.209			0.201	
Effect Size (F-square)	**Exogenous Variables**	**ANC**	**AVB**	**FL**	**OVC**	**RP**
	ANC	0.016	0.068	0.016	0.028	0.158
	AVB			0.084		
	FL			0.033		
	OVC			0.040		
	RP					
Co linearity (Inner VIF)	**Exogenous Variables**	**ANC**	**AVB**	**FL**	**OVC**	**RP**
	ANC	1.000	1.000	1.267	1.385	1.000
	AVB			1.048		
	FL			1.125		
	OVC			1.183		
	RP			1.728		
Predictive Relevance (Q-Square)	**Endogenous Variables**	**CCR**			**CCC**	
	ANC	0.010			0.593	
	AVB	0.036			0.487	
	FL	0.125			0.514	

VIF <= 5.0

Value larger than o indicates Predictive Relevance

OVC	0.093	0.609
RP	0.183	0.637

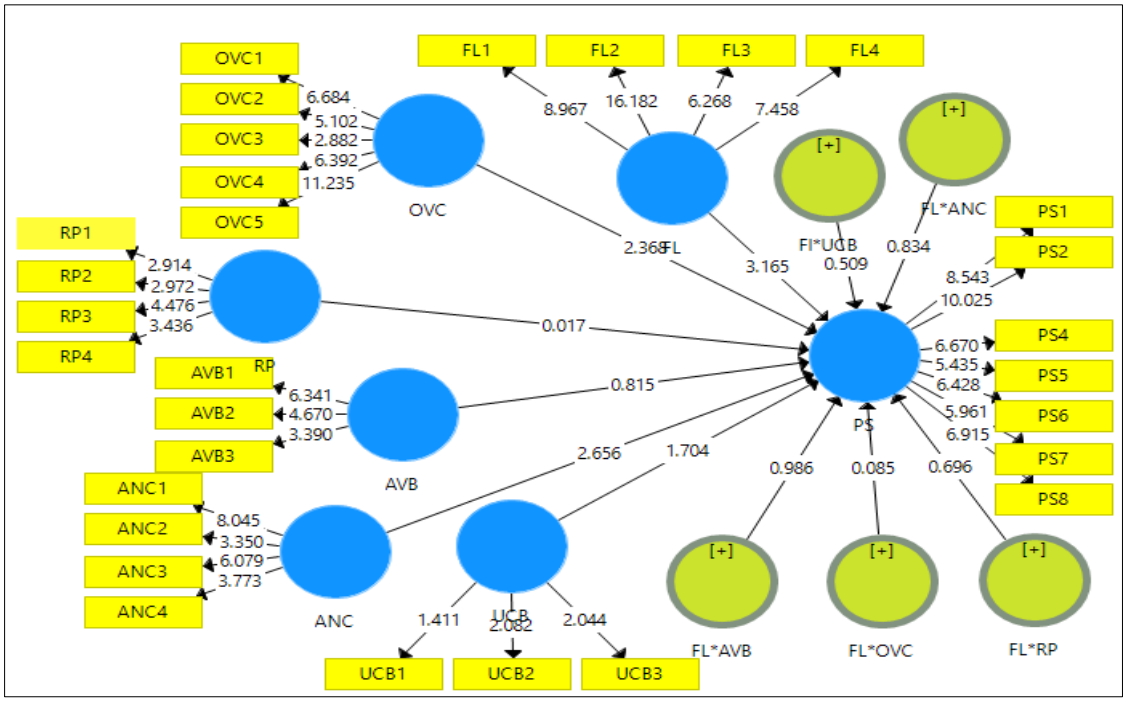

Figure 3. Structural Model

4.4 Hypothesis Testing

The importance of the relationship was determined by testing hypotheses in evaluating the goodness of fit. H1 states that overconfidence bias significantly influences project selection (PS). The result shows that overconfidence (OVC) has a significant influence on project selection ($\beta = 0.241$, $t = 2.507$, $p = 0.012$, $p < 0.05$). Hence, H1 is supported. Hypothesis H2 is between representativeness and project selection.

The results reveal that representativeness (RP) has an insignificant influence on project selection ($\beta = -0.002$, $t = 0.018$, $p = 0.986$, $p > 0.05$). Hence, H2 is not supported. H3 states that availability has a significant influence on project selection. The results show that availability (AVB) has an insignificant influence on project selection ($\beta = 0.073$, $t = 0.806$, $p = 0.420$, $p > 0.05$). Hence, H3 is also not supported. Anchoring and adjustment have a significant influence on PS. The results show that anchoring and adjustment (ANC) have a significant influence on project selection ($\beta = 0.206$, $t = 2.732$, $p = 0.006$, $p < 0.05$). Hence, H4 is supported by the study results.

H5 is that under-confidence has a significant influence on project selection. However, the results reveal that under-confidence (UCB) has an insignificant influence on project selection ($\beta = 0.216$, $t = 1.736$, $p = 0.083$, $p > 0.05$). Hence, H5 is not supported. Moderation analysis was conducted to check the moderating role of financial literacy. The results revealed that there was no significant moderating role of financial literacy between OVC and project selection ($\beta = -0.009$, $t = 0.084$, $p = 0.933$), representativeness and project selection ($\beta = -0.061$, $t = 0.722$, $p = 0.470$), availability and project selection ($\beta = -0.097$, $t = 0.992$, $p = 0.321$), anchoring and adjustment and project selection ($\beta = 0.081$, $t = 0.858$, $p = 0.391$) and UCB and project selection ($\beta = -0.050$, $t = 0.525$, $p = 0.600$). The results are listed in Table 6.

Table 6. Path Coefficient (Direct Effect) Result

Hypothesis	OS(Beta)	Mean (M)	S. D	T Statistics	P Values	Decision
ANC -> PS	0.206	0.211	0.075	2.656	0.006	Supported
AVB -> PS	0.073	0.085	0.091	0.815	0.420	Rejected
FL*ANC -> PS	0.081	0.065	0.094	0.834	0.391	Rejected
FL*AVB -> PS	−0.097	−0.084	0.097	0.986	0.321	Rejected
FL*OVC -> PS	−0.009	−0.034	0.112	0.085	0.933	Rejected
FL*RP -> PS	−0.061	−0.050	0.084	0.696	0.470	Rejected
FL*UCB -> PS	−0.050	−0.014	0.095	0.509	0.600	Rejected
OVC -> PS	0.241	0.248	0.096	2.368	0.012	Supported
RP -> PS	−0.002	0.025	0.094	0.017	0.986	Rejected
UCB -> PS	0.216	0.180	0.124	1.704	0.083	Rejected

4.5 Discussion

This study in Pakistan observed the impact of heuristic-driven biases on project selection. Moreover, whether financial literacy moderates the relationship between heuristic-driven biases and project selection was evaluated. To help entrepreneurs avoid making costly mistakes that may result from heuristic biases, the study suggested some solutions to overcome the negative effects. The results revealed that only two of five heuristic-driven biases (overconfidence and anchoring) significantly impact project selection. Furthermore, Smart PLS3 was used to check the moderating effect of financial literacy. The results showed that financial literacy does not moderate the relationship between heuristic-driven biases and project selection.

The findings showed that overconfidence has a positive significant impact on project selection, which is consistent with Alquraan et al. (2016); Alrabadi et al. (2018); Hayat and Anwar (2016); Qasim et al. (2019). According to Gigerenzer et al. (2011), overconfidence has a constructive effect on the choice to start a business. It might help entrepreneurs initially, uncover possibilities in challenging circumstances, and give them energy and passion. In addition, when one's knowledge and experience grow, one can easily become overconfident. Most respondents have a master's degree. The results show that anchoring and adjustment bias also positively affects project selection, which is consistent with the results found by Ishfaq and Anjum (2015). When making investment decisions, anchoring is useful (Suresh, 2013). In a risky environment where fast decisions are made by using overconfidence and anchoring bias; success, where the economy is notoriously unstable, is achieved (Quddoos et al., 2020).

The findings reveal that the rest of the heuristic-driven biases (availability, representativeness, and under-confidence) have insignificant influence on project selection. The most common biases in Islamabad and Rawalpindi SMEs are overconfidence and anchoring, which are positively related to project selection. Furthermore, financial literacy was analyzed as a moderator. The results showed that financial literacy does not moderate the relationship between heuristic-driven biases (overconfidence, availability, representativeness, anchoring, and under-confidence) and project selection.

This result is similar to the findings of Quddoos et al. (2020). Similarly, another study showed that financial literacy does not moderate the relationship between overconfidence and investment decisions (Novianggie & Asandimitra, 2019; Ranaweera & Kawshala, 2021). This result is probably obtained because entrepreneurs with basic financial literacy do not assist them in the uncertain financial environment. Moreover, according to another study, behavioural biases and financial literacy have no link (Sezer & Demir, 2015). Another reason could be that financial literacy may act as a mediator.

An entrepreneur's heuristics are helpful and advantageous when decision-makers have limited information or time to work with (Waweru et al., 2008). However, they may result in judgment blunders (Ritter, 2003). To avoid the negative effects of heuristics, entrepreneurs should use quantitative project selection methods, e.g. cost-benefit analysis, payback period, net present value, etc., to make a good decision and select the best option instead of relying on heuristics. People may learn to counteract the harmful effects of heuristic biases through time and experience (Anandarajan et al., 2008).

This study could improve entrepreneurial managers' knowledge of the impact of heuristic-driven biases. This study will greatly benefit entrepreneurs, managers, investors, and businesses. Entrepreneurs can make better decisions and follow effective strategies for better business opportunities by controlling the impact of their heuristic-driven biases. In addition, they will avoid costly blunders. Regarding the relationship between project selection and heuristics, this work will likely be one of the first in Pakistan because studies on heuristic-driven biases in Pakistan are scarce.

5. CONCLUSION AND RECOMMENDATIONS

This article in Pakistan observes the impact of heuristic-driven biases on project selection. The study also studied financial literacy as a moderator to check the relationship between heuristic-driven biases and project selection. To help entrepreneurs avoid making costly mistakes that may result from heuristic biases, we have proposed solutions to overcome their negative effects. A deductive approach was used since this study is grounded on the theoretical framework of behavioral finance.

It was found that while overconfidence and anchoring significantly influence project selection, the other heuristic-driven biases examined do not have a significant impact. Therefore, the study concludes that the heuristic approach is unsuitable when selecting a project, and entrepreneurs should focus on scientific studies and calculations. Additionally, financial literacy was found to have no moderation impact between these biases and project selection. These findings contribute to understanding how entrepreneurs make decisions and navigate biases in their decision-making processes. Entrepreneurs should employ quantitative project selection methods such as cost-benefit analysis, payback period, and net present value to mitigate the negative effects of heuristic-driven biases. Additionally, continuous learning and experience can help individuals counteract the harmful effects of biases over time. This study underscores the importance of improving financial literacy among entrepreneurs and managers and the need for further research. By recognizing and addressing heuristic biases, entrepreneurs can make more informed decisions and capitalize on better business opportunities, ultimately avoiding costly mistakes. Moreover, this study highlights the significance of exploring heuristic-driven biases in the context of Pakistan, which remains an understudied area in the literature. Further research in this field can contribute to a more comprehensive understanding of decision-making processes in entrepreneurial settings.

Author(s) Contributions: Conceptualization, Hira Asif; Methodology, Mariam Mansoor and Hira Asia; Software and Validation, Hire Asif; Formal analysis, Hira Asia; Investigation, Mariam Mansoor; Writing—original draft preparation, Hira Asif; Writing Review and Editing, Mariam Mansoor; Supervision; Mariam Mansoor; Project administration, Mariam Mansoor. All authors have read and agreed to the published version of the manuscript.

Ethical Statement: This study received written consent and ethical approval from Bahria University Islamabad and the school advisory board. All participants were formally informed verbally, and their consent was taken, which is confidential.

Competing Interests: The author(s) declared that this work has no competing interests.

Consent to Participate: As this study deals with human subjects, the collection of corresponding data or the concerning human rights issues are evaluated with informed consent.

Grant/Funding information: The author(s) declared that no grants supported this work.

Data Availability Statement: The associated data is available upon reasonable request from the corresponding author.

Declaration Statement of Generative AI: The author(s) of this work declared that they did not use any AI tools or program/software to draft this paper.

REFERENCES

Adielyani, D., & Mawardi, W. (2020). The influence of overconfidence, herding behaviour, and risk tolerance on stock investment decisions: The empirical study of millennial investors in Semarang City. *Jurnal Maksipreneur: Manajemen, Koperasi, dan Entrepreneurship*, *10*(1), 89-101. https://doi.org/10.30588/jmp.v10i1.691.

Adil, M., Singh, Y., & Ansari, M. S. (2021). How does financial literacy moderate the association between behaviour biases and investment decisions? *Asian Journal of Accounting Research*, *7*(1), 17-30. https://doi.org/10.1108/ajar-09-2020-0086

Adiputra, I. G. (2021). The influence of overconfidence, representative Bias, and risk tolerance in investment decision making: Evidence on stock investors in Indonesia. *Journal of Hunan University Natural Sciences*, *48*(4).

Adomako, S., & Danso, A. (2014). Financial Literacy and Firm Performance The moderating role of financial capital availability and resource flexibility. *International Journal of Management & Organizational Studies, 3(4).*

Adomako, S., Danso, A., & Ofori Damoah, J. (2016). The moderating influence of financial literacy on the relationship between access to finance and firm growth in Ghana. *Venture Capital*, *18*, 43-61. https://doi.org/10.1080/13691066.2015.1079952.

Ahmad, M. (2020). Does underconfidence matter in short-term and long-term investment decisions? Evidence from an emerging market. *Management Decision*, *59*(3), 692–709. https://doi.org/10.1108/MD-07-2019-0972

Ahmad, M., Shah, S. Z. A., & Abbass, Y. (2021). The role of heuristic-driven biases in entrepreneurial strategic decision-making: Evidence from an emerging economy. *Management Decision*, *59*(3), 669–691. https://doi.org/10.1108/MD-09-2019-1231.

Alquraan, T., Alqisie, A., & Al Shorafa, A. (2016). Do behavioural finance factors influence the stock investment decisions of individual investors? (Evidence from Saudi Stock Market). *American international journal of contemporary research*, *6*(3), 159-169.

Alrabadi, D. W. H., Al-Abdallah, S. Y., & Aljarayesh, N. I. A. (2018). Behavioural biases and investment performance: Does gender matter? Evidence from Amman Stock Exchange. *Jordan Journal of Economic Sciences*, *5*(1), 77-92.

Anandarajan, A., Kleinman, G., & Palmon, D. (2008). Novice and expert judgment in the presence of going concern uncertainty: The influence of heuristic biases and other relevant factors. *Managerial Auditing Journal*, *23*(4), 345-366. https://doi.org/10.1108/02686900810864309

Armansyah, R. F. (2021). Overconfidence, mental accounting, and loss aversion in investment decisions. *Journal of Auditing, Finance, and Forensic Accounting*, *9*(1), 44-53. https://doi.org/10.21107/jaffa.v9i1.10523

Aziz, B., & Khan, A. (2016). Behavioural factors influencing individual investor's investment decision and performance, Evidence from Pakistan Stock Exchange. *International journal of research in finance and marketing*, *6*(7), 74–86. http://euroasiapub.org/current.php?title=IJRFM

Bandura, A. (Ed.). (1997). The anatomy of stages of change. *American Journal of Health Promotion, 12*(1), 8–10. https://doi.org/10.4278/0890-1171-12.1.8

Baron, R. A. (1998). Cognitive mechanisms in entrepreneurship: Why and when entrepreneurs think differently. *Journal of Business Venturing*, *13*(4), 275–294. https://doi.org/10.1016/S0883-9026(97)00031-1

Bruch, E., & Feinberg, F. (2017). Decision-making processes in social contexts. *Annual Review of Sociology*, *43*, 207-227. https://doi.org/10.1146/annurev-soc-060116-053622

Brundin, E., & Gustafsson, V. (2013). Entrepreneurs' decision making under different levels of uncertainty: The role of emotions. *International Journal of Entrepreneurial Behavior & Research*, *19*(6), 568-591. https://doi.org/10.1108/IJEBR-07-2012-0074

Busenitz, L. W., & Barney, J. B. (1997). Differences between entrepreneurs and managers in large organizations: Biases and heuristics in strategic decision-making. *Journal of Business Venturing*, *12*(1), 9-30. https://doi.org/10.1016/S0883-9026(96)00003-1

Chao, R. O., & Kavadias, S. (2008). A theoretical framework for managing the new product development portfolio: When and how to use strategic buckets. *Management Science, 54*(5), 907-921. https://doi.org/10.1287/mnsc.1070.0828

Chin, W. W. (1998). The partial least squares approach to structural equation modelling. *Modern Methods for Business Research*, *295*(2), 295–336.

Dangol, J., & Manandhar, R. (2020). Impact of heuristics on investment decisions: The moderating role of locus of control. *Journal of Business and Social Sciences Research*, *5*(1), 1-14. https://doi.org/10.3126/jbssr.v5i1.30195.

Eisenhardt, K. M. (1999). Strategy as strategic decision making. *MIT Sloan Management Review*, *40*(3), 65-72. https://doi.org/10.1002/smj.4250130904

Eisenhardt, K. M., & Zbaracki, M. J. (1992). Strategic decision making. *Strategic Management Journal*, *13*(S2), 17-37. https://doi.org/10.1002/smj.4250130904.

Ekolu, S. O., & Quainoo, H. (2019). Reliability of assessments in engineering education using Cronbach's alpha, KR and split-half methods. *Global Journal of Engineering Education*, *21*(1), 24-29.

Eniola, A. A., & Entebang, H. (2016). Financial literacy and SME firm performance. *International Journal of Research Studies in Management*, *5*(1), 31-43. https://doi.org/10.5861/ijrsm.2015.1304

Fenton-O'Creevy, M., Soane, E., Nicholson, N., & Willman, P. (2011). Thinking, feeling and deciding: The influence of emotions on the decision making and performance of traders. *Journal of Organizational Behavior*, *32*(8), 1044–1061. https://doi.org/10.1002/job.720

Fornell, C., & Larcker, D. F. (1981). Evaluating structural equation models with unobservable variables and measurement error. *Journal of marketing research*, *18*(1), 39-50. https://doi.org/10.1177/002224378101800104.

George, B. A. (2007). *Strategic decision making in new ventures: The relationship between decision comprehensiveness and growth in differing environments* (Doctoral dissertation, Indiana University).

Gigerenzer, G. E., Hertwig, R. E., & Pachur, T. E. (2011). *Heuristics: The foundations of adaptive behaviour*. Oxford University Press. https://doi.org/10.1093/acprof:oso/9780195388435.003.0001

Gigerenzer, G., & Gaissmaier, W. (2011). Heuristic decision-making. *Annual Review of Psychology*, *62*, 451-482. https://doi.org/10.1146/annurev-psych-120709-145346.

Goodie, A. S., & Crooks, C. L. (2004). Time pressure affects performance in a base-rate task. *The Journal of General Psychology*, *131*(1), 18–28. https://doi.org/10.3200/GENP.131.1.18-28

Gudmundsson, S. V., & Lechner, C. (2013). Cognitive biases, organization, and entrepreneurial firm survival. *European Management Journal*, *31*(3), 278-294. https://doi.org/10.1016/j.emj.2013.01.001

Hackman, J. R., & Wageman, R. (1995). Total quality management: Empirical, conceptual, and practical issues. *Administrative Science Quarterly*, *40*(2), 309-342. https://doi.org/10.2307/2393640/

Hair Jr, J. F., Hult, G. T. M., Ringle, C. M., Sarstedt, M., Danks, N. P., & Ray, S. (2021). *Partial least squares structural equation modelling (PLS-SEM) using R: A workbook (1st Edition)*. Springer Nature. https://doi.org/10.1007/978-3-030-80519-7

Hair, J. F., Hult, G. T. M., Ringle, C. M., Sarstedt, M., & Thiele, K. O. (2017). Mirror, mirror on the wall: A comparative evaluation of composite-based structural equation modelling methods. *Journal of the Academy of Marketing Science*, *45*, 616-632. https://doi.org/10.1007/s11747-017-0517-x

Hammedi, W., van Riel, A. C., & Sasovova, Z. (2011). Antecedents and consequences of reflexivity in new product idea screening. *Journal of Product Innovation Management*, *28*(5), 662-679. https://doi.org/10.1111/j.1540-5885.2011.00831.x

Hayat, A., & Anwar, M. (2016). Impact of behavioural biases on investment decision; The moderating role of financial literacy. *SSRN Repository*. https://dx.doi.org/10.2139/ssrn.2842502

Heydarian, R. J.,(2020). The belt and road: China as the new vanguard of globalization. *The Indo-Pacific: Trump, China, and the New Struggle for Global Mastery*,119-147. Palgrave Macmillan, Singapore https://doi.org/10.1007/978-981-13-9799-8_5

Henseler, J., Ringle, C. M., & Sarstedt, M. (2015). A new criterion for assessing discriminant validity in variance-based structural equation modelling. *Journal of the academy of marketing science*, *43*, 115-135. https://doi.org/10.1007/s11747-014-0403-8

Hirshleifer, D. (2001). Investor psychology and asset pricing. *The Journal of Finance*, *56*(4), 1533-1597. https://doi.org/10.1111/0022-1082.00379

Hjeij, M. (2022). The heuristics applied by tech entrepreneurs in the Middle East during opportunity evaluation. *Journal of Entrepreneurship in Emerging Economies*, *15*(6), 1354–1372. https://doi.org/10.1108/JEEE-07-2021-0294

Hunguru, P., Sibanda, V., & Tadu, R. (2020). Determinants of investment decisions: A study of individual investors on the Zimbabwe Stock Exchange. *Applied Economics and Finance*, *7*(5), 38-53. https://doi.org/10.11114/aef.v7i5.4927

Huston, S. J. (2010). Measuring financial literacy. *Journal of Consumer Affairs*, *44*(2), 296-316. https://doi.org/10.1111/j.1745-6606.2010.01170.x

Ikram, Z. (2016). An empirical investigation on behavioural determinants, impact on investment decision making, moderating role of locus of control. *Journal of Poverty, Investment and Development*, *26*, 44–50.

Irshad, S., Badshah, W., & Hakam, U. (2016). Effect of representativeness bias on investment decision making. *Management and Administrative Sciences Review*, *5*(1), 26–30.

Ishfaq, M., & Anjum, N. (2015). Effect of anchoring Bias on risky investment decision. Evidence from Pakistan equity market. *International Journal of Engineering and Management Research 5*(4), 32-38.

Kahneman, D., & Tversky, A. (1979). Prospect theory: An analysis of decisions under risk. *Econometrica*, *47*(2), 263-293. https://doi.org/10.2307/1914185

Khalid, R., Javed, M. U., & Shahzad, K. (2018). Impact of Behavioral Biases on Investment Decision Making with Moderating Role of Financial Literacy. *Jinnah Business Review*, *6*(2), 34–41. https://doi.org/10.53369/rkxa7855

Khan, I., Afeef, M., Jan, S., & Ihsan, A. (2021). The impact of heuristic biases on investors' investment decision in Pakistan stock market: The moderating role of long-term orientation. *Qualitative Research in Financial Markets*, *13*(2), 252-274. https://doi.org/10.1108/QRFM-03-2020-0028

Khan, M. U. (2017). Impact of availability bias and loss aversion bias on investment decision making, moderating role of risk perception. *Management & Administration (IMPACT: JMDGMA)*, *1*(1), 17–28.

Kigen, P. S. (2020). *The Effect of Behavioral Biases on Investment Decision Making by Unit Trust Investors in Kenya* (Doctoral dissertation, University of Nairobi).

Kubilay, B., & Bayrakdaroglu, A. (2016). Empirical research on investor biases in financial decision-making, risk tolerance, and personality. *International Journal of Financial Research*, *7*(2), 171-182. http://dx.doi.org/10.5430/ijfr.v7n2p171

Kudratova, S., Huang, X., & Zhou, X. (2018). Sustainable project selection: Optimal project selection considering sustainability under reinvestment strategy. *Journal of Cleaner Production*, *203*, 469-481. https://doi.org/10.1016/j.jclepro.2018.08.259

Kuria, A. M. (2019). *Behavioural Biases of Real Estate Investors And Investment Performance in Kenya* (Doctoral dissertation, Dedan Kimathi University of Technology). http://repository.dkut.ac.ke:8080/xmlui/handle/123456789/4644

Loch, C. H., Solt, M. E., & Bailey, E. M. (2008). Diagnosing unforeseeable uncertainty in a new venture. *Journal of Product Innovation Management*, *25*(1), 28-46. https://doi.org/10.1111/j.1540-5885.2007.00281.x

Lyytinen, K., Mathiassen, L., & Ropponen, J. (1998). Attention shaping and software risk—a categorical analysis of four classical risk management approaches. *Information Systems Research*, *9*(3), 233-255. https://doi.org/10.1287/isre.9.3.233

Manimala, M. J. (1992). Entrepreneurial heuristics: A comparison between high PL (pioneering-innovative) and low PI ventures. *Journal of Business Venturing*, *7*(6), 477-504. https://doi.org/10.1016/0883-9026(92)90021-I

Menike, L. M. C. S. (2018). Effect of financial literacy on firm performance of Small and Medium Enterprises in Sri Lanka. *SSRN Electronic Journal*. http://dx.doi.org/10.2139/ssrn.3306719.

Merikas, A. A., Merikas, A. G., Vozikis, G. S., & Prasad, D. (2004). Economic factors and individual investor behaviour: The case of the Greek stock exchange. *Journal of Applied Business Research. 20*(4). https://doi.org/10.19030/jabr.v20i4.2227

Mitchell, R. K., Busenitz, L., Lant, T., McDougall, P. P., Morse, E. A., & Smith, J. B. (2002). Toward a theory of entrepreneurial cognition: Rethinking the people side of entrepreneurship research. *Entrepreneurship Theory and Practice*, *27*(2), 93–104. https://doi.org/10.1111/1540-8520.00001

Nareswari, N., Balqista, A. S., & Negoro, N. P. (2021). The impact of behavioural aspects on investment decision making. *Jurnal Manajemen Dan Keuangan*, *10*(1), 15-27. https://doi.org/10.33059/jmk.v10i1.3125

Nouri, P., Imanipour, N., Talebi, K., & Zali, M. (2018). Most common heuristics and biases in nascent entrepreneurs' marketing behaviour. *Journal of Small Business & Entrepreneurship*, *30*(6), 451-472. https://doi.org/10.1080/08276331.2018.1427406

Novianggie, V., & Asandimitra, N. (2019). The influence of behavioural bias, cognitive bias, and emotional bias on investment decisions for college students with financial literacy as the moderating variable. *International Journal of Academic Research in Accounting, Finance and Management Sciences*, *9*(2), 92-107. http://dx.doi.org/10.6007/IJARAFMS/v9-i2/6044.

Owusu, S. P., & Laryea, E. (2022). The impact of anchoring bias on investment decision-making: Evidence from Ghana. *Review of Behavioral Finance*, *15*(5), 729–749. https://doi.org/10.1108/RBF-09-2020-0223

Parveen, S., & Siddiqui, M. A. (2018). Anchoring heuristic, disposition effect and overconfidence bias in investors: A Case of Pakistan stock exchange. *Abasyn Journal of Social Sciences*, *11*(2), 280-294.

Parveen, S., Satti, Z. W., Subhan, Q. A., & Jamil, S. (2020). Exploring market overreaction, investors' sentiments and investment decisions in an emerging stock market. *Borsa Istanbul Review*, *20*(3), 224–235. https://doi.org/10.1016/j.bir.2020.02.002

Parylo, O. (2012). Qualitative, quantitative, or mixed methods: A research design analysis in articles on principal professional development (1998–2008). *International Journal of Multiple Research Approaches*, *6*(3), 297–313. https://doi.org/10.5172/mra.2012.6.3.297

Pettigrew, A. M. (2014). *The politics of organizational decision-making*. Routledge.

Pikulina, E., Renneboog, L., & Tobler, P. N. (2017). Overconfidence and investment: An experimental approach. *Journal of Corporate Finance*, *43*, https://doi.org/10.1016/j.jcorpfin.2017.01.002

Pinto, J. (2014). Entrepreneurs' cognitive biases and heuristics in entrepreneurial team recruitment. In *Academy of Management Proceedings*, *Vol. 2014*(1), 13976. Academy of Management Journal. https://doi.org/10.5465/ambpp.2014.5

Pokharel, P. R. (2020). Behavioural factors and investment decision: A case of Nepal. ~~*Available at SSRN Repository*~~. https://dx.doi.org/10.2139/ssrn.3687104

Pompian, M. M. (2012). *Behavioural Finance and Wealth Management: How to Build Investment Strategies that Account for Investor Biases (2nd Edition).*

Qasim, M., Hussain, R., Mehboob, I., & Arshad, M. (2019). Impact of herding behaviour and overconfidence bias on investors' decision-making in Pakistan. *Accounting*, *5*(2), 81–90. http://dx.doi.org/10.5267/j.ac.2018.7.001

Quaicoe, A., & Eleke-Aboagye, P. Q. (2021). Behavioural factors affecting investment decision-making in bank stocks on the Ghana stock exchange. *Qualitative Research in Financial Markets*, *13*(4), 425-439. https://doi.org/10.1108/QRFM-05-2020-0084

Quddoos, M. U., Rafique, A., Kalim, U., & Sheikh, M. R. (2020). Impact of behavioural biases on investment performance in Pakistan: The moderating role of financial literacy. *Journal of Accounting and Finance in Emerging Economies*, *6*(4), 1199-1205. https://doi.org/10.26710/jafee.v6i4.1512

Rasheed, M. H., Rafique, A., Zahid, T., & Akhtar, M. W. (2018). Factors influencing investor's decision making in Pakistan: Moderating the role of locus of control. *Review of Behavioral Finance*, *10*(1), 70-87. https://doi.org/10.1108/RBF-05-2016-0028

Raut, R. K., Das, N., & Mishra, R. (2020). The behaviour of individual investors in stock market trading: Evidence from India. *Global Business Review*, *21*(3), 818-833. https://doi.org/10.1177/0972150918778915

Rehan, R., & Umer, I. (2017). Behavioural biases and investor decisions. *Market Forces*, *12*(2).

Reinartz, W., Haenlein, M., & Henseler, J. (2009). An empirical comparison of the efficacy of covariance-based and variance-based SEM. *International Journal of Research in Marketing*, *26*(4), 332- 344. https://doi.org/10.1016/j.ijresmar.2009.08.001

Ritter, J. R. (2003). Behavioral finance. *Pacific-Basin Finance Journal*, *11*(4), 429-437. https://doi.org/10.1016/S0927-538X(03)00048-9

Sezer, D., & Demir, S. (2015). Investors' financial literacy and cognitive ability levels and their relationship with psychological illusions. *Journal of Accounting & Finance*, *4*(1), 57-73.

Shah, A. K., & Oppenheimer, D. M. (2008). Heuristics made easy: an effort-reduction framework. *Psychological bulletin*, *134*(2), 207. https://psycnet.apa.org/doi/10.1037/0033-2909.134.2.207

Shah, S. Z. A., Ahmad, M., & Mahmood, F. (2018). Heuristic biases in investment decision-making and perceived market efficiency: A survey at the Pakistan stock exchange. *Qualitative Research in Financial Markets*, *10*(1), 85–110. https://doi.org/10.1108/QRFM-04-2017-0033

Shane, S., & Venkataraman, S. (2000). The promise of entrepreneurship as a field of research. *Academy of Management Review*, *25*(1), 217–226. https://doi.org/10.5465/amr.2000.2791611

Shefrin, H. (2008). *A Behavioural Approach to Asset Pricing (2nd Edition)*. In Series: Academic Press Advanced Finance. Elsevier. https://doi.org/10.1016/B978-0-12-374356-5.X5001-3

Sherazi, S. K., Iqbal, M. Z., Asif, M., Rehman, K., & Shah, S. H. (2013). Obstacles to small and medium enterprises in Pakistan. Principal component analysis approach. *Middle-East Journal of Scientific Research*, *13*(10), 1325-1334.

Simon, H. A. (1991). Bounded rationality and organizational learning. *Organization Science*, *2*(1), 125–134. https://doi.org/10.1287/orsc.2.1.125

Simon, M., Houghton, S. M., & Aquino, K. (2000). Cognitive biases, risk perception, and venture formation: How individuals decide to start companies. *Journal of Business Venturing*, *15*(2), 113–134. https://doi.org/10.1016/S0883-9026(98)00003-2

Islam, S. (2012). Behavioural finance of an inefficient market. *Global Journal of Management and Business Research*, *12*(14), 12–34.

Ranaweera, S., & Kawshala, B. (2021). Influence of behavioral biases on investment decision making with moderating role of financial literacy and risk attitude: A study based on Colombo stock exchange. In *Proceedings of the 12th International Conference on Business & Information (ICBI 2021)*. SSRN Electronic Journal. https://dx.doi.org/10.2139/ssrn.4116979

Suresh, A. (2013). Understanding behavioural finance through biases and traits of trader vis-à-vis investor. *Journal of Finance, Accounting and Management*, *4*(2), 11–25. https://ssrn.com/abstract=2349672

Toma, F. M. (2015). Behavioural biases of the investment decisions of Romanian investors on the Bucharest stock exchange. *Procedia Economics and Finance*, *pp. 32*, 200–207. https://doi.org/10.1016/S2212-5671(15)01383-0.

Tversky, A., & Kahneman, D. (1973). Availability: A heuristic for judging frequency and probability. *Cognitive Psychology*, *5*(2), 207-232. https://doi.org/10.1016/0010-0285(73)90033-9.

UlAbdin , S. Z., Farooq, O., Sultana, N., & Farooq, M. (2017). The impact of heuristics on investment decision and performance: Exploring multiple mediation mechanisms. *Research in International Business and Finance*, *42*, 674–688. https://doi.org/10.1016/j.ribaf.2017.07.010.

Waweru, N. M., Munyoki, E., & Uliana, E. (2008). The effects of behavioural factors in investment decision-making: A survey of institutional investors operating at the Nairobi stock exchange. *International Journal of Business and Emerging Markets*, *1*(1), 24-41. https://doi.org/10.1504/IJBEM.2008.019243

West, R. F., Toplak, M. E., & Stanovich, K. E. (2008). Heuristics and biases as measures of critical thinking: Associations with cognitive ability and thinking dispositions. *Journal of Educational Psychology*, *100*(4), 930. https://psycnet.apa.org/doi/10.1037/a0012842

Zhang, H., Bij, H. V. D., & Song, M. (2020). Can cognitive biases be good for entrepreneurs? *International Journal of Entrepreneurial Behavior & Research*, *26*(4), 793–813. https://doi.org/10.1108/IJEBR-03-2019-017

Vol.2, Issue.1, (2024)
International Journal of Management Thinking
https://doi.org/10.56868/ijmt.v2i1.40

Assessing the Nexus between Social Responsibility, Environmental Initiatives, and Profitability: A Sustainable Finance Perspective of the Universal Banks in the Philippines

Denise Marie C. Aneslagon[1], Abba Jamiah P. Limbaga [2], Mae Ann S. Tomongha[3], Lance Bill Lim[4], Jeah Casayas[5], Jeanica Eivey R. Legaspi[6], Dale Q. Talaboc[7]

1-7. School of Business and Management, University of San Jose - Recoletos, Cebu City, 6000, Philippines

Article Information

Article Type: Research Article

Dates:
Received: October 02, 2023
Revised: March 19, 2024
Accepted: May 07, 2024
Available online: May 25, 2024

Corresponding Author:
Dale Q. Talaboc
daletalaboc@usjr.edu.ph
https://orcid.org/0009-0008-7815943X

ABSTRACT

This study examines the impact of social responsibility and environmental projects on the profitability of 10 Universal Banks in the Philippines within the context of the Bangko Sentral ng Pilipinas (BSP) through a sustainable finance framework. The research adopts a quantitative approach and analyses data from 2019 to 2021 using exploratory data analysis and regression analysis. These captured evolving trends or shifts in the relationship between banks' engagement in these projects and their financial performance. The study found that the number of social responsibility and environmental projects undertaken by Universal Banks did not significantly impact their profitability during this period (2019-2021). However, the study emphasizes the broader value of these initiatives, as they contribute to sustainability, promote corporate social responsibility, and align with global trends towards a more environmentally conscious and socially responsible business landscape. The research suggests that banks should continue to invest in social and environmental projects for their substantial societal and ecological impacts, aligning with the evolving needs and expectations of customers, investors, and the broader community.

Keywords: Universal Banks; Return on Equity; Social Responsibility Projects; Environmental Projects; Regression Analysis

1. INTRODUCTION

Sustainable finance includes climate, green, and social finance, along with more critical considerations for the long-term financial viability of the supported organizations and the operation and stability of the entire economic system they operate (Ziolo et al., 2021). According to Kumar and Prakash (2019), sustainable development was considered the support around which all development efforts should be focused. Alexander and Fisher (2018) claimed that social and environmental hazards were potentially endangering financial stability by becoming systemic. Furthermore, the main ecological sustainability risks had a detrimental impact on the banking industry and the economy included liability risks, physical and transitional hazards, and risks related to transition.

In recent years, there has been a growing emphasis on the integration of environmental and social initiatives by businesses worldwide, reflecting a global shift towards sustainable and responsible practices. In the context of Universal Banks in the Philippines, the extent to which environmental and social projects impact the profitability of these financial institutions remains unclear. As the banking sector is a critical player in the country's economic landscape, understanding the relationship between environmental/social projects and profitability is crucial for both the financial industry and the broader sustainable development goals. The lack of comprehensive research on this intersection creates a knowledge gap that hinders informed decision-making for banks, regulators, and stakeholders (Diokno, 2020).

According to the Bangko Sentral ng Pilipinas (BSP) Circular 1085, on April 29, 2020, the BSP issued the sustainable finance framework and required all banks to apply the framework, which established encompassing principles for incorporating sustainability principles along with environmental, social, and governance considerations into corporate and risk governance frameworks, strategies, and operations of banks as agreed by their board of directors. The researchers conducted quantitative research and examined the impact of the Universal Bank's Social responsibility projects (SRP) and Environmental-related projects (ERP) on the ten Universal Bank's profitability represented by the rate of earning (ROE) in 2019 and 2021 using the Exploratory Data Analysis.

The researchers then applied a panel regression analysis to evaluate the relationship between the number of social responsibility projects and the number of environmental-related projects contributing to Universal Bank's profitability. This study aims to analyze the impact of environmental and social projects on the profitability of universal banks in the Philippines, assessing their contribution to financial performance and competitive advantage. Additionally, it seeks to evaluate the long-term sustainability implications of banks' focus on environmental and social responsibility in the Philippine financial market. The study sought to answer the following questions:

1. How do environmental and social projects undertaken by universal banks in the Philippines impact their overall profitability?

2. To what extent do these projects contribute to the financial performance of universal banks in the Philippines?

3. Do universal banks with a strong focus on environmental and social responsibility demonstrate a competitive advantage in the financial market in the Philippines, and how is this advantage reflected in profitability metrics?

4. What are the potential long-term effects of environmental and social projects on the sustainability of the banking industry in the Philippines, both from an environmental/social and financial perspective?

2. LITERATURE REVIEW

Durrani et al., (2020) noted that many countries intend to establish or actively develop a sustainable financial system. The quantity of sustainable finance roadmaps demonstrated the most effective ways the financial sector could promote sustainable and inclusive economies. Additionally, many monetary and fiscal authorities in emerging economies seek ways to integrate environmental concerns such as climate change into their policy frameworks and encourage financial institutions to consider these issues when making credit, investment, and capital allocation decisions. Climate change and other environmental and societal risks to which the financial sector was vulnerable were cited as reasons why urgent action was required to safeguard the financial system (Battiston et al., 2017).

According to Ruiz and Weber (2021), the fundamental issue for the financial industry was establishing a sustainable financial system that required long-term operations that motivated institutions to pursue sustainable actions and contribute to sustainable development. In addition, the study noted that the promoters of the transition to sustainable finance included sustainability leaders in financial institutions and private codes of conduct addressing sustainability concerns. They underlined that a bank's primary business strategy that incorporated sustainability could be successful and benefit both firms. In the banking industry's corporate social responsibility (CSR), financial organizations explored innovative sustainability approaches beyond traditional charity operations and ethical considerations (Lin et al., 2019; Melé & Fontrodona, 2023). According to Schoenmaker & Schramade (2019), these new ways included incorporating non-financial information about sustainability. In addition, financial institutions should have found out if their risk management was well established to deal with the climate and environmental risks and stopped funding operations that hurt the climate and environment. Their main goal should have been making a wide range of new products contributing to a green and sustainable economy (Schoenmaker & Schramade 2019).

Moreover, financial institutions that implemented these sustainable practices produced more value for their shareholders as they protected the environment and, consequently, the economy's health, which enriched everyone in that sector (Alkaabi & Nobanee, 2019). Cabaron J.B and Cabaron R.R (2021) believed that sustainable banking policies and procedures significantly contributed to a profitable and sustainable world for both present and future generations, reducing the risk associated with their lending decisions and increasing their profits from doing business with financially rewarding emerging "green" companies. The study showed that companies aiming to make their corporate financial reporting practices more environmentally friendly generated more firm value individually and across other industries (Alkaabi & Nobanee, 2019).

According to Ramnarain and Pillay (2016), corporate culture and business endeavours, operational innovation and excellence, and a socially responsible and customer-focused attitude that went above and beyond the necessary regulatory requirements of a sustainable bank seamlessly incorporates banking sustainability. Čihák et al. (2012) focused on the essential traits of a sustainable financial system. These essential traits encompass four financial depths, which are access to financial services, intermediation effectiveness, financial stability supporting economic growth and poverty reduction.

2.1 Conceptual Framework

The Triple Bottom Line (TBL) concept expresses the extension of environmental objectives by integrating economic and social lines (Elkington, 1997). Triple Bottom Line (TBL) offered a model for evaluating an organization's effectiveness and performance regarding the economy, society, and the planet (Alhaddi, 2015; Goel, 2010). The Triple Bottom Line's (TBL) objective, directed towards businesses, regularly and fairly highlighted the importance of these institutions on the fronts of economics, society, and environment. Elkington listed the three lines as profit, people, and planet, which were employed to define the economic, societal, and environmental lines.

2.2 Economic Line (Profitability)

The economic line of the TBL framework denoted the impact of a company's business operations on the financial system (Elkington, 1997). It pertains to the economy's ability as one of the sustainability subsystems, to survive and grow to support subsequent generations (Spangenberg, 2005). The economic line evaluated how well the organization contributed to the economy's expansion and

linked it to it. It emphasized the economic value the company added to the environment in a way that benefited it and promoted the ecosystem's ability to support future generations.

2.3 Social Line (People)

The social line of TBL refers to the use of moral and advantageous business practices regarding the community, labour, and human capital (Elkington, 1997). These actions aimed to benefit society and "give back" to the community. For instance, paying fair wages and offering health insurance were a few of these behaviours. Beyond the moral duty of doing well for society, ignoring social responsibility could negatively impact a company's performance and sustainability. Recent instances from various businesses demonstrated that avoiding social responsibility had financial ramifications. During the 2002 local elections in the Bay Area of California, the public rejected the development of a Home Depot because they feared it would harm their community (Dhiman, 2008). According to Goel (2010), social performance is concerned with how an organization interacts with its surrounding area, and it encompasses things like employee relations, community engagement, and just compensation.

2.4 Environmental Line (Planet)

The environmental line of the TBL describes measures taken to preserve the environment and its resources for future generations. It involved decreasing one's ecological footprint, lowering the release of greenhouse gases, and conserving sources of energy (Goel, 2010). Environmental actions, such as the social component of TBL, impact an enterprise's ability to do business. Kearney et al. (2009) researched 99 firms focused on sustainability across 18 industries to examine how environmental actions affected the organization's performance. The industries included in the analysis ranged from food, the media, retail, and tourism to technology, automotive, and chemical. The six-month analysis period and research technique aimed to ascertain whether businesses that employed sustainable practices could improve the present economic climate. The study's sample included organizations with a sustainability emphasis, which was included in the Dow Jones Index.

Two phases of the analysis were carried out: three-month and six-month phases. During the present economic downturn, companies with strategies focused on preserving the environment, boosting their stakeholders' social well-being, and maximizing shareholder value outperformed their industry competitors financially. Financial advantages came from lower operational costs (such as energy and water usage) and higher profits from developing innovative sustainable products (Kearney et al., 2009).

2.5 Conceptual Model

The Conceptual model of how Universal Bank's number of social responsibility and environmental-related projects will influence the Philippines' Universal Bank's profitability. The variables of this study are shown in Figure 1. This study assessed the independent variables, number of social responsibility projects (SRP), and number of environmental-related projects (ERP) to determine if there was a significant impact on the dependent variable, Universal Bank's profitability ratio represented by Return on Equity (ROE) for the year 2019 and 2021. BSP Sustainable Finance Framework outlines the Bangko Sentral ng Pilipinas (2020) expectations regarding the incorporation of sustainability practices, namely those addressing the environmental and social (E&S) risk areas, in company governance and risk managerial guidelines, in addition to the overall strategy and operational processes of banks commensurate with their size, risk profile, and operational complexity.

As for disclosure requirements, banks are required to include the following details in their annual reports. It includes strategic objectives for sustainability and a willingness to take risks, a summary of the E&S risk management system, and products and services that follow generally accepted business practices and sustainability standards. The sustainability standards considered are social, environmental, and sustainability bonds. Other details incorporated in annual reports are exposures to E&S risk for the bank (broken down by sector or industry), data on the bank's exposure to current and anticipated E&S hazards as well as other programs that promote adherence to sustainable living guidelines and internationally recognized practices. The following are the independent and dependent variables that affects banks' processes and progress:

2.5.1 Profitability Ratio

A higher profitability ratio controlled the expansion of internal funds, which significantly impacted sustainable growth (Hartono & Utami, 2016). Return on equity (ROE) was used to assess profitability, an indicator of a company's capacity to produce net income on return of shareholder equity (Kontesa, 2015).

2.5.2 Social responsibility projects (SRP)

There were several reasons to believe that CSR initiatives could have altered a bank's processes and outcomes and conequently its effectiveness. CSR was necessary for these services to rebuild consumer trust, reputation, and business image (Bahta et al., 2020; Fandos-Roig et al., 2021). Additionally, a good reputation in the banking industry could have increased revenues by enabling banks to draw in more clients and charge higher interest rates on loans.

2.5.3 Environmental-Related projects (ERP)

Everything about the environment affects every facet of human life. A definitive relationship exists between humans and the environment; implying that if humans care for the environment, the environment will benefit them (Elkington, 1997). Murdifin et al. (2019) asserted that when a firm did not adequately control social and environmental issues, they had such significant effects that their intended effect of increasing profits resulted in numerous losses. Therefore, following hypotheses are proposed.

H1: More social responsibility projects decrease the profitability of universal banks.

H2: More environmental-related projects decrease the profitability of universal banks.

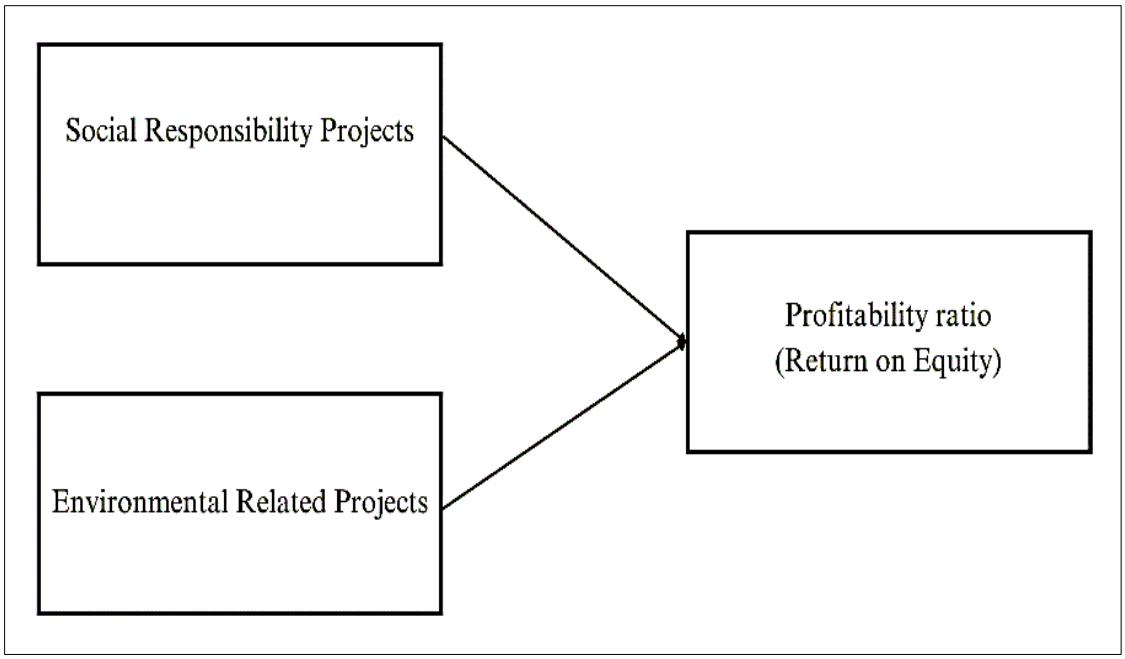

Figure 1. Conceptual Framework

3. METHODOLOGY

According to the BSP's Financial Stability Directories and Lists, in November 7, 2022, the Philippines' 20 universal banks were divided into three categories: private domestic, government, and foreign. Data were collected from each Universal Bank, and ten out of twenty adopted the BSP's Sustainable Finance Framework, which was the only research subject of this study. This study used regression and correlational analysis methods to accomplish this study.

The research instrument used was based on the concept of quantitative data, which was described as the collection of numerical data and the analysis of it using mathematically based techniques, such as statistics (Akcam et al., 2019). Data were collected through secondary data obtained from the Universal Bank's official websites based on the sustainability report and the annual report for 2019 and 2021. To examine the impact of the number of social responsibility projects (SRP) and the number of environmental-related projects (ERP) on Universal Bank's profitability (ROE), data was evaluated through a process called exploratory data analysis or data mining. The researchers then applied a panel regression analysis to evaluate the relationship between the number of SRPs and the number of ERPs in Universal Bank's profitability.

The researchers then applied a panel regression analysis to evaluate the relationship between the number of social responsibility projects and the number of environmental-related projects contributing to Universal Bank's profitability. The number of social responsibility projects and environmental-related projects were gathered manually. At the same time, the profitability ratio represented by ROE was already stated in the Universal Bank's sustainability report and annual report. Researchers evaluated each bank's sustainability report based on their profitability ratio, social responsibility projects, and environmental-related projects for 2019 and 2021. Panel regression analysis is a statistical method extending ordinary regression analysis to handle data with cross-sectional and time-series dimensions. It is beneficial when examining relationships over multiple periods and across different entities, such as banks. Here is a brief overview of how panel regression analysis works:

3.1 Data Collection

The researchers manually gathered data on the number of social responsibility projects and environmental-related projects for each bank. Universal Bank's sustainability and annual reports contained profitability data, represented by the return on equity (ROE). The dataset had a panel structure, where observations were made over multiple periods (2019 and 2021) for each bank. This allows for the examination of both within-bank and between-bank variations. The researchers specified a panel regression model to capture the relationship between the dependent variable (ROE) and the independent variables (number of social responsibility projects and environmental-related projects).

The model is presented in the Equation (1)

$$ROE_{it} = \beta 0 + \beta 1 \times Social\_Projectsit + \beta 2 \times Environmental\_Projectsit + \epsilon_{it} \quad (1)$$

Where, i represents the bank and t represents the period.

The model exhibits either fixed effects or random effects. Panel regression allows for the inclusion of fixed or random effects to account for unobserved heterogeneity across banks. This helps control the individual bank characteristics that may influence profitability. Moreover, the researchers likely conducted hypothesis tests to determine the significance of the coefficients (β1 and β2) to understand if there is a statistically significant relationship between social responsibility projects, environmental-related projects, and profitability. Researchers may have conducted various robustness checks to ensure the validity of their results. This could include testing for multicollinearity, heteroscedasticity, and other statistical assumptions. This data analysis technique allows researchers to explore and quantify the relationships between different variables while considering individual bank characteristics and changes over time.

4. RESULTS AND DISCUSSION

The researchers collected and analyzed all relevant information to achieve the study's goals, assess whether the number of social and environmental-related projects affected the profitability ratio represented by ROE of the 10 Philippine Universal Banks. Table 1 provides information on the profitability ratio, the number of social responsibility projects (SRP), and the number of environmental-related projects (ERP) of 10 Universal Banks in the Philippines, namely, Development Bank of the Philippines, (2019;2021) Security Bank Corporation (2021), Union Bank,(2019;2021), Rizal Commercial Banking Corporation (RCBC) (2019;2021), Land Bank, (2019;2021) the (BPI) Bank of the Philippine Islands, (2021) the (PNB) Philippine National Bank (2019;2021), East West Banking, China bank, (2019) and Banco De Oro (BDO) for the years 2019 and 2021.

Table 1. Ten (10) Universal Bank's Profitability Ratio

Universal Banks	Return on Equity		No. of SRP		No. of ERP	
	2019	2021	2019	2021	2019	2021
Development Bank of the Philippines	0.10	0.05	0.05	0.05	0.05	0.05
Security Bank Corporation	0.09	3	3	3	3	3
Union Bank	0.15	29	29	29	29	29
Rizal Commercial Banking Corporation	0.06	2	2	2	2	2
Land Bank	0.14	4	4	4	4	4
Bank of the Philippines Islands	0.11	0.06	0.06	0.06	0.06	0.06
Philippines National Bank	0.07	13	13	13	13	13
East West Banking	0.14	20	20	20	20	20
China Bank	0.11	3	3	3	3	3
Banco De Oro	0.10	4	4	4	4	4

Note: Return on Equity (ROE) versus Social Responsibility Projects (SRP) and Environmental-Related Projects (ERP); Number of Social Responsibility; Projects (SRP) and Number of Environmental-Related Projects (ERP) for the Years 2019 and 2021

The results from regression analysis, as presented in Table 2, showed that SRP 2019 and ERP 2019 do not significantly impact the profitability ratio of the Universal Banks for the year 2021. The SRP 2019 obtained a p-value of >0.05 (F=2.12, P=0.189), more significant than the required significance level of 0.05, indicating that it failed to reject the null hypothesis. The ERP 2019 obtained a p-value of >0.05 (F=0.00, P=0.979), greater than the required significance level 0.05, indicating that it failed to reject the null hypothesis. Hypothesis 1 was supported and consistent with prior research, and in order to meet social and environmental goals, banks must adopt ESG standards, which increase costs and decrease profitability (Galant & Cadez, 2017). These costs include investments in projects that reduce pollution or emissions, raise staff wages and bonuses, and participate in community activities such as donations and sponsorship.

Table 2. Analysis of Variance of SRP 2019 and ERP 2019 in Return on Equity

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Regression	2	0.001776	0.000888	1.06	0.396
SRP 2019	1	0.001773	0.001773	2.12	0.189
ERP 2019	1	0.000001	0.000001	0.00	0.979
Error	7	0.005855	0.000836		
Total	9	0.007632			

The correlation Table 3 provided shows the correlation coefficients between the variables ROE 2019, SRP 2019, and ERP 2019. The correlation coefficients for SRP 2019 and ERP 2019 are 0.482 and -0.022, respectively. These values indicate a moderate positive correlation between SRP 2019 and ROE 2019 and a weak negative correlation between ERP 2019 and ROE 2019. The correlation coefficient for SRP 2019 and ROE 2019 is 0.482, suggesting a moderate positive linear relationship between the two variables. Similarly, the correlation coefficient for ERP 2019 and ROE 2019 is -0.022, indicating a weak negative linear relationship between the two variables.

Table 3. Correlations ROE 2019, SRP 2019, ERP 2019

	ROE 2019	SRP 2019
SRP 2019	0.482	
	0.158	
ERP 2019	-0.022	-0.027
	0.952	0.941

The results from regression analysis, as presented in Table 4, showed that SRP 2021 and ERP 2021 do not significantly impact the profitability ratio of the Universal Banks for the year 2021. The SRP 2021 obtained a p-value of >0.05 (F=0.00, P=0.982), greater than the required significance level 0.05, indicating that it failed to reject the null hypothesis. The ERP 2021 obtained a p-value of >0.05 (F=0.21, P=0.662), more significant than the required significance level of 0.05, indicating that it failed to reject the null hypothesis. Hypothesis 2 was supported since it is not always true that "making a profit" equates to protecting the environment. Banks are choosing to contribute to financing environmental projects for the benefit of the planet as a whole rather than always to create a profit (Chan-Fishel & Lawson, 2007).

Table 4. Analysis of Variance of SRP 2021 and ERP 2021 in Return on Equity

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Regression	2	0.000715	0.000357	0.11	0.898
SRP 2019	1	0.000002	0.000002	0.00	0.982
ERP 2019	1	0.000684	0.000684	0.21	0.662
Error	7	0.022930	0.003276		
Total	9	0.023645			

Table 5 shows the correlation coefficients between ROE 2021, SRP 2021, and ERP 2021. The correlation coefficients for SRP 2021 and ERP 2021 are 0.036 and -0.174, respectively. These values indicate a moderate positive correlation between SRP 2021 and ROE 2021 and a weak negative correlation between ERP 2021 and ROE 2021. The correlation coefficient for SRP 2021 and ROE 2021 is 0.036, suggesting a moderate positive linear relationship between the two variables. Similarly, the correlation coefficient for ERP 2021 and ROE 2021 is -0.174, indicating a weak negative linear relationship between the two variables.

Table 5. Correlations ROE 2021, SRP 2021, ERP 2021

	ROE 2021	SRP 2021
SRP 2019	0.036	
	0.921	
ERP 2019	-0.174	-0.159
	0.631	0.660

4.1 Discussion

The researchers undertook a comprehensive examination to assess the influence of SRP and ERP on the profitability ratio (ROE) of 10 Philippine Universal Banks over the years 2019 and 2021. Through a rigorous analysis incorporating regression and correlation coefficients, the study revealed that neither SRP nor ERP significantly impacted the profitability ratio during either year. This finding supported Hypothesis 1, according to which prior research posited that pursuing social and environmental objectives could lead to increased costs and reduced profitability (Galant & Cadez, 2017).

Further scrutiny of the correlation coefficients disclosed a moderate positive relationship between SRP and ROE, alongside a weak negative relationship between ERP and ROE in 2019. Similarly, in 2021, Hypothesis 2 found support, suggesting that pursuing profit does not always align with environmental protection, and is also consistent with Chan-Fishel and Lawson's proposition (2007). The correlation coefficients for SRP and ERP in 2021 demonstrated a moderate positive relationship and a weak negative relationship respectively, with ROE. These nuanced findings emphasize the intricate dynamics between social and environmental initiatives and the financial performance of Universal Banks, providing valuable insights for both academic discourse and practical decision-making within the banking sector. The study focuses specifically on 10 Philippine Universal Banks over the years 2019 and 2021. The geographic and sectoral specificity may set it apart from broader or global studies encompassing a more comprehensive range of banks and regions.

The sample size and selection criteria may differ from those in previous studies, potentially influencing the generalizability of findings. Given the specific context of Philippine Universal Banks, cultural and institutional factors unique to the Philippines may shape the relationship between SRP, ERP, and profitability. Differences in these factors could contribute to distinctions from studies conducted in other regions.

5. CONCLUSION AND RECOMMENDATIONS

The study's conclusion on Universal Bank's social responsibility and environmental-related projects prompts a deeper exploration of the nuanced relationship between corporate sustainability initiatives and financial performance. Despite the absence of a statistically significant impact on profitability as reflected in Return on Equity (ROE) for 2021, the findings imply a more complex and multifaceted interplay between these variables. The observation that the number of Social Responsibility Projects (SRP) and Environmental-Related Projects (ERP) did not directly influence profitability suggests that at least within the examined timeframe financial gains may not be immediately evident from such initiatives. However, this conclusion does not negate the broader importance and potential benefits of integrating sustainability into banking practices. The mention of the BSP Sustainable Finance Framework introduces a forward-looking perspective, emphasizing the untapped potential for Philippine Universal Banks to play a pivotal role in sustainable development. While the current study did not uncover a direct link between specific project numbers and profitability, it highlights the transformative power of aligning business operations with sustainable finance objectives outlined in the framework.

The suggested avenues for banks to increase risk management, build their brand, and contribute to a sustainable and inclusive economy signal a strategic shift. The value derived from social responsibility and environmental projects might manifest in more than just immediate financial returns as in cultivating intangible assets such as reputation, risk mitigation, and a broader positive economic impact.

The conclusion encourages a holistic view of the relationship between banks, sustainability projects, and profitability. It underscores the notion that while direct financial impacts may take time to be evident, the long-term benefits and synergies derived from integrating sustainability into banking operations can be substantial, fostering a more resilient and responsible financial sector. This study is mainly limited to the 10 Universal Banks in the Philippines; therefore, the findings of the study cannot be generalized to other countries and banks. Future researchers might conduct further investigations involving various banking institutions to provide a more comprehensive insight into the correlation between the number of social responsibility initiatives, environmental-related projects, and their impact on profitability, as measured by these banks' Return on Equity (ROE) metrics. This extended research effort aims to uncover nuanced insights that can significantly contribute to the banking sector's strategic planning and decision-making processes.

Acknowledgements: We extend our heartfelt gratitude to all those who played pivotal roles in completing this research endeavour. Our sincere appreciation goes to our esteemed Research Teacher, Dr. Mary Joy C. Teodosio, whose expertise and unwavering support have guided us through this intellectual journey. We are deeply thankful to our dedicated Research Adviser, Dr. Dale Q. Talaboc, for providing invaluable mentorship and insightful feedback that significantly contributed to the quality and direction of our research. Special thanks to the esteemed panellists, Dr Cedric Val R. Naranjo, CPA, Dr Rosemarie V. Jacalan, CPA, and Dr Mary Joy C. Teodosio, LPT, for their constructive critiques and enriching contributions during the defence. To our devoted research team members, your collaborative efforts have been indispensable to the success of this project.

Author(s) Contributions: Conceptualization, Denise Marie C. Aneslagon; Writing and Drafting, Abba Jamiah P. Limbaga; Methodology, Mae Ann S. Tomongha; Data Collection, Jeannica Eivey R. Legaspi and Dale Q. Talaboc; Data Analysis, Lance Bill Lim, Jeah Casayas and Jeannica Eivey R. Legaspi; Final Drafting, Denise Marie C. Aneslagon and Abba Jamiah P. Limbaga; Revision, Denise Marie C. Aneslagon. All authors have read and agreed to the published version of the manuscript.

Ethical Statement: An ethical statement is not applicable because this study is based exclusively on published literature.

Competing Interests: The author(s) declared that this work has no competing interests.

Consent to Participate: As this study deals with human subjects, the collection of corresponding data or the concerning human rights issues are evaluated with informed consent.

Grant/Funding information: The author(s) declared that no grants supported this work.

Data Availability Statement: The associated data is available upon reasonable request from the corresponding author.

Declaration Statement of Generative AI: The author(s) of this work declared that they did not use any AI tools or program/software to draft this paper.

REFERENCES

Akcam, B. K., Guney, S., & Cresswell, A. M. (2019). Research design and major issues in developing dynamic theories by secondary analysis of qualitative data. *Systems*, *7*(3), 40. https://doi.org/10.3390/systems7030040

Alexander, K., & Fisher, P. (2018). Banking regulation and sustainability. *SSRN Repository.* https://dx.doi.org/10.2139/ssrn.3299351.

Alhaddi, H. (2015). Triple bottom line and sustainability: A literature review. *Business and Management Studies, 1(2), 6-10.* https://doi.org/10.11114/bms.v1i2.752

Alkaabi, H., & Nobanee, H. (2019). A study on financial management in promoting sustainable business practices & development. *SSRN Repository.* https://dx.doi.org/10.2139/ssrn.3472415

Bahta, D., Yun, J., Islam, M. R., & Bikanyi, K. J. (2020). How does CSR enhance the financial performance of SMEs? The mediating role of firm reputation. *Economic Research-Ekonomska Istraživanja, 34(1),* 1428-1451. https://doi.org/10.1080/1331677x.2020.1828130

Banco de Oro. (2019). *2019 annual report financial supplements*. BDO Unibank, Inc. https://www.bdo.com.ph/sites/default/files/pdf/BDO%20Unibank%202019-Annual-Report Financial-Supplements.pdf

Banco de Oro. (2021). *2021 sustainability report.* BDO Unibank, Inc. https://www.bdo.com.ph/sites/default/files/pdf/BDO-2019Sustainability%20Report.pdf

Banco de Oro. (2021). *2021 annual report financial supplements.* BDO Unibank, Inc. https://www.bdo.com.ph/sites/default/files/pdf/BDOUnibank-2021Annual-Report-Financial-Supplements.pdf

Directory of Banks and Non-Bank Financial Institutions. (2020). *Financial stability - Directories and lists.* Bangko Sentral ng Pilipinas. https://www.bsp.gov.ph/SitePages/FinancialStability/DirBanksFIList.aspx

BPI. (2021). *Stakeholder engagement.* Bank of the Philippine Islands. https://www.bpi.com.ph/governance/stakeholder/communities#:~:text=In%202021%2C%20community%20investments%20were,other%20areas%20within%20the%20Bank

Battiston, S., Mandel, A., Monasterolo, I., Schütze, F., & Visentin, G. (2017). A climate stress test of the financial system. *Nature Climate Change, 7(4),* 283-288. https://doi.org/10.1038/nclimate3255

Cabaron, J. B., & Cabaron, R. R. (2021). Evaluation of sustainable banking practices in the Philippines. *International Journal of Research in Commerce and Management Studies, 3(06),* 189-203. http://dx.doi.org/10.38193/IJRCMS.2021.3612

Chan-Fishel, M., & Lawson, R. (2007). Quid pro quo? China's investment-for-resource swaps in Africa. *Development, 50(3),* 63-68.https://doi.org/10.1057/palgrave.development.1100403

China Bank. (2019). *Annual financial and sustainability report 2019.* China Banking Corporation. https://www.chinabank.ph/pdf/2019_Annual_Report.pdf

Čihák, M., Demirgüç-Kunt, A., Feyen, E., & Levine, R. (2012). *Benchmarking financial systems around the world.* Policy Research Working Papers [Report Series]. Open Knowledge Repository, World Bank. *https://hdl.handle.net/10986/12031*

DBP. (2019). *2019 annual and sustainable development report.* Development Bank of the Philippines. https://www.dbp.ph/dbp-transparency-seal-2/corporategovernance/dbps-policy-on-communityinvolvement/#:~:text=DBP%20has%20strengthened%20its%20corporate,%2C%20environment%2C%20and%20OFW%20advocacy

DBP. (2021). *2021 annual and sustainable development report.* Development Bank of the Philippines. https://www.dbp.ph/publication/2021-annualand-sustainable-development-report/

Dhiman, S. (2008). Products, people, and planet: The triple bottom-line sustainability imperative. *Journal of Global Business Issues, 2(2),* 51-57.

Diokno, B. (2020). *Sustainable finance framework* (Circular No 1085). Office of the Governer, Bangko Sentral ng Pilipinas. https://www.bsp.gov.ph/Regulations/Issuances/2020/c1085.pdf

Durrani, A., Rosmin, M., & Volz, U. (2020). The role of central banks in scaling up sustainable finance–What do monetary authorities in the Asia-Pacific region think? *Journal of Sustainable Finance & Investment, 10(2),* 92–112. https://doi.org/10.1080/20430795.2020.1715095

EastWest. (2019). *2019 annual and sustainability report.* East West Banking Corporation. https://cms.eastwestbanker.com/sites/default/files/pdf/annualreport/EastWest-2019-Annual-and-Sustainability-Report-MainSection.pdf

EastWest. (2021). *2021 annual and sustainability report.* East West Banking Corporation.

https://cms.eastwestbanker.com/sites/default/files/pdf/annualreport/EastWest%202021%20Annua l%20an d%20Sustainability%20Report.pdf

Elkington, J. (1997). The triple bottom line. *Environmental Management: Readings and Cases, 2, 49-66.*

Fandos-Roig, J. C., Sánchez-García, J., Tena-Monferrer, S., & Callarisa-Fiol, L. J. (2021). Does CSR help to retain customers in a service company? *Sustainability, 13(1),* 300. https://doi.org/10.3390/su13010300

Galant, A., & Cadez, S. (2017). Corporate social responsibility and financial performance relationship: A review of measurement approaches. *Economic Research-Ekonomska Istraživanja, 30(1),* 676-693. https://doi.org/10.1080/1331677x.2017.1313122

Goel, P. (2010). Triple bottom line reporting: An analytical approach for corporate sustainability. *Journal of Finance, Accounting & Management, 1(1).*

Hartono, G. C., & Utami, S. R. (2016). The comparison of sustainable growth rate, firm's performance and value among the firms in Sri Kehati index and IDX30 index in Indonesia stock exchange. *International Journal of Advanced Research in Management and Social Sciences, 5(5),* 6881. https://doi.org/10.1080/20430795.2019.1625012

Kearney, M., Shine, R., & Porter, W. P. (2009). The potential for behavioral thermoregulation to buffer "cold-blooded" animals against climate warming. *In D. B. Wake (Ed.), Proceedings of the National Academy of Sciences.* PubMed Archive. https://doi.org/10.1073/pnas.0808913106

Kontesa, M. (2015). Capital structure, profitability, and firm value. What is new? *Research Journal of Finance and Accounting, 6(20),* 185-192.

Kumar, K., & Prakash, A. (2019). Developing a framework for assessing sustainable banking performance of the Indian banking sector. *Social Responsibility Journal, 15(5),* 689-709. https://doi.org/10.1108/SRJ-07-2018-0162

Land Bank (2019). *Annual report 2019- Responsive banking through digitalization*. Land Bank of the Philippines. https://www.landbank.com/images/inner_template/1608600287_LANDBANK%20ANNUAL%20REPORT%202019.pdf

Land Bank (2021). *Annual report 2021- Responsive Banking through Digitalization*. Land Bank of the Philippines. https://www.landbank.com/images/inner_template/1667350550_Land%20Bank%20of%20the%20Philippines%202021%20Annual%20Report.pdf

Lin, L., Hung, P. H., Chou, D. W., & Lai, C. W. (2019). Financial performance and corporate social responsibility: Empirical evidence from Taiwan. *Asia Pacific Management Review, 24(1),* 61-71. https://doi.org/10.1016/j.apmrv.2018.07.001

Melé, D., & Fontrodona, J. (2023). Ethics and corporate social responsibility. In *Encyclopedia of Business and Professional Ethics* (pp. 792-797). Cham: Springer International Publishing. https://doi.org/10.1007/978-3-030-22767-8_558

Murdifin, I., Pelu, M. F. A., Putra, A. A. H. P. K., Arumbarkah, A. M., Muslim, M., & Rahmah, A. (2019). Environmental disclosure as corporate social responsibility: Evidence from the biggest nickel mining in Indonesia. *International Journal of Energy Economics and Policy, 9(1),* 115-122. https://www.econjournals.com.tr/index.php/ijeep/article/view/7048.

PNB. (2019). *PNB 2019 annual report.* Philippine National Bank. https://www.pnb.com.ph/wp-content/uploads/docs/2019-AnnualReport.pdf

PNB. (2021). *PNB 2021 annual report.* Philippine National Bank. https://pnbwebsite.s3.apsoutheast1.amazonaws.com/uploads/docs/2021-AnnualReport.pdf

Ramnarain, T. D., & Pillay, M. T. (2016). Designing sustainable banking services: The case of Mauritian banks. *Procedia-Social and Behavioral Sciences, 224*, 483-490.

https://doi.org/10.1016/j.sbspro.2016.05.424
RCBC. (2021) *Annual and sustainability report.* Rizal Commercial Banking Corporation. https://www.rcbc.com/uploads/media/RCBC-2021-Annual-and-SustainabilityReport-V4_092022.pdf
RCBC. (2019) *Annual and sustainability report.* Rizal Commercial Banking Corporation. https://www.rcbc.com/uploads/media/06152020---RCBC-2019Sustainability Report.pdf
Ruiz, P. I. A., & Weber, O. (2021). The impact of financial sector sustainability guidelines and regulations on the financial stability of South American banks. *ACRN Journal of Finance and Risk Perspectives, 10(1),* 111–127. https://doi.org/10.35944/jofrp.2021.10.1.007.
Schoenmaker, D., & Schramade, W. (2019). Investing for long-term value creation. *Journal of Sustainable Finance & Investment, 9(4),* 356-377. https://doi.org/10.1080/20430795.2019.1625012
Security Bank. (2021). *2019, 2020, 2021 annual report*. Security Bank Corporation. https://www.securitybank.com/2021-annual-report/
Spangenberg, J. H. (2005). Economic sustainability of the economy: Concepts and indicators. *International Journal of Sustainable Development, 8(1-2),*47-64. https://doi.org/10.1504/IJSD.2005.007374
Union Bank. (2020). *Preparing for the future of banking: 2019 Annual report.* Union Bank of Philippines. https://www.unionbankph.com/sites/default/files/2021-04/Annual%20Report%202019~07-31-2020.pdf
Union Bank. (2022). *2021 annual report*. Union Bank of Philippines. https://www.unionbankph.com/sites/default/files/202206/UB%202021%20AR%20spread%20wi h%20notes.pdf.
Ziolo, M., Bak, I., & Cheba, K. (2021). The role of sustainable finance in achieving sustainable development goals: Does it work? *Technological and Economic Development of Economy, 27(1),* 45-70. https://doi.org/10.3846/tede.2020.13863.

Vol.2, Issue.1, (2024)
International Journal of Management Thinking
https://doi.org/10.56868/ijmt.v2i1.56

Examining Emotional Factors of Smart Toilets Design for China's New Elderly

Qiuyi Li[1], Rosalam Che Me[2*], Mohd Faiz Yahaya[3]

1-2. Department of Industrial Design, Faculty of Design and Architecture, Universiti Putra Malaysia, Serdang 43400, Malaysia
3. Malaysian Research Institute on Ageing (MyAgeing), Universiti Putra Malaysia, Serdang 43300, Malaysia

Article Information

Article Type: Research Article

Dates:
Received: February 18, 2024
Revised: April 22, 2024
Accepted: May 27, 2024
Available online: June 12, 2024

Corresponding Author:
Rosalam Che Me
rosalam@upm.edu.my
ORCID: https://orcid.org/0000-0001-9507 6056

ABSTRACT

The emergence of a "new elderly" group in China with unique emotional needs has highlighted the importance of smart toilet design. This study explores the emotional needs of the new elderly and the potential benefits of specialized sanitary products in addressing their emotional well-being. The study developed a framework based on Norman's theory on the Three Levels of Emotional Design (NTLTED) and Maslow's Hierarchy of Needs Theory (MHNT), which are widely used in emotional design. A quantitative method was employed, and a questionnaire survey was conducted to collect the data by using cluster sampling from the high-tech zone in Chengdu, Sichuan, China. A total number of 501 respondents participated, among which 394 were new elderly and 108 were traditional elderly. The findings from a case study involving 501 elderly participants emphasize the significance of emotional factors in product design for the new elderly, specifically in the context of intelligent toilets in China. High-quality materials, personalized safety features, and cognitive enhancement improves user satisfaction. Lastly, identified pain points underscore the need for privacy and safety measures, clear instructions, and sensory comfort. Manoeuvrability enhancement addresses limited deftness and instruction readability, while adaptability focuses on tactile and visual cues. Respect, belonging, and progression considerations are pivotal in ensuring user satisfaction and well-being. This study develops a framework based on Norman's theory and Maslow's Hierarchy of emotional design in smart toilets for China's new elderly and highlights the importance of personalized features for user satisfaction and well-being.

Keywords: Elderly; Smart Toilet; Emotional Design; Maslow's Hierarchy of Needs Theory (MHNT); Norman's theory on Three Levels of Emotional Design (NTLTED)

1. INTRODUCTION

The ageing population in China is expected to double by 2050 (Lobanov-Rostovsky et al., 2023), as the study highlights and therefore implies the importance of addressing older adults' physical and emotional needs. One critical need is the establishment of smart toilets, which can improve the physical and mental well-being of the aged person (Han et al., 2020). Integrating technologies into useable products can support and sustain an individual's healthy behaviour and enhance self-awareness and health literacy (Meyer et al., 2016). Smart toilets are particularly beneficial for addressing toileting issues, which often affect the emotional well-being of older adults (Balaceanu et al., 2019).

Prioritizing the specific needs of the elderly in product design, especially in the growing market for smart toilets in China (Gong et al., 2020), is essential for promoting overall well-being. Research on product design for the elderly in China, specifically smart toilets, highlights the importance of balancing functionality with emotional appeal. Studies by Teng and Shen (2018) and Wang and Liu (2020) emphasize the need for tailored designs, while Mao et al. (2022) suggested a balance between functionality and emotional appeal. However, comprehensive guidelines are lacking, and specific emotional factors relevant to the new elderly remain unexplored. This study aims to identify emotional factors in product design for the new elderly in China, focusing on smart toilets.

The term "New Elderly" originated in Italy, describing the elderly who have reached the official retirement age yet choose to continue working or actively participate in social activities (Ma, 2010). In China, due to societal advancements and improved living standards, a new cohort of elderly has emerged. The new elderly are open-minded, energetic, receptive to new experiences, eager for social engagement, and value social interaction and communication (Teng & Shen, 2018). The elderly experience vulnerabilities in skin healing, bone density, muscle mass, cognition, vision, and hearing. It is essential to design products that cater to the specific needs of older adults by incorporating ergonomic features, adjustable settings, and intuitive interface. Promoting physical activity and training through specialized equipment can enhance muscle strength, balance, and mobility. Additionally, addressing sensory impairments with design features like high-contrast displays can improve the user experience.

Emotions play a crucial role in the well-being of older adults, with positive emotions contributing to a fulfilling life and negative emotions often requiring adjustment. Elderly individuals may experience negative emotions such as fear of loneliness and low self-esteem, which can be mitigated through product design; however, enhancing the design of sanitary products like bathtubs, shower rooms, bathroom cabinets, toilets, and sinks to meet the emotional needs of older adults can contribute to their positive mood and overall satisfaction. By considering and addressing the emotional needs of the new elderly in product design, we can create solutions that support their well-being and enhance their quality of life. This study intends to explore the emotional product needs of the new elderly, necessitating an initial examination of this group's physical and psychological attributes.

2. LITERATURE REVIEW

2.1. Characteristics of the New Elderly

The relationship between mental and physical health is essential. Ohrnberger et al. (2017) found that health policies should consider the indirect effects between mental and physical health. Investing in health and promoting social interaction can improve the overall well-being of older adults. Additionally, regular physical exercise has been associated with improved mental health outcomes, such as reduced symptoms of depression, anxiety, and cognitive decline (Arent et al., 2000; Chen et al., 2022; Erickson et al., 2015). Research suggests that maintaining good physical health can positively impact psychological well-being in older adults. Regular physical activity improves cognitive function, reduces depression risk, and enhances mental well-being (Gordon et al., 2018; Mandolesi et al., 2018). Conversely, physical ailments like chronic pain or limited mobility contribute to psychological distress and lower quality of life (Gatchel et al., 2007). The new elderly group, a subset of the elderly population, also experiences the effects of ageing on their bodies.

Tortora and Derrickson (2019) categorize the eleven principal systems of the human body based on their functions and contributions to overall well-being. These systems include protection and movement, control and coordination, and sustenance and reproduction. Despite limited research on the physical characteristics of the new elderly, existing literature provides qualitative descriptions of their traits, lacking quantitative measurement studies. Previous studies (Mao et al., 2022; Teng & Shen, 2018; Wang & Liu, 2020) suggest that the new elderly exhibit higher levels of physical health, energy, and vitality compared to traditional elderly individuals. Through advancement in science, technology, and healthcare, they actively engage in exercise and healthcare practices, leading to improved physical fitness. While physiological functions may decline with age, the proportion of healthy and relatively healthy new elderly individuals has increased.

Table 1. Physical Characteristics of the New Elderly and Traditional Elderly

Physical Factors		**Traditional elderly**	**The new elderly**
Protection and Movement	The Skeletal, Muscular and Integumentary systems	Accessible to injuries and have decreased balance	Slowly aging
Control and Coordination	The Nervous and Endocrine Systems	Hearing, vision, reflexes, and Memory deteriorate, and the endocrine system changes.	Healthier
Sustenance and Reproduction	The Cardiovascular, lymphatic, respiratory, digestive, urinary and reproductive systems	The functions decrease	Healthier

Table 1 shows an individual's age; their physical, cognitive, and sensory abilities undergo changes that can affect their daily lives. The elderly experience vulnerabilities in skin healing, bone density, muscle mass, cognition, vision, and hearing. It is essential to design products that cater to the specific needs of older adults by incorporating ergonomic features, adjustable settings, and intuitive interfaces. Promoting physical activity and training through specialized equipment can enhance muscle strength, balance, and mobility. Additionally, addressing sensory impairments with design features like high-contrast displays can improve the user experience.

Table 2. Psychological Characteristics of the New Elderly and Traditional Elderly

Psychological Factors		**Traditional elderly**	**The new elderly**
Autonomy needs	Interest	More traditional	Gravitate towards things that are enjoyable and pursue trends
	Independence	More dependent on family	Not confined by traditional notions, possessing their way of thinking
Competence needs	Learning	Not very open to new things	More willing to acquire new things and skills
	Self-challenge	Less willing to put effort into challenging themselves	More willing to challenge themselves
Relevance needs	Relationships	Less relationship-building	Engage in meaningful and supportive connections
	Activities	Less involved in social activities	More adept at socializing

Wang (2021) found that the psychological needs of the new elderly are based on the self-determination theory, as labelled in Table 2. The autonomy needs of the new elderly include interest and independence, as they are drawn to enjoyable activities and tend to embrace new trends without being constrained by traditional norms. Competence needs to involve learning and self-challenge, with the new elderly seeking to acquire new skills and engage in tasks that push their capabilities. Relatedness needs to focus on relationships and activities, with the new elderly fostering meaningful interactions with family and friends and participating in group activities to enhance their sense of belonging and connection.

2.2. Smart Toilets for the Elderly

Smart toilets are technologically advanced systems with automated flushing, seat sanitization, and efficient water management (Gong et al., 2020). They utilize sensors and information and communication technology (ICT) for optimal functionality and data collection, offering health and hygiene (Tasoglu, 2022; Zakaria et al., 2018). There is a significant untapped market potential for intelligent toilets in China, emphasizing the need to explore their evolution in the country (Gong et al., 2020). The functions of intelligent toilets, such as health monitoring, personal hygiene, and comfort, can improve the toilet experience for the elderly, providing health advice and cleaning assistance (Wang & Camilleri, 2020). Smart toilets have a significant emotional impact on the elderly, categorized into intergenerational relationships, independence, comfort, and purchase intention. Health monitoring and emergency alerts may foster collaboration with the elderly's children, enhancing emotional dependence. The functionality of smart toilets can boost dignity and independence, especially for those with mobility impairments (Balaceanu et al., 2019). Additionally, smart toilets offer intelligent safety services, aiding in disease detection among the elderly (Fong et al., 2023). The emotional experience with these products influences the elderly's purchasing decisions, with perceived value in health care, technology, and usability being key factors (Esmaeilzadeh, 2023).

2.3. Theoretical Framework Construction

The introduction of an intelligent toilet and its emotional relationship with the elderly could be testified by theories related to emotional design and the needs of the new elderly. Mainly, Norman's Three-level theory of Emotional Design (NTTED) (Norman, 2007) is widely used in the field of emotional design, and Maslow's Hierarchy of Needs Theory (MHNT) by Abraham Maslow (1943) has also been widely used and proved. These two theories are suitable for this study to explore the factors of emotional needs of the elderly.

NTTED includes three levels: visceral, behavioral, and reflective level. At the visceral level of emotional design, users have instinctive responses to a design based on sensory experiences and aesthetics. For the elderly, especially those with visual impairments, designs must use clear fonts, contrasting colours, and intuitive icons to be easily understandable (Fang et al., 2016). The behavioural level focuses on usability and functionality, ensuring user-friendly products align with users' goals. It is crucial to elicit positive emotional responses and a sense of control, considering the potential physical limitations of the elderly. Designs should also incorporate the elderly's physical and mental health to influence their well-being (Elderkin-Thompson et al., 2008). The reflective level of emotional design aims to create meaningful experiences that align with users' values, aspirations, and identities. This level can evoke deeper emotions and personal connections, especially vital for the elderly with rich experiences and memories linked to various products and services (Martínez-López et al., 2021).

By considering the visceral, behavioral, and reflective levels of emotional design, designers can create products and services that cater to the physical and cognitive abilities of the elderly, enhancing their quality of life. Maslow's Hierarchy of Needs provides a framework for understanding the progression of fundamental human needs towards self-actualization. For the elderly, technology can assist in meeting physiological and safety needs (Kang & Lee, 2015), while ICT-based welfare services can address social and esteem needs (Chen & Schulz, 2016). Home automation and positive social support can enhance self-esteem, leading to self-actualization through leisure and cultural activities (Pal et al., 2018). Designing products that align with these needs can enhance the quality of life for the elderly. The study's rationale, as emphasized in the prior literature review, is that the physical and psychological dimensions of the ageing population are closely interconnected. Understanding the complexities of this demographics' emotional needs and thoroughly examining their behaviors from every conceivable angle. Thus, MHNT can address the extensive needs of the elderly, encompassing both physical and psychological aspects. NTLTED, the core theory of emotional design, can provide more targeted emotional design recommendations when combined with MHNT. Figure 1 shows the correlation between NTLTED and NHNT that Motivates Identifying the Emotional Variables for designing for the New Elderly.

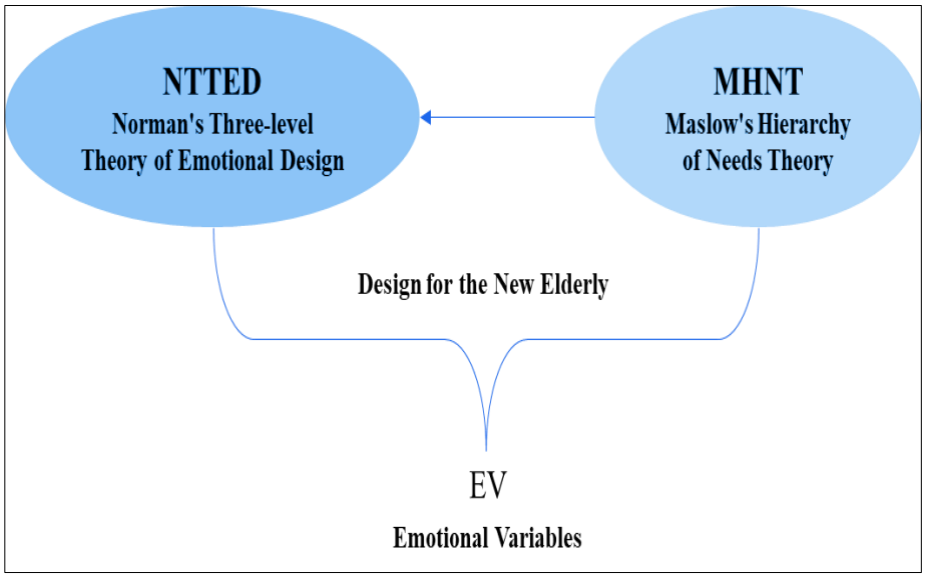

Figure 1. The Correlation between NTLTED and NHNT

Figure 1 illustrates the correlation between NTLTED and NHNT, aiding in identifying emotional variables (EVs) for designing products for the new elderly. NTLTED, serving as the central pillar of this study, offers a comprehensive perspective for understanding the emotional aspects of design when combined with MHNT. This correlation aims to distil and delineate the EVs for the new elderly, which is crucial for designing the research. This synergistic approach not only facilitates a deeper understanding of the emotional components concerning the new elderly but also lays the groundwork for practical applications and interventions to improve their well-being and quality of life.

2.4 Construction and Analysis of the Theoretical Framework

This study proposes a theoretical framework, as shown in Figure 2 that illustrates the process of identifying emotional factors in designing products for the new elderly. Firstly, the study analyzes the physical characteristics of the elderly (Protection and Movement, Control and Coordination, and Sustenance and Reproduction), as well as their psychological characteristics (Autonomy needs,

Competence needs, and Relevance needs), pinpointing critical points within each aspect. Subsequently, researchers employ the correlation between NTLTED as the core theory and MHNT to determine the EVs of the elderly, categorized primarily into three aspects: visceral, behavioral, and reflective.

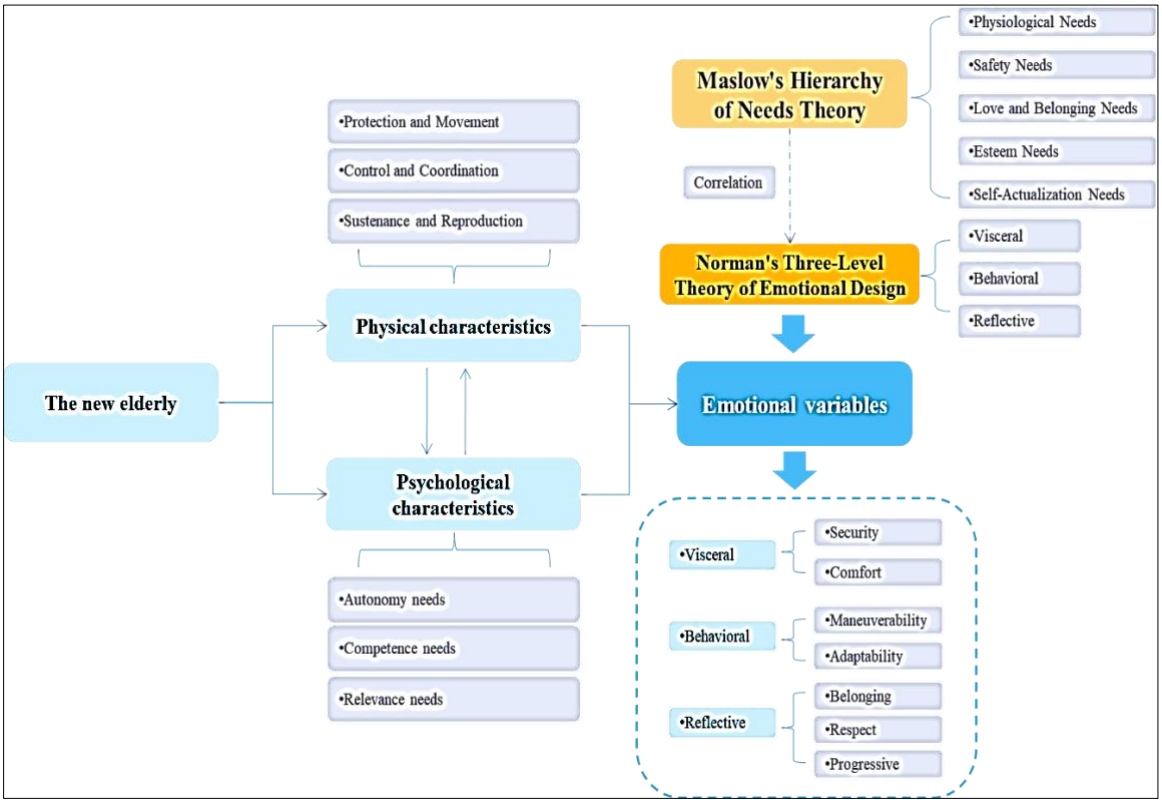

Figure 2. Theoretical Framework

The visceral level includes security and comfort, and security means products should provide a sense of safety to the new elderly groups, which is reflected in the product's function and appearance. Comfort refers to the new elderly's direct and indirect perception of a product's comfort level. When designing products, it is essential to fully consider their physical and psychological factors, such as their decline. The behavioural level encompasses maneuverability and adaptability. Maneuverability refers to the product's operation aligning with the physiological and psychological characteristics of the new elderly. For instance, considering the functional decline of the elderly, complicated operations should be minimized.

Adaptability implies that the product can adjust to the physiological and psychological changes of the new elderly. The reflective level includes belonging, respect, and progressiveness. Belonging signifies the elderly's longing for connections with others, items, or trust in someone or something. Respect denotes their desire to be treated equally and respected by others, much like younger people. Despite their advanced age, they strive to learn and integrate into society. Progressiveness reflects their willingness to accept and learn about world changes and adapt themselves to society's development.

3. METHODOLOGY

This study employs a quantitative method, and a questionnaire was conducted to collect the data. This study investigates the emotional needs of the new elderly groups in China for intelligent toilets as a product, focusing on the representative sample of the regional elderly population.

Cluster sampling is utilized as the method for this study. The research location chosen is the high-tech zone in Chengdu, Sichuan, China, representing the average level of developed cities in China. The population of the Chengdu high-tech zone is approximately 1,257,500, with the elderly accounting for 12.05%. The minimum sample size for this survey is 384, based on a population of 151,528, a 5% margin of error, and a 95% confidence level. An additional 10% of the minimum sample is necessary to account for potential errors, equating to 423 respondents. The questions in the questionnaire are set based on the emotional variables proposed in the theoretical framework. The questionnaire is structured into three sections to address research objectives.

These sections include Demography and Screening (Section A), Emotional Demands for Smart Products (Section B), and Emotional Improvements in Smart Toilets for the New Elderly (Section C). Additionally, the questionnaire was in both Chinese and English. All participants provided informed consent, and the study was conducted following the Declaration of Helsinki guidelines, approved by the Ethics Committee for Research Involving Human Subjects at Universiti Putra Malaysia (Ref. No: UPM/TNCPI/RMC/JKEUPM/1.4.18.2 (JKEUPM).

Table 3. Questions for Categorizing the New Elderly Population

Questions	Options	Score
Are you willing to accept and learn new things and technologies?	Yes	2
Are you eager to participate in social activities? (Including online and offline)	No	0
Are you willing to spend time on your hobbies?	Maybe	1

This study introduces three questions for screening the new elderly, as outlined in Table 3. Respondents who answer 'Yes' receive two points, 'No' earns zero points, and 'Maybe' results in one point. Those who accumulate four points or more are categorized as part of the new elderly group. Questionnaires are distributed via the online survey platform (www.wjx.cn). To ensure the precision of the target demographic, respondents' internet protocol (IP) addresses are restricted, allowing only individuals aged 60 and above to participate. This measure ensures that the data accurately reflects the elderly population. After discarding invalid questionnaires, researchers employ specific codes to align the data within SPSS, moving forward to the subsequent data analysis stage. After collecting and excluding invalid responses, 501 valid samples are available for analysis.

Table 4. KMO and Bartlett's Test

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.813
Bartlett's Test of Sphericity	Approx. Chi-Square	2383.017
	Df	1081
	Sig.	.000

Table 4 presents the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy and Bartlett's test of sphericity for the survey. The KMO value is 0.813, indicating that the sample is suitable for factor analysis. Bartlett's test of sphericity shows an approximate chi-square value of 2383.017 with 1081 degrees of freedom and a significance level (p-value) of 0.000, confirming that the correlations between items are sufficiently significant for factor analysis.

4. RESULTS AND DISCUSSION

4.1 Analysis of Demography and Screening

Table 5 covers the demographic analysis and shows that about 59.28% are male respondents, 40.70% are female respondents, and most are between 60 and 64 years old. Their occupational distribution is relatively balanced across various professions. The overall educational background is concentrated at a moderate level. The majority falls within the income range of 2000-5000 CNY (Chinese Yuan), and living alone is less common, with most elderly individuals residing with their families.

Table 5. Demographic Information of New Elderly and Traditional Elderly

Cross-tabulation (Chi-square) analysis results						
Questions	Demographic	Elderly type (%)		Total	$\chi 2$	p
		Traditional elderly	New elderly			
Gender	Male	68(62.96)	229 (58.27)	297(59.28)	0.73	0.379
	Female	40(37.03)	164(41.73)	204(40.71)		
Age	60-64 years	40(37.03)	237(60.30)	277(55.28)	24.35	0.000**
	65-69 years	26(24.07)	84(21.37)	110(21.95)		
	70-74 years	23(21.29)	44(11.19)	67(13.37)		
	75 and above	19(17.59)	28(7.12)	47(9.38)		
Occupation	Government or public sector employee	17(15.74)	69(17.57)	86(17.66)	3.88	0.58
	General employee in a company or organization	24(22.22)	67(17.04)	91(18.64)		
	Self-employed/ Entrepreneur	17(15.74)	54(13.74)	71(14.72)		
	Unemployed	19(17.59)	66(16.79)	85(16.96)		
	Retire	20(18.51)	73(18.57)	93(18.53)		
	Other	11(10.18)	64(16.28)	75(14.70)		
Highest level of Education	Elementary school diploma or below	22(20.37)	49(12.46)	71(14.72)	27.16	0.000**
	Junior high/ Senior high/ Secondary technical school diploma	46(42.59)	89(22.64)	135(26.96)		
	College/ Bachelor's degree	36(33.33)	236(60.01)	272(54.21)		

	Master's degree or above	4(3.70)	19(4.85)	23(4.51)		
Income per month?	2000 CNY and below	22(20.70)	62(15.76)	84(16.76)	28.21	0.000**
	2000~5000 CNY	60(55.56)	127(32.36)	187(37.25)		
	5000~8000 CNY	18(16.67)	110(27.90)	128(25.49)		
	8000 CNY and above	8(7.47)	94 (24.01)	102(20.59)		
Who do you live With?	Living alone	20(18.59)	1(0.25)	21(4.12)	165.98	0.000**
	With a spouse	30(27.78)	240(61.09)	270(53.92)		
	With children	32(29.30)	149(37.93)	181(36.18)		
	With others	26(24.74)	3(0.76)	29(5.78)		
Have you experienced any Major life changes recently that have affected your emotional well - being?	Yes, and it has been positive	43(39.15)	131(33.33)	174(34.71)	5.49	0.06
	Yes, and it has been negative	13(12.07)	28(7.15)	41(8.18)		
	No, I have not experienced any major life changes recently	52(48.18)	234(59.52)	286(57.08)		
Do you have access to Resources or support systems that help you manage your emotions?	No, I do not have access to resources and support systems	24(22.22)	104(26.43)	128(25.59)	0.801	0.371
	Yes, I have access to resources and support systems	84(77.78)	289(73.57)	373(74.51)		
Have you experienced any physical health issues that have affected your Emotional well -being?	Yes	78(72.22)	279(70.992)	357(71.27)	0.063	0.802
	No	30(27.78)	114(29.08)	144(28.73)		
Total		108	393	501		
*** p<0.05 ** p<0.01**						

For screening purpose, these three questions elicit that the total number of new elderly is 393, while the number of traditional elderly is 108. Table 6 shows that about 42.31% of new elderly respondents answered that they are willing to accept and learn new technologies, and about 48.30% stated that they may be, which could also be considered yes. However, only 9.38% of respondents were willing to learn new technologies. Most respondents were willing to participate in social activities in the follow-up question. About 50.90% of new elderly respondents said they love to spend time with their hobbies. In general, the differences between the new elderly and the traditional elderly are summarized as the new elderly population represents a significant segment among the younger elderly individuals, indicating an emerging trend in this demographic change.

Regarding education and income, the new elderly tend to possess higher education and income levels than the traditional elderly, highlighting potential socioeconomic advantages for this group. The new elderly are less likely to live alone and more likely to live with their spouse and children, emphasizing a higher level of family cohabitation and support. Both new elderly and traditional elderly acknowledge the impact of health issues on their psychological state, suggesting a shared understanding of the interplay between physical and mental health.

Table 6. Questions to Screen the New Elderly

Frequency analysis results			
Questions	Options	Frequency	Percent (%)
Are you willing to accept and learn new things and technologies?	No	47	9.381
	Maybe	242	48.303
	Yes	212	42.315
Are you eager to participate in social activities (Including online and offline)?	No	54	10.778
	Maybe	233	46.507
	Yes	214	42.715
Are you willing to spend time on your hobbies?	No	42	8.383
	Maybe	255	50.898
	Yes	204	40.719
Elderly type	Traditional elderly	108	21.557
	New elderly	393	78.443
Total		501	100.0

4.2 Analysis of the Psychological State Differences between New Elderly and Traditional Elderly

Table 7 shows that a significant proportion of the elderly have not experienced major life changes, while those who have experienced such changes tend to have a more positive outlook. A considerable portion of the elderly believe that health issues can impact their mood. Overall, the happiness index is relatively high among the elderly population. In addition, most of the elderly in this sample express a desire for social interaction, a sense of life purpose, and a relatively high level of happiness. They also tend to be satisfied with their current lives.

Table 7. Psychological State Data of the New Elderly and Traditional Elderly

Independent sample t-test				
	Elderly type (Mean±Std. Deviation)			
Questions	The Traditional elderly (n=108)	The new elderly (n=393)	t	p
How important is it for you to have someone to talk to regularly?	2.722±0.994	3.013±0.771	-2.814	0.006**
Do you feel like you have a sense of purpose or meaning in your life right now?	2.546±1.241	3.064±0.838	-4.084	0.000**
How often do you feel sad or down?	2.435±1.007	1.751±0.658	6.683	0.000**
How important is it for you to have activities to look forward to?	3.000±1.085	3.349±0.922	-3.345	0.001**

How satisfied are you with your current living situation?	3.204±1.083	3.489±0.907	-2.503	0.013*
How often do you feel happy or content?	2.481±1.009	2.710±0.837	-2.157	0.033*

* p<0.05 ** p<0.01

4.3 Analysis of Emotional demands of the New Elderly for Smart Products

Figure 3 shows that "New elderly" use about 34% of smartphones, followed by 29% of smart TVs, 19% of intelligent toilets, 13% of smart speaker devices, and 9% of other smart devices. The leading intelligent products used by the new elderly are smartphones and smart TVs. Additionally, the prevalence rate of smart toilets indicates a significant demand for intelligent toilets among the new elderly in China.

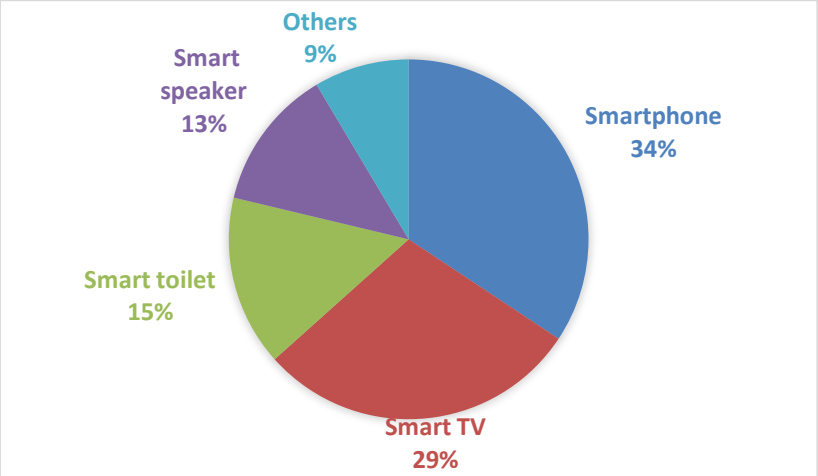

Figure 3. Categories of Innovative Products Used by New Elderly

In Table 8, the elderly were asked two questions, and it shows that the majority of the new elderly can quickly grasp the basic operations of smart devices, and most of the new elderly seek help from family members to learn how to use intelligent products. About 55.73% of participants claimed they would learn about new smart devices within an hour, and 65% claimed they would get help from family and friends to learn new innovative technology. In the follow-up questions, respondents were asked about the functions of the intelligent product. 27.57% of respondents claimed software issues or hardware problems could cause frustration.

Table 8. Maneuverability Data of Inconveniences When Using Smart Products

Response and popularity rate

Categories of "What inconveniences did you encounter when using smart products"	Response		
	N	Response Rate	Popularity
Complex operation steps	186	24.538%	47.328%
Confusion caused by too many features	186	24.538%	47.328%
The interface doesn't match your physical decline (such as vision, hearing, and haptics)	176	23.219%	44.784%
Software glitches or hardware malfunctions can make you frustrated or confused.	209	27.573%	53.181%

Others	1	0.132%	0.254%
Total	758	100%	192.875%
Goodness of fit: $\chi 2$=190.879 p=0.000			

Table 9 highlights the product's security data. About product's security attributes, the intelligent product's too many features or complex operation steps would confuse the user and add up to the frustration. Therefore, users showed preference for simple interface, and in terms of the security data of product appearance, respondents ranked "some basic warning colours," "stable structure," and "harmless materials" as significantly necessary. As for the security data of interactive experience, the response rates and prevalence rates of the options "Biometric authentication (such as face recognition and fingerprint reader)" and "Information security" are significantly high.

Table 9. Security Data

Response and popularity rate			
Options of "What kind of smart product appearance can make you feel safe"	Response		
	N	Response rate	Popularity Rate
Some basic warning colours	269	23.07%	68.45%
Stable structure	302	25.90%	76.85%
Human-machine size	193	16.55%	49.11%
Harmless materials	267	22.90%	67.94%
Others	135	11.58%	34.35%
Total	1166	100%	296.69%
Goodness of fit: $\chi 2$=78.974 p=0.000			
Biometric authentication (such as face recognition and fingerprint reader)	255	22.16%	64.89%
Appropriate voice prompts	209	18.16%	53.18%
Real-time alerts and notifications	230	19.98%	58.52%
Information security	323	28.06%	82.19%
Others	134	11.64%	34.10%
Total	1151	100%	292.88%
Goodness of fit: $\chi 2$=82.236 p=0.000			

Table 10 shows the comfortability of the products related to color matching, 'Harmony' is the most important consideration, followed by 'Warmth'. When considering materials, 'Safe material' is prioritized, followed by 'Durability' and 'Comfortable touch'. Understanding how to use the product is crucial for elderly users, with 'Leading you to know how to use the product' ranking first. Nostalgic styles are preferred, with 'Related to nostalgic feelings' being the most popular. Finally, for interface comfort, 'Icons guiding interface operations' are preferred, followed by 'Concise content'.

Table 10. Comfortability of the Product

How do you want the colours of intelligent products to make you feel?	Mean	Std. Deviation
Reliability	4.064	0.844
Harmony	4.135	0.814
Warm	4.092	0.828
Luxury	3.359	0.904
Elegance	3.774	1.004
Clean	3.636	1.051
the colours of intelligent products	3.843	0.581
What material can give you a good experience while using intelligent products?	**Mean**	**Std. Deviation**
Comfortable touch	3.837	1.015
Safe	4.112	0.819
Matching the function of the product	3.817	0.949
Durable	3.855	0.94
kind of material	3.905	0.687
What kind of patterns on intelligent products can make you feel pleasant?	**Mean**	**Std. Deviation**
Related to your personal preference	3.751	1.01
It can lead you to know how to use the product	4.092	0.962
Related to the shape of intelligent product	3.748	0.982
Fashionable	3.695	1.044
Traditional	3.735	1.043
kind of patterns	3.804	0.796
What kind of intelligent product shape do you prefer?	**Mean**	**Std. Deviation**
Related to your personal preference	3.718	1.057
Related to your beliefs	3.697	1.029
Related to your nostalgic feelings	4.094	0.829
Fashionable	3.725	1.04
Traditional	3.695	1.056
product shape	3.786	0.783
What interface operations can make you feel comfortable?	**Mean**	**Std. Deviation**
Concise content	3.738	1.015
Appropriately sized icons	3.641	1.084
Icons that fit your aesthetic	3.692	1.017
Icons can guide you to operate	3.997	0.896
Interface operations	3.767	0.77

Table 11 shows the average value of product feedback, and the range of adaptability that the product offers. The adaptability data highlights that ‘practical guidance which can quickly improve the new elderly's user experience when using intelligent products’ ranks first as being user-friendly. And ‘quick tips in case of emergency’ ranking second, ‘to adapt to your functional decline and customize an operation plan’ is number three on the list, and ‘clear feedback on whether the product is working correctly’ comes fourth. It also shows the value of innovative product interaction methods. The acceptance of the intelligent product interaction method through ‘voice interaction’ is the highest ranking, and ‘touch interaction’ranks second. Furthermore, ‘Motion interaction’ ranked as third, and ‘augmented reality’ (AR) and ‘virtual reality’ (VR) interaction ranked fourth.

Table 11. Adaptability Data

What kind of product feedback can enhance your user experience when using intelligent products?	Mean	Std. Deviation
Provide effective guidance	4.02	0.909
Adapt to your functional decline and customize an operation plan	3.705	1.007
Clear feedback on whether the product is working properly	3.631	1.052
Quick tips in case of emergency	3.812	0.94
Product feedback	3.792	0.772
How willing are you to try different methods of interacting with intelligent products?	**Mean**	**Std. Deviation**
Voice interaction	4.069	0.899
Touch interaction	3.72	1.002
Augmented Reality (AR) and Virtual Reality (VR) interaction	3.565	1.011
Motion interaction	3.674	1.107
intelligent product interaction methods	3.757	0.8

Table 12 clearly shows that individuals place a high value on the sense of respect, belonging and progressiveness that well-designed smart products offer. When it comes to belonging, reliable performance and personalized features are of key importance, followed by safety and a unique appearance or function. It exhibits that high-quality, emotionally resonant, interactive, personalized, and intelligent products are the most respected. Regarding self-improvement, high-quality products are seen as the most stimulating, followed by products that stimulate imagination, improve creativity, and enhance a sense of responsibility. These findings suggest that individuals value innovative products that function well and cater to their emotional and self-improvement needs.

Table 12. Data of Belonging & Respect & Progressive

What kind of feeling can an excellent innovative product bring to you?	Mean	Std. Deviation
A sense of belonging	3.743	1.004
Be Respected	4.127	0.848
A feeling of satisfaction	3.684	1.006
kind of feeling	3.852	0.77
What kind of product features can bring you a sense of belonging?	**Mean**	**Std. Deviation**
A unique appearance or function	3.595	1.055
Personalized	3.735	1.031
Reliable performance	4.211	0.826
Safety	3.733	1.014
kind of product features	3.819	0.786
Which features of an intelligent product can make you feel respected?	**Mean**	**Std. Deviation**
High-quality	4.003	0.944
Personalized	3.893	0.963
Interactive	3.964	0.992

Emotional resonance	3.99	0.939
Which features of an intelligent product can make you feel respected?	3.962	0.798
Which features of an intelligent product can give you a sense of self-improvement?	**Mean**	**Std. Deviation**
Stimulating your imagination	3.908	0.879
Improving your cognition	4.099	0.807
Improving your creativity	3.885	0.878
Improving your sense of responsibility	3.875	0.822
Which features of an intelligent product can give you a sense of self-improvement?	3.942	0.652

4.4 Analysis of Emotional Improvements of Smart Toilet Designed for the New Elderly

Table 13 shows that most individuals prioritize privacy when using intelligent toilets. Safety features such as Grab bars, non-slip flooring, and an 'Emergency call button' are considered necessary by nearly half of the users, with the emergency call button ranking second. 'Natural lighting', 'Soft colours', and 'Decorative plants' contribute to a comfortable and relaxed environment, with 'All of the above' being the most preferred option. In alleviating anxiety, users believe all listed features can help, with 'Voice-guided instructions' ranking second, 'Aromatherapy dispensers' third, and 'Built-in speakers to play calming music' fourth. Moreover, as for features to alleviate anxiety when using a smart toilet, nearly half of people consider that all of the above features can ease the anxiety by using smart toilets. Besides, ‘Voice-guided instructions’ ranks second, ‘Aromatherapy dispensers’ is third, and ‘Built-in speakers’ to play calming music' is fourth.

Table 13. Visceral Level Factors of Smart Toilet (N=393)

Questions	Options	N	Percent (%)
How important is privacy to you？	Not important	6	1.527
	Somewhat important	12	3.053
	Very important	128	32.570
	Extremely important	247	62.850
What safety features do you think are necessary for a smart toilet?	Non-slip flooring	57	14.504
	Grab bars	69	17.557
	Emergency call button	84	21.374
	All of the above	183	46.565
What type of design can help create a comfortable and relaxing environment?	Natural lighting	96	24.427
	Soft colours	77	19.593
	Decorative plants	43	10.941
	All of the above	177	45.038
Which of the following features can help alleviate anxiety?	Built-in speakers to play calming music	34	8.651
	Voice-guided instructions	97	24.682
	Aromatherapy dispensers	85	21.628
	All of the above	177	45.038
Total		393	100.0

As shown in Table 14, to exercise various operations poses 'difficulty with fine motor skills or have limited dexterity' is the most annoying feature, which is the number one trouble, 'Confused caused by how to choose functions' ranks second, 'Difficult to read small text or locate the controls on the smart toilet operation' ranked third, 'Challenging to remember how to operate' is fourth, and 'Others' is fifth.

Table 14. Maneuverability Factors of Smart Toilet (N=393)

Response and popularity rate			
Options of "What operational troubles have you experienced (may you encounter) while using a smart toilet?"	Response		
	N	Response rate	Popularity rate
Confused caused by how to choose functions	246	27.182%	62.595%
Have difficulty with fine motor skills or have limited dexterity	264	29.171%	67.176%
Difficult to read small text or locate the controls on the smart toilet	200	22.099%	50.891%
Challenging to remember how to operate	146	16.133%	37.150%
Others	49	5.414%	12.468%
Total	905	100%	230.280%
Goodness of fit: $\chi 2$=166.431 p=0.000			

In Table 15, as for the Adaptability factors 'Tactile feedback like vibration is difficult to feel' is the most confusing. 'Visual cues are difficult to identify' is second. 'The temperature feedback of the heated seat is not clear' ranks third. 'Have difficulty understanding Maintenance Alerts' ranks fourth, while 'Others' ranks fifth.

Table 15. Adaptability Factors of Smart Toilet (N=393)

Response and popularity rate			
Options of "What kind of smart toilet feedback will trouble you?"	Response		
	N	Response rate	Popularity rate
Visual cues are difficult to identify	254	21.453%	64.631%
The temperature feedback of the heated seat is not clear	236	19.932%	60.051%
Have difficulty understanding Maintenance Alerts	198	16.723%	50.382%
Tactile feedback like vibration is difficult to feel	302	25.507%	76.845%
Others	194	16.385%	49.364%
Total	1184	100%	301.272%
Goodness of fit: $\chi 2$=33.297 p=0.000			

To identify the belonging factors, Table 16 indicates that the majority of the samples are 'Health monitoring'. Besides, 'Voice activation (Can recognize voice well for interaction)' ranks second and 'Adjustable seat height' ranks third. The fourth choice is 'Night lights'.

Table 16. Belonging Factors of Smart Toilet

Question	Options	Frequency	Percent (%)
What kind of smart toilet improvements can give you a sense of belonging?	Health monitoring	203	51.654
	Voice activation (Can recognize voice well for interaction)	104	26.463
	Adjustable seat height	44	11.196
	Night lights	38	9.669

	Others	4	1.018
Total		393	100.0

Regarding respect factors, Table 17 shows that the improvement of smart toilets with 'Privacy screens' is the optimal way to remind people of belonging, ranking first, 'A quiet flush' ranks second, 'Pleasant lighting' ranks third, and 'Warm reminder' ranks fourth. 'Others' is number five.

Table 17. Respect Factors of Smart Toilet (N=393)

Response and popularity rate			
Options of "What kind of smart toilet features can promote a sense of dignity while using the toilet?"	Response		
	N	Response rate	Popularity rate
A quiet flush	257	26.413%	65.394%
Privacy screens	292	30.010%	74.300%
Pleasant lighting	222	22.816%	56.489%
Warm reminder	183	18.808%	46.565%
Others	19	1.953%	4.835%
Total	973	100%	247.583%
Goodness of fit: $\chi 2$=231.764 p=0.000			

As for the progressive factors represented by Table 18, a sense of respect that helps you take care of yourself' ranks first, 'Feel safe when using the smart toilet' is second, 'Feel comfortable when using the smart toilet' ranks third, 'Feels happy after using the toilet' ranks fourth, and 'Others' ranked fifth.

Table 18. Progressive Factors of Smart Toilet

Response and popularity rate			
Options of " How does a good smart toilet make you feel "	Response		
	N	Response rate	Popularity rate
Feel safe when using the smart toilet	299	24.548%	76.081%
Feel comfortable when using the smart toilet	296	24.302%	75.318%
Feel happy after using the toilet	272	22.332%	69.211%
A sense of satisfaction that you can take care of yourself	311	25.534%	79.135%
Others	40	3.284%	10.178%
Total	1218	100%	309.924%
Goodness of fit: $\chi 2$=215.998 p=0.000			

4.4 Discussion

The comparison between the new elderly and traditional elderly revealed significant differences in several areas, consistent with the findings of Teng & Shen (2018). This study expands on their work by specifically focusing on the emotional factors influencing product design for the new elderly in China, particularly in the context of smart toilets.

The new elderly, characterized by higher education levels, higher incomes, and a greater willingness to adopt new technologies, exhibit distinct emotional needs compared to the traditional elderly. These differences highlight the necessity for tailored product designs that cater to the unique emotional and practical needs of this demographic group. By starting with NTTED (Norman, 2007) and incorporating NHNT (Maslow, 1943), this study highlights the significance of the seven EVs, specifically visceral (security and comfort), behavioral, and reflective (belonging, respect, and progressiveness), as shown in the survey data, and consequently leads to discussing the key factors influencing each EV. For the new elderly, security and comfort are critical visceral factors. Fang et al., (2016) suggests that for visually impaired elderly, design should use clear, large fonts, contrasting colors, and intuitive icons for better discernibility and understanding.

This study more comprehensively identifies key security elements such as information security, stable structures, basic warning information, and non-hazardous materials. Besides, as for comfort, preferences included harmonious and warm colors, nostalgic shapes, guiding patterns, and safe durable materials. These preferences emphasize the importance of designing products that evoke positive emotional responses through their physical attributes, contributing to overall user satisfaction.

Maneuverability and adaptability are crucial at the behavioral level. Elderkin-Thompson et al. (2008) emphasizes that the physical and mental well-being of the elderly should be considered in design, as their self-perceptions of energy and health are linked to prefrontal brain morphology, which can be influenced by product and service design. The new elderly often face difficulties with fine motor skills and complex operation steps. Therefore, this study recognizes that assistive functions and clear operational steps are essential. Effective guidance and customizable operation plans are also highly valued, with voice interaction being the preferred method. These features ensure that the products are user-friendly and can be easily adapted to meet individual needs, enhancing the overall user experience.

Reflective factors encompass respect, belonging, and progressiveness. Martínez-López et al. (2021) highlights the role of social support in preventing depressive symptoms among the elderly. This suggests that products and services promoting social interaction can positively influence the reflective level of emotional design for the elderly. This study suggests that the new elderly prioritizes respect, with high-quality materials, emotional resonance, and interactivity being crucial. Privacy screens and quiet flush systems were among the most valued features, reflecting the deep-seated need for dignity and privacy. Belonging factors such as reliable performance and personalized safety features were also significant. Health monitoring and voice activation features made users feel part of a caring and supportive environment.

Progressiveness was reflected in the desire for self-improvement and cognitive stimulation, with features enhancing cognition and stimulating imagination being highly valued. The function of a good smart toilet can enhance the dignity of the elderly (Balaceanu et al., 2019), for example Fong et al., (2023) underscore their role in disease detection among the elderly through IoT-driven technology and Esmaeilzadeh (2023) points out that the elderly's willingness to use smart toilets is contingent on their perceived value, which includes health care, technology, and usability benefits. Therefore, it is significant to identify the pain points that significantly impact the user experience of the new elderly.

Based on the seven emotional factors, this study identified several pain points. Firstly, privacy was of utmost importance, with features such as emergency call buttons, grab bars, and non-slip flooring being essential for safety. Comfort-enhancing features like natural lighting, soft colors, voice-guided instructions, and aromatherapy dispensers were also crucial in creating a relaxing environment.

Secondly, the new elderly often experience difficulties with fine motor skills and complex operation steps. This frustration is compounded by challenges in reading small text and locating controls. Effective guidance and customizable operation plans can alleviate these issues, making the smart toilets more user-friendly. Thirdly, privacy screens and quiet flush systems promote dignity and respect. Health monitoring and voice activation features foster a sense of belonging, making users feel part of a caring and supportive environment. Features that enhance cognition and stimulate imagination support the users' desire for self-improvement and continuous learning.

Therefore, integrating NTTED and NHNT in evaluating the emotional factors in product design has proven effective. The insights gained from this study can guide future designs to better cater to the evolving needs of the new elderly, ultimately enhancing their quality of life and emotional well-being. These findings underscore the importance of addressing both practical and emotional needs in product design to create fulfilling and dignified user experiences for the new elderly.

5. CONCLUSION AND RECOMMENDATIONS

Based on the data analysis, the researchers critically identified and ranked the emotional factors influencing product design for the new elderly in China, particularly in the context of intelligent toilets. Regarding the selection criteria, factors that had a minimal impact on the relevant categories were omitted, while factors with a significant influence were selected and ranked in Figure 4. Additionally, different factors may influence each other mutually. In conclusion, this study highlights the crucial factors influencing the design of smart toilets for the elderly at visceral, behavioural, and reflective levels.

Visceral factors emphasize the importance of security, comfort, and aesthetic appeal. Behavioural factors focus on assistive functionalities and clear operational steps for improved manoeuvrability and adaptability. Reflective factors underline the significance of respect, belonging, and progressiveness, ensuring the elderly feel valued and supported. Based on these insights, we recommend integrating safety features like emergency call buttons and non-slip flooring, incorporating natural lighting and soft colors for comfort, and enhancing user interactions with voice-guided instructions and health monitoring systems. These recommendations aim to address the pain points of the elderly, ensuring smart toilets are secure, user-friendly, and emotionally satisfying. The study found that 42.31% of the elderly are willing to accept and learn new technologies, while 9.38% are less inclined. The elderly often live with their families, indicating a higher family cohabitation and support level. They are socially active, have vigorous life pursuits, and maintain an optimistic attitude, leading to higher satisfaction and happiness than traditional elderly respondents. Most elderly individuals can quickly learn the basics of smart devices with family assistance.

Recommendations include prioritizing using safe, durable, and comfortable materials in product design. Colour harmony and warmth are essential for comfort. Voice interaction is the most preferred method, followed by touch and motion interactions. Designers should consider the elderly's physical and mental health, incorporating features that address common difficulties such as limited dexterity and readability issues. By focusing on the visceral, behavioural, and reflective levels of emotional design, products can be tailored to meet the needs of the elderly, enhancing their quality of life. Technology should assist in meeting their physiological and safety needs, while ICT-based welfare services can address social and esteem-level needs. Home automation and positive social support can enhance self-esteem and lead to self-actualization.

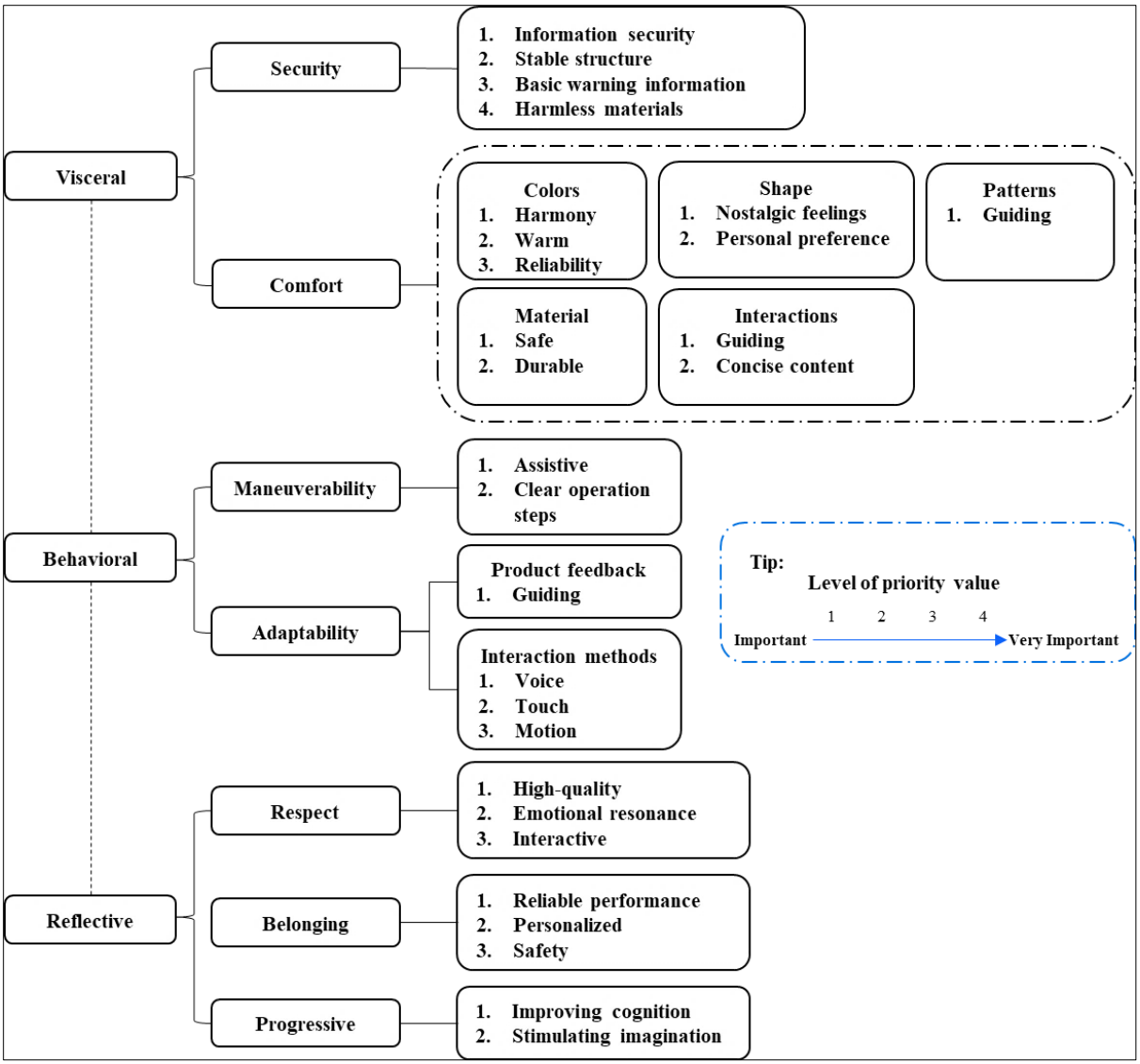

Figure 3. Emotional Factors in Product Design for the New Elderly in China

6. LIMITATIONS AND FUTURE STUDIES

The limitations of this research are threefold. Firstly, regarding the respondents, there are potential regional and cultural biases, self-reporting biases, and a limited coverage of product fields. Secondly, while the study exclusively targets the new elderly in China, engaging with new elderly groups in other regions would necessitate further research and validation. Moreover, the emotional factors suggested additional validation. Although the study provides general emotional factors, more detailed and specific emotional factors would require further research.

This research refines our understanding of the characteristics of the new elderly group in China. However, due to a current scarcity of quantitative research on the physical characteristics of this group in China, the study offers only a broad description based on existing literature. It is recommended that future product designs for the new elderly involve detailed measurements of this demographic's physical data to better accommodate their physical needs. Additionally, while this study focuses on the new elderly in representative regions of China, it may not account for varying factors from different regions, such as religious and cultural influences. Therefore, designing products for the new elderly in diverse

cultural regions of China should incorporate additional emotional need factors. Nevertheless, the emotional factors from this study are generally applicable. Moreover, the theoretical framework devised in this study centered on the emotional needs of the new elderly towards products, which consequently may require further investigation and validation if applied to other groups. Furthermore, the emotional factors proposed in this study, based on the emotional needs of the new elderly in China, represents a relatively broad standard. Designers are encouraged to refine and validate their products according to the specific traits of the target group. In addition, the design suggestions for smart toilets proposed in this study, tailored to the emotional needs of the new elderly, provide a general direction for design. Detailed design elements should be more thoroughly explored and substantiated according to practical scenarios.

Author(s) Contributions: Qiuyi Li: Conceptualization, Research Design and Data Collection; Mohd Faiz Yahaya: Writing—original draft preparation; Rosalam Che Me: Data Analysis and Revision of Manuscript. All authors have read and agreed to the published version of the manuscript.
Ethical Statement: This study was granted ethical permission and consideration from the Declaration of Helsinki guidelines, approved by the Ethics Committee for Research Involving Human Subjects at Universiti Putra Malaysia (Ref. no: UPM/TNCPI/RMC/JKEUPM/1.4.18.2 (JKEUPM).
Competing Interests: The author(s) declared that this work has no competing interests.
Consent to Participate: As this study deals with human subjects, the collection of corresponding data or the concerning human rights issues are evaluated with informed consent.
Grant/Funding Information: The author(s) declared that no grants supported this work
Data Availability Statement: The associated data is available upon request from the corresponding author.
Declaration Statement of Generative AI: The author(s) of this work declared that they did not use any AI tools or program/software to draft this paper.

REFERENCES

Arent, S. M., Landers, D. M., & Etnier, J. L. (2000). The effects of exercise on mood in older adults: A meta-analytic review. *Journal of Aging and Physical Activity*, *8(4)*, 407-430. https://doi.org/10.1123/japa.8.4.407

Balaceanu, C., Marcu, I., Suciu, G., Dantas, C., & Mayer, P. (2019). Developing an intelligent toilet system for ageing people and persons with disabilities. In *Proceedings of the 6th Conference on the Engineering of Computer-Based Systems* (pp. 1-4), ACM Digital Library. https://doi.org/10.1145/3352700.3352716

Chen, Y. R. R., & Schulz, P. J. (2016). The effect of information communication technology interventions on reducing social isolation in the elderly: A systematic review. *Journal of Medical Internet Research*, *18(1)*, e4596. https://doi.org/10.2196/jmir.4596

Chen, Z., Wu, Z., Zheng, S., Liu, C., Wu, Q., & Li, S. (2022). Effect of exercise interventions on the depression of older adults: A meta-analysis. *International Journal of Sport Psychology*, *53(6)*, 543-568. https://doi.org/10.7352/IJSP.2022.53.543

Elderkin-Thompson, V., Ballmaier, M., Hellemann, G., Pham, D., Lavretsky, H., & Kumar, A. (2008). Daily functioning and prefrontal brain morphology in healthy and depressed community-dwelling elderly. *The American Journal of Geriatric Psychiatry, 16(8)*, 633-642. https://doi.org/10.1097/jgp.0b013e3181794629

Erickson, K. I., Hillman, C. H., & Kramer, A. F. (2015). Physical activity, brain, and cognition. *Current Opinion in Behavioral Sciences*, *4*, 27-32. https://doi.org/10.1016/j.cobeha.2015.01.005

Esmaeilzadeh, P. (2023). Older adults' perceptions about using intelligent toilet seats beyond traditional care: Web-based interview survey. *JMIR mHealth and Health*, *11(1)*, e46430. https://doi.org/10.2196/46430

Fang, Y. M., Chen, K. M., & Huang, Y. J. (2016). Emotional reactions of different interface formats: Comparing digital and traditional board games. *Advances in Mechanical Engineering, 8(3)*. https://doi.org/10.1177/1687814016641902

Fong, D., Sood, S. K., & Rawat, K. S. (2023). Empowering elderly care with intelligent IoT-driven smart toilets for home-based infectious health monitoring. *Artificial Intelligence in Medicine*, *144*, 102666. https://doi.org/10.1016/j.artmed.2023.102666

Gatchel, R. J., Peng, Y. B., Peters, M. L., Fuchs, P. N., & Turk, D. C. (2007). The biopsychosocial approach to chronic pain: Scientific advances and future directions. *Psychological Bulletin, 133*(4), 581–624. https://doi.org/10.1037/0033-2909.133.4.581

Gong, M., Li, K., Tian, T., Mao, X., & Wang, C. (2020). Research and analysis on the development of intelligent toilets. In *The 2020 International Seminar on Artificial Intelligence, Networking and Information Technology, Vol. 1684*(1), (pp. 12-38). IOP Publishing. https://doi.org/10.1088/1742-6596/1684/1/012038

Gordon, B. R., McDowell, C. P., Hallgren, M., Meyer, J. D., Lyons, M., & Herring, M. P. (2018). Association of efficacy of resistance exercise training with depressive symptoms: Meta-analysis and meta-regression analysis of randomized clinical trials. *JAMA Psychiatry*, *75(6)*, 566-576. https://doi.org/10.1001/jamapsychiatry.2018.0572

Han, R., Shao, D., & Wang, Y. (2020). The design of a senior family bathroom system is based on demand theory. In *E3S Web of Conferences, Vol. 179,* 02080. EDP Sciences. https://doi.org/10.1051/e3sconf/202017902080

Kang, J. K., & Lee, J. Y. (2015). Status and tasks of ICT-based welfare services for the elderly living alone. *Journal of Digital Convergence*, *13(1)*, 67-76. https://doi.org/10.14400/jdc.2015.13.1.67

Lobanov-Rostovsky, S., He, Q., Chen, Y., Liu, Y., Wu, Y., Liu, Y., Venkatraman, T., French, E., Curry, N., Hemmings, N., Bandosz, P., Chan, W. K., Liao, J., & Brunner, E. J. (2023). Growing old in China in socioeconomic and epidemiological context: Systematic review of social care policy for older people. *BMC Public Health, 23(1)*, 1272. https://doi.org/10.1186/s12889-023-15583-1

Ma, S. (2010, August 14). We are approaching the "new elderly" in Italy. *Guangming Daily*, p. 006.

Mandolesi, L., Polverino, A., Montuori, S., Foti, F., Ferraioli, G., Sorrentino, P., & Sorrentino, G. (2018). Effects of physical exercise on cognitive functioning and well-being: Biological and psychological benefits. *Frontiers in Psychology*, *9*, 509. https://doi.org/10.3389/fpsyg.2018.00509

Mao, B., Fang, Z. T., & Wang, C. (2022). Research on the design strategy of products for the new elderly. *Package & Design*, (02), 124-125.

Martínez-López, J. Á., Lázaro-Pérez, C., & Gómez-Galán, J. (2021). Burnout among direct-care workers in nursing homes during the COVID-19 pandemic in Spain: A preventive and educational focus for sustainable workplaces. *Sustainability, 13(5)*, 2782. https://doi.org/10.3390/su13052782

Maslow, A. H. (1943). A theory of human motivation. *Psychological Review*, 50(4), 370-396. https://doi.org/10.1037/h0054346

Meyer, J., Heuten, W., & Boll, S. (2016). No effects, but valuable? Long-term use of innovative health devices. In *Proceedings of the 2016 ACM International Joint Conference on Pervasive and Ubiquitous Computing: Adjunct* (pp. 516-521). ACM Digital Library. https://doi.org/10.1145/2968219.2968314

Norman, D. (2007). *Emotional design: Why we love (or hate) everyday things (Kindle Edition)*. Basic Books.

Ohrnberger, J., Fichera, E., & Sutton, M. (2017). The relationship between physical and mental health: A mediation analysis. *Social Science & Medicine*, *195*, 42-49. https://doi.org/10.1016/j.socscimed.2017.11.008

Pal, D., Triyason, T., Funilkul, S., & Chutimaskul, W. (2018). Smart homes and quality of life for the elderly: Perspective of competing models. *IEEE Access*, *6*, 8109-8122. https://doi.org/10.1109/access.2018.2798614

Tasoglu, S. (2022). Toilet-based continuous health monitoring using urine. *Nature Reviews Urology*, *19*(4), 219-230. https://doi.org/10.1038/s41585-021-00558-x

Teng, Y., & Shen, J. (2018). Research the design trends of "new elders" from the perspective of successful ageing. *Design*, *1*, 20-22.

Tortora, G. J., & Derrickson, B. H. (2019). *Introduction to the human body (11th, EMEA Edition)*. John Wiley & Sons.

Wang, S. Z., & Liu, Y. X. (2020). Research on intelligent product design based on new and old populations. *Design* (04), 102-103. https://doi.org/10.1109/icid54526.2021.00045

Wang, X. J., & Camilleri, M. (2020). An intelligent toilet for personalized health monitoring. *Nature Reviews Gastroenterology & Hepatology*, *17(8)*, 453-454. https://doi.org/10.1038/s41575-020-0320-x

Wang, X. X. (2021). Research on the design strategy of new entertainment products for the elderly from the perspective of positive psychology. *Design,* (03), 100-102.

Zakaria, F., Ćurko, J., Muratbegovic, A., Garcia, H. A., Hooijmans, C. M., & Brdjanovic, D. (2018). Evaluation of an intelligent toilet in an emergency camp. *International Journal of Disaster Risk Reduction*, *27*, 512-523. https://doi.org/10.1016/j.ijdrr.2017.11.015

Vol.2, Issue.2, (2024)
International Journal of Management Thinking
https://doi.org/10.56868/ijmt.v2i1.47

The Effect of Remittances on Economic Expansion and Poverty Reduction: Evidence from Pakistan

Muhammad Haroon Raza

National University of Modern Languages, Department of Economy, Islamabad, 44000, Pakistan

Article Information

Article Type: Research Article

Dates:
Received: February 19, 2024
Revised: June 23, 2024
Accepted: July 07, 2024
Available online: July 14, 2024

Corresponding Author:

Muhammad Haroon Raza
Haroonrazakayani039@gmail.com
https://orcid.org/0009-0003-60629476

ABSTRACT

This study investigates the impact of remittances on economic growth and poverty reduction in Pakistan. The research aims to empirically examine the relationship between remittances, economic expansion and poverty reduction. Using data from 1980 to 2021, sourced from the World Bank, the study employs the Augmented Dickey-Fuller test to assess the stationarity of variables. The results indicate that all variables are stationary using the Autoregressive Distributed Lag (ARDL) approach for analysis. The ARDL bound test confirms a long-term relationship between the variables. In the context of economic growth, the study finds that remittances have a positive and significant impact, with a 1% increase in remittances associated with a 0.26% rise in GDP. However, the study observes a negative impact of foreign direct investment on GDP. Regarding poverty reduction, the results suggest that remittances have a negative and insignificant effect on poverty, with a 1% increase associated with a 0.53% decrease in poverty. Granger causality tests reveal unidirectional causation between remittances and economic growth and between remittances and poverty. The findings underscore the importance of remittances in influencing economic growth and poverty reduction in Pakistan. Recommendations include policies to enhance remittances' positive impact on economic growth and poverty alleviation. The study's implications extend to policy recommendations, emphasizing the potential benefits of remittances in fostering economic growth and poverty reduction. Policymakers are encouraged to consider remittances' positive impact when formulating sustainable development strategies. Additionally, the research contributes to the existing literature by providing insights into the nuanced relationships among remittances, economic growth, and poverty alleviation in Pakistan.

Keywords: Remittances; Economic Growth; Poverty Reduction; Pakistan; ARDL; Granger Causality; Sustainable Development

1. INTRODUCTION

Remittances, often defined as the transfer of money or resources by individuals working abroad to their home countries, constitute a significant component of international financial flows. In the context of Pakistan, remittances primarily refer to the funds sent by Pakistani expatriates living and working overseas to their families and communities back home.These remittances can take various forms, including cash transfers, bank deposits, or in-kind contributions (Kousar et al., 2019).

Remittances is defined as "the sum of workers' remittances, compensation of employees, and migrants' transfers (Filipović et al., 2022). The broad definition of remittance encompasses not only cash transfers but also non-monetary resources, such as goods and services sent by migrants to support their families (Mubeen et al., 2016). According to Murata (2018) remittances are often distinguished from other forms of financial inflows, such as foreign aid or foreign direct investment, by their personal and familial nature, as they represent the earnings of individual migrants rather than official transfers between governments or corporations.

From a socioeconomic perspective, remittances represent a crucial link between migration and development, as they have direct implications for the welfare and well-being of recipient households and communities. Remittances serve as a source of income for families left behind by migrants, enabling them to meet their basic needs, access essential services such as education and healthcare, and invest in income-generating activities (Antman, 2013). Therefore, remittances are often seen as a form of social protection and poverty alleviation, particularly in countries with high levels of emigration and economic hardship (Akeel, 2023).

Remittances, or financial transfers from overseas Pakistani to their home countries have evolved as an important component of international finance, strengthening economic linkages between sending and receiving countries. As millions of people relocate in search of better economic prospects, the influence of remittances on both individual households and national economies has grown in importance and attention. In the context of Pakistan, where remittances play a significant role in the economy, understanding their impact on economic expansion and poverty reduction is of paramount importance. Remittances contribute to Gross Domestic Product (GDP) which stabilize the balance of payments and stimulate domestic demand, thereby fueling economic growth. Moreover, remittances have been shown to reduce poverty levels and improve household welfare by providing a steady source of income for millions of families across the country (Zaman et al., 2021). Therefore, the scope of its study has an intrinsic value for researchers.

Iqbal et al., (2018) postulated that an increase in remittances (in terms of GDP) leads to the increase in the per capita income in the economy. This increase in the per capita GDP could be primarily due to the increase in the consumption of the low-income recipients. The flows of remittances are increasing rapidly in developing and developed countries (Zaman et al., 2021). In comparison with other developing nations, Pakistan is renowned for its high levels of migration and remittances from its employees. It is contended that this high level of migration is the result of poor economic states of the nation in light of the fact that the nation is contending with such a vast array of problems, such as unemployment, lack of education, inflation, poverty, and bombardment. The average Pakistani citizen is leaving their country in search of employment and to improve their prospects for essential luxuries. It is also argued that due to the erratic employment situation, people are relocating to other nations in order to provide their children everyday comfort by finding employment, and that this brain drain problem is a result of this unemployment in home-country (Kamran et al., 2014).

Mughal et al., (2023) reported that an international inbound remittance market in Pakistan has increased at 2.8% during 2022 to reach US$ 29.87 billion in 2023. Over the forecast period (2023-2028), market size is expected to record a CAGR (Compounded Annual Growth Rate) of 2.2%, increasing from US$ 29.06 billion in 2022 to reach US$ 33.36 billion by 2028. Remittances are the monetary transfers done by international migrants to their families in their origin countries. They distinguish themselves from other forms of capital inflow, such as direct investment, loans, and grants (Abbas et al., 2021).

Investing and consuming more is a sign of economic development since remittances reduce poverty, improve health care and education. Yang et al., (2020) found that the main way to eliminate poverty and alleviate financial difficulties faced by migrant families in their home countries is through workers' remittances, these remittances have a beneficial effect on reducing the gap in income and wealth disparity within migrant nations.

The goal of this study is to determine how remittances affect Pakistan's economic growth and efforts to combat poverty? The stated literature only considers worker's remittances and economic growth as variables, leading to existing gaps in research. This existing gap is due to the absence of new variables to assess their impact. A positive correlation is established between two variables (remittances and economic growth) only. Additionally, various versions are employed to analyze empirical data from different countries and sample periods in order to investigate the effect. Rahman (2014) identifies how remittances affect economic growth. In this new study, we aim to address the research gap by incorporating remittances with other macroeconomic variables using the ARDL approach to figure out how it would affect Pakistan's economic growth. The existing literature provides limited insights into how remittance-inflows interact with various economic indicators, including GDP (Gross Domestic Products), GFCF (Gross fixed capital formation), FDI (Foreign direct investment), and trade openness, hindering a holistic understanding of their collective influence on long-term development. This research aims to address this knowledge gap, offering a detailed examination of the relationships between remittances, economic indicators, and poverty, thereby contributing valuable insights for policymakers and scholars invested in optimizing the impact of remittances on Pakistan's economic well-being. Therefore, the objectives are:

1. To find out how remittances affect economic growth and reduce poverty.
2. To empirically examine the extended connection between remittances, economic expansion, and the reduction of poverty.

2. LITERATURE REVIEW

The phenomenon of remittances and its economic implications have garnered substantial attention within academic, economic, and policy-oriented discourse. Jawaid and Raza (2016) investigated the impact of worker remittances and their volatility on economic growth in Asia, and they used long-term series data from 1975 to 2009. The research findings revealed a significant positive long-term correlation between remittances and economic expansion in India, Sri Lanka and Nepal. However, in the case of Pakistan, the results indicated a substantial and negative long-term correlation based on the co-integration test. One limitation of this study was its exclusive focus on the South Asian region, limiting the generalizability of the findings to other contexts.

Abduvaliev and Bustillo (2020) employed a panel data set on economic growth and poverty metrics (including poverty headcount, poverty gap, and poverty severity) across ten selected former post-Soviet republics within the Commonwealth of Independent States (CIS). The researcher

discovered that a 1.0% increase in remittance flows leads to an approximate 0.25% rise in per capita GDP and a 2.0% decrease in poverty severity on average. The analysis suggests that remittances have significantly reduced poverty by boosting income and stabilizing consumption.

Kousar et al. (2019) examined the impact of financial development and foreign remittances on poverty in Pakistan. The study used the ARDL-Bounds testing approach for robust inferences. The results show that in the short-term period, remittances increase poverty and income inequality, which is further translated into its long-term impact. The results confirmed the inverted U-shaped relationship between per capita income and income inequality. In contrast, the second-order coefficient of per capita income substantially declines poverty incidence in a country. In the long-run, the results disappear and become a U-shaped relationship between income inequality and the country's per capita income.

The researcher also observed that education decreases income inequality in the short-term and long-term period. However, it increases poverty in the long-run. The unemployment rate substantially damaged the pro-poor growth scenario, as a high unemployment rate increases both the poverty rates and income inequality, which made people experiencing poverty suffer more than the non-poor in a country. Subsequently, it was concluded that holistic financial development positively impacts poverty reduction in the long-run.

Ahmad et al. (2016) researched the influence of worker remittances on Pakistan's economic growth. The study analyzed the data from 1980 to 2010, using GDP as the dependent variable, and the independent variables are worker remittances, exports, gross domestic product and foreign direct investment. The study employed the Ordinary Least Square (OLS) method and discovered substantial benefits of worker remittances on economic development, indicating a strong relationship between the two. However, the study should have considered other variables, such as investment, education, health, and livelihood standards, which are essential to understanding worker remittances' full implications.

Hayat et al. (2013) investigated the impact of foreign remittances on the economic growth of Pakistan. The ARDL is used to identify the long-term relationship between the variables. GDP is the dependent variable, while foreign remittances, FDI, inflation and exchange rate are independent variables. Results indicate that foreign remittances positively and significantly affect Pakistan's GDP, while inflation and exchange rates negatively affect economic growth. Foreign direct investment has a positive but insignificant relation with Pakistan's GDP. It concludes that Pakistan needs a stable and visionary government to enhance foreign capital inflow and boost investment and economic growth.

Dilshad (2013) conducted an empirical investigation of the effects of remittances on economic growth. The study utilized time series analysis from 1991 to 2012, employing a regression model to assess the correlation. The findings indicated a significant positive association between remittances and economic growth. Using the Co-integration technique, Rahman (2014) revealed a significant positive correlation between worker remittances and economic growth. However, the study did not include other macroeconomic variables that could influence economic growth. Tahir et al. (2015) noted that the study had limitations, including potential data limitations and a lack of comprehensive analysis of external factors that could impact economic growth in Pakistan.

Ahmad et al. (2016) found that foreign remittances and foreign direct investment (FDI) were influential in developing Pakistan's economy. The study also suggested that policymakers should focus on enhancing the inflow of remittances and FDI to achieve sustainable long-term economic growth. Mubeen et al. (2016) investigated the significance of international remittances on Pakistan's financial progress. Secondary data from 1980 to 2011 was used, and multiple regression analysis of the relationship between the variables was examined. The findings showed that foreign direct investment

(FDI), agricultural growth, and worker remittances had a beneficial impact on GDP. FDI also had a small but positive impact on financial development. However, the study revealed that foreign remittances led to declining domestic savings and investment, limiting financial innovation and economic expansion.

Similarly, Meyer and Shera (2017) studied how remittances affected economic growth. The panel data collection covered 1999 to 2013 and included data from six countries with high remittance reception. The study examined the link between remittances and economic growth using multiple regression analysis. The findings showed that in most countries, remittances comprised more than 10% of GDP and served as the primary source of income from foreign currencies.

However, the study solely focused on the impact of remittances on economic growth. It did not consider other potential channels of influence, such as poverty reduction, income inequality, and human capital formation. The topic of foreign remittances as a source of economic growth is the sole focus of our study. We have gathered various researches that explicitly gave us a thorough overview of past studies. The critical probing of economic growth, poverty alleviation, and re-evaluating their relationship to other variables such as foreign remittances, GDP, and FDI is manifested.

2.1 Theoretical Framework of the Study

The Neoclassical Growth Theory is adapted by the researchers within the framework of the effect of remittances on economic expansion and poverty reduction. According to Neoclassical Growth Theory, economic growth is primarily driven by factors such as capital accumulation, technological progress, and labor productivity (Sredojević et al., 2016). Remittances can be seen as a form of external capital inflow which can contribute to investment and capital accumulation in recipient countries like Pakistan (Tahir et al., 2015). Therefore, increased investment can lead to higher economic growth rates, job creation, and ultimately cause poverty reduction.

A significant aspect of Neoclassical Growth Theory is that increased capital accumulation is essential for sustained economic growth. So, remittances can be a sustainable source to contribute in capital formation by financing investment in physical infrastructure, such as housing, businesses, and infrastructure projects. In Pakistan, increased consumer spending fueled by remittance-influx may lead to higher levels of imports as well as increased exports in sectors catering to domestic and international demand. Finally, this economic theory provides a framework for understanding the complex relationship between remittances, economic expansion, and poverty reduction in Pakistan. Empirical research that applies this theoretical perspective can help policymakers design more effective strategies to harness the developmental potential of remittances for the benefit of the country's economy and society.

2.2 Framework of the Study

This research attempts to determine the sources and irregularities of Pakistan’s economic development and consequently play a key role in mitigating poverty. The capital influx assimilated in the form of GDP (Gross Domestic Product) inherently derived from the economic growth caused by the perpetual spurt of remittances, FDI, GFCF, and trade collectively devises the research framework as shown in Figure 1 and Figure 2. It highlights the poverty framework and following influencing variables.

- **Gross Domestic Product (GDP)**

  The value of all goods and services generated inside a country's domestic boundaries during a particular year is added to determine the country's GDP.

- **Remittances**

  Remittances are non-commercial transfers of money made by expatriates, diasporas, or anyone with ties to another country's culture to support a household.

- **Gross Fixed Capital Formation (GFCF)**

  The sum of resident producers' fixed asset investments during a specific period is known as gross fixed capital formation. Assets from production processes consistently and continuously used in other production processes for at least a year are known as fixed assets.

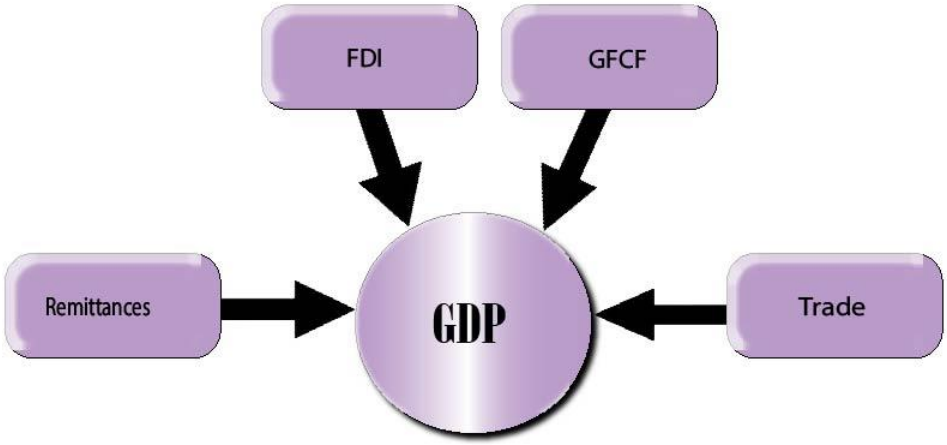

Figure 1. Gross Domestic Product Framework

- **Foreign Direct Investment (FDI)**

  A party from one country invests in a business or organization in another to establish a long-term partnership.

- **Trade**

  Trade is the act of purchasing, selling, or exchanging commodities or services between people, companies, and nations.

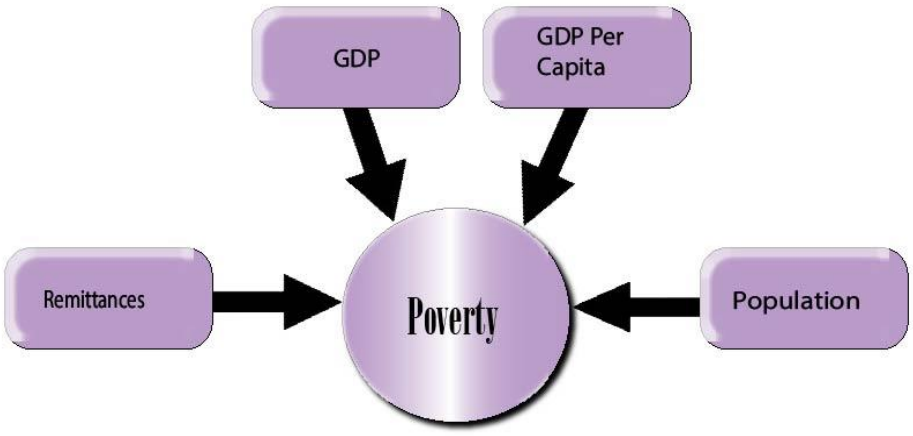

Figure 2. Poverty Framework

- **Poverty**

  Poverty is defined as a state in which individuals or groups lack resources and fail to provide even the bare minimum necessities of life. People in poverty are prone to poor living standards. The "poverty headcount ratio" is the proportion of the population that lives in poverty. In this study, the researcher collected data on the poverty headcount ratio from 1980-2020 from Macro trends.

- **Population**

  A population is a whole set of people, whether that set is a country or a group of people that share some traits. The World Bank's time series data was collected from 1980 to 2021.

3. METHODOLOGY

Theoretical and empirical literature predicts that remittances contribute not only to the growth process of the recipient country but also play an essential role in reducing poverty. This study intends to explore the effect of remittances on real GDP and poverty in Pakistan. We specify two independent models for remittances: growth and poverty.

3.1 Remittances and Growth

We specify an empirical to explore the impact of remittances on economic growth. The Model is shown in equation 1

$$lGDP_t = \alpha_0 + \beta_1 lREM_t + \beta_2 lGFCF_t + \beta_3 lFDI_t + \beta_4 lOP_t + \varepsilon_t \quad \text{(Eq 1)}$$

Where LGDP (Log of Gross Domestic Product), LREM (Log of Remittances), LGFCF (Log of Gross Fixed Capital Formation), LFDI (Log of Foreign Direct Investment), LOP (Log of Trade Openness) are noted in the equation.

Previous studies suggest that remittances positively affect economic growth by reducing the current account deficit, external borrowing, and availability of foreign exchange (Iqbal et al., 2018). The impact of human capital, investment, and trade openness on output is assumed to be positive. We used a model similar to that suggested by Ravallion and Chen (1997) to explore the impact of remittances on poverty.
The model is written in equation 2.

$$lP_t = \alpha + \beta_1 lGDP_t + \beta_2 lGDP\_per\_capita_t + \beta_3 lPOP_t + \beta_4 lREM_t + \varepsilon_t \quad \text{(Eq 2)}$$

Where LP (Log of Poverty Head Count Ratio LGDP), LGDP per capita (Log of Gross Domestic Product Per Capita), LPOP (Log of Population), and LREM (Log of Remittances) are noted in the equation. The expected signs of β1, β2, and β3 are negative, positive and positive/negative, respectively.

To estimate both models in equations (1) and (2), the Autoregressive Distributed Lag (ARDL) method developed by Pesaran et al. (2001) has been used. This technique is more appropriate for small sample sizes and can be implemented regardless of whether the underlying variables are I (0) or I (1). In this approach, the long-term and short-term parameters of the model are estimated simultaneously. ARDL formulation is drawn in Equation 3.

$$\Delta Y = \beta 1 + \beta 2 Yt - 1 + \beta 3 Zt - 1 + \sum_{i=1}^{k} \beta 4 \Delta Yt - 1 + \sum_{i=1}^{k} \beta 5 \Delta Zt - 1 + \in \quad \text{(Eq 3)}$$

Where Y is the dependent variables, Z is the vector of explanatory variables included in the regression equations 1 and 2. The bounds testing procedure developed by Pesaran et al. (2001) tests the long-run relationship among the variables in equation (3). The test is based on the F test for co-integration analysis. The null hypothesis is that the coefficients β2 and β3 are jointly equal to zero. In other words, the null hypothesis states that no long-term relationship exists between the variables in equation (3).

The computed F-statistics is compared with the critical value bounds of the F-statistic. If the computed F-statistic is higher than the upper bound of the critical value of the F-statistic, the null hypothesis would be rejected and vice versa. The study aims to focus on the Pakistani population, encompassing economies with varying levels of remittance dependence. Nations with a significant share of remittances in their GDP are targeted explicitly for in-depth analysis. The study aims to capture the nuances of remittance trends across a spectrum of economic conditions. It examines how overseas remittances affected Pakistan's economic expansion and elimination of poverty.

Data from the WDI (World Bank Indicator) time series from 1980 to 2021 is used for the analysis. The two separate models address remittances, economic growth, and poverty, with dependent variables for the models such as GDP and poverty for the time series (1980 to 2021) study. The explanatory variables include GDP, remittances, GFCF, FDI, trade openness, GDP per capita, and Population. The variables are scrutinized to assess and draw inferences regarding the significance and insignificance of their relationship with economic expansion and remittances sent home by expatriates and foreign settlers.

3.1 Data Collection

Using data from 1980 to 2021, sourced from the World Bank, the study employs the ARDL (Augmented Dickey-Fuller test) to assess the stationarity of variables.

4. RESULTS AND DISCUSSION

This section discusses econometric issues related to the variables' stationarity and long-term impacts. The Augmented Dickey-Fuller test analyzes the data's stationarity, as shown in equation 4, to determine the descriptive analysis of GDP.

$$lGDP_t = \alpha_0 + \beta_1 lREM_t + \beta_2 lGFCF_t + \beta_3 lFDI_t + \beta_4 lOP_t + \varepsilon_t \quad \text{(Eq 4)}$$

Descriptive statistics shown in Table 1 indicate that the average Gross Domestic Product (GDP) grows 4.74 percent annually. It has a very moderate growth rate. In 1980, the growth rate was very high, 10.2 per cent, but in 2020 it was shallow i.e., -1.27 per cent due to the lockdown because of COVID-19. The value of the standard deviation of GDP is 2.218189, which shows the dispersion from the mean value. On average, Gross Fixed Capital Formation (GFCF) grows 15.8 per cent annually. In 1993, the growth rate was very high, i.e., 19.1 per cent, but in 2011 it was low i.e., 12.52 per cent. The standard deviation value of GFCF is 1.710881, which shows the dispersion from the mean value. On average, remittances grow 5.25 percent annually.

In 1983, the growth rate was very high i.e., 10.2 per cent, but in 2000 it was shallow i.e., 1.31 percent. The value of the standard deviation of remittances is 2.317735, which shows the dispersion from the mean value. On average, foreign direct investment (FDI) grows by 0.87 percent annually.

The value of the standard deviation of FDI is 0.776188. On average, trade grows 37 percent annually. The growth rate was high, 97.7 percent in 1989, but it was low 24.7 percent in 2016. The standard deviation value of trade is 14.56105, which shows the dispersion from the mean value.

Table 1. Descriptive Statistics

Variable	Mean	Median	S. D
GDP	4.745724	4.8396	2.218189
GFCF	15.8205	16.23262	1.710881
Remittances	5.25864	5.102886	2.317735
FDI	0.879513	0.646792	0.776188
Trade openness	37.03449	33.16201	14.56105

Table 2 shows the descriptive analysis and determines the average poverty growth of 31.8 percent annually. In 2020, the poverty rate was very high i.e., 37.2 per cent and in 1981 it was as low as 26.4 percent. The standard deviation value of poverty is 2.807894, which shows the dispersion from the mean value. On average, Gross Domestic Product (GDP) grows 4.74 percent annually. In 1980, the growth rate was very high i.e., 10.2 per cent, but in 2020 it was very low i.e., -1.27 per cent due to the lockdown in COVID-19 scenario. The value of the standard deviation of GDP is 2.218189, which shows the dispersion from the mean value. On average, GDP per capita grows 2.04 per cent annually. An average remittance grows 5.25 percent annually. The value of the standard deviation of remittances is 2.317735, which shows the dispersion from the mean value.

$$lP_t = \alpha + \beta_1 lGDP_t + \beta_2 lGDP\_per\_capita_t + \beta_3 lPOP_t + \beta_4 lREM_t + \varepsilon_t \quad \text{(Eq 5)}$$

Table 2. Descriptive Statistics (Variable Statistics)

Variable	Mean	Median	S. D
Poverty	31.8335	31.9568	2.807894
GDP	4.7457	4.8396	2.218189
GDP per capita	2.0465	1.872129	1.989536
Population	2.6073	2.592221	0.832913
Remittances	5.2586	5.102886	2.317735

Table 3 displays the Augmented Dickey-Fuller (ADF) Unit Root Test. The findings demonstrate that every variable is stationary at the level of significance. GDP is a dependent variable integrated at the level difference I (0). Since the probability value is less than 0.05 and less than 0.0023, GDP is significant at a threshold of significance of 5%. Remittances are one of the independent variables integrated at the first difference I (1). The probability value is 0.0000 which is less than 0.05, and it

indicates that payments are considerable at 5%. GFCF is one of the independent variables integrated at the first difference I (1).

The probability value of 0.0000 (less than 0.05) shows that GFCF is significant at a 5% significance level. FDI is one of the independent variables integrated at the first difference I (1). The probability value is 0.0000 (less than 0.05) implying that FDI is significant at a 5% significance level. Trade is one of the independent variables integrated at the first difference I (1). The probability value is 0.0000 (less than 0.05) and suggests a significance level of 5% for the deal.

Table 3. Unit Root Test

Variables	Test Statistics	Probability	Order of Integration
LGDP	-4.152745	0.0023	I(0)
LRemittances	-5.499871	0.0000	I(1)
LGross Fixed Capital Formation	-5.790371	0.0000	I(1)
LForeign Direct Investment	-5.816148	0.0000	I(1)
LTrade openness	-6.918147	0.0000	I(1)

The ARDL bound test results are shown in Table 4. The obtained results indicate that by comparing the F-statistic with the previously provided bounds. There is a long-term link between the variables if the F-statistic value is greater than the upper bound critical value. Conversely, there is no long-term association if the F-statistic value is lower than the upper bound critical value. Given the findings, it is possible to conclude that the variables have a long-term association since the estimated F-statistic value of 7.048077 surpasses the upper bound critical value of 3.49 at a 5% significance level.

Table 4. ARDL Bound Test

F-Statistic	7.048077	
Significance	**Lower Bound**	**Upper Bound**
10 %	2.2	3.09
5 %	2.56	3.49
2.5 %	2.88	3.87
1 %	3.29	4.37

Table 5 illustrates the long-term coefficients estimated through an ARDL approach to co-integration. The results show that remittances favor and significantly influence economic growth. According to the coefficients, a 1% increase in remittances is projected to raise GDP by 0.26%. On the other hand, the influence of GFCF is positive but not statistically significant. According to the findings, an increase of 1% in GFCF resulted in an increase of 0.42% in economic growth. As opposed to the coefficient for FDI, it exhibits a negative and significant effect. It shows that a 1% increase in FDI will result in a 0.16% decline in GDP. However, it is essential to note that this finding contradicts the generally observed positive relationship between FDI and GDP, as an increase in FDI usually corresponds to an increase in GDP. Lastly, trade openness demonstrates a negative and insignificant effect. The results show that economic growth is reduced by 0.03% for every 1% rise in trade openness.

Table 5. ARDL Long Run Results

Variables	Coefficients	Std. Error	t-statistic	Probability
LRemittances	0.266620	0.127609	2.089345	0.0456

LGross Fixed Capital Formation	0.426244	0.680236	0.626613	0.5358
LForeign Direct Investment	-0.165728	0.091266	-1.815867	0.0797
LTrade openness	-0.039949	0.266783	-0.149744	0.8820

Unit Root Tests are displayed in Table 6, and the findings demonstrate that every variable is stationary at the significance level. Poverty is a dependent variable integrated at the level difference I (0). Since the probability value is less than 0.05 and less than 0.0007, poverty is significant at a level of significance of 5%. One of the independent variables integrated at the level difference I (0) is the gross domestic product (GDP). Since the probability value is less than 0.05 and less than 0.0023, GDP is significant at a threshold of significance of 5%. One of the independent variables integrated at the level difference I (0) is GDP per capita. Assuming a 5% significance level, the probability value 0.0003, which is less than 0.05, indicates that GDP per capita is significant. One of the independent variables that is integrated at the first difference, I (1), is the population.

Since the probability value is less than 0.05 and less than 0.0035, the population is significant at a level of significance of 5%. Remittances are one of the independent variables that are integrated at the first difference I(1). The probability value is 0.0000 (less than 0.05) implying that remittances are significant at a 5% significance level.

Table 6. Unit Root

Variables	Test Statistics	Probability	Order of Integration
LPoverty	-4.568450	0.0007	I(0)
LGDP	-4.152745	0.0023	I(0)
LGDP per capita	-4.826456	0.0003	I(0)
population	-4.003042	0.0035	I(1)
LRemittances	-5.499871	0.0000	I(1)

The ARDL bound test result is displayed in Table 7, determined by comparing the F-statistic to the values of the bounds provided earlier. If the F-statistic value is higher than the upper bound critical value, there is a long-term association between the variables and vice versa if it is lower. The calculated F-statistic value of 4.069031 is more than the upper bound critical value of 3.49 at the 5% significance level, demonstrating the long-term relationship between the variables.

Table 7. ARDL Bound Test

F-Statistic	4.069031

Significance	Lower Bound	Upper Bound
10 %	2.2	3.09
5 %	2.56	3.49
2.5 %	2.88	3.87
1 %	3.29	4.37

Table 8 shows the estimated long-term coefficients using an ARDL approach to co-integration. The examined results of GDP show a negative and statistically insignificant effect on Poverty. The coefficients of remittances show that a 1 % increase in GDP will decrease poverty by 0.39%. GDP per capita also show a negative and insignificant effect. The results of GDP per capita show that a 1% rise in GDP per capita resulted in a 0.26 per cent reduction in poverty. The coefficient population has a

positive and significant effect. According to the population coefficient, a 1% increase in population will result in a 0.48% rise in poverty. Remittances show a negative and insignificant effect. The results of remittances demonstrate that a 1% increase in remittances causes a decrease in poverty of 0.53%.

Table 8 ARDL (Long Run Results)

Variables	Coefficients	Std. Error	t-statistic	Prob.
LGDP	-0.395389	0.543391	-1.588925	0.1122
LGDP per capita	-0.267223	0.498911	-1.411933	0.5233
LPopulation	0.480198	0.338436	1.344481	0.0275
LRemittances	-0.534868	0.065554	-1.447225	0.1468

The Granger Causality Test shows in Table 9 that the null hypothesis exists since no causation exists when the p-value is more significant than 0.05. When the LGDP p-value is less than 0.05, the null hypothesis is rejected and the alternative hypothesis –that the LGDP causes the LGFCF is accepted. When the p-value for Remittances is less than 0.05, the null hypothesis is rejected and the alternative hypothesis—that LREM causes LGDP is accepted. LGDP demonstrates that we accept the null hypothesis since no causation exists as the p-value is more significant than 0.05. As the p-value is more extensive than 0.05 in both outcomes, indicating no causation, Trade and LGDP demonstrate that we accept the null hypothesis. If the LFDI p-value is less than 0.05, the null hypothesis is rejected, and the alternative hypothesis –that LFDI causes LGDP is accepted. LGDP demonstrates that we accept the null hypothesis since no causation exists as the p-value is more significant than 0.05.

$$\mathrm{lGDP_t} = \alpha_0 + \beta_1 \mathrm{lREM_t} + \beta_2 \mathrm{lGFCF_t} + \beta_3 \mathrm{lFDI_t} + \beta_4 \mathrm{lOP_t} + \varepsilon_t$$

Table 9. Granger Causality Test

Null Hypothesis:	Obs	F-Statistic	Prob.
LGFCF does not cause LGDP.	38	1.13284	0.3343
LGDP is not Granger Cause by LGFCF		7.77170	0.0017
LGDP is not Caused by LREM.	38	2.10118	0.0314
LREM is not Granger Caused by LGDP.		0.98313	0.3848
LGDP is not Caused by LTRADE.	38	0.33233	0.7196
LGDP is not Granger Caused by LTRADE		1.01306	0.3741
LGDP is not Granger Caused by LFDI	38	4.62365	0.0170
LGDP is not Granger Caused by LFDI		1.16895	0.3232

Table 10 shows that if the LPoverty p-value is less than 0.05, the null hypothesis is rejected and the alternative hypothesis that LPOV does cause LGDP is accepted. If the p-value for LGDP_per_capita is less than 0.05, the null hypothesis is rejected and the alternative hypothesis that LGDP per capita causes LPOV is accepted. LPOV demonstrates that we accept the null hypothesis since no causation exists when the p-value is more significant than 0.05. Population and poverty demonstrate that the null hypothesis is accepted since no causal relationship exists and both outcomes have p-values more prominent than 0.05. LRemittances demonstrates that we accept the null hypothesis since no causation exists when the p value is more significant than 0.05. If the LPoverty p-value is less than 0.05, the null hypothesis is rejected and the alternative hypothesis that LPOV does induce LREM is accepted.

$$lP_t = \alpha + \beta_1 lGDP_t + \beta_2 lGDP\_per\_capita_t + \beta_3 lPOP_t + \beta_4 lREM_t + \varepsilon_t$$

Table 10. Results Of the Granger Causality Test

Null Hypothesis	Obs	F-Statistic	Prob.
The LPOV is not caused by LGDP.	38	2.38472	0.1078
LGDP is not Granger Caused by LPOV.		2.52253	0.0956
LPOV is not Granger Caused by LGDP_PER_CAPITA	23	9.82201	0.0013
LGDP_PER_CAPITA is not Granger Caused by LPOV		0.26264	0.7719
LPOP is not Granger Caused by LPOV	38	0.25537	0.7761
LPOV is not Granger Caused by LPOP		0.73772	0.4857
LREM is not Granger Caused by LPOV	38	2.05899	0.1432
LPOV is not Granger Caused by LREM		4.70813	0.0157

4.1 Discussion

The objectives of this study were to explore the relationship between remittances, economic growth, and poverty reduction in Pakistan. By conducting a thorough analysis, the study aimed to provide insights into impact of remittances on macroeconomic indicators and household welfare, thereby contributing to the existing literature on migration, development, and poverty alleviation. Remittances have emerged as a significant source of external finance for developing countries, including Pakistan. The influx of remittances can influence recipient countries' economic growth and poverty dynamics. Therefore, understanding the impact of remittances on these variables is crucial for policymakers aiming to design effective development strategies. The findings revealed a significant positive association between the country's remittances, economic growth, and poverty alleviation. This discussion will delve into the implications of these findings, their alignment with prior research, and the broader implications for policy and practice.

Previous studies have provided valuable insights into the relationship between remittances, economic growth, and poverty reduction. Research by Mubeen et al. (2016) and Najifa and Asif (2023) found a positive association between remittances and economic growth in Bangladesh, attributing this effect to increased household consumption and investment. Similarly, Tahir et al. (2015) highlighted the role of remittances in improving the living standards and reducing poverty in Pakistan. Moreover, recent studies have reinforced this perspective, providing further evidence of the positive impact of remittances on economic growth.

Nadeem et al. (2019), conducted in Pakistan, found that remittances significantly and positively affect GDP growth, particularly in sectors such as construction and services. This finding underscores the role of remittances as a source of investment and consumption, stimulating economic activity and fostering growth in recipient countries. Javid et al. (2012) examined the channels through which remittances affect economic growth in Pakistan and identified both direct and indirect pathways. The direct effect involves increased household consumption and investment spurred by remittance inflows,

while the indirect effect operates through the financial sector, where remittances contribute to higher savings and investment rates. This comprehensive analysis highlights the multifaceted nature of the relationship between remittances and economic growth, emphasizing the need for nuanced policy interventions to maximize their developmental impact.

The second objective of this study is to investigate the impact of remittances on poverty alleviation in Pakistan, aiming to contribute to understanding how remittance inflows affect household welfare and socioeconomic inequality. Remittances play a crucial role in poverty alleviation by providing direct financial support to recipient households, enabling them to meet basic needs such as food, shelter, and healthcare. However, the extent to which remittances contribute to poverty reduction varies depending on factors such as the size of remittance inflows, household characteristics, and the broader economic context. This objective seeks to deepen our understanding of the relationship between remittances and poverty alleviation in Pakistan. In this country, a significant proportion of the population lives below the poverty line. Recent research has shed light on the positive impact of remittances on poverty alleviation in Pakistan.

Rehman et al. (2023) found that remittance-receiving households are less likely to be in poverty than non-recipient households, indicating the poverty-reducing effect of remittance inflows. Moreover, the study observed that remittances improve education and healthcare outcomes among recipient households, further enhancing their socioeconomic well-being.

Akeel (2023) explored the role of remittances in reducing income inequality in Pakistan and found evidence of a redistributive effect. The study revealed that remittance inflows contribute to narrowing the income gap between remittance-receiving and non-recipient households, thereby promoting greater socioeconomic inclusivity. This finding underscores the potential of remittances to alleviate poverty at the household level and mitigate broader socioeconomic disparities within society.

Additionally, recent studies have highlighted the importance of financial inclusion initiatives in maximizing the poverty-alleviating impact of remittances. For example, a study by Kousar et al. (2019) emphasized the role of mobile banking and digital financial services in enhancing the accessibility and efficiency of remittance transfers, ensuring that remittance benefits reach the intended recipients promptly and securely. Such technological innovations have the potential to amplify the poverty-reducing effects of remittances by facilitating financial inclusion and empowering recipient households to make informed financial decisions. This study has provided valuable insights into the relationship between remittances, economic growth, and poverty reduction in Pakistan. By addressing the objectives, this study contributes to understanding the role of remittances in shaping socioeconomic outcomes in developing countries.

This study has provided valuable insights into the relationship between remittances, economic growth, and poverty reduction in Pakistan. By addressing the objectives, this study contributes to the understanding of the role of remittances in shaping socio-economic outcomes in developing countries. The positive association between remittances and economic growth, as well as their significant impact on poverty alleviation, underscores the importance of policies that support and harness the potential of remittance inflows for sustainable development. The policymakers must heed the implications of this study and prioritize initiatives aimed at maximizing the developmental impact of remittance inflows. Enhancing the efficacy and accessibility of remittance transfer mechanisms, promoting financial inclusion, and fostering a facilitating environment for investment are paramount. By harnessing the potential of remittances effectively, policymakers can not only accelerate economic growth but also advance progress towards poverty alleviation and sustainable development goals.

5. CONCLUSION AND RECOMMENDATIONS

The study mainly focused on the importance of remittances inflow and its implication for economic growth and poverty reduction. By using the ARDL approach we analyzed the impact of remittances inflow on economic growth and poverty. It is found that remittances affect economic growth positively and significantly. Findings show that remittances substantially influence and have a statistically significant impact on poverty reduction and growth in Pakistan. The findings of this study infer that international labor migration has potential benefits for poor people in developing countries like Pakistan in the long run. When utilized appropriately and efficiently, remittances also have the potential to assist in tackling challenges such as brain drain and excessive migration, while also contributing to the achievement of sustainable development. It is suggested that to improve the accuracy and transparency of data related to remittances, GDP, and other economic variables, collaborative efforts between government agencies, financial institutions, and international organizations can contribute to more reliable and comprehensive datasets.

Furthermore, the research recommends promoting financial inclusion initiatives to ensure remittance recipients can access formal banking and financial services. As a result of unfriendly policies, some remittances are still transferred through hundis (illegal way of money transfer), so Pakistan should implement policies that encourage and provide incentives for the entry of remittances through appropriate channels. Moreover, government can help leverage remittances for productive investments and foster economic growth at the grassroots level. Socio-economically, investing in educational and skill development programs that empower individuals to contribute meaningfully to society is a great leap forward. A skilled workforce can attract higher levels of foreign investment and contribute to the country's overall economic development. The government may encourage remittance recipients to invest their money in local businesses and infrastructure projects. This will help create jobs, stimulate economic growth, and increase the country's tax revenue.

Inclusively, the government should formulate a policy that enhances the amount of remittances by reducing the transaction cost of transferring the remittances through formal channels. Remittances may be a priority for Pakistan because they contribute to economic growth and significantly reduce poverty. Remittances serve as a crucial contributor to foreign exchange and play a vital role in solving the nation's balance of payments issue. In the long run, the remittance inflow can lead to sustainable growth, welfare improvement, and the upgradation of poor households as the impact of remittance expands over time. Therefore, we can accelerate economic growth and nurture a better future by assessing the situation and adopting the right policies.

6. FUTURE IMPLICATIONS

As technological advancements continue, exploring the impact of innovative remittance channels, such as block chain-based platforms and digital currencies is crucial. Assessing the implications of these technologies on the speed, cost, and accessibility of remittance transfers can guide regulatory frameworks and industry practices. Future research can delve deeper into dynamic economic modelling to understand the evolving relationship between remittances and key economic variables. Longitudinal studies and predictive modelling can provide insights into how changes in remittance patterns influence economic stability over time. Future studies should assess the impact of global crises such as pandemics or economic recessions on remittance trends. Understanding how remittance-dependent economies navigate and recover from such crises can guide the preparation of responsive

strategies. Addressing these future implications requires a multidisciplinary approach involving researchers, policymakers, financial institutions, and international organizations. By proactively addressing these areas, stakeholders can contribute to the sustainable utilization of remittances for economic development and poverty reduction.

Acknowledgments: I am deeply grateful to my late parents for their unwavering support and encouragement throughout my academic journey. Their values, wisdom, and love remain a source of inspiration in my daily life. I extend heartfelt thanks to my family for their steadfast support and understanding during the writing and publication of this article. Your belief in me and encouragement have been crucial in overcoming challenges and reaching milestones. I am also thankful to my mentors, colleagues, and peers for their guidance, insights, and constructive feedback, which significantly shaped this work. Lastly, I appreciate the readers and contributors whose engagement and contributions enrich the dialogue in our field. This publication honors the enduring influence of my parents and family, who continue to inspire me in all my endeavors.

Author(s) Contributions: The author solely contributes to the drafting and data collection of this paper.

Ethical Statement: An ethical statement is not applicable as this study is based exclusively on published literature.

Competing Interests: The author(s) declared that this work has no competing interests.

Consent to Participate: It is not applicable considering the nature of the study.

Grant/Funding Information: The author(s) declared that no grants supported this work.

Data Availability Statement: The associated data is available upon reasonable request from the corresponding author.

Declaration Statement of Generative AI: The author(s) of this work declared that they did not use any AI tools or program/software to draft this paper.

REFERENCES

Abbas, Q., Hanif, I., Iqbal, W., & Iqbal, N. (2021). Improving the energy and environmental efficiency for energy poverty reduction, In F. Taghizadeh-Hesary, N. Panthamit, N. Yoshino (Ed.), *Poverty Reduction for Inclusive Sustainable Growth in Developing Asia,* 231-248. Springer Nature. https://doi.org/10.1007/978-981-16-1107-0_11

Abduvaliev, M., & Bustillo, R. (2020). Impact of remittances on economic growth and poverty reduction amongst CIS countries. *Post-Communist Economies*, *32*(4), 525-546. https://doi.org/10.1080/14631377.2019.1678094

Ahmad, M., Ilyas, M., & Rehman, C. A. (2016). The impact of workers' remittances on the economic development of Pakistan. *Oman Chapter of Arabian Journal of Business and Management Review, 6*(5), 48-54. https://doi.org/10.12816/0036842

Akeel, H. (2023). Do Remittances Reduce Poverty? Evidence from Asian Countries. *Cuadernos de Economía*, *46*(131), 145-155.

Antman, F. M. (2013). The impact of migration on family left behind. In A. F. Constant, K. F. Zimmermann (Eds.), *International Handbook on the Economics of Migration* (pp. 293-308). Edward Elgar Publishing. https://doi.org/10.4337/9781782546078.00025

Dilshad, W. B. (2013). Impact of workers' remittances on economic growth: An empirical study of Pakistan's economy. *International Journal of Business and Management*, *8*(24), 126. https://doi.org/10.5539/ijbm.v8n24p126

Filipović, J. V., Milosavljević, Z. T., & Ruso, J. V. (2022). The impact of social and monetary diaspora remittances on society and economy of home country: The case of Serbia. *Sociološki Pregled*, *56*(3), 873-903. https://doi.org/10.5937/socpreg56-39412

Hayat, M. F., Ahmad, N., & Ahmad, A. (2013). Foreign remittances and economic growth in Pakistan: An empirical investigation. *Journal of Basic and Applied Scientific Research*, *3*(7), 813-819. https://mpra.ub.uni-muenchen.de/49132/1/MPRA_paper_49132.pdf

Iqbal, N., Mohsin, M., Karim, S. A., & Iqbal, S. (2018). Financing for poverty reduction determinants in rural Pakistan. In K. Ozyer, M. S. Döven (Ed.), *International Conference on Contemporary Issues in Business & Economics (ICCIBE)* (pp. *569*-575). Gaziosmanpasa University, Turkey. https://doi.org/10.1007/978-981-16-1107-0_8

Javid, M., Arif, U., & Qayyum, A. (2012). Impact of remittances on economic growth and poverty. *Academic Research International*, *2*(1), 433.

Jawaid, S. T., & Raza, S. A. (2016). Effects of workers' remittances and its volatility on economic growth in South Asia. *International Migration*, *54*(2), 50-68. https://doi.org/10.1111/imig.12151

Kamran, A., Alam, S., Ghias, K. A., & Ali, S. N. (2014). Economic determinants of workers' remittances in Pakistan. In J. Xu, J. Fry, B. Lev, A. Hajiyev (Eds.), *Proceedings of the Seventh International Conference on Management Science and Engineering Management* [Lecture Notes in Electrical Engineering], *Vol 241*, (pp. 415-424). Springer. https://doi.org/10.1007/978-3-642-40078-0_36

Kousar, R., Rais, S. I., Mansoor, A., Zaman, K., Shah, S. T. H., & Ejaz, S. (2019). The impact of foreign remittances and financial development on poverty and income inequality in Pakistan: Evidence from ARDL-bounds testing approach. *The Journal of Asian Finance, Economics and Business*, *6*(1), 71-81. https://doi.org/10.13106/jafeb.2019.vol6.no1.71

Meyer, D., & Shera, A. (2017). The impact of remittances on economic growth: An econometric model. *Economia*, *18*(2), 147-155. https://doi.org/10.1016/j.econ.2016.06.001

Mubeen, R., Nazam, M., Batool, A., Akram, S., & Ishtiaq, M. (2016). Impact of foreign remittances on the financial development of Pakistan. *American Scientific Research Journal for Engineering, Technology, and Sciences.26*(4), 54-65. https://doi.org/10.52131/pjhss.2024.v12i2.2267

Mughal, K. S., Arby, M. F., Babar, S., Ilyas, S., & Schneider, F. (2023). Estimates and economic analysis of informal remittances for Pakistan. *Journal of the Asia Pacific Economy*, *28*(1), 199-215.

Murata, A. (2018). International migration and remittances for economic development in Bangladesh: An overview. In Y. Sawada, M. Mahmud, N. Kitano (Eds.), *Economic and Social Development of Bangladesh* (pp. 93-113). Palgrave Macmillan, Cham. https://doi.org/10.1007/978-3-319-63838-6_5

Nadeem, M. A., Abidi, S. M. R., Khan, N. U., & Zhu, L. (2019). Migration impact on remittances special focus on gulf countries: A case study of Pakistan. *North American Academic Research*, *2*(8), 62-80.

Najifa, E., & Asif, M. (2023). Shadows of support: Unveiling the hidden realities of remittances by British Bangladeshi migrant's family back home. *International Journal of Trend in Scientific Research and Development, 7*(6), 477–488.

Pesaran, M. H., Shin, Y., & Smith, R. J. (2001). Bounds testing approaches to the analysis of level relationships. *Journal of Applied Econometrics*, *16*(3), 289-326. https://doi.org/10.1002/jae.616

Rahman, Z. U. (2014). Worker's remittances and economic development in Pakistan: A time series analysis (1980-2010). *Journal of Economics and Sustainable Development*, *5*(22), 51-54.

Ravallion, M., & Chen, S. (1997). What can new survey data tell us about recent changes in distribution and poverty? *The World Bank Economic Review*, *11*(2), 357-382. https://doi.org/10.1093/wber/11.2.357

Rehman, M. U., Shah, Z., & Rehman, Z. U. (2023). Impact of the foreign remittances on economic growth and poverty reduction: An analysis of Pakistan's economy. *Journal of Humanities, Social and Management Sciences (JHSMS)*, *4*(1), 58-77. https://doi.org/10.47264/idea.jhsms/4.1.5

Sredojević, D., Cvetanović, S., & Bošković, G. (2016). Technological changes in economic growth theory: Neoclassical, endogenous, and evolutionary-institutional approach. *Economic Themes, 54*(2), 177-194. https://doi.org/10.1515/ethemes-2016-0009

Tahir, M., Khan, I., & Shah, A. M. (2015). Foreign remittances, foreign direct investment, imports and economic growth in Pakistan: A time series analysis. *Arab Economic and Business Journal*, *10*(2), 82-89. https://doi.org/10.1016/j.aebj.2015.06.001

Yang, Y., de Sherbinin, A., & Liu, Y. (2020). China's poverty alleviation resettlement: Progress, problems and solutions. *Habitat International*, *98*, 102135. https://doi.org/10.1016/j.habitatint.2020.102135

Zaman, S., Wang, Z., & Zaman, Q. U. (2021). Exploring the relationship between remittances received, education expenditures, energy use, income, poverty, and economic growth: Fresh empirical evidence in the context of selected remittances receiving countries. *Environmental Science and Pollution Research*, *28*(14), 17865-17877. https://doi.org/10.1007/s11356-020-11943-1