ISSN: 1995-1272
Vol.19, No.1
Spring 2025

FWU Journal of Social Sciences

Quarterly Publication

Shaheed Benazir Bhutto Women University Peshawar, Pakistan

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FWU Journal of Social Sciences

Spring 2025 Vol.19, No.1

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FWU Journal of Social Sciences, Spring 2025, Vol.19, No.1, 1-11
DOI: http://doi.org/10.51709/19951272/Spring2025/1

Undergraduate English Majors' Views on ChatGPT in Academic Writing: Perceived Vocabulary and Grammar Improvement

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This study investigates undergraduate English majors' perceptions of ChatGPT in enhancing vocabulary and grammar in academic writing. Utilizing a mixed-methods convergent design, data were collected from 31 students via pre- and post-survey questionnaires, 20 participants' reflective journals, and semi-structured interviews with 10 volunteers. Quantitative findings revealed significant improvements in students' perceptions of vocabulary accuracy, relevance, and depth. Thematic analysis of qualitative data identified benefits such as enriched vocabulary, improved grammatical accuracy, and increased confidence in academic writing. Challenges included overdependence, difficulty interpreting feedback, and a lack of originality in AI-generated suggestions. Students employed strategies to optimize ChatGPT use, such as asking specific questions, selectively applying feedback, and balancing AI input with personal judgment. The study highlights ChatGPT's ability to provide tailored feedback, foster confidence, and support vocabulary development while underscoring the importance of responsible use to mitigate overreliance and maintain originality. The findings underscore ChatGPT's potential to enhance academic writing skills when integrated thoughtfully into curricula. However, overuse risks shallow learning (e.g., overdependence on the tool, or difficulty in interpreting feedback), suggesting a need for instructional strategies that can promote rigorous analysis with AI tools. Future research should explore long-term impacts, comparisons with other AI tools, and strategies for ethical and effective integration of ChatGPT in higher education.

Keywords: ChatGPT, vocabulary, grammar, academic writing, English majors, language learning with AI

The integration of artificial intelligence (AI) into educational practices has gained significant popularity in recent years, revolutionizing traditional approaches to teaching and learning. Tools like ChatGPT, a language model developed by OpenAI, have emerged as transformative resources, particularly in language learning and academic writing. With over 100 million users reported globally within months of its release, ChatGPT has gained widespread popularity for its ability to provide instant feedback, generate personalized learning experiences, and refine written output (e.g., Liu, 2023; Shaikh et al., 2023). As higher education increasingly embraces AI technologies, understanding how tools like ChatGPT influence learning outcomes, especially in areas such as writing skills, vocabulary, and grammar, has become a pressing concern.

Existing research highlights the potential of ChatGPT to enhance students' language learning experiences. For instance, Athanassopoulos et al., (2023) showed that ChatGPT has shown to significantly improve vocabulary and grammar usage among diverse populations, including students with limited language proficiency. Studies also emphasize the tool's ability to provide real-time feedback, offer context-based vocabulary examples, and facilitate personalized exercises tailored to learners' individual proficiency levels (Liu, 2023; Mai et al., 2024; Pellicer-Sánchez, 2015). These capabilities position ChatGPT as a valuable supplementary tool for modern language education. However, alongside these benefits, there are significant challenges. Researchers have raised concerns over the risks of over-reliance on AI tools, which may lead to shallow learning, as students accept suggestions passively without fully understanding the underlying principles (e.g., Bae & Bozkurt, 2024; Zhai et al., 2024). Ethical concerns, such as the potential for plagiarism and the reliability of AI-generated content, further underscore the importance of examining how these tools are integrated into educational contexts (Gerlich, 2025).

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This study seeks to address these gaps by exploring undergraduate English majors' perceptions of ChatGPT's role in enhancing vocabulary and grammar in academic writing. While previous research has predominantly highlighted the technical capabilities of AI tools (e.g., Bae & Bozkurt, 2024; Bastani et al., 2024; Nugroho et al., 2023; Zhai et al., 2024), this study emphasizes user perspectives, particularly among learners who are directly impacted by these technologies. By investigating the benefits and challenges identified by undergraduate students, this research aims to provide a balanced understanding of ChatGPT's educational value and offer actionable insights for educators and policymakers. Addressing the dual imperatives of maximizing benefits and mitigating challenges, this study contributes to the ongoing scholarly dialogue on responsibly integrating AI tools in higher education. To obtain the research objectives, two questions were proposed:

Research Questions

RQ1: How do undergraduate English majors perceive the effectiveness and usability of ChatGPT in improving vocabulary and grammar in academic writing?

RQ2: How do undergraduate English majors perceive the benefits, challenges, and strategies associated with using ChatGPT to enhance vocabulary and grammar in academic writing?

Literature review

ChatGPT as a Tool for Language Learning

An increasing number of studies have explored ChatGPT's potential in enhancing language learning, particularly in writing classes. As an AI language model developed by OpenAI, ChatGPT provides feedback on vocabulary and grammar, assisting learners in improving their writing skills. A study conducted in a Junior High School in Greece demonstrated that ChatGPT significantly enhanced students' vocabulary and grammar, especially for those with migrant or refugee backgrounds. The study reported an increase in the total number of words, unique words, and average word count per sentence, indicating its value as a tool for language learning (Athanassopoulos et al., 2023). Additionally, research on EFL learners showed that ChatGPT helps grasp vocabulary and grammar, enhancing writing abilities (Mai et al., 2024). In a similar vein, Polakova and Ivenz's (2024) study investigated the effectiveness of ChatGPT feedback in enhancing the writing skills of EFL students, finding significant improvements in various aspects of writing, including conciseness and grammar. Another recent study by Biju et al., (2024) also revealed that the participants in the AI-assisted group exhibited improved attitudes toward language learning and heightened motivation. They appreciated the timely feedback and perceived fairness in the AI assessments, which contributed to increased engagement. While both groups showed improvements in writing skills over the study period, the experimental group outperformed the control group in the post-test assessments. However, the difference was not statistically significant. By offering tailored feedback and generating context-based examples, ChatGPT enables learners to refine their language skills dynamically, making it a valuable addition to modern language education.

Personalized Learning and Vocabulary Development

One of ChatGPT's key strengths is its ability to provide personalized, adaptive learning experiences. It tailors vocabulary exercises to students' proficiency levels, ensuring the content aligns with their individual needs (Mai et al., 2024). This individualized approach fosters learner engagement by introducing words that are both challenging and relevant (Li et al., 2024). ChatGPT's ability to generate context-based examples further enhances learning, helping students understand vocabulary usage in various situations (Nugroho et al., 2023; Obeidat et al., 2024). Pellicer-Sánchez (2015) found that contextualizing vocabulary through sentences improves retention compared to rote memorization. Interactive features such as vocabulary quizzes, flashcards, and word challenges increase motivation through gamification while offering real-time feedback on usage, enabling students to refine their vocabulary in real-time (Hung, 2015; Özdemir & Seçkin, 2024; Teymouri, 2024).

Enhancing Writing Skills and Grammar Accuracy

ChatGPT supports writing improvement by providing grammar corrections, synonym suggestions, and writing prompts, which expand vocabulary and enhance sentence fluency. For instance, Nisperos et al., (2024) observed that AI-generated prompts fostered creativity and fluency, encouraging students to think critically about style and vocabulary. ChatGPT's editing and revising capabilities, such as suggesting synonyms and rephrasing sentences, help students produce clearer, more sophisticated texts (Liu, 2023). Additionally, the importance of scaffolding in a knowledge-building environment was emphasized, demonstrating that structured teacher guidance enhances students' interaction patterns, social epistemic networks, and overall academic performance (Li et al., 2024). These findings suggest that when combined with AI-based tools like ChatGPT, teacher scaffolding can further support student engagement and knowledge co-construction, creating an enriched learning environment for developing writing skills. This guidance builds confidence and enables learners to integrate new vocabulary meaningfully into their writing. Additionally, Nasim and Mujeeba (2024) highlighted how EFL students and instructors perceive common errors in writing mechanics, which can help frame how AI tools like ChatGPT may address or miss certain writing issues. Studies

involving Chinese and Greek EFL learners reported improvements in grammar, composition structure, and diverse word usage, further supporting ChatGPT's effectiveness in enhancing writing quality (Xiao & Zhi, 2023). By continuously refining grammar and word choice, ChatGPT empowers students to produce clear, well-structured texts.

Students' Perceptions and Practical Benefits

Students generally perceive ChatGPT as a valuable resource for language learning. They appreciate its ability to provide definitions, synonyms, and contextual alternatives, which improve vocabulary acquisition and language comprehension (Nugroho et al., 2023). Xiao and Zhi (2023) reported that students noticed improvements in textual quality and language nuance understanding when using ChatGPT for language learning tasks. Additionally, ChatGPT fosters critical thinking and collaborative learning, essential for mastering language skills (Avsheniuk et al., 2024). Tran and Tran (2023) noted that it cultivates critical digital literacies, equipping students to engage effectively in digital environments. Beyond cognitive benefits, practical advantages include expanded vocabulary, improved grammatical structures, and enhanced conversational skills (J. Li et al., 2024; Shaikh et al., 2023). ChatGPT's user-friendly design and real-time feedback make it a revolutionary tool that combines social interaction with educational purposes (Liu, 2023).

Challenges and Recommendations for Responsible Use

While ChatGPT offers substantial benefits, it raises concerns about over-reliance and academic integrity. Gerlich (2025) warned that excessive dependence on AI tools may hinder independent cognitive skills and deeper language understanding. Overuse could result in shallow learning, as students might accept AI-generated suggestions without fully comprehending vocabulary nuances or grammatical principles (Zhai et al., 2024). Additionally, ChatGPT's instant feedback, while useful, may encourage superficial engagement with material, as pointed out by Kazemitabaar et al., (2024). There are also risks of inappropriate or overly complex suggestions, which could confuse learners (Bastani et al., 2024). To address these issues, educators must guide students toward responsible use of AI tools. Teachers should integrate ChatGPT into curricula thoughtfully, emphasize the importance of independent skill development, and provide ethical guidance to prevent plagiarism or misuse (Ngo, 2023). Encouraging balanced use and critical evaluation of AI outputs ensures that students optimize the benefits of ChatGPT while alleviating its potential drawbacks.

Another concern pertains to the ethical implications of using AI tools like ChatGPT. Students express apprehensions about the potential misuse of AI in academic settings and the reliability of the information provided. As Liu (2023) noted, while ChatGPT is often accurate, it may occasionally produce misleading or incorrect information, which can pose challenges for students who lack the expertise to critically evaluate its outputs. These concerns highlight the need for students to approach AI tools with caution and a critical mindset. Research also suggests that AI literacy training could help students develop skills to assess the reliability of AI-generated content and use it effectively in academic contexts (Bastani et al., 2024).

Method

Research design

The study employed a mixed method using a convergent design (Creswell & Creswell, 2018) to comprehensively examine undergraduate English majors' perceptions of ChatGPT's role in improving vocabulary and grammar in academic writing. The rationale for this design was to integrate quantitative and qualitative data to gain a well-rounded understanding of students' experiences. Quantitative data from pre- and post-survey questionnaires provided measurable changes in students' perceptions, while qualitative data from reflective journals and semi-structured interviews offered in-depth insights into students' experiences, challenges, and strategies when using ChatGPT. The convergent design allowed simultaneous data collection and comparison, ensuring a comprehensive and triangulated analysis of findings. Particularly, survey data was administered to the participants via Google Form, while the data from reflective journals were collected during the time they learned the academic writing subject, and the semi-structured interviews were performed after their end-course exam for the subject. Thirty-one students participated in the questionnaire survey, in which twenty of them wrote five reflective journals each, and ten out of these twenty volunteered to be interviewed.

Participants

The study participants were from a private university in the Mekong Delta, Vietnam. They were second-year English majors who were voluntarily participated in the study. To ensure their anonymity and confidentiality, pseudonyms were used, such as Student 1, or Student 2. Additionally, they were informed of the ability to withdraw at any time during the study.

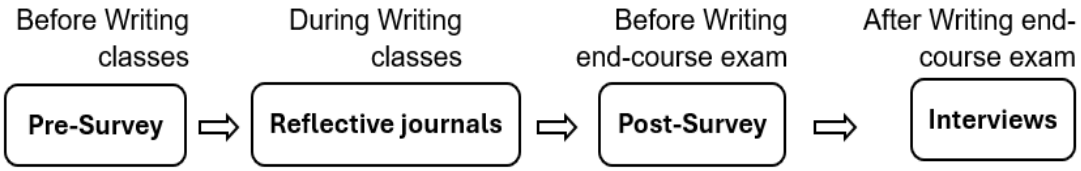
Data Collection and Analysis

Data collection

The study instruments included a 28-item 5-Likert-scale questionnaire, adapted from Paul and Elder (2019) for the purpose of collecting quantitative data. At the beginning of the academic writing course, pre-survey questionnaires were conducted to assess initial perceptions of ChatGPT's impact on vocabulary and grammar. At the end of the course, post-survey questionnaires were administered to them to see how differently they perceived the effects of ChatGPT on their vocabulary and grammar improvement. During the study, the participants were encouraged to write reflective journals to report on how they used ChatGPT to improve their grammar, vocabulary, and the quality of their writing paper in general, and twenty of them completed five journals each. Additionally, after taking the end-course exam, among these twenty participants, ten of them were willingly taking part in semi-structured interviews. The data collection procedure was illustrated in Figure 1 below:

Figure 1

The study data collection procedure



The questionnaire was piloted with students of the same English majors from another class to evaluate its internal consistency. Cronbach's Alpha for all variables during the pilot phase exceeded 0.7 (Table 1), indicating that the research tool was reliable for further data collection. The semi-structured interviews were also piloted with two students from this class, both of whom easily understood all the questions without requiring additional clarification.

Data analysis

The questionnaire data were analyzed using SPSS 27, employing descriptive analysis, while the reflective journals and interviews were analyzed using thematic analysis as proposed by Braun and Clarke (2006). Braun and Clarke's (2006) six-step thematic analysis is a widely used qualitative research method for identifying, analyzing, and reporting patterns (themes) within data. It is a flexible and systematic approach that allows themes and codes to emerge inductively (from the data) or deductively (guided by theory). This study employed an inductive approach to ensure that findings were closely tied to participants' experiences and the context of the data. These steps include (1) Familiarization with data: The researcher read and re-read the transcripts many times to gain deep understanding of the content; (2) Generating initial codes: The data was systematically coded to identify meaningful features; (3) Searching for themes: Codes were grouped into broader themes representing significant patterns; (4) Reviewing themes: Themes were refined to ensure coherence and relevance; (5) Defining and naming themes: Themes were clearly defined, capturing the essence of the data; and (6) Writing the report: A narrative was developed, using data extracts to support the themes.

Table 1

Reliability Statistics of piloting phase

Variables	Cronbach's Alpha	N of Items
Clarity	.800	4
Accuracy	.703	4
Precision	.834	4
Relevance	.829	4
Depth	.878	4
Breath	.923	4
Logic	.861	4

Results

Questionnaire-survey results

RQ1: How do undergraduate English majors perceive ChatGPT's role in improving vocabulary and grammar in academic writing?

To answer Research Question 1, pre-&post-survey questionnaires were used. A paired t-test was conducted to analyze differences in students' perceptions of ChatGPT's impact on vocabulary and grammar before and after using

ChatGPT. This test was selected because it accounts for the dependent nature of the data, where the same participants provided responses at two time points (Field, 2018). The paired t-test is appropriate for assessing within-subject changes over time while controlling for individual differences (Pallant, 2020). Additionally, paired t-tests remain valid when the sample size is sufficiently large (typically n > 30-50), even if the data is not normally distributed (Field, 2018).

The participants' changes in their perceptions of the effects of ChatGPT on their vocabulary and grammar improvement (Table 2) were analyzed using descriptive analysis as follows:

Table 2

Students' perceptions of ChatGPT's effects on vocabulary and grammar improvement

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	Upper			
Pair 1	Clarity (Pre) – Clarity (Post)	.08065	.90459	.16247	-.25116	.41245	.496	31	.623
Pair 2	Accuracy (Pre) – Accuracy (Post)	.42742	.98572	.17704	.06586	.78898	2.414	31	.022
Pair 3	Precision (Pre) – Precision (Post)	.24194	1.09065	.19589	-.15812	.64199	1.235	31	.226
Pair 4	Relevance (Pre) – Relevance (Post)	.49194	1.18758	.21330	.05633	.92754	2.306	31	.028
Pair 5	Depth (Pre) – Depth (Post)	.50806	1.32049	.23717	.02371	.99242	2.142	31	.040
Pair 6	Breadth (Pre) – Breadth (Post)	.43548	1.36010	.24428	-.06340	.93437	1.783	31	.085
Pair 7	Logic (Pre) – Logic (Post)	.23387	1.25820	.22598	-.22764	.69538	1.035	31	.309

Table 2 shows the results of the analysis of students' perceptions before and after the survey, revealing improvements in certain aspects. The analysis revealed significant increases in students' perceptions of Accuracy, Relevance, and Depth, as indicated by their positive mean differences and statistically significant p-values ($p < 0.05$). Specifically, accuracy (mean difference = 0.42742, $p = 0.022$), relevance (mean difference = 0.49194, $p = 0.028$), and depth (mean difference = 0.50806, $p = 0.040$) showed notable improvements. In contrast, perceptions of Clarity, Precision, Breadth, and Logic did not show significant changes, as their p-values were greater than 0.05. For example, clarity (mean difference = 0.08065, $p = 0.623$) and logic (mean difference = 0.23387, $p = 0.309$) exhibited only small and non-significant shifts.

To assess the practical significance of these changes, Cohen's d was used to measure the effect sizes: Small effect: $d \approx 0.2$ (minimal impact), medium effect: $d \approx 0.5$ (moderate impact), large effect: $d \geq 0.8$ (strong impact). The results showed that Accuracy ($d = -0.434$), Relevance ($d = -0.414$), and Depth ($d = -0.385$) demonstrated moderate effect sizes, indicating that while ChatGPT had some impact, the effect was not strong.

Overall, the results suggest that while there were no substantial changes in perceptions of clarity, precision, breadth, or logic, students reported meaningful improvements in their perceptions of accuracy, relevance, and depth after the post-survey. These findings highlight areas of growth and stability in students' evaluations of their learning experiences.

RQ2: What are the benefits, challenges, and strategies undergraduate English majors identifying when using ChatGPT to enhance vocabulary and grammar in academic writing?

To answer this question, the author applied thematic analysis guided by Braun and Clarke (2006). The themes and codes emerged from reflective journals by twenty participants and ten semi-structured interviews were reported as follows:

1. **Benefits of Using ChatGPT**

Vocabulary Enhancement

ChatGPT significantly enriched students' vocabulary, enabling them to integrate advanced and varied word choices into their writing. Many students reported notable improvements in their ability to use new vocabulary effectively. For instance, one student shared, *"I learned new vocabulary, including collocations"* (Student 2). Another

highlighted the practical value of ChatGPT's suggestions, stating, *"I found the suggestions helpful, and I often reused vocabulary or sentence structures it provided"* (Student 10). Reflective journals echoed similar sentiments. One student stated, *"ChatGPT gives me plenty of appropriate vocabulary choices and very good sentence structure recommendations"* (Student 7). Another added, *"It helps me expand my vocabulary and explore diverse ways of structuring arguments"* (Student 10).

Grammar Improvement

Another widely recognized benefit of ChatGPT was its ability to enhance grammatical accuracy. Students noted that ChatGPT's feedback helped them refine not only grammar but also aspects such as cohesion and coherence. One student explained, *"ChatGPT helped me improve my writing, such as grammar, word usage, cohesion, and coherence"* (Student 1). Another emphasized its role in addressing structural weaknesses in their writing: *"ChatGPT pointed out structural errors, word usage, and grammar mistakes, making my writing clearer and better"* (Student 6). A reflective journal supported this view: *"It refines grammar and makes my writing clearer and more polished"* (Student 6). Additionally, a student shared that *"ChatGPT helped adjust grammar structure and improve sentence flow"* (Student 12).

Improved Academic Writing Style

Students credited ChatGPT with helping them develop a more refined and academic tone in their writing. Initially, many students struggled with informal language, vague expressions, and a lack of coherence in their academic essays. However, through iterative revisions with ChatGPT, they learned to refine their word choices, sentence structures, and overall organization. ChatGPT's advanced vocabulary and sentence structure suggestions contributed to the quality of their academic prose. One student remarked, *"I learned how to use words to give my writing a more academic tone"* (Student 4). Similarly, another added, *"The vocabulary ChatGPT suggested was often at a higher level, making my writing feel more advanced"* (Student 4). A reflective journal noted that *"It provides suggestions that make my drafts more comprehensive and polished"* (Student 10).

Furthermore, several students emphasized that ChatGPT helped them recognize and eliminate redundancy, improving the conciseness and coherence of their essays. The tool encouraged them to explore new vocabulary, test different syntactic structures, and experiment with more formal academic phrasing, which ultimately led to noticeable improvements in their writing clarity. A student shared, *"It helps me practice various writing styles and explore new vocabulary, which will improve my writing range and depth"* (Student 4). These insights suggest that ChatGPT's role extended beyond surface-level grammar corrections to foster deeper engagement with academic conventions, allowing students to produce texts that were not only technically accurate but also more structured, coherent, and stylistically aligned with academic expectations.

Confidence Building

Finally, ChatGPT played a significant role in boosting students' confidence in their writing abilities. Its constructive feedback provided reassurance and a sense of control over their work. For example, one student shared, *"I felt more confident about my writing after receiving ChatGPT's advice"* (Student 8). Another echoed this sentiment, explaining, *"I felt reassured when ChatGPT suggested ways to improve my writing"* (Student 10). Reflective journals reinforced this perspective. One student stated, *"It reassures me by giving feedback that aligns with my intentions"* (Student 10), while another wrote, *"Using ChatGPT saves time and boosts my confidence by improving grammar and ideas"* (Student 11).

2. Challenges of Using ChatGPT

Overdependence

A major concern among students was the tendency to rely excessively on ChatGPT, potentially hindering their independent writing abilities. One student acknowledged this issue, saying, *"I think it's easy to rely on it for writing, especially when I feel lazy"* (Student 8). Similarly, another admitted, *"There were times when I used ChatGPT for everything without thinking much myself"* (Student 10). Reflective journals highlighted similar concerns. One student wrote, *"Using ChatGPT results in too many restrictions on my critical thinking skills"* (Student 13), while another observed, *"Over-reliance on ChatGPT can hinder independent thinking and creativity"* (Student 9).

Difficulty Understanding Feedback

Some students struggled to interpret the feedback provided by ChatGPT, particularly when the suggestions were unclear or overly complex. As one student shared, *"ChatGPT gave suggestions that were hard to understand; I read them but didn't know what they meant"* (Student 2). Another added that ChatGPT's responses occasionally failed

to address their specific queries: *"Sometimes ChatGPT didn't answer the question I wanted to ask"* (Student 3). Reflective journals supported these challenges, with one student stating, *"The feedback doesn't always fully grasp the nuances of my argument"* (Student 9). Another noted, *"It sometimes provides vague answers that don't help much"* (Student 12).

Lack of Originality

The perceived lack of originality in ChatGPT's suggestions was another concern. Some students felt that the AI offered generic ideas that lacked creativity or personalization. One student explained, *"I felt its suggestions were familiar and lacked originality"* (Student 8). Another noted that while the feedback was polished, it often did not align with their unique ideas: *"ChatGPT writes very polished content, but it doesn't align with my ideas"* (Student 4). A reflective journal added, *"ChatGPT sometimes lacks the depth needed for nuanced and creative writing"* (Student 7).

Overwhelming Suggestions

Students occasionally felt overwhelmed by the sheer volume of suggestions provided by ChatGPT, especially when broad or vague queries were posed. One student expressed this frustration, saying, *"ChatGPT gives too many suggestions, and I feel confused about which ones to choose for my writing"* (Student 9). Another highlighted the challenge of processing extensive feedback: *"When I asked about the whole essay, ChatGPT provided so much feedback that it made me feel overwhelmed"* (Student 5). Reflective journals echoed this sentiment: *"Too many suggestions at once can be overwhelming and unclear"* (Student 12). Another student noted, *"The number of suggestions sometimes distracts me from focusing on specific improvements"* (Student 11).

3. Strategies for Effective Use

Asking Specific and Targeted Questions

One of the most effective strategies employed by students was crafting specific and focused questions to improve the relevance of ChatGPT's feedback. By narrowing down their queries, students found that the suggestions were more accurate and actionable. For example, one student shared, *"I learned that the clearer my question, the more accurate ChatGPT's suggestions were"* (Student 10). Another emphasized the importance of dividing their questions into manageable parts, focusing on individual sections of their essays: *"I ask questions for each section, such as whether the introduction has enough of a hook, paraphrasing, and a thesis statement"* (Student 7). Reflective journals further supported this approach, with one student noting, *"I understand how to generate questions to gain more effective feedback from ChatGPT"* (Student 9).

Selective Application of Feedback

Students developed a critical approach to applying ChatGPT's feedback, choosing only the suggestions that aligned with their ideas and goals. This selective strategy ensured that they retained ownership of their work while incorporating helpful recommendations. One student explained, *"I only use suggestions that fit with my ideas"* (Student 3). Similarly, another noted, *"I only edit and apply the suggestions that make sense"* (Student 6). A reflective journal entry echoed this: *"I assess ChatGPT's feedback and only apply relevant points"* (Student 6).

Balancing AI Input with Personal Judgment

Another effective strategy was striking a balance between relying on ChatGPT's feedback and maintaining personal judgment. Students emphasized the importance of retaining their original ideas and critically assessing ChatGPT's suggestions. One student said, *"Even if ChatGPT gives suggestions, I still consider whether they fit my writing"* (Student 9). Another added, *"I keep my original ideas if they make sense and only edit the necessary parts based on ChatGPT's feedback"* (Student 1). Reflective journals reinforced this: *"I rely on ChatGPT but also reflect on its suggestions to ensure they align with my ideas"* (Student 11).

Limiting ChatGPT Usage

To prevent overdependence, students limited their use of ChatGPT, focusing only on key aspects of their writing. This approach encouraged independent thinking and minimized reliance on AI. One student shared, *"I only ask four or five questions to avoid depending on it too much"* (Student 1). Another agreed, stating, *"Five questions are enough, asking too many prevents students from thinking for themselves"* (Student 8). Reflective journals supported this practice, with one student writing, *"Limiting ChatGPT's use helps me develop my critical thinking skills"* (Student 7).

Discusion

This study explored undergraduate English majors' perceptions of ChatGPT as a tool for improving vocabulary and grammar in academic writing. The findings provide a nuanced understanding of the tool's educational value, aligning with and extending prior research, while also highlighting novel insights and contextual nuances.

The study's findings corroborate prior research emphasizing ChatGPT's potential to enhance vocabulary and grammar. Similar to the work of Athanassopoulos et al., (2023), participants in this study reported significant improvements in vocabulary range and usage. These improvements were observed through both quantitative data, which indicated enhanced perceptions of vocabulary depth and accuracy, and qualitative reflections, where participants frequently highlighted how ChatGPT's tailored feedback introduced them to advanced vocabulary and practical sentence structures. As in previous studies (Liu, 2023; Mai et al., 2024), students found ChatGPT's tailored feedback and context-based suggestions instrumental in refining their language skills. For instance, participants noted that ChatGPT's vocabulary recommendations were relevant and effective, enabling them to expand their academic writing capabilities, echoing Pellicer-Sánchez's (2015) findings on contextualized vocabulary learning.

In terms of grammar improvement, this study aligns with Xiao and Zhi (2023) who documented ChatGPT's role in enhancing grammatical accuracy and coherence. Participants frequently highlighted the tool's ability to identify and correct grammatical errors, refine sentence structure, and improve text cohesion, confirming earlier observations about its effectiveness in supporting structured writing tasks. For example, one participant noted, "ChatGPT pointed out specific grammatical errors I often overlooked, helping me improve sentence clarity." Another shared, "The tool's suggestions for sentence structure and word choice made my writing more coherent and polished, especially in academic contexts." These participant insights vividly illustrate the practical impact of ChatGPT on their writing process.

While many findings align with existing literature, this study also reveals nuanced differences. Unlike earlier works, which predominantly examined the technical capabilities of ChatGPT (Bastani et al., 2024; Nugroho et al., 2023), this research focused on the user experience, particularly perceptions of confidence-building and independence. A key insight from this study is the role of ChatGPT in fostering students' confidence in their writing abilities. For instance, participants expressed that receiving immediate, constructive feedback made them feel more assured about their writing. One student noted, "ChatGPT's suggestions gave me confidence because they often aligned with what I was trying to achieve," while another shared, "Using ChatGPT helped me see my mistakes clearly, which boosted my confidence to try new vocabulary and sentence structures." These examples underscore the psychological benefits of integrating AI tools into academic writing. Participants described increased assurance in their work, which aligns with prior research highlighting AI's role in fostering user confidence in language learning (Avsheniuk et al., 2024). However, many studies primarily focus on tangible outcomes like vocabulary range or grammatical accuracy (Liu, 2023; Xiao & Zhi, 2023). This confidence-building aspect is significant because it encourages students to approach academic writing with greater self-reliance and motivation. By feeling assured in their ability to refine and improve their work, students are more likely to engage deeply with the writing process, experiment with advanced vocabulary, and focus on developing their unique voice in academic discourse. Such psychological benefits play a crucial role in fostering a positive and proactive learning environment, which is essential for academic success.

While these psychological benefits are noteworthy, it is equally important to consider areas where ChatGPT's impact on student perceptions was less pronounced. While the results indicated significant improvements in students' perceptions of vocabulary accuracy, relevance, and depth, perceptions of clarity, precision, breadth, and logic did not show notable changes. One potential explanation is that these aspects may require more advanced or nuanced feedback, which current iterations of ChatGPT might not fully provide. Another possibility is that students prioritized vocabulary and grammar over broader aspects like logic or precision, given their immediate relevance to language learning. Further research could investigate how these aspects are addressed by AI tools or develop strategies to enhance their focus in AI-assisted learning.

Additionally, challenges identified in this study differ slightly from those highlighted in earlier research. While overdependence on AI tools has been discussed (Zhai et al., 2024), this study provides a more granular view, such as students feeling overwhelmed by excessive feedback or struggling with the tool's inability to fully align with their unique ideas. This challenge could be more pronounced among students with limited experience in critical evaluation or those from educational backgrounds with less exposure to independent learning practices. For example, students accustomed to teacher-led instruction may find it harder to critically assess AI feedback. Future studies could explore these dynamics across different cultural or educational contexts to provide tailored recommendations. This level of detail offers valuable insights for educators seeking to balance the benefits and drawbacks of integrating AI tools in academic curricula.

This study contributes new perspectives by highlighting strategies students use to optimize ChatGPT's benefits while mitigating challenges. For instance, students emphasized the importance of asking specific, targeted questions to improve the relevance and clarity of ChatGPT's feedback. Peer collaboration activities, where students compare AI-generated suggestions with peer feedback, can further develop evaluative skills and build a community of shared learning. These strategies underscore the need for critical engagement with AI tools, a point less explored in prior studies focused on passive tool usage. Additionally, providing training sessions to help students interpret and apply AI-generated feedback effectively can enhance their ability to critically assess and implement suggestions.

Moreover, the findings suggest that ChatGPT's impact extends beyond technical skill improvement to include the cultivation of critical digital literacies. Participants noted the importance of balancing AI input with personal judgment, a skill essential for navigating the complexities of digital learning environments. This balance can be cultivated through specific instructional strategies, such as integrating reflective practices into assignments, encouraging peer review to complement AI feedback, and providing training on critically evaluating AI-generated suggestions. These approaches can empower students to use AI tools effectively while maintaining their own critical and creative input. This insight aligns with emerging discussions on digital literacy (Tran & Tran, 2023) but adds specificity by linking it to AI-assisted writing tasks.

The current study also has implications for practice. The findings highlight the dual imperatives of maximizing ChatGPT's benefits and mitigating its challenges. Educators are encouraged to guide students in adopting strategies such as selective feedback application, balancing AI inputs with independent thought, and limiting overreliance on the tool. These practices can help students harness ChatGPT's potential while maintaining academic integrity and fostering autonomous learning.

Conclusion

This study explored the perceptions of undergraduate English majors regarding ChatGPT as a tool for enhancing vocabulary and grammar in academic writing. Key findings indicate that students perceive ChatGPT as beneficial for improving vocabulary depth, grammatical accuracy, and overall writing confidence. The tool's ability to provide instant feedback and tailored suggestions significantly contributed to their development of academic language skills. Additionally, the study highlighted the psychological benefits of ChatGPT, such as increased self-assurance and a willingness to experiment with advanced language features.

Despite these benefits, the study also identified notable challenges, including the risk of overdependence on the tool, difficulty in interpreting feedback, and the potential for overwhelming suggestions. Some participants felt that ChatGPT's responses lacked originality or failed to fully align with their unique ideas, indicating a need for balanced usage and critical evaluation of AI-generated content.

Educators play a crucial role in instructing students to exploit the advantages of ChatGPT while upholding academic integrity and fostering independent writing skills. By integrating ChatGPT responsibly into academic curricula, teachers can help students navigate the evolving landscape of AI-assisted learning and prepare them for the demands of academic writing.

Limitations

The study's limitations include a small and context-specific sample size, as participants were drawn exclusively from a private university in Vietnam. This restricts the generalizability of findings to other academic settings or diverse student populations. Furthermore, the reliance on self-reported data through surveys, reflective journals, and interviews may introduce biases related to students' perceptions or social desirability.

Recommendations for Further Research

Future studies should explore the long-term impact of ChatGPT on writing proficiency across broader and more diverse student populations. Comparative research evaluating ChatGPT's effectiveness alongside other AI tools could provide deeper insights into its unique contributions to language learning. Additionally, experimental designs that incorporate control and treatment groups could offer more robust evidence of ChatGPT's impact on academic writing outcomes. Further investigation into strategies for integrating ChatGPT into curricula responsibly, with a focus on minimizing overreliance, would also be valuable for educators and policymakers.

By addressing these gaps, future research can provide a more comprehensive understanding of ChatGPT's potential and limitations, guiding its effective integration into higher education.

Acknowledgment

The author is grateful to the participants for their willingness to participate in the current study. Without their contribution, this study could not have been completed.

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FWU Journal of Social Sciences, Spring 2025, Vol.19, No.1, 12-24
DOI: http://doi.org/10.51709/19951272/Spring2025/2

The Hidden Drivers of Social Transfers: Understanding How Risk Perception Influences Social Transfer Decisions in Turkey

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Targeted transfer programs have gained significant attention as effective tools for poverty alleviation. While the targeting mechanisms in social transfer programs have been successful in identifying individuals in need, their implementation often encounters challenges and failures. This study seeks to examine the differences in risk perception among poor households regarding their participation in social transfer programs. A theoretical model was developed to explore the relationship between risk aversion and financial transfers, and the analysis was further supported by statistical and econometric methods using the Income and Living Conditions Survey of Türkiye. The findings indicate that, under varying levels of risk aversion, while the impact of economy-wide risks on the uptake of social transfers remains consistent, idiosyncratic shocks and changes in utility have differential effects on participation. Specifically, households with higher levels of risk aversion tend to participate more actively in social transfer programs. These results underscore the importance of households' risk perceptions in shaping policies related to social transfers and poverty reduction. Programs should incorporate behavioral factors alongside economic indicators to improve efficiency and fairness. This study's validity is limited by the assumption of a constant risk aversion coefficient for all households, as individual risk preferences were not measurable.
Keywords: human behavior, social environment, social policy, welfare reform, program evaluation, Türkiye

The Hidden Drivers of Social Transfers: Understanding How Risk Perception Influences Social Transfer Decisions in Turkey

Social transfer programs are an essential component of many development strategies with governments, as well as non-governmental organizations using them to increase the efficiency of scarce resources in reducing poverty, complementing investments in health, education, and other areas. Social transfer programs can be in the form of unconditional transfers, conditional cash transfers, cash for human development programs, and public works[1]. These different forms have various advantages and disadvantages (Ladhani & Sitter, 2020; Devereux, 2002).

The typical targeted program has components of design and implementation of the policy, determination of directly affected groups, direct spillover and feedback effects of the program, and budgetary costs of the program (Schaffner, 2014). These components determine the costs and the benefits of the program. The program may aim to reduce poverty, or vulnerability, or to affect the behaviors of the targeted individuals or households. Governments choose the proper social transfer instruments based on their policy priorities, the country's poverty profile, administrative capacity, and the resources available to finance the program (Samson et al., 2006).

Policymakers may choose to adopt a targeted or untargeted approach while determining the program design. Compared to untargeted transfers, targeted transfers have a greater potential to reduce poverty and reach a higher number of beneficiaries under a limited budget constraint. Coady et al., (2004a) investigated the programs implemented in the

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[1] Among the quite rich literature, see Coady et al., (2004a), Samson et al., (2006), Garcia and Moore (2012), and Abramo et al., (2019) for the details of these programs.

world and found that when compared to an untargeted program, the median targeted program provides 25% more resources in the bottom two quantiles. Despite these advantages, targeted programs come with political risks and require higher administration costs in order to determine who is poor. The success of the program in the targeted approach strictly depends on the accurate targeting of beneficiaries.

Countries employ different targeting methods depending on their social, political, institutional, and economic conditions. We can classify these methods as, (i) individual assessment, which involves retrieving details and information about the poor by using means tests and proxy means tests, which were used in numerous programs such as the Progresa program in Mexico and Familias en Acción program in Colombia, (ii) categorical targeting, where officials specify particular groups concerning geographic location, age, gender, disability or vulnerability, (iii) self-targeting, where the poor can select themselves for the project, and (iv) community–based targeting, such as the Old Age Allowance Scheme in Bangladesh, where community representatives select local beneficiaries. Targeting methods can also be used in combination to increase efficiency like in the Bolsa Familia program in Brazil which combines four different programs (Vadapalli, 2009). Geographic targeting, proxy means tests, and community-based targeting programs are used in combination in Mexico's Oportunidades conditional cash transfer program as well (Samson et al., 2006). Coady et al., (2004b) found that, on average, over two targeting methods are combined in 122 targeted transfer programs in 48 countries.

Targeting mechanisms in social transfer programs were generally successful in identifying who the poor are Researchers, however, have concerns about their effectiveness due to the imprecise identification of truly impoverished households (Ladhani & Sitter, 2020; Coady et al., 2004b; Coady & Parker, 2009; Azevedo & Robles, 2013). In these targeting strategies, especially prevalent in developing countries, the poor may be excluded from the program, or the non-poor may be included in the program. Coady et al., (2004a) examined 122 targeted antipoverty programs and discovered that in one-quarter of these programs, non-poor recipients benefited from a larger share of the program than poor recipients.

The design and implementation of the programs require careful determination of risk perceptions of poor households. Maitre et al., (2020) analyzed social risk groups and their access to social transfers in Ireland, finding that high-risk groups demand more support. They used the 2017 SILC data from Ireland to estimate social risk differences in accessing social transfer programs. The authors defined three different social risk groups, lone parents and their children, individuals in households where at least one working-age member has a disability, and individuals aged over 65. Working-age adults who are not lone parents, and who do not have a disability, along with their children were taken as a reference group. They focused on three specific transfers namely, housing, healthcare, and childcare, and concluded that housing transfers were more common among older respondents, vulnerable social risk groups would get a medical card with a higher probability, and higher social risk groups demanded more childcare. They also discovered that vulnerable groups benefited the most from the transfers and that deprivation of the poor was lower when more than one transfer was used. Sakha (2019) investigated macro and micro-level factors determining changes in risk preference over time in Rural Thailand and concluded that risk preferences were affected by time-varying macro-level and state-dependent micro-level variations. People who were exposed to shocks tended to choose less risky economic activities and the impact continued for a longer period of time after the shock. Similarly, Gollier and Pratt (1996) found that individuals facing higher background risks become more risk-averse, aligning with this study's argument that risk perception affects social transfer participation.

In practice, perfect targeting is not always possible as errors of exclusion and inclusion occur frequently[2]. A reduction in these errors is necessary to increase the efficiency of the program. Studies like Coady et al., (2004a) demonstrate that targeted transfers benefit more recipients under tight budget constraints but also bring political and administrative challenges. Azevedo and Robles (2013) suggested a multidimensional targeting approach to improve the performance of targeting mechanisms. In addition to the monetary income dimension, they also added the education and health-nutrition dimensions. For other dimensions, they included one intermediate indicator while incorporating several risk indicators for the education and health dimensions. They also determined deprivation limit values for each dimension and defined the weight of each indicator in each dimension. They applied their method to the data from the Oportunidades program in Mexico and showed that the multidimensional method reduced traditional targeting errors and raised the efficiency of the program in selecting beneficiaries.

[2] For example, Seleka and Lekobane (2020) assessed the targeting effectiveness of fifteen social programs in Botswana using data from the Botswana Multi-topic Household Survey and found that, except in one case, these programs covered the minimum of the poor. The programs were mostly ineffective and had large leaks to the non-poor. Thus, they suggested reforms in the programs to improve targeting effectiveness and to keep program leakages at minimum.

This study extends the suggestion of Azevedo and Robles (2013) by searching for another room to improve the current targeting models. We argue that households' risk perception along with the idiosyncratic and covariate risks they face is an important dimension in determining the genuine impoverished candidates. Adding the household risk perception dimension is especially important in the self-targeting methods where households decide whether to apply for a program and in the individual assessment targeting methods where program officials select households. This risk perception is contingent on the various stages in the participation process of these programs, namely, identification of households, application for the program, and acceptance into the program.

Establishing a successful social transfer program requires careful analysis of the poor. A person who psychologically thinks that he/she needs to help the most may seek and apply for more social aid even if he/she is not poor. Here, a market failure arises from asymmetric information such that a person is better informed about how much risk he/she is exposed to than other potential poor persons. In these cases, a higher share of the transfers can go to "psychologically desperate" but non-poor recipients instead of the poor but not "psychologically desperate" candidates. As a result, taking into account how households and/or individuals perceive risk when designing a social assistance program will improve targeting decisions and help choose the most effective targeting strategy.

The study by Sadoulet et al., (2004) is related to this article but examines the issue from reverse causality. They inquired about the risk coping role of Conditional Cash Transfer programs in child labor and education in the Mexican Progresa program. Estimations of static and dynamic decision models concluded that Conditional Cash Transfer programs could provide an important safety net role, as they protected child education from several idiosyncratic and common-variable shocks reinforcing the argument that risk exposure should be considered in program design.

This study contributes to the literature by analyzing the effect of risk perceptions when taking up social transfers. The data employed in the analyses is from Türkiye, which has created an integrated social assistance system within the past two decades. This e-government platform streamlines every stage involved in social assistance management. In the past, several social assistance programs had distinct procedures and required separate paperwork to be verified in hard copy forms.

This study comprises five stages. First, we theoretically construct a model showing the relationship between individual risk perception and taking up social transfers; second, determinants of disposable income before the income transfers are estimated; third, the relationship between households' idiosyncratic shocks and frequency of social transfer applications are statistically analyzed; fourth, the targeting performance of Türkiye's social transfer system is evaluated; and, fifth, panel data random effects and panel logit estimations are conducted to investigate how taking up social transfers differs depending on the varying risk perceptions in Turkish households.

To our knowledge, there is an absence of research that examines the risk perceptions of households in the design and determination of social transfers. In addition, the few studies regarding the success of cash transfers in Türkiye are mostly descriptive and/or investigate the impact of social transfers on poverty and/or inequality (Günes, 2012; Abdul-Rahman et al.; 2024, Ceren and Erdem, 2019; Tekguc, 2018; Şeker, 2008; Baylan, 2019).

The results reveal that individuals' perception of shocks is an important factor in accessing social transfer programs in Türkiye. The findings of this research could therefore inspire policymakers to recognize the risk perceptions of households in the program design which in turn would help refine eligibility requirements, strategies for benefit distribution, and governance structure choices.

In the following section, we briefly discuss the social assistance system in Türkiye and move on to construct an empirical model and present the estimation method in section three, with a description of the data in section four. The results and analyses for the impact of risk perceptions on social transfers are stated in section five, followed by the conclusion.

The Integrated Social Assistance Information System of Türkiye

The social benefits model in Türkiye can be studied in four parts. The first of these is the "public central social benefits", which include benefits provided by the central government. In addition, municipalities locally provide "public local social benefits". Enterprises in the private sector provide the "private sector social benefits" and the last type of aid is the "civil social benefits" which is provided by non-governmental organizations and individuals. Each type of benefit has its advantages and disadvantages (Khan et al.; 2024, Incedal, 2018).

Türkiye's current public social transfer system has a history of nearly half a century. The social assistance system prior to this was paper-based, requiring citizens to get documents in hard copy forms from various organizations. Over time, several new social assistance programs were developed and implemented including the provision of coal and food, programs to promote access to education by providing free textbooks and school lunches, cash transfers for widows, and a conditional cash transfer program for education and health. Türkiye's Integrated Social Assistance Information System was developed in 2010 and has been in effect since. It is an e-government system receiving social assistance applications from poor people, creating household files, querying personal data and socio-economic information and wealth positions of individuals from central databases, keeping reports on the households' socio-economic status based on the social investigation carried out on-site, and making decisions regarding eligibility for social transfers. It is an information system that serves the citizens, wherein bank instructions regarding aid payments and automatic accounting for all aid are carried out electronically, and citizens are able to view the results of their social assistance applications through the e-government portal.

The social protection system in Türkiye was assisting only a small section of the society prior to the 2000s. Social transfers became an important social policy tool in Türkiye after the launch of new programs and especially after the development of the Integrated Social Assistance Information System in 2010. Thus far, it has functioned as a supportive mechanism, particularly in eradicating the exclusion of the impoverished from being able to Access healthcare and education and in breaking the cycle of poverty.

Now the social assistance system serves as the most important tool in reducing poverty. Between 2010 to 2017, the Integrated Social Assistance Information System in Türkiye processed 30 million citizens' applications for social assistance and completed 340 million assistance transactions worth a total of US$13 billion (Ministry of Family and Social Policies and World Bank, 2017). The number of people receiving salaries within social protection was reported to be more than 14 million people in 2018 and 2019. The share of social protection assistance in the GDP was 11.8% in 2018 and 12.3% in 2019. In both these years, the three groups that received the largest share of benefits are retired/elderly people, the sick and those in need of medical assistance, and widows/orphans. In addition, while over 90% of the benefits were unconditional, over 67% of the benefits were in cash (TURKSTAT, 2019).

Method

Empirical Model

The empirical model is based on one of the basic models in the uncertainty literature. Suppose that a poor person with a concave utility function has a particular level of certain income, y_c, without any future income prospect, and below a minimum acceptable poverty line, B. Let us assume that when an individual engages in his or her regular business activities, the payoffs are uncertain in advance because of an uncertain business environment. We can consider the payoffs as a gamble, whether positive or negative, such that her income will be $y_c + z_s$ where z_s is a payoff with a probability of p_s in states. We assume the payoff z_s to be random and to be a result of the weighted sum of the systematic and idiosyncratic risks faced by individuals. We also suppose that a government decides that a citizen should have a minimum acceptable amount of income, B, in cases where their income falls below that level. The government won't take any action if an individual has an income $y_c + z_s \geq B$, however, if the income is $y_c + z_s < B$, the government allows them to apply for social assistance such that the money transfers, m, help to pull them out of poverty; $y_c + z_s + m = B$. Therefore, an individual is going to have either an expected income $\sum p_s(y_c + z_s) \geq B$ from her business activities or an income after the money transfer from the government. The money transferred to an individual is like a risk premium for the government to hold their wealth at some constant level and is like insurance for an individual against shocks.

For the poor person, the utility from an income before the government transfer must be equal to the utility from facing a gamble with a certain income. Therefore,

$$V(B-m) = \sum p_s V(y_c + z_s). \quad (1)$$

Applying the Taylor series expansions to the left and right sides of the equation gives:

$$m = \frac{V(B) - V(y_c)}{V'(B)} - \frac{1}{2}\frac{V''(y_c)\sigma_z^2}{V'(B)} \quad (2)$$

The amount of money transferred to an individual depends on (i) how utility rises due to money transfer, $\frac{V(B)-V(y_c)}{V'(B)}$ is normalized by the marginal utility at the basic income level, (ii) how risk-averse that individual is at a certain income, $\frac{V''(y_c)}{V'(B)}$, and (iii) the variance of the payoffs an individual faces, σ_z^2. We can further decompose the variance of the payoffs as shocks specific to that individual and shocks specific to the macro-economic and socio-political environment in which an individual lives (Chaudhuri, 2003). The model deduces that the money transfer will be larger as utility rises more due to the money transfer, an individual is more risk-averse, and an individual is faced with more shocks.

Estimation Methodology

The model in Section 3.1 links the risk perception of an individual with social transfers. Based on equation 2, we can construct the empirical model by adding the poverty level of the household into it:

$$m_{it} = \alpha_{0i} + \alpha_1(UR)_{it} + \alpha_2(CWS)_{it} + \alpha_3(IS)_{it} + \alpha_4(P)_{it} + u_{it} \quad (3)$$

Where, *UR* is a rise in utility from the money transfer normalized by the marginal utility at the basic income which is the income with social transfers, *CWS* is a country-wide shock, *IS* is an idiosyncratic shock, and *P* is a Foster-Greer-Thorbecke poverty index[3] with α =0, 1, and 2. Theoretically, we expect all coefficients to be positive.

The first step in the analysis is to choose the utility function. Here, we assume that the utility is $U(w)^i = (w_i^{1-\sigma})/(1-\sigma)$ where *w* is a welfare measure of individual *i*, and the parameter σ captures the curvature of the utility function and is interpreted as the household's relative risk aversion coefficient. Individual perception of risk varies depending on the individuals' family background, beliefs, socio-political environment, education, and the type of job they have. Since we cannot estimate the risk aversion coefficient of each individual[4], we assign different values for σ between $[0, 3]$ assuming a common risk aversion coefficient for each individual (Ligon and Schechter, 2003).

To estimate an idiosyncratic shock in a household, we followed the method suggested by Celidoni (2013) who used the model devised by Chaudhuri (2003). In this method, a household's income in any given period depends on the characteristics of the household and the macro-economic and socio-political environment in which they live:

$$y_{h,t} = y(X_{h,t}, \delta_t \gamma_h, u_{h,t}) \quad (4)$$

where $X_{h,t}$ shows the observable household characteristics, δ_t represents a vector of parameters describing the state of the economy at time *t*, γ_h is an unobserved, time-invariant household-level effect, and $u_{h,t}$ is any idiosyncratic shock. We treat $\delta_t \gamma_h$ as fixed effects. Amemiya's (1977) three-step, feasible generalized least squares procedure, is used to get an efficient estimate of the variance of idiosyncratic components of household income.

Data

Data for this study comprises micro and macro variables. The effective exchange rate data was obtained from the database of the Central Bank of Türkiye to calculate country-wide shock, a macro variable. The data for micro variables was taken from the Income and Living Conditions Survey panel data set of the Turkish Statistical Institute, TURKSTAT, with the wave covering the period 2016-2019. 20760 people responded to this wave, with the number of respondents being 5190 each year. The Income and Living Conditions Surveys are carried out regularly every year since 2006 in accordance with the studies compliance with the European Union. To obtain the target variables requested by EUROSTAT, TURKSTAT created the Income and Living Conditions Survey questionnaire to calculate indicators such as income, poverty, and other living conditions.

Based on this survey, the amount of social transfers is calculated as the sum of unemployment benefits, survivors' benefits (including death grants), sickness benefits, disability benefits (including ghazi and honor pensions), the value of child-related allowances in kind, child-related allowances in cash, housing allowances received, other social allowances

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[3] The Foster-Greer-Thorbecke indices are proposed by Foster et. al. (1984). Its general formula is $P_\alpha = \frac{1}{n}\sum_{i=1}^{n}\left(\frac{z-y_i}{z}\right)^\alpha$. When α = 0, it measures the share of poor people in the population. α = 1 measures the normalized average poverty gap corresponding to the depth of the poverty, and α = 2 measures the severity of poverty by giving greater weight to income deficits further away from the poverty line.

[4] Measuring individual risk aversion coefficients requires specific risk aversion questions in surveys. Unfortunately, TURKSTAT's Income and Living Conditions Survey does not include this kind of question. For studies calculated individual risk aversion coefficients, see, for example, Guiso and Paielle (2008), Kim and Lee (2012) and Jung (2015).

in cash received in during income and value of other social allowances in kind. These transfers are recorded as part of the household's total disposable income. As a result, we deducted them from the household's total disposable income to calculate disposable household income before government aid.

In all estimations, disposable household incomes before and after government aid are measured at the household level and adjusted for household size and composition using the modified equivalence scale of OECD[5], transformed to real terms, and then used in natural logarithmic forms[6]. Therefore, the household is taken as the unit of the analysis, instead of the individual.

CPI (2010=100) is used to make income real. Poor households are defined as households with an income lower than the poverty line which is 60% of the median income before social transfers. We calculated utility rise as the difference between household disposable incomes after and before government aid, divided by the marginal utility of income after government aid. The country-wide shocks variable is measured by taking yearly percentage changes of the real effective exchange rate of Türkiye.

Results

Türkiye's integrated social transfer system has various advantages, such as the consolidation of services under one single structure, improved information communication and sharing of information, and reduced time and costs. It would be beneficial to measure the targeting performance of Türkiye's social transfer system to understand the magnitude of its success in channeling benefits to the target population before moving to other analyses.

A common approach to measuring errors and accuracy in targeting is to calculate the leakage and under coverage rate of the program (Coady et al.; 2004a, Hassan et al.; 2023, Ravallion; 2016). This approach comprises a calculation of the under-coverage rate which is the portion of poor households categorized as non-poor (exclusion error) and leakage rate which is the proportion of non-poor households categorized as poor (inclusion error)[7].

We achieve perfect, accurate targeting when there are no exclusion and inclusion errors.
Table I shows under coverage and leakages rates following the method devised by Coady et al., (2004a). Since the data set is panel data, the same number of beneficiaries over the period was used in the panel. While 65.9% of poor households were included in the program (successful targeting for the poor), 34% of the poor were not included in the program (under coverage rate, exclusion error), and the proportion of non-poor in the program was 46% (leakage rate, inclusion error). Thus, we can conclude that although there are many beneficiaries in Türkiye's integrated social transfer system, such high levels of under coverage and leakage rates show that the effectiveness of the targeting is not as successful as it is widely used and the system needs to be developed from this point of view.[8] However, despite this, they are not as high as the targeting ineffectiveness in the study by Seleka and Lekobane (2020) for Botswana, where close to half of the program beneficiaries were non-poor and over one-third of the poor people were not covered by programs.

[5] The modified OECD equivalence scale gives a weight of 1 to the reference person of the household, 0.5 for household members age 14 and over and 0.3 for others in the family.
[6] For a few households with negative or zero disposable incomes after the subtraction of cash transfers, we accepted incomes as 2 to add them into the sample.
[7] The under coverage rate is measured by dividing the number of poor households excluded from the program by the total number of poor, the leakage rate is measured by dividing the number of non-poor households in the program by the total number of households in the program. Two other performance indicators showing the success of the programs are (i) the targeting effectiveness ratio which is measured by dividing the number of poor people in the program by the total number of households in the program, and (ii) the coverage ratio which is measured by dividing the number of poor households in the program by the total number of poor households.
[8] The calculations were made by taking the poverty line as 60% of the median income (before the social transfers) of the households in the panel over the period 2016-2019. This poverty line is not the official poverty line in Türkiye and social transfers are not given based on this poverty line. However, they may be a close representative of them even the performance ratios are not the exact indicators.

Table I
Performance Ratios of the Programs in Türkiye

	Welfare Status of Households		
Number of households	**Poor**	**Non-poor**	**Total**
in the program	3382	2906	6288
out of the program	1746	12726	14472
Total	5128	15632	20760
Targeting effectiveness (%)	Leakage rate (%)	Coverage rate (%)	Under-coverage rate (%)
53.7	46.2	65.9	34.0

Notes: Computed by the author from the Income and Living Conditions Survey (TURKSTAT, 2016-2019).

Having determined the effectiveness of the various Turkish social programs, we will proceed to conduct econometric estimations to examine whether risk perceptions of households have any effect on them taking up social transfers. When this effect is discovered, it may prompt officials to look for ways to improve the effectiveness of the programs.

Based on the theoretical model, equation 3 was constructed for this analysis. The idiosyncratic shocks in equation 3 must be separately estimated since this variable cannot be proxied by any other indicator. We estimated them using the method proposed by Amemiya (1977). To do that, equation 4 in Section 3.2 was specified in the econometric model as:

$$\ln y_{ht} = \lambda_o + \lambda_1 X_{ht} + e_{ht} \quad (5)$$

where X_h shows the observable household characteristics and e_{ht} is a composite error term. The state of the economy at the time *t*, and an unobserved time-invariant household-level effect is described as:

$$e_{ht} = \delta_t \gamma_h + u_{h,t}$$

In equation 5, e_{ht} captures the household's idiosyncratic factors. Chaudhuri (2003) assumes that the variance of e_{ht} is determined by the same household characteristics:

$$\sigma^2_{e,h} = X_h \theta \quad (6)$$

We used Amemiya's (1977) three-step Feasible Generalized Least Squares (FGLS) method to get consistent and asymptotically efficient estimates. The steps in this method are as follows:

i. Model 5 is estimated using the OLS procedure.
ii. The residuals from the first step are used to estimate-

$$\hat{e}^2_{OLS,h} = X_h \theta + \upsilon_h$$

iii. The predictions from the second step are used again to transform the equation-

$$\frac{\hat{e}^2_{OLS,h}}{X_h \hat{\theta}_{OLS}} = \left(\frac{X_h}{X_h \hat{\theta}_{OLS}} \right) \theta + \left(\frac{v_h}{X_h \hat{\theta}_{OLS}} \right) \quad (7)$$

The OLS procedure is applied to estimate this transformed equation. Then, $X_h \hat{\theta}_{FGLS}$ provides a consistent estimation of the variance of the idiosyncratic component of household income, $\sigma^2_{e,h}$.

The OLS estimation of equation 5 can ascertain determinants of household income. We used the panel data random-effects method to estimate that model. Besides the suggestion of the Hausman test, it is because the random-effects method allows heterogeneity across units, which is more suitable in our case and the fixed effects model could not estimate the time-invariant variables.

The estimation results are shown in Table II in which the coefficients fit well with theoretical expectations. All coefficients are statistically significant, and income is positively related to education level, age, marriage, and health condition of the household head. In contrast to these results, an individual's income is observed to be lower if the household head is a woman, the household size is larger, and the dependency rate is higher.

Having ascertained the idiosyncratic shocks, the next exercise was to determine the relationship between the idiosyncratic shock households face and the number of beneficiaries in the program. Idiosyncratic shocks induce strong precautionary motives for households to stabilize their incomes. Increasingly diversified and frequent shocks make households more risk averse. One way to reduce the exposure of households to any kind of shock ex-ante is to participate in the country's social assistance program which will help them be more resilient to idiosyncratic and/or common shocks.

Table 2

The Determinants of Household Income

Dependent Variable: ln (disposable per-household income excluding social transfers)	2016-2019
Gender of head	-0.252
	(-5.82)*
Age of head	0.007
	(9.54)*
Household size	-0.035
	(-19.90)*
Education of head	0.229
	(38.30)*
Marital status	0.130
	(7.20)*
Health status	0.042
	(5.93)*
Employment status	0.108
	(13.20)*
Dependency rate	-0.0005
	(-3.77)*
Constant	7.299
	(63.13)*
Number of observations	20760
R-square (overall)	0.29
Wald Chi-square	3066.88
	(0.00) *

Notes: *t*-statistics (derived from heteroscedasticity robust standard errors) are in parentheses, * shows that the coefficient is significant at 1%. Numbers in parentheses for Wald Chi-square are *p*-values.

Table III summarizes the mean values of idiosyncratic shocks and social transfer application frequencies across different categories of society. The first column gives results in line with expectations: mean values of idiosyncratic shocks decrease as the level of health and education of household heads increases. In contrast, they are higher for female-headed households. The mean value of idiosyncratic shocks is lower for married households and increases in households where the household heads are single or have ended their marriage. The last column indicates a pattern between the mean value of idiosyncratic shocks and the number of households in the program. It shows that the category with higher idiosyncratic shocks is also a category with a higher number of households participating in the program. Therefore, it can be concluded that a household faced with larger idiosyncratic shocks participated more in a social transfer program and could thus balance the adverse effects of idiosyncratic shocks.

Table 3

Idiosyncratic Shocks and Applications for Social Transfers Across Categories

	Mean value of idiosyncratic shocks	1	2	(2/1)(%)
Education				
Illiterate	0.231	1631	1132	69.41
Literate but not a graduate	0.142	1151	635	55.17
Primary school	0.086	8742	2698	30.86
Secondary, v. secondary or primary education	0.062	2518	674	26.77
High school	0.059	1764	355	20.12
Vocational or technical high school	0.047	1544	308	19.95
Faculty/university, college, or higher education	0.048	3410	486	14.25
Gender				
Female	0.258	3608	2354	65.24
Male	0.05	17152	3934	22.94

Marital status				
others (widowed/divorced/separated)	0.261	3351	2265	67.59
never married	0.137	683	219	32.06
married	0.049	16726	3804	22.74
General health status				
very bad	0.161	233	127	54.51
bad	0.142	2310	1110	48.05
so, so	0.106	5910	2037	34.47
good	0.066	11238	2766	24.61
very good	0.057	1069	248	23.20

Notes: 1: total frequency, 2: frequency of households participating in social transfers.

Table IV presents the estimation results of equation 3 with incrementally increased risk aversion coefficients in utility functions. In addition, the model was separately estimated with different poverty indices. As theoretically expected, the coefficients of being poor and facing idiosyncratic and country-wide shocks are statistically significant and positive in all regressions. The effects of poverty and idiosyncratic shocks are higher as common risk aversion coefficients become larger, while the impact of country-wide shocks is constant across different risk aversion coefficients in each regression. If we assume the common contention that poorer people are willing to be more risk-averse than the wealthier, the effects of poverty and idiosyncratic shocks on taking up social transfers become larger as risk aversion is higher.

Table 4

Estimation of Social Transfers: 2016-2019

Dependent Variable: ln (per-household social transfers from the government)

		σ=0	σ=0.5	σ=1	σ=1.5	σ=2	σ=2.5	σ=3
Poverty index with α=0	Constant	0.474 (11.51)*	0.412 (10.09)*	0.372 (9.14)*	0.352 (8.64)*	0.343 (8.42)*	0.339 (8.33)*	0.338 (8.29)*
	Poverty	0.942 (17.89)*	1.054 (20.17)*	1.126 (21.47)*	1.161 (22.01)*	1.177 (22.23)*	1.183 (22.31)*	1.186 (22.35)*
	Idiosyncratic shocks	12.13 (25.51)*	13.39 (29.92)*	14.2 (32.76)*	14.6 (34.07)*	14.77 (34.60)*	14.84 (34.82)*	14.86 (34.90)*
	Country-wide shocks	0.008 (3.48)*	0.007 (3.39)*	0.007 (3.33)*	0.007 (3.29)*	0.007 (3.27)*	0.007 (3.27)*	0.007 (3.26)*
	Utility rise	1.1 (10.58)*	0.526 (9.40)*	0.204 (8.80)*	0.068 (8.18)*	0.021 (7.15)*	0.006 (6.16)*	0.002 (5.55)*
	R^2	0.39	0.36	0.35	0.34	0.33	0.33	0.33
		σ=0	σ=0.5	σ=1	σ=1.5	σ=2	σ=2.5	σ=3
Poverty index with α= 1	Constant	0.552 (13.12)*	0.489 (11.82)*	0.452 (11.03)*	0.434 (10.66)*	0.427 (10.51)*	0.425 (10.46)*	0.424 (10.44)*
	Poverty	1.733 (12.30)*	2.328 (17.93)*	2.704 (21.71)*	2.895 (23.53)*	2.979 (24.33)*	3.013 (24.67)*	3.026 (24.83)*
	Idiosyncratic shocks	12.32 (25.87)*	13.32 (29.67)*	13.85 (31.66)*	14.06 (32.43)*	14.12 (32.70)*	14.14 (32.79)*	14.14 (32.83)*
	Country-wide shocks	0.008 (3.48)*	0.008 (3.53)*	0.008 (3.56)*	0.008 (3.57)*	0.008 (3.58)*	0.008 (3.59)*	0.008 (3.59)*
	Utility rise	0.955 (8.64)*	0.391 (7.10)*	0.122 (5.67)*	0.029 (3.81)*	0.005 (1.90)***	0.0007 (0.68)	0.000 (0.10)
	R^2	0.38	0.36	0.35	0.35	0.35	0.35	0.35
		σ=0	σ=0.5	σ=1	σ=1.5	σ=2	σ=2.5	σ=3
Poverty index with α= 2	Constant	0.613 (14.16)*	0.548 (12.83)*	0.513 (12.11)*	0.498 (11.81)*	0.492 (11.71)*	0.49 (11.68)*	0.49 (11.67)*
	Poverty	0.751 (3.62)*	2.021 (11.10)*	2.822 (16.75)*	3.224 (19.60)*	3.398 (20.84)*	3.466 (21.37)*	3.49 (21.60)*
	Idiosyncratic shocks	12.7 (25.95)*	13.86 (30.44)*	14.39 (32.57)*	14.55 (33.25)*	14.58 (33.45)*	14.58 (33.51)*	14.58 (33.53)*
	Country-wide shocks	0.007 (3.12)*	0.007 (3.20)*	0.007 (3.27)*	0.007 (3.30)*	0.007 (3.32)*	0.007 (3.33)*	0.007 (3.34)*

Utility rise	1.106 (8.76)*	0.41 (6.63)*	0.105 (4.51)*	0.014 (1.82)***	-0.001 (-0.62)	-0.002 (-1.99)**	-0.001 (-2.55)*
R^2	0.35	0.33	0.32	0.32	0.32	0.32	0.32

Notes: The random effects model is used in the estimations. The number of observations is 20760 in each estimation. *t*-statistics (derived from the heteroscedastic robust standard errors) are in parentheses. *, **, *** * shows that the coefficient is significant at 1%, 5% and 7%, respectively. The *p*-values for Wald Chi-square (not shown here) are significant at 1% in all regressions.

In addition, the range of poverty coefficients expands in the models where poverty variables become more sensitive to income changes, as risk aversion coefficients become higher. When a household is more risk averse and when the poverty index indicates the depth and severity of poverty, the impact of poverty on taking up social transfers increases, and decreases when the poverty index is just the headcount index losing sensitivity to income distribution among the poor.

We observe an opposite relationship between utility rise and its effect on taking up social transfers. The coefficients of the utility rise variable become lower in the models as the risk aversion coefficient rises. In the first regression, when poverty is measured by headcount ratio, the coefficients are statistically significant and positive but decrease with higher risk aversion parameters. In the second model, while the effect of utility rise is positive and statistically significant for low-risk aversion parameters, it shrinks quickly and turns out positive but insignificant, as the risk aversion parameter rises. The coefficient of utility rise even turns out to be negative and statistically significant in the third model where the poverty indicator demonstrates the severity of poverty. The higher σ corresponds to the more sharply curved utility function and therefore, the less utility rise from the social transfers and, at the extreme, participating in the program provides less utility for very high risk-averse households when the poverty index gives more weight to the extremely poor.

To strengthen the findings, we estimated the logit model by transforming the dependent variable as a binary variable. It takes a value of 1 if the household takes part in the system and 0 otherwise. Table V gives the panel binary logit estimates of the preceding model using different poverty rate indices. We excluded the utility rise variable from the estimations because of its perfect correlation with the dependent variable. In Table V, since the estimated Wald Chi-square values are highly statistically significant, we can reject the null hypothesis that all coefficients are simultaneously equal to zero. Similarly, significant Chibar-square values show that the random effects logit model is chosen over the pooled logit model.

In all regressions, all variables are individually, as well as collectively and statistically significant at the 1% significance level and display the expected signs. The poverty coefficients expand as poverty indices become more sensitive to income distribution. However, the coefficients of the country-wide shocks and idiosyncratic shocks are almost similar in all models.

Table 5

Logit Estimation of Social Transfers: 2016-2019

Dependent Variable: Participating in the social transfer system

Poverty index with	α=0	α=1	α=2
Constant	-4.476 (-36.08)*	-4.26 (-34.64)*	-4.305 (-32.43)*
Poverty	2.691 (23.16)*	7.102 (22.27)*	9.972 (15.81)*
Idiosyncratic shocks	20.00 (25.81)*	18.79 (23.57)*	20.18 (23.95)*
Country-wide shocks	0.021 (3.46)*	0.022 (3.59)*	0.020 (3.36)*
Wald Chi-square	1298.09 (0.00)*	1112.29 (0.00)*	1220.57 (0.00)*
Chibar-square	4837.83 (0.00)*	4728.51 (0.00)*	5116.49 (0.00)*
Average marginal effects			
Poverty index with	α=0	α=1	α=2
Poverty	0.195	0.475	0.604

	(15.72)*	(19.56)*	(13.60)*
Idiosyncratic shocks	1.454	1.257	1.222
	(37.87)	(33.18)*	(34.99)*
Country-wide shocks	0.001	0.001	0.001
	(3.43)*	(3.57)*	(3.33)*

Notes: The random effects logit model is used in the estimations. The number of observations is 20760 in each estimation. *t*-statistics (derived from heteroscedastic robust standard errors) are in parentheses. The numbers in parenthesis below the Wald Chi-square and Chibar-square tests are the *p*-values. * shows significance levels at 1%.

We must present the marginal effect of each variable on the probability of participating in the social transfer system for each model type since the coefficients do not give us the rate of change of probability for a unit change in the regressor. As observed in Table V, the marginal effects of the poverty variable get higher as poverty indices become more sensitive to income distribution. In contrast to this, the marginal effect of the country-wide shocks variable remains the same and is relatively very low in each model. The average marginal effects of poverty and idiosyncratic shocks are quite large in all three models. For example, the coefficient of 1.454 suggests that if the idiosyncratic shocks rise by one unit, on average, the probability of participating in the social system rises by 145%. Similarly, the coefficient of 0.475 suggests that if the poverty index with $\alpha=1$ increases by a unit, on average, the probability of participating in the social system increases by 47.5 percent. We can thus conclude that the idiosyncratic shocks have the largest effect on the probability of taking up social transfers followed by the poverty level of the households.

The combined results of the panel data random effects model and logit model show that the idiosyncratic shocks and poverty have the largest effect on the probability of taking up social transfers and the impact of these variables is higher for more risk-averse households. Therefore, we can conclude that more risk-averse households take up social transfers at a higher rate and are also more likely to seek social transfers.

Concluding Remarks

Most targeted programs aim to reduce current poverty by providing cash or food to needy people. The costs to determine who is in need and the impact of the program on directly and indirectly affected groups are two key elements in targeting error discussions. Targeting failures occur because of the asymmetric exchange of information between program officials and poor households.

To reduce targeting errors, a study by Azevedo and Robles (2013) suggests a multidimensional methodology in which they consider poverty beyond a monetary phenomenon. This study aims to examine the scope to improve the current targeting methodologies following the approach by Azevedo and Robles (2013). The study extends risk perception theories by linking them to social transfer participation, emphasizing the psychological aspects of economic decision-making. It suggests considering the risk perceptions of the applicants in determining the target population as well as the design and implementation of the program. We assume that participants in the program will be more likely the members of the community who psychologically think that they need help the most. To the best of our knowledge, this is the first study that examines the risk perceptions of the applicants on the effectiveness of the targeted transfer programs.

This study developed a brief theoretical model to construct the link between risk perceptions of individuals and social transfers. The Income and Living Conditions Survey panel data set from Türkiye was used for statistical and econometric analyses. It was discovered that individual characteristics of households are the main determinants of disposable income levels. The calculations for the effectiveness of the targeting program in Türkiye showed that the program was not as successful as much as it is in the majority of the other parts of the world. Therefore, better methods may be needed to improve the effectiveness of the program. We statistically indicated a pattern between the mean value of idiosyncratic shocks households face and the number of households in the program. The results show that exposure to shocks is different for households across different categories of society. When faced with greater idiosyncratic shocks, the likelihood of participation in a transfer program also increases.

We estimated panel data random effects models derived from the theoretical model by assuming common risk aversion coefficients. The results from random effects models showed that while the impact of country-wide shocks is constant across different risk aversions, the effect of poverty and idiosyncratic shocks is higher when the risk aversion coefficients of households are greater. The panel data logit models also concluded that the idiosyncratic shocks and poverty have the largest effect on the probability of taking up social transfers. These results suggest that individuals' perception of shocks is an important factor in taking up social transfers in Türkiye.

These results, at least in the case of Türkiye, present an important role of individual risk perceptions in taking up social transfers. Policymakers can improve targeting mechanisms by integrating psychological screening tools to assess risk perception among applicants. It would be better to identify the poor beyond the monetary dimension in social programs and considering the risk perception of the applicant is one of them. Given the findings, programs should consider behavioral factors alongside economic indicators to enhance efficiency and fairness.

The validity of our approach is limited by the data such that it could not allow us to measure the risk aversion of each individual. Instead, we had to assume that all households had the same constant risk aversion coefficient. Using individual risk aversion coefficients could provide deeper insights. Future research could explore how non-economic factors (such as cultural norms and trust in institutions) impact program participation. Further studies should investigate the long-term effects of risk perception on economic mobility and dependency on social transfers.

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FWU Journal of Social Sciences, Spring 2025, Vol.19, No.1, 25-33
DOI: http://doi.org/10.51709/19951272/Spring2025/3

The New Great Game in Central Asia: Pakistan's Interests in the Regional Power Play

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The New Great Game is a power struggle for dominance and geopolitical supremacy in Central Asia, to control energy reserves, establish monopoly over supply routes and capture lucrative high-stakes energy projects. The huge energy reserves of Central Asia have paradoxically become a bone of contention, fostering an uncooperative environment, fuelling political differences, and exacerbating high-stakes power politics, thereby jeopardizing the collaborative relationships among the regional and global stakeholders. The primary objective of this research article is to undertake a comprehensive comparative analysis of the competing interests of Pakistan alongside with those of regional players including China, Russia, and India through examining the intricacies of convergence and divergence of their engagement in the region. The theoretical framework of Geopolitics provides a nuanced lens to contextualize regional dynamics, explain and analyse the patterns of cooperation and competition of different players in Central Asia. The paper argues that Pakistan's interests in Central Asia can be best served by harmonizing its policy with China and Russia, and forming cooperative partnerships with Iran and Turkey. This research paper will equip Pakistan's policymakers and diplomats with a deeper understanding of the competing interests enabling informed decision-making to achieve strategic and political objectives.

***Keywords*:** New great game, geopolitics, energy, Pakistan, Russia, China, India.

The term "New Great Game" is a concept presented by Pakistani writer Ahmed Rashid in the 1990s. It is a power struggle for controlling energy resources in Central Asia (Rashid, 2009). Historically speaking, the term "Great Game" was adopted by Arthur Connally in 1834 (Connally, 1934) and referred to the 19th century struggle between Tsarist Russia and the British Empire for the control of Central Asia and Afghanistan (Abbas, 2012). Central Asia holds a huge amount of natural resources including oil, gas, gold and copper. According to estimates, the region possesses 31.246 billion barrels of oil reserves, 265 trillion cubic feet of natural gas, 38,704 million short tons of Coal, 928 thousand tons of Uranium, and 460 billion kilowatts of Hydropower capacity per year (Asian Development Bank, 2010). It is estimated that under the Caspian Sea lay the world's largest undeveloped fossil fuel reserves. These resources have attracted the interests of western as well as regional powers. There is a hard contest among extra-regional and regional players for access to these gas and oil resources (Edwards, 2003).

Energy security is the most important element of survival at present. The reward in this power politics is not just access to the vast amount of gas and oil deposits, but also monopoly over the energy supply routes, financial gains from oil and gas pipelines, and oil consortiums. Every country needs a smooth and cheap energy supply, not subject to any interruption. Considering the depletion of energy resources in the Middle East and North Sea region, Central Asian energy resources have emerged as a viable alternative. It has compelled both regional and extra-regional powers to give attention

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to Central Asian energy resources. Basically, the New Great Game started for getting maximum benefits from the energy resources of Central Asia after the disintegration of the USSR in 1991.

The region's geo-strategic significance and energy resources have attracted regional and global powers to engage actively, increase their influence, and control the energy resources for their strategic advantages. The interests of these powers in Central Asia are influenced by its energy resources and the strategic location as a channel of crossroads for major economic corridors linking the East, West, North, and South. Thus it gave birth to geopolitics in the region. Their interests in this region are reflected in what Halford Mackinder observed many years ago. He asserted, he who rules the heartland, rules Asia. He who rules Asia, rules the world (Chowdhury & Abdullah, 2015). It is a very important region having abundant natural resources and significant strategic location, and maximum command and control on it will provide the main players with maximum economic benefits and strategic strength (Khan, 2022).

This article aims at to delve into a comprehensive comparative study of Pakistan's interests alongside those of Russia, China, and India-four crucial regional stakeholders. This research article discusses the complexities of their interests, recognizing areas of convergence and divergence, within the context of Central Asia. This article strives to contribute meaningfully to the debate on the New Great Game highlighting the complex web of interplay between the interests of Pakistan with other competing stakeholders in the region. This region has recently emerged as a geopolitical hotspot, where these countries are actively engaged in vying for their influence and strategic goals. This article will apprise the Pakistan's policy makers and diplomats with comprehensive understanding of the competing interest to take informed decisions about achieving their strategic and political goals. This article also highlights the potential of cooperation with friendly countries to align their objectives for gaining regional stability. Moreover, this article will also provide nuanced understanding of the potential risks of competition, enabling relevant stakeholders to make informed decisions about investments, partnerships, and strategic engagements.

Geopolitics: Theoretical underpinning

Geopolitics is an interdisciplinary approach that posits the multifaceted relationships between politics, geography and international relations. Rudolf Kjellén, coined the term "geopolitics" and defined it as the "science of states as life forms, based on demographic, economic, political, social and geographical factors" (Scholvin, 2016). This theoretical framework seeks to understand how states interact with each other in certain geographical entity, influence each other behaviour in the pursuit of power or interests (Kaplan, 2009). This framework is rooted in the realist understanding where states try to maximize their power and self-interest in the anarchic global order (Anuchin, 2019). The classis geopolitics approach highlights the importance of geographical features where states and other actors compete for control over territory, resources, strategic locations and routes. On the other hand, the critical geopolitics approach criticise the traditional approach and instead focuses on non-state actors and their role in shaping the global politics (Fettweis, 2015).

The theoretical paradigm of Geopolitics helps to understand, explain and evaluate the intricacies of the New Great Game in Central Asia by taking into account crucial elements such as historical background, geographical importance, energy resources, security of the region, and the influence of external players. Additionally, it enables to predict their policy behaviour through geographical variables in the power politics play currently on-going in Central Asia.

At present, the term 'New Great Game' is applied to characterise contemporary geopolitics in Central Asia, referring to the rivalry of different regional and extra-regional players in the region for greater influence, control, hegemony, domination, and revenues. This Game is far more complicated, confusing, and serious than its precursor of the nineteenth century. Ahmed Rashid says that the crux of the Game is centered on Moscow's efforts to maintain control over CARs and regulate the movement of the Caspian Sea's region's energy resources via multiple Moscow-operated pipelines (Rashid, 2009). At the same time, the US attempts to prevent Moscow's dominant influence and control over the region. Likewise, other regional countries are working to establish ties with CARs to import energy resources and become the preferred path for energy pipelines connecting the East, South, and West.

Recently the US has intensified its focus on China. The scope of the geopolitical tension is far greater. Tensions between the US and China extend into economic, scientific, and military domains, as both countries compete for influence in critical areas such as the Indo-Pacific and Africa. China is establishing economic partnerships via programs such as

BRI, SCO and the BRICS coalition. Simultaneously, the United States has forged several bilateral economic and defence deals with nations around Europe and the Indo-Pacific while also spearheading alliances such as NATO and the Quad. There is a rising China-Russia alliance, supported by North Korea and Iran. The economic aspect of US-China rivalries is pivotal to the New Great Game, as both countries compete for technical superiority, international trade hegemony, and control over global financial institutions.

Method

The data for this research paper was collected through qualitative and descriptive approach. The purpose of this paper is to understand Pakistan's interests alongside with those of regional players including China, Russia, and India through examining the intricacies of convergence and divergence of their engagement in the region. This research qualitative methodology is supported by interpretive epistemology. The literature comprises of collecting and confronting a variety of government and organization reports, articles, historical records, books, and policy papers. A thematic analysis approach was adopted for data analysis. Thematic analysis is a broad term that explains a common data analytic process for qualitative or interpretive research. This research study thematic analysis includes: reviewing the data collected from various sources, assigning meaning (coding), classifying data into basic themes, searching for developing patterns, assessing the applicability of findings to the questions posed in the study, and ultimately writing up the findings and interpretations.

New Great Game and Competing Interests of Major Players

As Hilary Clinton once declared, "the future of global politics will be decided in Central Asia, not in Iraq or Afghanistan, and the United States will be right at the centre of the action" (Rahim, 2017). All the actors who are engaged in the New Great Game have different types of interests. Russia seeks to increase the European gas dependence over its resources, while the United States tries to diversify the European energy supply and keep it away from Moscow's control. The United States' objective of containment of China and Russia in Central Asia has intensified the New Great Game. The US intends to prevent regionalism to stop regional hegemony and attain its foreign policy objectives more easily. America is specifically interested in using CARs and the Caspian region's untapped energy resources. The Baku, Tbilisi, and Ceyhan (BTC) pipeline is an attempt to counterbalance the influence of Russia, China and Iran (Khan, Hussian & Rehman, 2017). Broadly speaking, the United States has three key strategic objectives in Central Asia. Its first objective is that CARs sovereignty and independence must be protected. The second objective is that they should share their gas and oil with each other. Washington's third objective is to counter Beijing's and Moscow's increasing influence in Central Asia.

The United States has signed several agreements with CARs to effectively maintain its influence in the region. The US also intends to help the CARs boost their oil and gas industries and ensure economic development while attempting to keep them out of Moscow's circle of influence (Oliker & Shlapa, 2005). It also proactively encourages and supports its firms engaged in oil and gas production and pipeline projects to export Central Asian oil and gas to Western countries. The US strategic objectives in the region and the presence of its military basses like Manas (Kyrgyzstan) and Karshi-Khanabad (Uzbekistan) (Adnan & Fatima, 2015) have also affected CARs relations with Russia and China.

China is another potential stakeholder in Central Asia and an important player in the New Great Game. Today, China and Central Asia have a 3,300 km long common boundary and share cultural ties. China is one of the principal trade partners of CARs. CARs expect that China can offer them easy access to the Asian-Pacific markets. Stable politics and advanced transportation facilities in China have inspired CARs to establish strong trade ties with China. Beijing's basic policy objectives towards Central Asia are FRI, constructing transportation routes, ensuring its energy supply, increasing trade, and stabilizing Central Asia. Beijing has constructed many pipelines to import oil and gas from the Central Asian countries.

One of the main problems for foreign investors in CARs is the sustainable transportation of energy resources to the international markets. The fact is that today's real "game" is the infrastructure development and the capability of the actors to get as smoothly linked as possible throughout the regions. The monopoly of Moscow on infrastructure and transportation routes of Central Asia and Transcaucasia during the Soviet era is gradually eroding. CARs struggle for

southern outlets is supported by the international community, resulting in more market access and bypassing of Russia. For instance, the Baku-Tbilisi-Ceyhan pipeline, the second Eurasian land bridge, the trans-Caspian pipeline, the Panj River bridges joining Afghanistan and Tajikistan, and many other projects are being planned in the region.

Post-US Withdrawal Scenario of New Great Game

After the US and NATO withdrawal from Afghanistan and the recapture of Kabul by the Taliban in August 2021, some basic dynamics of the New Great Game have been changed due to the regional countries' changing priorities and policy options. The matter of handling Afghanistan under the Taliban is on the one hand a source of tensions between regional countries and on the other, this has further intensified the existing geopolitical rivalry between the US, Russia and China (Khan, Dawar, & Khan, 2023). Pakistan favours engagement with the Taliban to get access to Central Asia, tackle the issue of TTP, maximize its policy options vis-à-vis India in regional affairs, and "minimize Indian role in Afghanistan to stop its backing of separatist movements in Pakistan" (Fair, 2014); China is concerned about the potential spread of terrorism to the nearby Xinjiang Region; Russia is concerned about potential destabilisation of its Central Asian partners, ISKP, IMU and also has serious "concerns about the Chechen rebels" (Lewis, 2020); Iran is worried about the security of Shia community in the Afghanistan; and India, which had vigorously backed the previous democratic Afghan government, views the Taliban's seizure of power as a loss of its investment and influence in Afghanistan.

Most importantly, in the post-withdrawal era, ISKP presence in Afghanistan is a real and common security threat to all regional countries that compelled even past rivals to work together. For example, relations between Iran and the Taliban have transformed dramatically, started cooperation to eliminate ISKP since mid-2010s (Dreazen, 2016). After the Taliban takeover, Iran provided humanitarian aid, entered into a formal agreement to improve cross-border trade, provided 100 megawatts of electricity, and aligned its Afghan strategy with the other parties involved. In late October 2021, Tehran hosted a meeting of foreign ministers from neighbouring countries of Afghanistan, including China, Pakistan, Russia, Tajikistan, Turkmenistan and Uzbekistan (Masahiro, 2022). In the 1990s, Iran and Taliban relations were primarily hostile due to the killing of thousands of Taliban fighters by Shia and Northern alliance forces and then the revengeful persecution of the Shia Hazara minority in Afghanistan. Even Iran's assistance to the Northern Alliance was more than what Pakistan had provided the Taliban. Additionally, in 1998, Iran responded to the murders of its diplomats and a journalist in Afghanistan by threatening war against the Taliban by mobilising its troops near to the afghan border. Now, after the US withdrawal, the neighbouring countries have established contacts with the Taliban due to their own security problems. However, this may not be the only factor influencing their policy decisions.

There is also another critical geostrategic issue in the post-US withdrawal period. If the Taliban fails to fulfil their promise to stop terrorist organizations such as Al-Qaeda or ISKP operations from their country and the latter get enabled to launch an attack on the US, then the government of the US will probably counter the threat through an 'over the horizon' method. Drone operations are potential, but now, the US lacks facilities in Afghanistan or in any neighbouring country for their deployment. While it is possible to control drones from US bases located in the Gulf nations, the geographical distance would make its operations ineffective. In such a situation, the US would strive to borrow airbases in Central Asia. On one hand, such a move will be strongly opposed by Russia as well as China and on the other hand, it will lead to serious rivalries between the airbase lender country and the Afghan Taliban.

Pakistan's Interests Vis-à-Vis Other Key Players

Central Asia is very important for Pakistan for several reasons, including the plentiful natural energy reservoirs and other types of mineral resources, geographic location, landlocked nature, and sharing borders with China and Russia. All the actors who are engaged in Central Asia have different types of interests. Mostly, the economic interests of the countries involved in Central Asia are almost the same, but the political and strategic interests of different countries are different from each other. Being located at the crossroads of Central Asia and South Asia, Pakistan is well positioned to serve as a route connecting different regions and offering easy access of landlocked Central Asia to the sea. From the beginning, Pakistan is attempting to have a preferred land route to Central Asia. For this purpose, Pakistan has prioritised the region in its foreign policy since 1991 and still working hard to bring CARs into its sphere of influence and connectivity.

Connectivity is one of the most important elements in the New Great Game. Regarding connectivity and provision of CARs access to the international market via Pakistani territory, Islamabad is facing tough competition with Russia and Iran as they enjoy many advantages despite the closeness of Pakistani ports to Central Asia. Pakistan is lacking the necessary infrastructure to persuade CARs. However, the Gwadar Port and the planned road and railway networks connecting CARs to the Arabian Sea and the People's Republic of China through the Karakoram Highway bless Pakistan with potential opportunities to provide an outlet for the region.

Pakistan's Interests vis-à-vis China

China has many goals to achieve from its engagement in Central Asia, including the enhancement of trade relations, which is currently 28 billion dollars, FDI, construction of pipelines to import oil and gas, control drugs trafficking, ensure border safety and control the spread of extremism, terrorism, and separatism. China is following the five principles of peaceful coexistence in Central Asia while pursuing its interests in the region. Conversely, Islamabad's objectives are the same as those of the Chinese. Therefore, wide cooperation between both countries in Central Asia is possible and will be very beneficial. China's technical and economic help in the construction of the Gwadar port and operationalization of the QTTA route via China connecting Pakistan with Central Asia have the potential to integrate further the interests of Pakistan, China and CARs. China's engagement with Central Asia is fast growing, and CARs are also emphasizing their ties with China too much. Beijing's investment in Central Asia reached about 50 billion dollars (Khetran and Khalid, 2019). Chinese policies are soft, avoiding dictations and interference in the domestic affairs of CARs; therefore, they are compatible with China.

Like Islamabad, Beijing also needs secure energy supplies as its energy requirements are increasing day by day. It is importing energy resources from Central Asia to fulfill its growing requirements. Over the last two decades, China has made significant investments in Central Asia's transportation and energy infrastructure. The existing gas pipeline provides 55 billion cubic meters gas annually to China. Likewise, an oil pipeline from Kazakhstan exports 20 million tons oil daily to China (Khetran & Khalid, 2019).

China significantly benefits from its endeavours to enhance its financial, logistical, and political connections in this unstable and resource-abundant region. It could escalate the struggle among major regional powers (Sahakyan, 2021). From 2001 until the change in focus towards containment of China, the main focus of the national security strategy of the US remained counter-terrorism. At present, US foreign policy is focusing exclusively on the containment of China. The decline of Western influence in Central Asia, the clash between Western stake-holders and Russia, the escalating competition between the United States and China, and the deepening collaboration between China and Russia all significantly impact the region. In such a crucial political environment in the region, China seems to consolidate its position in regional affairs. It has been evident from its active participation and increasing role in Afghan affairs after the US withdrawal and holding of the China-Central Asia Summit in May 2023 in the Xi'an city of China- the starting point of the ancient Silk Road. It is pertinent to mention that the summit occurred at the same time as the G7 summit in Japan, where the US sought support for its policies against China.

Pakistan's Interests vis-à-vis Russia

Russia is the most important player in this New Great Game. Russia wants to keep the region under its influence. Central Asia is dominated by its influence on Russian infrastructure for the oil and gas supply to the international market and for trade on its seaports. Russia has a significant economic and political hold on Central Asian Republics and does not want to undermine its economic, political, and strategic goals in the region. Moscow has four policy goals in Central Asia. First, to stop the entry of religious extremists, revolutionaries, drug dealers, and criminals into Russia (Alison & Johnson, 2001). Second, safeguard the ethnic Russian minorities residing in the 'near abroad' having a cultural and political affinity with the new Russian state. Third, to control the Turkish and Iranian influence in Central Asia as CARs have deep-rooted historical and cultural links with Turkey and Iran. Since the collapse of the USSR, Turkey, and Iran have been following a proactive policy to establish friendly relations with CARs. Fourth, to keep CARs dependent on its infrastructure for energy resources export to international markets and trade over its ports. Russia is using the Primakov

Doctrine in its foreign policy towards the region. Its aim is to increase the influence of Moscow in regional affairs and dominate it.

Moscow also desires to be the corridor of Central Asia's gas and oil export to the international market, keep CARs dependent on Russian ports, utilize its natural resources, invest in the exploration of natural resources, develop infrastructure to ensure interregional connectivity, collective security as Collective Security Treaty Organization has been founded aimed to abstain the member countries from the use of force against members and the member states may not join any other military alliance, maintain its military bases in the region, keep away the region from the influence of the US and other Western countries, sell weapons, fight terrorist and extremism, control drug trafficking and ensure regional integration.

There are many differences and similarities in the interests of Pakistan and Russia in Central Asia. Unlike Russia, Pakistan has no intention of dominating the region. Both countries share common interests such as to import energy resources from the region, became a preferred corridor for the CARs access to ports. It is true that both countries did not enjoy good relations because of Islamabad joining the Western bloc during the Cold War period and Islamabad's Afghan policy. The Russia-India close ties and CARs pro-India policies have also created challenges for Pakistan. Pakistan needs to establish good political and economic ties and promote collaboration in various fields in Moscow. However, in the last few years, relations between the two countries have significantly improved. Due to the changing regional and global geopolitical scenarios, their relations have normalized. Convergence and respect for each other's interests in Central Asia and Afghanistan are the primary driving forces behind this change.

In the changing geopolitical dynamics of the region, the US hegemonic attitude has also played a role in pushing Islamabad and Moscow closer to some extent and led to the synchronization of their policies. In the global arena, the post-Crimea escalated the rivalry between Moscow and Washington, and subsequent Western economic sanctions forced Russia to turn to the East and Southeast for new political, strategic, and economic allies. When the world order changed from unipolar to bipolar with the culmination of the Cold War, Moscow started searching for potential regional partners and allies to recover its previous position. The intensification of Russian conflict with the Western block has further compelled Moscow to prioritise regional countries in its foreign policy.

On the other hand, Pakistan became a victim of the US hegemonic attitude and suffered massive material and human casualties in the war on terror. Even the United States did not acknowledge the efforts and sacrifices of Pakistan in the war on terror, signed a nuclear agreement with India, jeopardized the balance of power in South Asia by making a strategic alliance with India, and assigned India the leading role in Afghanistan at the cost of security interests of Pakistan. As a result, Pakistan began seeking opportunities to strengthen ties with Russia to diversify its international connections. The reconciliation between Pakistan and Russia has also benefited from Beijing's strong partnership with Moscow and its long-standing friendship with Pakistan. Islamabad and Moscow have recently achieved progress in political, strategic, and diplomatic ties. It is helping Pakistan to consolidate its position in regional geopolitics. In the past, Pakistan faced problems due to its strained relations with Russia.

The normalisation of their relations also led to an increase in their bilateral trade; in 2020, it reached an all-time high of $730 million (Khan, 2021). Recently, they signed an agreement to build a 1,122-kilometer-long gas pipeline from Karachi to Lahore. It is a 2.25 billion dollar project called "Pakistan Steam Gas Pipeline". It is a major project that the two nations have planned since they chose to put their Cold War rivalries behind them and embarked on a new age of bilateral relationships. It became a landmark initiative for cooperation between Pakistan and Russia. It is going to consolidate their attempts to diversify foreign policy choices.

CARs would welcome Russia and Pakistan's partnership as they would be the eventual beneficiaries. Currently, the Russia-China-Pakistan axis is a source of regional stability, prosperity, and harmony. In light of the arguments of Buzan's regional security complex theory, regional security is linked tightly to a grouping of regional countries because of security interdependence. In this context, Russia, Pakistan, and China can perform a key role in ensuring cooperation and restoration of peace in the region. Iran can also work with this club and will be very important if join. Instability has

jeopardized peace, harmony, and economic development in the whole region. The region is self-sufficient in most of the basic requirements and the countries have much potential for each other, but political differences, uncooperative framework and power politics of extra-regional powers have jeopardised the establishment of collaborative relations among regional countries.

Pakistan's Interests vis-à-vis India

By engaging with Central Asia, Pakistan has also cultivated a strategic interest beyond merely political and economic ones. Pakistan aims to defuse the Indian influence in CARs as it enjoys strong relations with CARs. Even India runs Farkhor air bases in Tajikistan. Basically, Pakistan is trying to connect CARs and make them dependent on its Gwadar port, while India is trying to develop the Chabahar port of Iran to decrease the importance of Gwadar for CARs. New Delhi is working to develop the Chahbahar port and Chabahar-Zahedan railway line to create an alternate trade route to Kabul and Central Asia, bypassing the territory of Pakistan. For this purpose, India has allocated ₹1 billion in its 2021-2022 budget (Nag, 2021). A memorandum of understanding was inked between Iranian Railways CDTIC and Indian Railways IRCON for building this railway line during the Indian Premier's visit to Iran in May 2016. The rail project aims to connect the Chahbahar port with Afghanistan and then with Central Asia. Uzbekistan is already involved in the Chahbahar project. It is also already connected with Afghanistan through a 75km Hairatan-Uzbekistan rail link, which will further extend to Iran according to the Indian plan.

Being part of the New Great Game, India is trying to strengthen its position in the region to preserve its strategic objectives in Afghanistan and restrict access of Pakistan to Central Asia. According to Indian policymakers, an extended role in Afghanistan is the most effective approach to counter Pakistan. India cannot afford to allow Afghanistan to be used as an instrument of Islamabad's regional strategy. New Delhi gained a good opportunity after the US occupation of Afghanistan to strengthen its footsteps in the country and deepen its links with CARs. The US presence in the region after the 9/11 attacks helped India develop strong connections with CARs.

The United States and India have increasingly aligned their interests since both countries are wary of having exclusive Russian or Chinese power in the region. New Delhi's key objectives in the region are to get access to energy resources, counter Pakistan's influence, establish good trade relations, and establish itself as a prominent actor in the emerging interaction of extra-regional powers. To counter Pakistan, India is looking for ways to get benefits from Central Asia (Singh, 2005). These power politics have jeopardised Pakistan's position in Central Asia.

Conclusion

The new Great Game is meant to gain access to the resources of Central Asia and control the trade and energy supply routes in the region. Each actor in this Game has different policy objectives and interests. Russia wants to keep its hegemonic position in the Central Asian energy trade, India wants to import energy resources and bypass Pakistan in giving access to CARs to the international market whereas China's policy is to import energy resources and invest in energy and infrastructure related projects in the region. While Pakistan, being an important country at the crossroads of South and Central Asia, is strategically significant for CARs. Pakistan wants to import energy resources, become a regional trade hub by giving access to CARs to its ports, and make a strong political alliance with these Muslim countries. Pakistan has a strong desire and expectations for access to the economic opportunities, energy resources, the trade market of CARs and to exert its political and cultural influence in the region. Besides its significant strategic location, Pakistan is an important state in terms of its military strength and nuclear capability. Therefore, Pakistan's role in the New Great Game should not be underestimated.

Islamabad confronts strong competition from the India-Tehran nexus in the region, as they have distinct advantages. It is also worth noting that despite the rivalry with Tehran, there are certain areas of cooperation, notably in the oil industry. Iran also controls vital transport routes into Landlocked Central Asia and provides transit routes. A good option for Pakistan is to further synchronise its policy with China and Russia in Central Asia. It will serve its interests in the region and will defuse the impacts of the New Great Game over it. Normalization of relations between Pakistan and Russia, its close working with China, and formulation of cooperative partnerships with Iran and Turkey in Central Asia

rather than competition will support the future of Pakistan's interests in the region. Moreover, Pakistan needs to proceed carefully to maintain balance between its relationship with US and China to the possible extent.

Pakistan is positioned as a key participant in the New Great Game and as such it has the potential to develop and provide an energy export transit route not just to South Asia but to other parts of the world as well. Energy politics have been ferocious, combative, and vigorous, often changing the terms of the New Great Game. Its supply infrastructure is much more complicated now, and Islamabad could be a smart and conscious participant in the New Great Game to get maximum share out of it. Pakistan must take strong diplomatic steps to enhance its ties with Central Asian states. Its multilateral strategy to strengthen connections with regional nations, particularly via the SCO, is also commendable.

Pakistan has the opportunity to play a pivotal role in fostering regional cooperation. By advocating for economic integration and connectivity projects, Pakistan can position itself as a key player in regional stability and development. Strengthening ties with neighbouring countries through trade agreements and joint infrastructure projects can enhance its influence and portray Pakistan as a cooperative partner. Pakistan may establish itself as a pivotal contributor to regional stability and prosperity by promoting economic integration and connectivity initiatives. Enhancing relationships with regional countries via trade agreements and collaborative infrastructure initiatives may augment its influence and present Islamabad as a productive ally. The country's foreign policy needs to shift from a predominant emphasis on security to a more equitable strategy that prioritizes economic growth, regional integration, and multilateral partnerships. Last but not the least, Islamabad should focus on maintaining friendly relations with Kabul and restoration of peace and stability in its regions adjacent to Iran and Afghanistan.

Funding

This study has been supported by the Chinese National Foreign Expert Project.

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FWU Journal of Social Sciences, Spring 2025, Vol.19, No.1, 34-46
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Estimating The Socioeconomic Factors Associated With Carbon Emissions at The Household Level For a Sustainable Future In Pakistan. A Case Study of Urban And Peri-Urban Areas of Faisalabad

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Ever-accelerated urbanization and climate change pose significant challenges for sustainability especially in Pakistan. This study examines the social and economic features associated with the emission of CO2 from the household sector in Pakistan. This research concept constructed on the questionnaire and interview-based survey of 280 household respondents from seven major urban and peri-urban areas to estimate carbon emission from residential consumption from Faisalabad city of Pakistan in 2024 through conducting a survey and for carbon metric tons calculation, the web-leading calculator for carbon emission has been used. Carbon emissions in urban areas from the primary sources of household are 0.99 metric tons in urban areas and 0.23 metric tons in peri urban from electricity, Gas, and oil burning, 3.29 and 3.10 from transport carbon emissions respectively in urban and peri-urban areas. Secondary Carbon emission sources contribute 2.520 metric tons in urban areas and 2.02 in other areas. These results indicate that socio-economic features (Income, house size, family size, and electricity bills) are the main contributors as Overall carbon emission is 3.98 metric tons from urban areas and 3.28 in peri urban area that represents 2/3 of carbon emission in the atmosphere, showing the scarcity of low carbon emission policies in the city. These verdicts highlight emission of carbon due to household's activties poses serious challenges in achieving the SDGs goals for the green economy and society. Formulating custom-made strategies for areas and household usage is compulsory to minimize the issue and accomplish towards sustainable future for Pakistan.

Keywords: environmental sustainability, Carbon emission, socioeconomic factors, sustainable future

Global climate changes happen due to Excessive Population growth and urbanization. Pakistan remains among the top nations on the climate change vulnerability index. Pakistan emitted 185.5 million tons of CO2 in 2015 as compared to 2008 the emission was 147.8 million tons (Shaikh, 2015). At present Pakistan's carbon, emission is increasing and stands at 428.6 million tons, CO2 is the Major contributor to is emission of greenhouse gasses (GHG) (Chandrasekhar, 2023). According to Qamar, uz Zaman in Pakistan's climate change policy, (Mustafa, 2015)estimation has gone wrong as Carbon emissions will reach 400 million of tons if the circumstances remain the same by the end of 2030 but current surveys report that this ceiling situation has been achieved in 2023 (Chandrasekhar, 2023). The household contribution to carbon emission is a substantial issue around the world but Pakistan ranks less developed country where climate change was not a significant issue before a couple of years ago. Now this issue is gaining popularity due to mass urbanization, increased industrialization, income per capita, better living standards, family size and use of home appliances and technology, and innovation in consumption forms of fuels, electricity, and gas these are responsible factors for carbo emission from the household sector. Population growth is always the center of issues in fewer countries that increase the use of domestic vehicles and energy demand ultimately transport volume increases. Amount of Carbon emission differ from area to area and household to household. It depends on the usage of consumption categories as directly related to electricity, fuel and transportation (Khan, 2017). After a careful review of the literature. We can categorize the consumption patterns of households into different categories.
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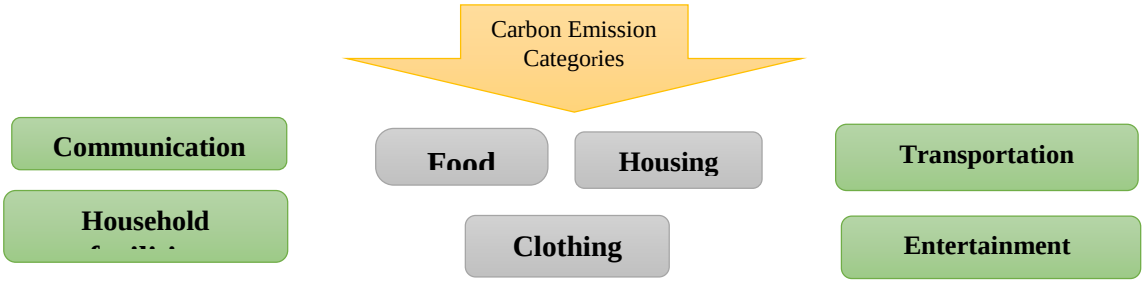
The residential final consumption can be categorized as:



Carbon dioxide CO2, Methane CH4, and Nitrous Oxide N2O are three major and most emit gasses in the atmosphere that are the main reason behind climate change and global warming other are Sulfur hexafluoride SF6 and Tropospheric ozone O3, CCL2F2, CCI2F2 (Shahbaz, 2014). These gasses hold the heat near to earth's atmosphere for a long time that why serious concern arises for global warming.

This paper draws the understanding of carbon emission prediction through pattern of consumption of diverse areas of Faisalabad. Faisalabad is 3rd largest city in Pakistan with the population of 10.6% contribution to the total population of Pakistan (District, 2023). UNO introduced the agency to combat and estimate carbon emissions on the state level but residents of Faisalabad are uninformed of the situation of carbon emissions and their dangerous effects the on atmosphere as well as the economy and society to align with SDGs goals namely SDG 11 (Sustainable cities and communities), SDGs 13 (Climate action). The Exploration of the socioeconomic determinants of household carbon emissions can inform the development of policy interventions that encourage energy efficiency, urban emissions mitigation, and climate resilience in urban and peri-urban Pakistan (Masood et al., 2022). Today people dos not pay proper attention to the environmental degradation but in future the most affected part of the sector is household. Directly the urbanization is epicenter of the carbon emissions and indirectly the generation of electricity through fuels and gasses for domestic purpose in Pakistan is a high contributor to carbon emission

The most important objective of the research is to provide assistance through data and findings that plays a significant role in coping the climate change. In order to provide a better living environment and achieve low carbon society, this study provide a customized pathway for residential areas of Faisalabad, Pakistan, and an over for the other communities.

First, limited focus on household emissions of carbon in developing countries. Ignoring the content and features affecting the carbon emission through households in less developed countries including Pakistan. Third largest city always neglected and there is lack of proper study on emission from household level. That is why a proper survey through questionnaire is conducted in order to cope this problem.
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Neglecting the level of Emission, Previous studies considerate the state-level effect of carbon emission on the economy but ignore the consumption-oriented society and the consumption pattern of households at every level. There is a lack of literature and research studies that identify the presence of carbon emissions.

Transport only considers the factor that affects the carbon emission and the only factor, which contributes to emissions. Other economic and societal circumstances do not take into attention. Previous literature mentioned that transport and domestic vehicles have a direct relation but income of the household, family size, age, and literacy rate, do not consider in calculating factors. Now this study take a step towards the households features and estimate the carbon emission.

Lack of knowledge of low carbon society is also a major flaw because developing countries society are inadequate in gaining knowledge about new terminology and danger. They are unaware of the consequences of carbon emissions and flop to explore the effect over the period on health, education, food, transportation, and future prospects. Lack of government consistent policies and cooperation, in some research where government agencies are involved and foreign funds are available to these researchers but there is a need of the hour that more detailed and customized research and campaigns will organize in the society for the households in lecturing the carbon emission.

This study is addressing economic and societal problem of carbon emission in developing countries in general and specifically within the borders of Pakistan cities. The inevitability, strong relevance and in depth analysis provide the

way to achieve the green economy and communities. This paper focuses the flaws that governments and agencies working on the green economy generally ignore the basic sector of society because, with households, they cannot fully achieve their goals of the green economy in developing countries. This study weighs on the low carbon society complements the relevance and importance.

This study through its findings and analysis provides the highlights for agencies, states, and other international organizations to achieve the goals of sustainable development. A depth analysis, delivers the expected consequences and the effectiveness of policies to cope the carbon emissions at household level. This research is custom made and easily implemented into society to slow down the carbon emission and guaranteeing the sustainable future for Pakistan and other developing countries in the region. Green future can be easily predicting by estimating carbon emission, household consumption pattern, scientific knowledge and benefit of low carbon society at household level. This study is impactful in addressing this issue and contributes in making the green economy and society.

There is limited studies and research available on the concept of carbon emission by household in developing countries especially in Pakistan, this study intends to bridge the gap through examining household Carbon emission in Faisalabad, Pakistan, which is the 3rd largest city by population in Pakistan and 2nd largest in the eastern areas of the region (District, 2023). This area is affected in winter through smoke and in summer, hot weather is taking the lives of the people. The study highlights the socioeconomic factors that exaggerate this issue and adversely affect the society due to per capita income, consumption pattern, domestic usage of vehicles, Electricity fuel and gas usage. In short, these factors are the hazard to sustainable future of the society.

This study highlights the answers the following relatable questions at household level:
Given the limited research and studies on the phenomenon of child labor in Arab societies, the current study aims to fill this gap by examining child labor in Egyptian society, which is one of the prominent Arab societies where this issue is widespread. Taking a socioeconomic perspective, the study recognizes child labor as a challenging social condition that harshly affects many Arab children due to poverty, hunger, deprivation, and family breakdown, thereby posing a threat to Egypt's sustainable future. In light of this, the study seeks to answer the following question:
Q. How, and why do the features of socioeconomic income per household, literacy rate (Education level), Age, size of the family, Consumption pattern of Electricity, Gas, and Fuels reason to affect the Carbon Emission?
In a developing society like Pakistan, The typical phase of this study creates a Customized base of detailed analysis and investigates the economic and societal connection to Carbon emissions. This study will do significant scientific support and compromise valued visions, ensuring the base for research in this field.

Under this study, the innovative part is as follows: Mainly focus on household communities in particular areas of cities. This paper bridges the gap in this field of research by investigating household carbon emissions inevitability, strong relevance, and in-depth analysis provide the way to achieve a green economy and communities.

Literature Review

Carbon emission has been a dangerous and longstanding issue in Developing countries like Pakistan, but from last decade, it has seen a surge in its occurrence because of the economic crisis of the country. For example, Khan (Khan, 2017) highlighted that residential consumption of electricity, automobile combustion, fuel used for cooking, and heating caused for high rate of GHG emission in the air in the Lahore city of Pakistan. Huiyu (Huiyu, 2019) referred to the factors to affect carbon emissions and reduce the emission, Household consumption patterns, and emissions in urban and rural areas of Beijing based on income level, habits of people regarding spending, access to infrastructure, and availability of services. Ottelin (Ottelin, 2019)investigates the effects of urbanization on household's carbon footprints in European cities where 7 percent is less emission of carbon than rural areas in Europe as income and household features are the base of study. Wang (Wang, 2018) refers economic growth expansion leads to urbanization, increase in energy consumption and carbon emission. Various stages of development proposed the demand for transportation and growth in the industrial sector, advancement in technology coupled with growth lead and carbon economy. Miao (Miao, 2017)emphasis the overall carbon emission and energy demands due to the complexity of urban residential energy consumption patterns. The primary indicators of energy consumption trends and carbon emission is affecting from size of households, income, building and lifestyle of the people in China. Moreover states that development, infrastructure, and need for energy, and governmental policies are the main indicators of consumption patterns of energy and Carbon emission. Verma (Verma, 2021) investigates the measures that adopted to offset the negative impacts of urban areas life and their consequences on environmental understanding. Easy access to energy for urban families uses equipment that is energy intensive, heating systems in winter and insulation systems, domestic automobiles. These elements are considering cause root at world platforms for energy consumption and carbon emission.

(IEA 2019) reports emphasize the difference between high income and low-income households within the cities. This reports states that urbanization and income of the households are the linked with carbon emission because more income leads the migration to the more developed areas and demands more energy intensive consumptions, transportation. The per capita carbon emission of households in urban areas are greater than the rural areas. In urban areas, the energy mix societies based on fuels that affect sustainability through air pollution and climate change. Wiedenhofer (Wiedenhofer, 2017) mentions the carbon emission differences in Chinese household according to income level consumption pattern and sustainable development. Basic arguments show that families with more income use goods and services resulting the more carbon emissions. Urban middle class and rich people in emerging nations like China has more carbon emission society due to its economic development and growth as 5% households population results the 19% carbon emission as 1.7 tons carbon emission is calculating in urban rich areas and 0.5 to 1.6 tons in rural areas where income is low. Minh (Minh, 2023) discusses the EKC (environmental Kuznets curve) that the degradation ithe n environment increases due to expansion in the economy and drops particular income levels. The Carbon emission has strong connection with economic growth, renewable energy uses, Smart FDI (Foreign Direct Investment). Income level and FDI can mitigate the consequences of Carbon emission. Renewable energy, clean technology can promote the long-term economic development to achieve the sustainable future under the Paris Agreement.

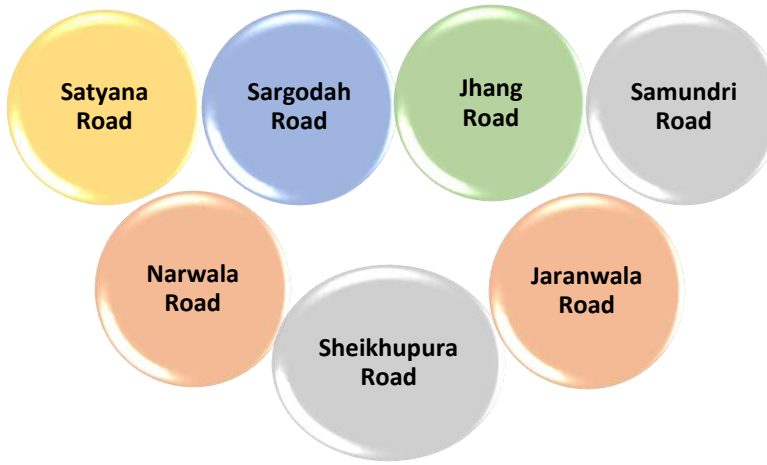
Carbon footprints theory: This theory highlights direct and indirect carbon emission caused through anthropogenic activities, which includes the consumption pattern of households, means of transportation and use of energy. Carbon footprints theory focuses a roadmap for measuring the carbon emissions from individuals or groups and examining various attitudes contribute to total emission (Ivanova, 2016). . The development of a detailed methodology for calculating the direct and indirect carbon emission at every level including household, society, regional, and international levels.

This study investigates the household's carbon emission through primary and secondary sources (Food, Domestic vehicles, etc) in urban and peri-urban areas that are directly related to carbon footprints theory. The implication of this theory at the household level on consumption patterns verdict that the wealthy households are more sensitive to having larger emissions of carbon which helps in explaining the emission from urban and peri-urban in this study.

Sociotechnical transition Theory: This theory gives attention to the transition phase based on technological regime especially high carbon to low carbon regime. This study follows the path of urban and peri-urban household's sociotechnical changes how these areas has sociotechnical transition of low carbon emission. Environmental Kuznets curve: EKC (Environmental Kuznet curve) presents the hypothesis degradation of the environment as carbon emission accelerates the economic development to a certain point and then starts to deteriorate economies' transition to further sustainable practices. This study aligns with EKC, it help so investigate the income level of urban and peri-urban households income level households.

Method

The research area consists of all the seven major roads of urban and peri-urban areas of the third largest city of Pakistan. The total number of households living in this area estimated about according to the records of the Pakistan Bureau of Statistics. The selection of this area for study within the Pakistani society based on the following reasons. These seven major roads are almost cover the whole area and considered the high household density. This factor proves them accurate for studying carbon emission because the more number of households are facing the more carbon emission.



These major seven road areas are diverse regions within Pakistan. By opting for this area, the researcher has to capture a bigger representation of Pakistani society. The selected areas show the undeniable observation of carbon emission due to increased growth in industry and population. This visible presence permits precise and accurate calculation of carbon emissions in Pakistan. These seven major roads provide the opportunity for data collection and availability due to high concentration of households around Faisalabad, Pakistan. This provided the records of estimated number of households resident in areas that facilitated in understating the gage of the problem and formatting the sample size for this research.

The sample size was calculated on behalf of the study community using as shown in Eq. 1 (Loru, 2020) used the confidence interval of 95 % and significance level of 5% in this study

$$n = \frac{N}{1 + N(e)2} \dots\dots\dots\dots\dots$$

Kothari (Kothari, 2004) discussed in detail the result can use from the sample to generalize about the whole population until it actually represented. This study used a sample of respondents from each urban and peri-urban area from seven major roads. This study obtained a sample of 280 respondents who participated in a collection.

Whereas n is the sample size to be studied, N is the number of household respondents or Population size and e is the margin of error in the study.

$$n = \frac{280}{1 + 280(0.05)2} = 164\ households$$

The researchers can choose the respondents according to the judgment that all are provided with the necessary and desired information. The researchers can obtain a 164 respondent sample size from the total targeted population dealing with carbon emissions. The study used multistage sampling because it can easily administrable than other single-stage sampling designs plus the vast quantity of components can be sampled for a given cost because of chronological clustering where which is not feasible in other sampling designs (Kothari, 2004).

Carbon emission The IPCC (IPCC, 2006) provided the base for a methodological approach to calculate the inventories of carbon emissions, now accepted worldwide. Carbon emission factors are projected by multiplying performed activity data (consumption partners of energy, cooling, heating (Electricity bills) with equivalent emission dynamics. This study used default carbon emission factors introduced by IPC. From all sources, carbon emissions are given under (Eq. 1)

$$Ei = \sum A \times \mathrm{EF} \qquad (Eq.1)$$

It should be that Ei is the given carbon emission from all the sources: A is the activity performed data that emits the carbon, and EF is the carbon emission factor of the given gas, oil, electricity category from its source. This equation used to estimate households carbon footprints, specifically applied during collection of data from households. It provides

a method to assess these emissions of urban and peri urban areas editing comparing with in different socioeconomic features.

Table 1

Age and Education of participating Household respondents (Respondents=280)

Variables	statement	Mean	S.D
Age	Urban, 16 to 70 years	34.6	12.5
	Peri-Urban, 15 to 76 years	39.2	13.5
	Overall, 15 to 76 years	36.9	13.5
Education	Urban, up to PhD	10.59	5.8
	Peri-Urban, up to Masters	7.30	5.3
	Overall, upto PhD	8.94	5.4

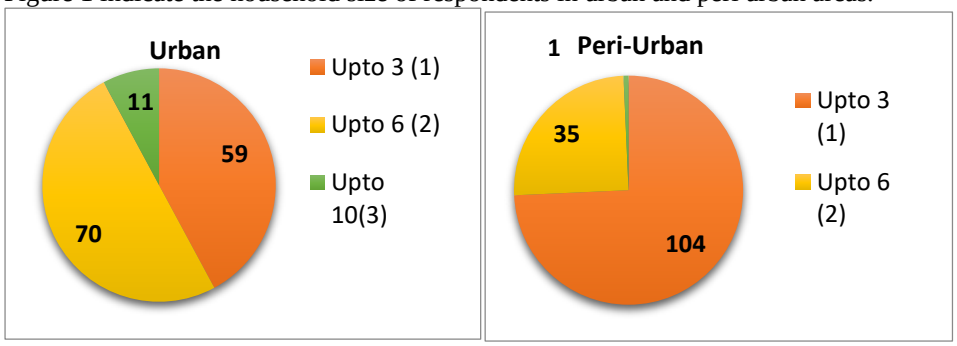
Note* Data in Table 1, the mean value of the number of respondents within each group for the respective variables. The stranded deviation represents that how much or proportion of the respondents data distribute around the mean.

Age and Education Factors: Table 1 shows that carbon emission at high in middle age group because of high mobility and use of energy. This partner suggest the strong association between age and education needing targeted mitigation strategies. This study explains the age of the respondents in urban areas are between 16 to 70 years of old, and the mean value (34.6) represent the wide variety of life stages with S.D (12.5) showing moderate means carbon emission tends to peak in middle age due to lifestyle choices and mobility in urban area. In Peri-Urban areas, data represents that emission increases with age, at peak in middle age due to high economic and social activities and consumption patterns. Overall data suggests that carbon emissions at its peak in middle age of the respondents because of lots of travel related to work and diverse consumption patterns. The significance of the education mean value (10.59) and S.D value 5.8 represent the respondents' must complete the secondary level of education and variability of education level respectively. Higher education leads to sustainability and low per capita carbon emissions because of more maintainable practices in lifestyle and consumption choices. In peri-urban, education is somehow secondary level as mean value (7.30) and SD (5.3) but not leading to intensive higher education. Overall the mean (8.94) of the education group, advises a lack of awareness and sustainability practices irrespective of education up to PhD tends to complex carbon emission.

Figure 1

Respondent's household size Square feet (Marla in Pakistan)

Figure 1 indicate the household size of respondents in urban and peri urban areas.

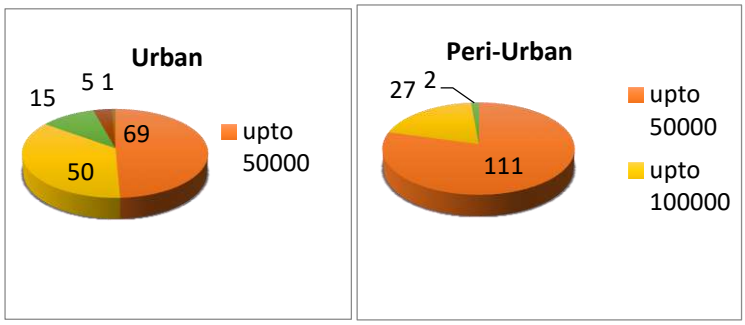


Note* Data in Figure 1 shows the house size of the respondents according to Pakistani society basic local unit Marla (one Marla = Square feet).

House size Factor: Figure 1 shows that smaller households in peri urban areas lead to lower carbon emission because they do not usually need higher energy for consumption and emission still low (Ahmed et al 2021) . This study examines the higher concentration of smaller houses 74.3% of households in 3 Marlas (~ 816 square feet) in peri-urban areas tends to have low carbon emission as compared to urban areas 42.1% of households. Larger houses available in urban areas 50 % and 7.9% of households in up to 6 and 10 Marlas (~ 1632 & 2720 square feet) require more energy for heating, cooling, Lighting, and electricity bills than peri-urban households 25% and 0.7% in same square feet.

Figure 2

Respondent's household income (PKR)



Note*Figure 3 shows the monthly income category of the household respondents in both areas.
(One USD = 276 PKR)

Income Factor: The income distribution diversification is more in urban areas as a higher portion of earnings is between 100,000 and 300,000 PKR (400 to 1200 USD) and have access to more energy-intensive goods such as home appliances and vehicles while in Peri-urban areas most of the households earn upto 50,000 PKR (250 USD). Higher income leads to energy-intensive consumption and carbon emission significantly is higher in urban areas. Hassan and Raza (2023) evident that households with high income per capita demand luxury goods (household appliences demand shown in table 6) for use which leads to more energy usage so that high income households cause to emit more emission. Before jumping into the survey, the household respondents were mature enough, participated voluntarily in the interview, and answered the questions. This study follows all ethical and international known guidelines and pertinent professional principles. The researcher certified compliance with all relevant rules and regulations to keep the confidentiality of the respondent's information.

Interviews: The interviews designed and conducted after a discussion based on a study sample consisting of households in both urban and peri-urban areas. The objective of the interviews was to categorize the socioeconomic features of households that emit carbon to the environment. In addition, the interviews are expected to overview the social and economic challenges tackled by households with direct requirements that need immediate consideration.
The researcher prepared the research questionnaire in order to facilitate the interviews. The questionnaires and interviews consisted of appropriate questions and phrases and the process kept simple, and translated in the local language in time of need. Theoretical and empirical frameworks from the literature review provided the base for the interview questionnaire structure. The data is collected specifically based on equation 1. The relevance and rationality of the interview questionnaires confirmed through these steps:

a. Interview questionnaire rationality/Validity: The pretesting technique used: The preliminary form of questionnaires presented to 20 members of the teaching and research team specialized in environmental economics, climate change, and energy economics from different universities. The experts suggest recommendations and responses after their review and evaluation. The interview questionnaires adapted and unified the expert's suggestions to its final stage. The updated version of the questionnaire included 32 phrases intended to discourse the primary research questions of the study.
b. Field survey:

Observation: The simple observation tools apply to note and observe the appearances and activities of the households. This included the household conditions in which respondents have been residents and their lifestyle. The seven major roads (Jaranwala Road, Sargodha Road, Narwala Road, Satyana Road, samanduri Road, Jhang Road, Sheikhupura Road) of Faisalabad city in Pakistan.

Time: The research conducted within the time limit from January 2023 to September 2024.The respondents of the research were from selected areas of seven major roads that met the benchmark for the proposed sample.
Statistics analysis: Data collection included managing the questionnaire interview of 280 respondents and these conducted by using equation 1 for carbon emission. Each statement of respondents' answers from questionnaires can determined through the Likert scale. This scale used to measure the field survey respondents' motives, opinions, and attitudes related to each phrase or statement in the questionnaires. The study used the statistical software for data sciences (STATA) to fulfill the statistical analysis need. The data examined and construed by applying various statistical coefficients containing frequencies, mean, and stranded deviation. The accuracy of the model is achieved through the implication of statistical criteria as the rationality of the least square assumption is satisfied, the higher the value of adjusted R square, the lower the standard error value practically, and T statistics, and F statistics values are significant.

Results and Discussion

Distribution of household's carbon emission sources: This has been admitted fact that Carbon emission is the aftermath of human activities such as the burning of fuels, usage of vehicles, industrialization, and urban activities. The basic forms of carbon emission due to housing activities (electricity, gas), Transport (cars, bikes, buses), and secondary sources (Food, clothing, entertainment). The primary sources considered such as household consumption patterns of electricity, heating, and cooling from natural gas, and home appliances while transport is also another major contributor to carbon emission. The lack of public transport infrastructure and undue domestic use of fuel-based cars, bikes, and buses provide significant amounts of carbon emissions. Food consumption and production, clothing, and leisure activities includes the secondary source of emission in lifestyle. These activities somehow directly or indirectly challenge sustainable future growth and development in urban areas. This data is collected by using web leading carbon footprint calculation.

Table 2

Sources for a Households carbon emission (Metric Ton/M) in urban and peri urban areas

Sources	Urban (Metric Ton/Month)			Peri-Urban (Metric Ton/Month)		
	Max	Min (S.D)	Mean	Max	Min (S.D)	Mean
Primary (household Electricity, Gas, etc)	0.03	0.1296 (0.17)	0.99	0.02	0.0782 (0.06)	0.23
Transport (Cars, Bikes, Buses, Planes, etc)	0.02	0.8354 (1.1)	3.29	0.02	0.3769 (0.58)	3.10
Secondary (household Food, clothing)	0.016	0.8251 (0.83)	2.52	0.09	0.9805 (0.57)	2.02
Total (other factors)	0.26	1.7864 (1.1)	3.98	0.17	1.4232 (0.74)	3.28

Note* the data in table 2, Minimum (Min): the minimum represents the minimum quantity in a set of data. The data specifies the lowest emission of carbon per month documented for every source in urban and peri-urban areas. Mean:

This is normally a representation of the average carbon emission per month from the mentioned sources. Standard deviation: S.D. suggests how the carbon emission data is varied and consistent. The low value of S.D. indicates similar carbon emissions among households though High S.D. reflects the emission levels among households vary. Maximum (Max): This column refers to the highest quantity in the data set. The Max is the maximum-recorded carbon emission value for every source in urban and peri-urban areas.

Table 2 indicates the amount of carbon emission related to households from three different sources in areas which is calculated by using web leading calculator. The monthly carbon emission from a household's primary source is 0.1296 metric tons in urban areas as compared to 0.0782 metric tons emission in peri-urban areas, because of lifestyle choices and easy access to energy-intensive infrastructure. Urban area's emission is approximately 0.8354 metric tons per month as 0.3769 metric tons per month in peri-urban areas. Under these conditions, total carbon emission is 3.98 metric tons per month for 140 respondents from urban areas in Faisalabad society while 3.28 metric tons of total emission recorded from the same number of respondents in peri-urban areas.

Distribution of household's Carbon emission category:

This study investigates households from their carbon emission because it is important for socioeconomic planning and a sustainable future. This information supports making active, targeted, and justifiable steps to cope with carbon emissions in society. The signatory countries of the Paris Agreement identify the household's carbon emission categories as the primary objective to reduce global warming below 2^{0}C through evaluation and observation.

Table 3

Categories of carbon emission households per month in urban and peri-urban areas

Categories (Emissions Metric tons)	Urban		Peri-Urban		Total	
	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
0 - 1 Metric tons	44	15.5	38	13.5	82	29.00
1 - 2 Metric tons	49	17.5	61	22.0	118	39.5
2 – 3 Metric tons	19	7.0	37	13.0	56	20.0
3 + Metric tons	28	10.0	4	1.5	32	11.5
Total	140	50.0	140	50.0	280	100.0

Note* The data in Table 3, Frequency: Frequency helps specify households participate in the category of carbon emission with the perfect picture of emission distribution among different groups. Percentage: % percentage shows the

extensiveness and rigor of the data within the population. Percentage presents the proportion of households that fall under each category compared to the whole sample size, regularized frequency data within peri-urban and urban areas. Total: The overall sample size from urban is 140 households and 140 sample size from peri-urban areas which combines the total number is 280 households. Table 3 data shows 29% of overall households fall under the 0 -1 level, 39.5% of households come within the 1 -2 category, the 2-3 level has 20 % of households, and 11% under the 3 plus category. The 1- 2 metric tons category is the largest group in this study due to transportation in peri-urban areas and energy-induced consumption in urban areas.

Table 3 identifies categories of carbon emissions into four levels (0-1, 1-2, 2-3, and 3 plus metric tons per month) in urban and peri-urban areas. Observation has been recorded that 15.5% of urban households and 13.5% of peri-urban households fall between 0-1metric ton per month of carbon emission. This level represents that households opt for less energy-intensive life choices, awareness of sustainable society, and less energy-induced consumption patterns. Households fall into the category of 1-2 metric tons monthly representing 39.50 of the total sample 22% from peri-urban areas and 17.5% households from urban areas. This largest group is considered to be a moderate energy group because of its energy consumption patterns, usage of own and public vehicles on long communal routes, and energy needs for houses. The high consumption of transport, energy-induced houses, and large family size are the reasons for the category that 7% of urban households and 13% of peri-urban households under 2-3 metric tons per month of carbon emission. The 3 plus category reflects less share of emissions in urban (10%) and peri-urban (1.3%) households because high use of energy in terms of consumption, transport, and manufacturing.

Socio-economic Household Characteristics with Carbon Emission in urban areas: The climax is that all the respondents in the sample study highlight numerous significance positive and negative consequences subsequent to the carbon emission shown in Table 4. The study represents the analysis of carbon emission and household socioeconomic variables (House size, family size, income, and electricity bills) in urban areas. This analysis demonstrates a major relationship that delivers a vision of how these variables contribute to carbon emissions.

Table 4

Household characteristics family Size, House size, and income and electricity bills with carbon emission in urban areas

Variables	Carbon Emission	Family Size	House size	Income	Electricity Bills
Carbon Emission	**1**				
Family Size	r=0.1299 p=0.1261	**1**			
House Size	r=0.2898 p=0.005	r=0.059 p=0.486	**1**		
Income	r= 0.318 p=0.001	r=0.335 p=0.695	(r=0.365) (p=0.00)	**1**	
Electricity Bills	r=0.380 p=.000	r=0.335 p=0.019	r=0.443 p=0.000	r=0.362 p=0.000	**1**

Table 4 shows the correlation among different household socioeconomic factors focus on family size, house size, household income and electricity bills as indicated Pearson correlation coefficient (r) and corresponding p-value (p). Every value in table presents the strength and significance of the relationship among variables

Table 4, the very first result attained is weak and statistically not significant, showing the relationship between carbon emission and family size as r = 0.1299, p = 0.1261. Families in Urban areas of Faisalabad city have more education level, awareness of low carbon society, and standardized use of energy households that's why results attained in this study show that big families do not play a decisive role in carbon emission determination. Big-area house needs more energy for cooling, lighting, and heating in urban areas resulting in higher carbon emissions. The data shows positive results of carbon emission and house size that is moderate and significant statistically as such r = 0.2898, p = 0.005. Carbon emission and income per capita variables show the result of significance r = 0.318, p = 0.001. In urban areas, there are more employment opportunities, bigger homes, more house appliances and the use of energy-intensive goods, energy-intensive consumption pattern contributes the higher emissions. In urban areas, this study shows the strong relationship between carbon emissions and electricity bills. The values of r = 0.380 and p = 0.000 represent the major indicators of carbon emission in urban areas households. The amount of electricity bills shows the consumption of energy in households so bills mostly are on the higher side in urban areas.

Socio-economic Household Characteristics with Carbon Emission in Peri-urban Areas:

This part of the study represents the relationship between carbon emission and household socio-economic variables (House size, family size, income, and electricity bills) in peri-urban areas.

Table 5

Household characteristic family size, House size, income and electricity with carbon emission in peri-urban areas

Variables	Carbon Emission	Family Size	House size	Income	Electricity Bills
Carbon Emission	**1**				
Family Size	r=0.335 p=0.000	**1**			
House Size	r=0.378 p=.000	r=0.354 p=.000	**1**		
Income	r=0.346 p=.000	r=0.389 p=.000	r=0.303 p=.003	**1**	
Electricity Bills	r=0.112 p=.187	r=0.206 p=.014	r=0.049 p=.557	r=0.257 p=.021	**1**

the data in Table 5. Pearson correlation coefficient: r is the quantity that measures the direction and strength of a linear relationship between two variables ranging from -1 to +1. This shows how much the intensity of the relationship among variables such as family size, house size, income, and electricity is correlated with carbon emission. p-value shows the indication that the correlation is significant statistically. These value demonstrations in the study validate that the relationship or quantity observed from r that occurs is by chance or is meaningful statistically. p-value threshold is often used 0.05 as a $p < 0.05$ this result is considered statistically significant alternatively $p \geq 0.05$ this result is statistically not meaningful.

Table 5, the study shows that family size has a positive relationship with carbon emissions in peri-urban areas due to long routes, conventional means of transportation and energy-intensive home appliances, and traditional energy consumption partners in big families. The r = 0.335 and p = 0.000 suggest that large family size has a positive impact and is statistically significant for carbon emission. In peri-urban areas, the vertical houses societies are mostly in trend, more population and expanded house size have shown strong and meaningful relationships on carbon emission as r = 0.378 and p = 0.000. Households with a high income ratio invest in energy-intensive goods and services as buying private vehicles and home appliances which shows a positive and significant effect on carbon emission as r = 0.346 and p = 0.000. Shockingly, the electricity bills in peri-urban areas represent a weak and not meaningful impact on carbon emission due to the use of primary and traditional means of energy sources. Households in these areas mostly not rely on electricity because they used to burn the wood for heating and making food. Therefore, there is a weak and statistically insignificant relationship r = 0.112, p = 0.187 in this study.

Table 6

Household energy intensive appliances in urban and peri urban areas

Items	Urban			Peri-Urban		
	Min	Mean (SD)	Max	Min	Mean (SD)	Max
Fridge /Freezer	1	1.22 (0.47)	3	0	0.89 (0.46)	3
Air Conditioner	0	1.09 (1.04)	6	0	0.19 (0.48)	3
Ovens	0	0.95 (0.49)	3	0	0.36 (0.49)	2
Iron	0	1.14 (0.46	3	0	1.01 (0.36)	4
Water pumps	1	1.03 (0.17)	2	1	1.01 (0.11)	2
Television	1	1.37 (0.68)	5	0	1.09 (0.60)	4
Mobile Phones	1	4.24 (2.20)	20	1	3.09 (1.9)	14
Washing Machine	1	1.61 (0.53)	3	0	1.16 (0.62)	4
Air Cooler	0	0.47 (065)	4	0	0.26 (0.46)	2
Cooking range	0	0.48 (059)	2	0	0.37 (0.69)	2
Fan	1	5.62 (2.20)	12	1	3.94 (1.8)	10
Water filter	0	0.13	3	0	0.02	2

		(0.40)			(0.24)	
PC/Laptop	0	1.03 (1.02)	4	0	0.47 (0.70)	3

Socio-economic Household Characteristics shown in table 4 as family size, house size, income and electricity bills with Carbon Emission in urban areas , all the respondents aligns the significant contribution to carbon emissions. The findings of this study have support from previous study, house size and energy consumption has a positive relationship due to energy-intensive appliances (Table 6) and more demand for energy in urban areas (ones, 2011). Although the link between house size and energy use is established (Wilson & Boehland, 2005; Lenzen et al., 2006), our research empirically measures this link in the peri-urban and urban Faisalabad setting using original household-level data. These results have policy implications for policymakers by determining key points of intervention to minimize household carbon footprints. Big houses and income are the major indicators of carbon emission while electricity demand for consumption plays a crucial role in urban areas (Ivanova, 2016). This is evident with findings that high demand for energy in urban areas due to more approach towards electrical appliances, the density of the population, and energy-intensive consumption (Liu X. Z., 2021). As per the finding shown in table align with a previous study, Peri-urban areas in Faisalabad city are mostly less developed, households mostly have dependence on traditional energy sources for cooking, heating, and lighting, cover long distances to find out the source of earning, energy-based home appliances and vehicles (Huang, 2022). Transport emission is a significant part of household activities as low in peri-urban areas comparatively due to fewer domestic vehicles per household, use of public transport, and limited access to leisure trips (Newman, 2019). The previous studies align with findings that higher consumption-related emission is recorded in urban areas due to the easy availability of markets and income sources although peri-urban areas have also substantial emissions from long communal routes and local domestic activities (Ivanova, 2016). Wealthy urban areas emit more carbon due to more use of energy and frequent travel mostly air travel while moderate emissions are from lower income and semi-rural life choices. At the same time, urban areas are moderate due to awareness of sustainability factors for environments and peri-urban areas emit more carbon due to the long distance from house to means of earnings. This study shows that both urban and peri-urban households participate equally but reasons for emission have been changed and recorded differently (Wiedmann, 2020).

Various noticeable socioeconomic factors influence to dominant carbon emission in the locality of urban and peri-urban areas of Faisalabad, Pakistan to deliver perceptions of sustainability. These factors consist of income level, education, age, and house size boost carbon emission at every level as well as affect the environment and global warming. The study reveals that carbon emission intensity varies between urban and peri-urban areas due to energy demand, consumption patterns, transportation modes, income level, accessibility to home appliances, and education. The urban areas households produce more carbon emissions than peri-urban areas special concerns are the housing sector and domestic use of transportation. On the other hand, households from peri-urban areas show less carbon emission due to limited access to transportation, income generation facilities, less home appliances but these are also the major contributors to carbon emission. Socioeconomic factors such as income, education level, preferences play a decisive power in the carbon emission of households. The study findings also prove with literature and theories such as EKC and sociotechnical transition that propose sustainability, economic development, and urbanization alleviate environmental depletion in the areas.

Conclusion and Recommendations

Households are the major sector with unplanned urbanization and unsuitable measures for sustainability leading to exacerbating emissions. The government's role is crucial in this matter, should design the campaigns and programs that advocate energy-efficient practices in urban and peri-urban areas. There must be the announcement of tax incentives and subsidies for houses in case they to agree the use of renewable energy sources like solar systems, insulation, and energy-efficient home appliances that can considerably cope with emissions from electricity and gas. Energy efficient and sustainable structures of buildings should float the plans to encourage emission reduction. Green urban planning concepts including solar designs, green technology, water conservation systems and energy-efficient materials should be compulsory in urban and peri-urban development areas. A massive network of Public transport should be provided in order to reduce the dependence on private vehicles. Cycling lanes, indorsing carpools, and electric public transport and private vehicle systems should be developed to reduce this sector's emission. Public attitude and changes in attitude are the major part of coping with carbon emissions at the level of the household. Advocacy campaigns should be tossed in order to educate the people about the impact of environmental depletion and their habits of consumption and energy use. This study aligns that the income level of households always plays an important role in calculating carbon emissions. To provide access to renewable energy options like energy-efficient home appliances, green technology assists emission to keep at a low level without shifting any financial burdens on households. In light of this study's findings, The researcher draws the significance of a particular conclusion that distinguishes carbon emission in urban and peri-urban areas of Faisalabad, Pakistan society from other frameworks. The custom-made strategies have been developed according to the

local circumstances and distinctive features of Faisalabad, Pakistan as Provide subsidies and tax incentives, interest-free loans, and microfinance on installing the solar system and micro gird system for peri-urban areas of Faisalabad households. Faisalabad and similar areas within Pakistan and other developing countries can convert high carbon emission society into low carbon emission through determined efforts and deployment of sustainable practices.

This research adds to the literature by giving a local custom made, experimental investigation of household carbon emissions from peri-urban and urban areas of Faisalabad, Pakistan, based on primary survey data rather than using aggregated country data. This study, unlike the current literature based on income or energy consumption, includes socioeconomic controls like household size, education level, and house size and family size, giving a complete picture of the determinants of emissions. Further, this interpret the heterogeneity of energy consumption patterns through electricity bills between peri-urban and urban households, providing useful lessons for the formulation of targeted low-carbon policies. By filling these knowledge gaps, the findings provide evidence-based policy recommendations for promoting sustainable household energy practices, making useful contributions to academic literature and practical policymaking in the area of carbon reduction strategy.

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FWU Journal of Social Sciences, Spring 2025, Vol.19, No.1, 47-55
DOI: http://doi.org/10.51709/19951272/Spring2025/5

Political Inertia Leads to Fascism: A Critical Analysis of Israel-Palestine Conflict

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This study reconnoitres the deep-rooted nature of Israeli aggression towards Palestinians from the lens of systemic and structural international factors. Since October 2023, over 46,000 Gaza inhabitants have been killed amid ever-increasing violence uncovering a grievous humanitarian crisis comprising widespread disease(s), famine, and the collapse of basic health and social services. The international society regardless of ample evidence of genocide, has failed to act conclusively, manipulated by international power dynamics and 'false equivalencies' that abstruse the disproportionate suffering wreaked on Palestinians as compared to ventures taken by Hamas. The study critiques – the inaction of global society and particularly, the systemic and structural provision Israel obtains from international power stakeholders, underpinning how this patronage perpetuates Israel's aggressive policies towards Palestinians. To examine this patronage relationship, the study employs the concept of 'political inertia' of Francis Fukuyama from holistic optics. The research contends that the international society's failure to address Israel's genocide - symbolises a suggestive political failure that inherits in 'systemic-structural' power dynamics which underpins Israel's fascist behaviour.

Keywords: Israel-Palestine, Hamas, political inertia, genocide, Humanitarian Crisis.

"I cannot understand the passive response of the whole civilized world to this modern barbarism. Does the world not see that Hitler is aiming for war?" – Albert Einstein

A three-phased agreement, encompassing a ceasefire reached on January 17, 2025, aspires to end the 15-months of war between Israel and Hamas that devastated Gaza (Al Jazeera , 2025), perished more than 46,000 people in Gaza since October 2023 (Fick, 2025). This indicates a pivotal accomplishment in restoring peace and undertaking the humanitarian situation after destabilising the Middle East. As, Andrea De Domenico, Deputy Head, United Nations Office for the Coordination of Humanitarian Affairs, rightly pointed out during the war towards an international community it "has to answer the question of how much human suffering can be tolerated in the name of security?" (Grunblatt, 2024).

What alternative rationalise exists for the theatre of terror that Israel is conducting against women and children in Gaza, in addition to President Biden's "overt contempt for Palestinians, his dehumanisation of Arabs, and his involvement in what numerous experts have described as a potential genocide," as expressed by Arwa Mahdawi in The Guardian (Mahdawi, 2024). According to United Nations Population Fund (UNPF), about 10% of Gaza's population has been killed, and up to 1.9 million people have experienced forced relocation (UNFPA, 2024). Today, diseases are transmitted, hospitals are being demolished, and children are starving to death in Gaza, creating a humanitarian disaster (UNICEF, 2025). In essence, the healthcare system has been crumpled. As De Domenico rightly argued there is a "systematic dehumanisation of civilians" in West Bank and Gaza.

Simultaneously, Israel disseminates meaningless propaganda to conceal apparent war crimes. Megan K. Stack argued in The New York Times, "Israeli officials have denied that they are to blame for the starvation of civilians and have said that there was no shortage of food in Gaza" (Stack, 2024). They have also accused Hamas of stealing humanitarian goods and claimed that the UN had neglected to provide food. In global power politics the phenomenon of 'false equivalency' prevails which is providing bolster to Israel's fascism (Krishna, 2023). It is absurd to

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comprehend the denunciation of the deaths of civilians, particularly children, within the prism of false equivalency, which holds that all parties to the Gaza War hold equal responsibility.

The Palestinian people have endured far worse suffering and terror at the hands of the Israeli state, both in the past and present, due to the immoral and massive scale of violence perpetrated against them (Alhossary, 2023). But 'one thing has been made clear on the world stage: There is vastly documented evidence that Israel is committing genocide against Palestinians' as the US Campaign for Palestinian Rights correctly proclaimed (Johnson, 2024). In fact, "The evidence of genocidal intent is not only chilling, it is also overwhelming and interconvertible" asserted Tembeka Ngcukaitobi (South African Lawyer) (Abuznaid, 2024). Although the ruling of the International Court of Justice (ICJ) is to be applauded for issuing arrest warrants for Prime Minister Netanyahu for war crimes against humanity it is not to be difficult to understand why he is still free! (Fernandez, 2024).

The 'systematic and structural' augment provided by global power players to Israel is the reason behind its genocide and fascism (Feinstein, 2023). Adila Hassim of the South African legal team cautioned that "genocides are never declared in advance" in her opening statement before the ICJ, in January 2024 to hear Israel's case for the Crime of Genocide (Al-Kassab, 2024). The UN Convention defines a crime against humanity as one committed with the intent to destroy a racial, ethnic, religious, or national group, in whole or in part. They construct it in ages with the backing of global state players like in the case of Israel (Al-Kassab, 2024). The political scientist Thomas Hobbes is credited with observing that human behaviour is fundamentally driven by self-interest and selfishness (Nweke, 2022). He contends that the concepts of morality, politics, ethics, and international law that societies uphold are essentially theoretical and normative. Hobbes' remarks can be applied to modern Middle Eastern politics, where a multitude of entities, both state and non-state, are active and manipulate regional dynamics to suit their agendas.

This study examines the structural and systematic core of Israel's barbarism which leads to its fascist political behaviour towards Palestinian people. The concept of structure and system is borrowed from Kenneth Waltz's phenomenal work *Man, State and the War* and *Theory of International Politics.* In international politics, the word structure exhibits the distribution of power and system demonstrates the anarchic nature of the world. The structure describes the hierarchical power differences that Israel and Palestine have which are intrinsically backed by systematic factors. The systematic factors prevail in an anarchic system because of power politics led by global state players to strengthen Israel – economically, militarily, politically, and institutionally. The study highlights that the biggest failure of the global community is its inability to force Israel to stop its genocide. To examine this discourse, the research work has applied the concept of political inertia from the political philosophy of Francis Fukuyama (Fukuyama, 2014) and Bart Zantvoot (Zantvoot, 2016). The political inertia indicates the reluctance of global institutions and state political systems to change and maintain the existing order (Doc McKee, 2024).

Israel-Palestine Conflict from Historical Lens

The geopolitics and history of the Middle East are deeply intertwined with the present-day Israel-Palestine conflict. The onset of the conflict is linked with the late 19th and early 20th centuries when Palestine was a part of the Ottoman Empire (McGreal, 2023). During this period, there was an uprising of Zionist immigration, which exacerbated tensions between Jewish and Arab communities. At the end of WWI, Britain was given an international mandate to govern Palestine by the League of Nations. The UN General Assembly in 1947 adopted a proposal to divide Palestine into two states – an Arab state and a Jewish state (MFA, s.d.). However, the Palestinian people and the peripheral Arab states were vehemently against this decision (Kelman, 2007). Consequently, the first Arab-Israeli War began in 1948 with the State of Israel's declaration of independence in May 1948. During this war, countless Palestinians were forcibly evacuated from their homes and displaced. This momentous event is often referred to as the Nakba, which indicates catastrophe in the Arabic language (Narea, 2023).

Eventually, Israel annexed several territories that were meant for the future state of Palestine. The Palestine Liberation Organisation (PLO) was established in 1964 to act as the global representative organisation for all Palestinians, particularly those who were living in mandated Palestine before the creation of the State of Israel. Once the Six-Day War in 1967 ended, PLO's prominence grew fundamentally (Ghanem, 2013). Following Israel's conquest of the Sinai Peninsula in Egypt and the Golan Heights along the Jordan River in the aftermath of the Six-Day War, Egyptian President Anwar Sadat pursued diplomatic efforts to bring about a peaceful settlement in compliance with UN's Resolution 242 (Jouejati, 2023). Israel was required by this resolution to give back the territory it had taken. These demands were rejected by Israel, and the tensions that followed eventually resulted in the Yom Kippur War in 1973.

After the start of the 1st intifada in 1987, Hamas was founded as a group that opposed the PLO's secular stance. After its emergence, Hamas established itself with a separate identity that held a position of exercising resistance through military means until the independence of Palestine. According to the organization's 1988 charter, Palestine is an Islamic homeland that should not be ceded to non-Muslims and is inviolable. Moreover, Hamas perceives it as a religious obligation of Palestinian Muslims to fight a holy war to reclaim Palestinian land from Israel (Teran, 2024).

The 2nd Intifada, which took place in the 2000s and continued for five years, was far more violent and bloodier than the first and claimed 4,973 Palestinian lives (Adam, 2020). Following a devastating suicide attack in March 2002, Israel launched Operation 'Defensive Shield,' and resumed control of sections of West Bank and Gaza. Israel built barriers of separation, as well. The violence had decreased by 2005 (Rojas, 2016). After winning the 2006 legislative election, Hamas seized power in Gaza in 2007 (Tharoor, 2023). The existing war is linked with the surprise attack of Hamas on October 7, 2024, which jeopardise the Israel state. Consequently, at least 1,139 people were killed and 240 were seized as hostages. In response, Israel initiated the 'existential genocide' (Byman, 2024).

Gaza's Humanitarian Crisis: How Terrible Is It?

The situation in Gaza is worrisome and complex to elucidate. A pervasive sense of despair prevails everywhere in Gaza. The UN secretary general for humanitarian affairs stated that "it was worse than 'awful scenes' he witnessed during the civil war in Syria a few years ago" (Arnold, 2024). And "Gaza is worst humanitarian crisis I have seen in 50 years" (Arnold, 2024). The Lancet, a well-reputed journal, published a study titled 'Counting the Dead in Gaza: Difficult but Essential' which precisely portrays the situation (Khatib, 2024). The Gaza Health Ministry is increasingly encountering difficulties in attaining and gathering statistics due to the extensive destruction of infrastructure. The UN projects that 35% of the Gaza Strip's structures would have collapsed, suggesting that there are probably a significant number of dead still under the debris—more than 10,000, according to estimates (Rasha Khatib, 2024).

The Gaza war has had a devastating effect on healthcare access and service. The World Health Organisation (WHO) data indicate that "16 out of 36 hospitals of Gaza were partially operational, with 20 closed" (Lords Library , 2025). Moreover, residents - especially children are now more susceptible to infectious diseases due to inadequate sanitation, mobility constraints, infrastructural breakdown, and shortages of clean water (UNOCHA, 2024). Since mid-October, there has been a reported rise in the number of cases of diarrhoea and polio among children under five years old. Additionally, there have been more cases of skin rashes, respiratory infections, scabies, lice, chicken pox, and rashes (WHO, 2023). If we compare the rates of diarrhoeal infections with those before the recent fighting, they have grown by over 23 times (WHO, 2023). Medical associations have released warnings about the possibility of disease epidemics in these conditions.

The mental and reproductive health of the Palestinians is directly affected by the psychological toll of the war. A UN expert warned that "acute mental distress that will turn into anxiety and other kinds of mental illnesses later on in life is important to start thinking intentionally about" (Reuters, 2024). There has been a striking increase in both the number of births and difficulties during pregnancy, making women and children especially vulnerable. The current crisis in Gaza has increased the likelihood of long-term mental health issues, including Post-Traumatic Stress Disorder (PTSD), for children who already have mental health issues. People with chronic medical illnesses are even more at risk since they cannot get the treatment they need due to the gasoline crisis, the lack of shelters, and the previous airstrikes that affected medical transport (Reuters, 2024).

The international community must act immediately to protect civilians, supply basic humanitarian requirements, and prevent an imminent health catastrophe in Gaza, as the war has generated a devastating humanitarian situation. The academic community has a dual moral responsibility to promote and support policies that emphasised saving lives and preventing additional human suffering. Moreover, the measures to ensure safe transport of food, medicine, water, and other basic human needs.

It is requisite to document the number and nature of causalities in this war. A correct estimation of the magnitude is necessary to recognise the actual cost of the war and ensure historical responsibility (Moorthy, 2022). The international law also mandates it. As the interim measures outlined by the ICJ in January 2024 for Israel must "take effective measures to prevent the destruction and ensure the preservation of evidence related to allegations of acts within the scope of the Genocide Convention" (Khatib, 2024). The sole organisation keeping track of the deceased is the Gaza Health Ministry. The delineated data will also be essential for arranging humanitarian help, rebuilding infrastructure, and recovering from the war.

The Scale of War

After Hamas's attack in October 2023 and Israel's offensive response, it became quite evident that the war's ramifications would be extended beyond Gaza. As a result of their relational ties, major nations are drawn into this war in a convoluted manner. The situation in the Middle East and the Levant could not be contained because an international coalition of Palestinian supporters interfered or threatened political or military vengeance against Israel's genocide (Al Talei, 2023). It was claimed that Iran was instigating anti-Israeli or anti-Western actions through its backing of the 'axis of resistance' in Yemen, which included the Houthis, the Lebanese Hezbollah, the Shiite militias in Iraq, and Hamas and Islamic Jihad in Gaza (Al Talei, 2023). However, it was evident that Iran sought to exert control over these groups to avoid confrontation with Israel and the US. On the other hand, there were around a hundred assaults on US bases in Iraq, three US soldiers killed in Jordan, rockets launched into Israeli territory by Hezbollah, and missile and drone attacks against Western ships in the Red Sea and the Gulf of Aden, two of the busiest maritime trade routes, by the Houthis (Al Jazeera , 2024).

The maritime security of the ships had been compromised by Houthis creating the Red Sea Crisis. Since October 2023, military tensions in the Red Sea have increased to a never-before-seen degree. Houthi troops in Yemen have launched multiple drone and missile assaults against military and commercial ships as payback for Israel's continuous assault on Gaza. On January 12, 2024, the US and Britain launched an operation against Houthi sites within Yemen under the banner of Operation Prosperity Guardian, a global military coalition created to protect the Red Sea from Houthi threats (Hamasaeed, 2024). The security forces of Australia, Canada, Bahrain, Denmark, New Zealand, Singapore, and other countries joined this alliance.

Over 60 ships were attacked between November 2023 and June 2024; several of them sank, posing an ecological concern, prompting military responses from the US and the UK, including the destruction of Houthi land targets (Euronews, 2024). To avoid the Red Sea and the Suez Canal, whose traffic was cut by 65%, several hundred ships were rerouted across Africa. This increased shipping costs and stoked concerns about a return of global inflation (Baraniuk, 2024). Regardless of those endeavours, international trade via the Red Sea and the Strait of Bab al-Mandab became a major target of Houthi rebels stationed in Yemen in mid-November, posing a significant security risk. Within weeks, the situation worsened, with negative consequences for trade and transportation (Baraniuk, 2024).

The Red Sea's strategic significance for global trade is largely dependent on the Bab el-Mandab Strait, which divides Yemen and Djibouti. It's one of the busiest cargo and oil transit hubs in the world, handling over 12% of all goods traffic passing through it (Notteboom, 2024). Choke points as supply networks are being weaponised geo-politically, making them increasingly vulnerable as tools of economic statecraft. States' incentives and actions in the area of international security have a significant regional component, as renowned academic Buzan has manifested (Buzan, 2003). As a result, the main neighbourhood of a state is the source of its security concerns. There are relationships between the security of one state and the security of other states in the region. Actors are likely to feel the strongest threats when they are local (Barry Buzan, 2003). The Red Sea Crisis and the way that the attacks in Gaza are escalating regional tensions throughout the Middle East are examples of the same.

Moreover, following Israel's attack on the Iranian Consulate in Damascus on April 1, 2024, which resulted in the deaths of two Iranian generals and twelve civilians. Consequently, Iran attacked Israeli territory on April 14, 2024, using drones and missiles (Loanes, 2024). Iran's response was entirely defensive by maintaining the deterrence equilibrium with Israel. Since October 2023, Israel vowed to kill the significant leadership of Hamas and Iran's Islamic Revolutionary Guard Corps (IRGC). As of August 2024, Israel has reportedly killed these commanders of Hamas – Ibrahim Biari, Saleh-al-Arouri, Marwan Issa, Mohammad Deif, Ismail Haniyah. The IRGC commanders that killed by Israel are; Razi Mousavi, Mohammad Reza Zahedi (Kierszenbaum, 2024).

The scale of the Gaza war has so widened that it rattled university campuses across the US since April 2024 – including Yale University, the Massachusetts Institute of Technology, New York University and Tufts University etc. (Iqbal, 2024). Hundreds of students and university staff protested against the US government's support of Israel. The protests in universities were so strong and evident that many analysts urged that history is repeating in US educational campuses. The famous US journalist, Ray Hanania, indicated that "What played out in 1968 is playing out again today and, coincidentally, is also having a significant impact on a presidential election" (Hanania, 2024). Time will draw the lines regarding it!

Discussion – Political Inertia and Israel's Fascism

The Gaza war is a manifestation of disequilibrium which has been constructed since 1948. The existential war rightly depicts the political and institutional limits of global stakeholders over Israel. The primary concern of this study is why it took 15 months to stop Israel. To inspect it this study has applied the philosophy of political inertia. Political inertia refers to the tendency of political systems and institutions to resist change and maintain the current state of affairs (Doc McKee, 2024). Here, concerning political systems mean anarchic behaviour of states and institutions represent the global institutions (Kocs, 1994). As Francis Fukuyama argued in *Political Order and Political Decay* political inertia is a feature intrinsic to political systems (Zantvoot, 2016). Institutional rigidity and cognitive factors are both deeply ingrained in human nature. The concept of inertia needs to be examined from three distinct angles – historical, functional, and normative for a complete understanding of Israel's fascist behaviour (Zantvoot, 2016).

Political inertia in historical context refers to the historical analogy of Israel's establishment as a state by illegally annexing the land of Palestine. As Oren Yiftachel mentioned in his phenomenal work "Is the battle raging between Israel and Gaza a colonial war? In his study, he contends that 'Settler Colonial' (SC) interactions concerning Palestinians and Jews in Israel and Palestine have resulted in this horrifying situation (Yiftachel, 2023). Therefore, colonial and counter-colonial forces (Hamas) are expressed in the current war asymmetrically (Yiftachel, 2023). However, he also contends that the contemporaneous situation has amply demonstrated that the SC paradigm by itself is unable to adequately explain the myriad factors influencing Israel/Palestine 'generally' and the Gaza hotspot in 'particular.' The SC paradigm is frequently at odds with national, religious (including Jewish and Islamist fundamentalists), liberal, geopolitical, and international systematic forces (Yiftachel, 2023).

Beyond highlighting these forces' strong presence and how far they extend 'beyond the local axis of settler-indigenous dialectics,' there isn't much space to get into here. It is crucial to recognise the stark power disparities that exist between the non-state actors (Hamas & Hezbullah) and the strong Israeli government, as well as the reality that only a small portion of Palestinians share the anti-colonialist ideologies of Islamic Jihad and Hamas. In conclusion, the Gaza War serves as a hotspot in the struggle between Palestinians and Islamist non-state organisations against Israeli settler colonialism. The political geography with the anxieties of different generations, it seems that we are fighting both a colonial and a counter-colonial war at the same time.

Political inertia's "functionality" with supporting variables is another feature that makes it stronger. One instance of primitive accumulation is the blockade of Gaza and the West Bank. Late October 2024, saw an upsurge in Israeli bombing, and Israel started granting permits to foreign energy corporations to explore for gas and oil off the coast of the Mediterranean (Transnational Institute, 2024). This action was a part of Israel's larger plan to become a major energy hub and gas producer in the region, as well as a substitute for Russian gas in Western Europe. A December advertisement for the construction of opulent homes in destroyed Gaza neighbourhoods was published by an Israeli real estate company that is well-known for creating settlements in occupied Palestinian territory. Other ads emphasised the Ben Gurion Canal Project's rebirth, which has been inactive since it was first conceived in the 1960s (Khalil, 2023).

The idea entails constructing a substitute for the Suez Canal, which is now operated by Egypt, which would connect the Mediterranean to the Negev desert and Gaza from the Gulf of Aqaba. The existence of Palestinians in Gaza is the only obstacle preventing the recently revised Canal project. Following the Hamas attack on October 7, Israel sent thousands of Palestinian labourers back to Gaza, and Israeli businesses requested permission from the government to replace those workers with 100,000 Indian labourers (Khan, 2023). Even in the thick of the conflict, thousands of Indian labourers were flooding Israel by the beginning of 2024.

The last facet that contributes to political inertia is the problematic of international norms that resist institutional change (Zantvoot, 2016). Since October 2023, international institutions have exercised extreme restraints in their efforts to compel Israel to stop its genocide with the support of major power stakeholders in the world. The only talks, apart from the January 2025 truce, that happened comprised multiple mediators, including Egypt, Qatar, and the United States. The result was a brief ceasefire that was repeatedly extended in November 2023, during which Israel freed Palestinian captives and Hamas released hostages (Reuters, 2023). Additional discussions for the extension of ceasefire, release of hostages and prisoner exchanges have occurred, and following multiple setbacks, the UN Security Council ultimately resolved (with the US abstaining) to require: "an immediate ceasefire for the month of Ramadan respected by all parties leading to a lasting sustainable ceasefire, and also demands the immediate and unconditional release of all hostages, as well as ensuring humanitarian access to address their medical and other humanitarian needs, and further demands that the parties comply with their obligations under international law in relation to all persons they detain" (UN News, 2024).

The US, eventually, tabled a new Security Council resolution that was approved on June 10, 2024, with Russia abstaining (DW, 2024). The resolution sought to end the Gaza War by negotiating a comprehensive ceasefire agreement that would be implemented in three stages. While some Israeli government officials criticised the plan, Hamas accused Israel of being ambiguous over the actual end of hostilities and disengagement from the Gaza Strip. The US behaviour towards Israel is questionable particularly its providence of institutional cushions to Israel's genocide by voting against a Gaza ceasefire draft UNSC resolutions (Al Jazeera , 2024). Meanwhile, the US administration, since October 2023, has 'enacted legislation providing at least $12.5Bn of military aid to Israel and nearly $3.8 billion approved in March 2024' (Merrow, 2024).

With this economic and military aid, the Israeli economy is rightly equipped for the mass murder of Palestinians. As William I. Robinson correctly noted, Gaza serves as a warning sign that, in the years to come, genocide could be used politically to resolve the irreconcilable conflict between excess capital and excess humankind (Nguyen, 2024). When a situation threatens international peace and security and directly impacts one of the permanent members—the US, or its interests, the UNSC has once again shown its inefficiency and paralysis in the context of the Israel-Palestine conflict. Throughout the history of the Israeli-Palestinian conflict, the US has consistently exercised its veto power over any SC decision that went against Israeli interests (Nguyen, 2024).

Fukuyama argues that blindly adhering to compromised norms gives leaders an evolutionary advantage because they enable sophisticated social behaviour (Fukuyama, 2014). The issue lies in the fact that regulations that were beneficial or fitting in a particular situation are nonetheless implemented when those conditions alter. To better navigate their surroundings and manage international society, leaders build 'mental models' and rule-based organisations. However, these models become psychologically embedded in the minds of people, giving them 'intrinsic value' (Zantvoot, 2016) like Benjamin Netanyahu possesses. John Kiriakou rightly deconstructed how Israel perceived the notion of 'hostages' and 'detainees' to frame its barbarism (Jones, 2023). Therefore, it would seem that Fukuyama is making the case that political inertia is the outcome of irrational action, which arises from people's psychological and emotional attachment to unsuitable or ineffective institutions and mental models (Fukuyama, 2014). Rational trade-offs between efficiency and flexibility lead to the fact that established regulations are hard to modify.

Conclusion

On reasonable grounds it's not hard to believe that Israel is committing genocide in Palestine and no one has the audacity to stop it! The political landscape of Palestine is being transformed by the ongoing existential struggle, which is a terrible by-product of the Zionist settler colonial effort that lasted for a century. A 'theatre of terror,' severe medication shortages, and a lack of staff members are all results of the Israel-Hamas conflict, which has also produced the worst humanitarian catastrophe in recent memory. There is an immediate need for international involvement since it has exacerbated the already overburdened healthcare system and contributed to increasing rates of diseases and famine!

The complications and implications of the Israel-Palestine conflict have extended far beyond its immediate borders, encompassing multiple states and non-state actors while and escalating regional tensions. The Red Sea Crisis, compelled by Houthi attacks, has disrupted global trade and increased shipping costs, underlining the vulnerability of maritime key chokepoints. The conflict has also prompted military responses and deepened geopolitical rivalries, with significant impacts on international security and regional power dynamics. As global trade routes face unprecedented threats and the Middle East becomes increasingly volatile, the broader implications of the conflict underscore the urgent need for diplomatic efforts to stabilize the region and mitigate further escalation.

Despite the widespread evidence of genocidal actions and the devastating impact on Gaza's population, global responses have largely been marked by indifference or false equivalency. This negligence perpetuates the cycle of violence and suffering, reflecting a troubling failure of international mechanisms to address or halt the ongoing atrocities. The study underscores that this inaction is driven by systemic-structural factors and political inertia. Israel's fascist behaviour is driven by political inertia which led to horrid behaviour and unwillingness to modify because it imbibed into the minds of leader(s). The significant step is to highlight a critical need for a re-evaluation of global priorities and interventions based on humanity.

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FWU Journal of Social Sciences, Spring 2025, Vol.19, No.1, 56-75
DOI: http://doi.org/10.51709/19951272/Spring2025/6

The Effectiveness of Technology-Project-based Learning (TPBL) Module in Fostering Children's Creative Thinking Skills Through Science Education

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Early science learning has the potential to enhance children's creative thinking skills through quality learning, but this requires well-structured activities and a supportive learning environment. The purpose of this study is to evaluate the effectiveness of the Technological-Project-based Learning (TPBL) Module in early childhood education to enhance the creative thinking skills of children. This study employed a mixed-methods design, where qualitative data was collected using interview instruments and quantitative data was gathered using pre and post-tests. The study involved 2 preschool teachers and 50 preschool children. After an 8-week intervention, the findings revealed a significant positive change in the mean score of children's thinking skills in the treatment group, with the average pre-test score of M = 32.60 and a post-test score of M = 55.16. Additionally, the results indicated a significant difference between the treatment and control groups based on the post-test, with $p < 0.05 = 0.001$. A p-value below 0.001 signifies that this outcome is exceedingly improbable to have arisen by chance. Furthermore, interview data indicated that participants found the TPBL module to be a highly impactful initiative in enhancing their creative thinking skills, as it involved engaging projects and allowed them to make decisions collaboratively with peers. These implications encourage schools to provide technological learning materials to ensure quality science education, in line with 21st-century education standards.

Keywords: ***e***arly science; preschool; project-based learning; technological-based learning

Research on the pedagogy and acquisition of understanding of science in preschoolers has become an acknowledged discipline over the past twenty years (Trundle & Saçkes, 2024). The cumulative evidence from an expanding corpus of literature indicates that the introduction of science in developmentally suitable manners may facilitate young children's sensory discovery of their environment and establish essential knowledge and skills for enduring science education, alongside fostering a profound appreciation for nature (Trundle, 2015; Trundle & Saçkes, 2012). Early science education is essential for cultivating curiosity (Bjerknes et al., 2024), enhancing problem-solving abilities (Dewi et al., 2024), and developing fundamental skills (Sjöström, 2021) that children can leverage in their future academic pursuits. It offers young children the chance to investigate their surroundings through experiential activities, inquiry-driven learning, and interdisciplinary methods that combine science with other disciplines (Alan & Mumcu, 2024).

A fundamental component of early science education is project-based learning (PBL), which has demonstrated enhancements in children's cognitive abilities, motivation, and collaboration skills. This methodology enables youngsters to immerse themselves in scientific principles through the execution of real-world projects, fostering collaboration and enhancing practical problem-solving skills. The adaptability of PBL allows it to be utilized in diverse educational environments, integrating science concepts with collaborative learning, inquiry-based instruction, and digital resources to enhance the educational experience (Howitt et al., 2020; Chen et al., 2023). Additionally, early science education is essential for the cultivation of communication skills, enabling children to articulate ideas, disseminate discoveries, and cooperate with peers. Research indicates that including STEM (Science, Technology, Engineering, and Mathematics) activities in preschool can markedly improve creativity, problem-solving abilities, and general academic preparedness (Vongkulluksn et al., 2018; Aldemir & Kermani, 2017).

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These initiatives seek to enhance children's current education while equipping them for a future in which science literacy and problem-solving skills are essential for success in various fields. To gain a comprehensive understanding of the significance of early science education, you may examine the complete publications and studies cited, including those by Howitt et al., (2020) and Chen et al., (2023). The significance of science education (Foti, 2021) in preschool is highlighted by its capacity to cultivate curiosity, problem-solving abilities, and critical thinking from a young age. Taşdemir and Yıldız (2024) emphasize that science activities in preschool address children's educational requirements while also igniting their inherent curiosity about the world. Early science education establishes fundamental abilities crucial to lifelong learning and a profound comprehension of science concepts.

According to research by Kalogiannakis et al., (2021), science education for children is characterized as an interactive and engaging process that employs gamification to improve learning experiences. Behnamni et al., (2020) investigated technology-based learning (TBL) for young children, emphasizing the potential of well-designed games to foster creativity. These games offer organized yet flexible settings that encourage children to make decisions, enhancing critical thinking and creativity. TBL can function as an interactive platform for cultivating cognitive flexibility, essential for creativity. More profoundly, a thorough literature analysis conducted by Naimah (2022) revealed that the utilization of technological resources, such as educational videos, in science teaching enhances students' comprehension and academic performance. Some science topics are challenging for children to comprehend; nevertheless, guidance, exploration, simulation, and visualization through educational videos can enhance their conceptual knowledge (Berg et al., 2019; Shui et al., 2019; Ugwuanyi et al., 2020; Wu et al., 2021). Therefore, the integration of PBL and TBL, referred to as Technology-Project-Based Learning (TPBL), can be implemented through blended learning. Irwanto and Setyo Rini (2024) assert that blended learning can significantly enhance learners' motivation in science-related education. This finding aligns with Yıldız Taşdemir and Gürler Yıldız's (2024) study, which emphasizes that children should be given opportunities to explore topics through engaging activities, such as incorporating technological materials in classroom learning activities (Yıldız & Selvi, 2015).

Interestingly, both TBL and PBL approaches in early science education offer numerous benefits for children's development (Rahmawati et al., 2020). Wong (2019) demonstrated that the amalgamation of these two approaches is essential for augmenting children's involvement and cultivating abilities such as problem-solving and collaboration. It facilitates a more personalized, dynamic, and contextually relevant learning experience. Effective integration necessitates the utilizations of familiar tools that resonate with children and guarantees that technology is congruent with educational objectives. It fosters creativity and critical thinking, rendering the learning experience more dynamic and relevant to future employment (Jabbar & Halim, 2024). The selection of PBL-TBL in school environment constitutes an effective strategy for maximizing its application in education, leveraging contemporary communication methods, and addressing the requirements of modern learners, particularly concerning e-learning and smartphone utilization (Munawaroh et al., 2022). The emergence of fourth-generation technological tools profoundly influences education as a whole and project-based learning in particular (Al-Mawlid, 2019), while also equipping teachers and learners with cutting-edge tools to investigate, experiment, and understand the complexities of the natural world (Doyan et al., 2021).

Literature Review

Learning Module in Early Science Education

The implementation of learning modules is crucial in the instruction of science (Khabibah et al., 2017), particularly within early childhood education environments (Letchumanan & Aidah, 2024; Rasdi et al., 2021; Mashudi et al., 2024). Numerous studies over the past five years emphasize the significance of science education in preschool through the utilization of modules for children (Ghazali et al., 2024; Ghazali et al., 2021). Learning modules often promote active learning, wherein children with educational content via experimentation, investigation, and discourse. This method enables children to engage more actively in the learning process and enhances their comprehension of science concepts by allowing them to personally experience exploration and problem-solving. The outcomes of a study by Hsin and Wu (2023) illustrate the significance of systematic concept acquisition in enabling preschool children to acquire foundational science skills while also fostering their creative abilities in executing science-related tasks. The findings indicate that indigenous children utilizing the science learning module enhance their creative thinking skills more rapidly (Hsin & Wu., 2023) than those employing a standard science learning strategy (Cooper et al., 2020). To investigate the significance of employing science learning modules for preschoolers, the findings of Dongjin and Ashari (2024) through systematic analysis indicate that the implementation of activities utilizing these modules, particularly in early science, can enhance children's critical thinking skills. This empowerment enhances their creativity in executing the assigned tasks through the activity. Thus, ensuring the quality of education through the implementation of learning modules in schools necessitates that teachers play a pivotal role. They must create a responsive environment and introduce science content actively, as such content does not emerge autonomously (Henriksson et al., 2023).

Enhancing the quality of learning through learning science modules requires alignment between the teacher's proficiency in conveying the module content and the varying capacities of children to comprehend that content (Suwartiningsih, 2021). In the classroom, it is inappropriate to offer individual learning modules that alone foster creativity, innovation, and student autonomy in the educational process (Fadhli, 2022). Therefore, it is imperative to develop learning modules designed for personalized instruction for all students (Rahmawati et al., 2023), as this will facilitate the comprehension of specific concepts and foster motivation and a positive desire to learn (Rohaizad et al., 2017).

TPBL in Education

Science teachers assert that science classes ought to be more relevant to real-world contexts to help learners comprehend the essential role of science in daily life (Oxford University Press, 2024). However, the pedagogical approach to science in schools has faced longstanding criticism for its disconnection from other crucial educational objectives, including inquiry and problem-solving abilities, civic engagement, agency, and a commitment to addressing future challenges (Alzen et al., 2023; Schwartz et al., 2023; Thomas & Boon, 2023). The issue of diminishing leaners interest in the field of science is increasingly concerning and frequently addressed in contemporary discourse (Shanmugam & Balakrishnan, 2018). This presents a challenge for teachers to devise a solution that engages and motivates learners to study science subjects. Consequently, it is imperative to diversity instructional methods to prevent leaners ennui and, crucially, to engage their interest in the subject matter (Mahamod & Mustapha, 2007). International reforms in science education recognize the necessity for significant changes in pedagogy, curricular resources, and evaluation methods (Penuel et al., 2022). Over the past decade, numerous studies have examined the integration of Project-Based Learning (PBL) with technology (Haataine & Aksela, 2021; Jabbar & Halim, 2024; Rahmawati et al., 2020) within the educational context. From the standpoint of early childhood education, the promotion of science education through the integration of these two techniques, operationally referred to as TPBL, effectively stimulates children's creative thinking skills. The study by Parwoto et al. (2024) revealed that children in the treatment group engaged in TPBL activities exhibited a higher level of creative thinking skills compared to those in the control group utilizing conventional learning methods and indirectly it proves that TPBL-focused activities can stimulate children's creative expression during science activities (Chen et al., 2024; Meyer & Crawford, 2011).

This study implements TPBL activities in early science education by adopting the PBL Model presented by Pekins (2008) (See Figure 1.0). The figure depicts a research framework highlighting the interaction between the teacher and children through five organized steps. The main keyword in this study is the mediation process defined by Vygotsky. The foundation of Vygotsky's sociocultural framework is his mediation theory, which uses language as a key mediating tool to investigate how social interaction impacts human cognitive development. According to Vygotsky, mediation entails the use of cultural instruments and symbols, particularly language, to cultivate advanced cognitive functions that surpass inherent capabilities. Through the utilisation of these tools in social settings, individuals assimilate cognitive processes, altering their comprehension and interaction with the world (Ghassemi & Asgarzadeh, 2017).

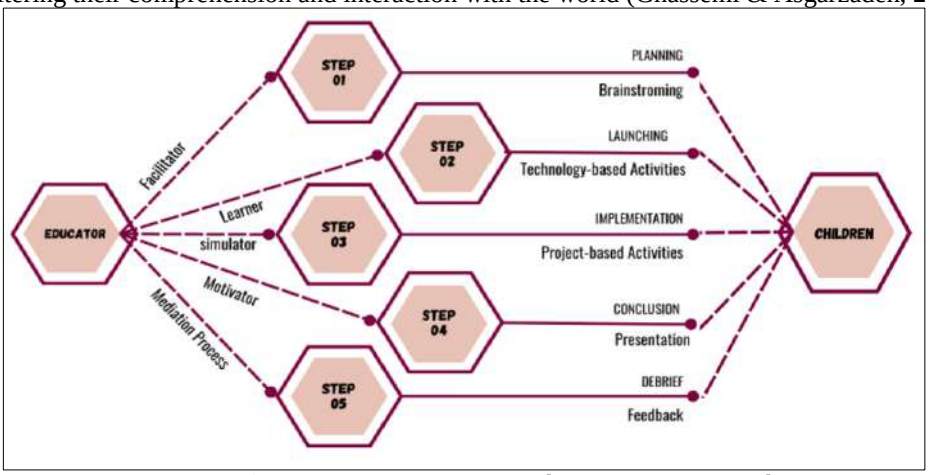

Figure 1.0: TPBL Framework in Current Research

In this study, teachers serve as mediators in the learning and facilitating process (Vygotsky, 1978). They act as facilitators, guiding children through the Zone of Proximal Development (ZPD)—the gap between what a child can do independently and what they can achieve with assistance (Wertsch, 1985). At the same time, teachers employ instructional strategies such as scaffolding (Woods et al., 2020; Yawilong, 2022) to provide essential support for

children's learning, systematically withdrawing this assistance as their competence increases. In addition, children play the role of active learners (Bodrova, 2019; Smolucha & Smolucha, 2021). They are not passive consumers of knowledge; rather, they are active participants in the learning process. The mediation process promotes participation in activities that require creativity, critical thinking, and problem-solving skills. Children internalize their interactions with teachers, peers, and structured learning modules, thereby transforming their cognitive functioning. On the other hand, learning modules serve as instruments for mediation (Kozulin & Presseisen, 1995). Early science learning modules, crafted with specific cultural and cognitive tools such as language, symbols, or interactive activities, are crucial in shaping children's engagement with knowledge. These modules offer children the opportunity to practice and implement new abilities within their ZPD. Language-based learning modules enable children to enhance their linguistic and cognitive abilities by interpreting and generating meaning through content interaction and teacher assistance.

Based on Figure 1.0, it illustrates that the teacher plays multiple roles throughout the learning process: as a facilitator, learner simulator, motivator, and mediator. These roles are crucial as they guide and support the children at each stage of the project-based learning process as below:

- Step 1 - Planning (Brainstorming): This step involves initial planning, where both the teacher and the children brainstorm ideas to define the project's goals. It sets the foundation by identifying key themes or questions.
- Step 2 - Launching (Technology-based Activities): In this phase, when the project is launched, the teacher becomes a leaner to learn with children through TBL ativity. This could include research, exploring resources, or introducing tools they will use in the project.
- Step 3 - Implementation (Project-based Activities): This is the core of the TPBL framework, where children actively engage in hands-on, PBL tasks. The teacher acts as a facilitator, guiding children as they explore, experiment, and build their project.
- Step 4 - Conclusion (Presentation): At this stage, children present their project or findings. This presentation phase allows them to demonstrate their understanding and what they have accomplished. Additionally, the teacher acts as a motivator, encouraging children to be brave in sharing what they have successfully produced.
- Step 5 - Debrief (Feedback): Finally, the process concludes with feedback. Here, the teacher and children reflect on the project, discuss what went well, and identify areas for improvement. Feedback is essential to reinforce learning and ensure a clear understanding.

In summary, this TBPL framework highlights an interactive and iterative approach. Within this framework, the teacher plays a pivotal role in facilitating the learning experience, fostering an environment where children feel encouraged to undertake independent project work. The teacher supports children in reaching well-informed conclusions, thereby enhancing their engagement and comprehension through structured feedback.

Measurement of Children's Creative Thinking Skills

The exploration of creative thinking in school-aged children generates significant interest among researchers and teachers regarding the potential for conventional classroom learning activities, when conducted in a supportive environment, to enhance cognitive and creative abilities (Wang, 2012). This inquiry is particularly significant as research on children's learning and education increasingly substantiates the notion that creative thinking—encompassing skills such as idea generation or divergent thinking—does not occur in isolation from learning activities, but rather through them (Dijksterhuis & Ritter, 2019; Kim et al., 2019). Recently, teachers increasingly recognize the need of cultivating children's creative thinking (Kim & Park, 2020). Reviewing from this perspective, the enhancement of children's creative thinking skills at the educational center will transpire through cooperative learning, wherein innovative solutions to learning challenges are collaboratively devised with peers (Segundo Marcos et al., 2024). Another insightful finding from past research is children do exhibit enhanced creativity in task execution when had the opportunity to engage in a sustained intense program (Gu et al., 2019). Although previous literature (Treffinger & Isaksen, 2013) supports that creativity is essential for preparing new generations of learners for an uncertain future, there is a lack of practical guides for teachers to help students identify their creative talents and enhance their creative thinking skills (Abdulla & Cramond, 2017). Consequently, to facilitate the continuous evaluation and interpretation of children's creativity development, it is essential for teachers or researchers to be familiar with the most effective ways obtainable. The utilization of suitable measurements to assess an individual's creative development is crucial within the context of learning.

Over the past decade, numerous studies have demonstrated the significance of employing the Torrance Tests of Creative Thinking (TTCT) in social science research (Abdulla Alabbasi et al., 2022; Humble et al., 2016; Krumm et al., 2018; Soh et al., 2021). TTCT is utilized by a large number of individuals, and it can be utilized for testing purposes by individuals of varying ages (Zhao et al., 2019). Particularly, the test is mostly utilized for the purpose of evaluating the individuals' capacity for divergent thinking. According to Theoharopoulou et al., (20200), the predominant factors that determine a subject's score are their level of fluency, adaptability, originality, and elaboration in their responses. Torrens

believed that divergent thinking (Mumford et al., 2001) was the basis of creativity, and he developed tests that placed an emphasis on evaluating different types of thinking. Among all creative tests, the TTCT is the one that has been around the longest, has been the subject of the most extensive study, and is the one that is utilized in educational settings the most frequently (Theoharopoulou et al., 2020). Therefore, Wang and Ismail @ Kamal (2023) suggested that TTCT is not only capable of evaluating individual thinking based on a variety of factors, but it is also useful for teachers in terms of how they interact with their learners.

Aim and research questions

We undertook a study aimed at elucidating the effects of a TPBL Learning Module, termed MyPreScience Learning Module, on children's creative thinking abilities (assessed via the TTCT test) and the nature of specific educational inquiries, characterized by their divergent skills (Guilford, 1950). This was executed in reaction to the previously identified research need. To achieve this purpose, we considered the following research questions (RQs):

- RQ1: What is the mean score of the treatment group before and after they used the MyPreScience Module to evaluate their progress using the TCTT measurement?
- RQ2: Is there a significant difference in the mean score of creative thinking skills between the treatment and control groups following an 8-week intervention measured by TCTT??
- RQ3: Is the MyPreScience Learning Module effective in preschool for enhancing children's creative thinking skills through independent interviews?

Method

Design

Context

This research employed a mixed-methods design (Zainudin et al., 2021). This design is a research methodology that integrates quantitative and qualitative components inside a single study. The objective is to achieve a more thorough comprehension of a study subject by using the benefits of both methodologies. This study employs a sequential explanatory design (Ivankova et al., 2006). This design is a category within mixed methods research. This category involves the initial collection and analysis of quantitative data (quasi-experimental), succeeded by qualitative data (interviews). The objective of the use of this design category is to elucidate or augment the outcomes of quantitative research using qualitative insights. This study was executed over a duration of 10 weeks, with the initial week allocated for pre-tests. Monitored the period from the second week to the ninth to execute the research intervention. The tenth week comprises post-tests and independent interviews with an teacher from the treatment group.

Participants

A total of 50 children were selected as participants for this study. All of the participants originated from two separate preschools located in a remote area of a Malaysian state. The ages of the participants range from 5 to 6 years (M = 6). Preschool A was assigned as the experimental group, whilst group B was assigned as the control group. They were divided into two separate groups. Furthermore, two teachers participated in this study, each representing a distinct group. Both teachers possess a bachelor's degree in Preschool Education and have over 15 years of experience in teaching preschool children. Both teachers are female.

Instruments

a. MyPreScience Learning Module (Translated from Malay Language as *Modul MyPreScience*)

Prior to the utilization of this learning module in the study, it underwent a developmental process. Ten experts were recruited to assess the usability of this module in preschool education. The study's findings indicate a solid consensus that the module is suitable for children aged 5-6 years, achieving a value of 1 (k = 1) in agreement. Upon completion of this learning module (refer to *Figure 1*), it will be utilized during the 8-week intervention by teacher and children from the treatment group. Out of the 10 developed projects, only eight projects were chosen (refer to *Figure 2*) by the teacher for the implementation of activities in early science education. Teachers were allotted one week to identify the necessary tools for their instructional methods in preschool. Conversely, teachers in the treatment group were permitted to employ any instructional methods during the eight instructional sessions.

Figure 1: Front Page of MyPreScience Learning Module

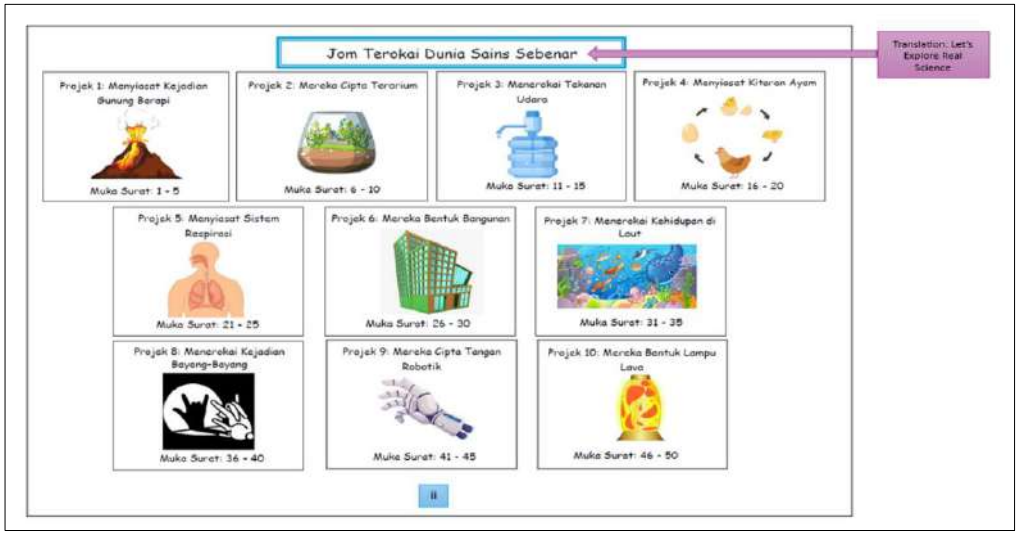

Figure 2: Ten projects developed in MyPreScience Learning Module

According to the data presented in Table 1 below, only eight of these ten projects were utilized by teachers:

Table 1
Eight Projects Selected in Eight-Week Intervention

Project	Intervention Week	Selection Yes	Selection No
1. Exploration of volcano eruption	1	✓	
2. Design of terrarium	2	✓	
3. Exploration of air pressure			×
4. Exploration of chicken cycle	3	✓	
5. Exploration of respiratory system	4	✓	
6. Design of building	5	✓	
7. Exploration of ocean animals	6	✓	
8. Exploration of shadow			×
9. Design of robotic arm	7	✓	
10. Design of lava lamp	8	✓	

b. Creative Thinking Skills Assessment (CTSA)

CTSA assesses an individual's capacity to conceive, assess, and enhance ideas in innovative and practical manners. It generally entails duties that necessitate innovative thinking, creative problem-solving, and the generation of original solutions. These evaluations can be utilized in educational environments to cultivate and analyze students' creative thinking capabilities, which are increasingly acknowledged as vital competencies for success in the 21st century. This assessment was adapted from the TTCT test by Ernawati and Muhaimin (2019), and it comprises a series of pre-tests and a series of post-tests. Due to the children's limited comprehension of the questions posed, each test was answered by teachers from both groups.

To enable teachers to assess the development of children's creativity from many viewpoints, current

researchers have concentrated on the constructs and 12 items utilized in this exam, as illustrated in *Table 2*. It summarizes constructs and items related to CSTA. It categorizes the skills into four main constructs, each with associated items that reflect specific aspects of creative thinking

Table 2

Constructs and Items in CSTA

No.	Construct	No.	Item
1.	Fluency	1.	Sparking ideas
		2.	Give suggestions
		3.	Active attitude
2.	Flexibility	4.	Generate ideas
		5.	Identify the problem
		6.	Present ideas
3.	Originality	7.	Give ideas
		8.	Empowering ideas
		9.	Adding ideas
4.	Elaboration	10.	Determine the truth
		11.	Develop ideas
		12.	Reaching Decisions together

Prior to the use of CTSA in an actual study, pilot experiment was conducted in a different preschool, revealing that 25 children demonstrated a notable mean (*m*) score disparity between the pre-test and post-test, changing from *m* = 32.32 to *m* = 51.48. Consequently, following the implementation of one of the ten projects outlined in the MyPreScience Module, positive results regarding creative thinking were observed among the children.

c. Interview Form: Learning Module Effectivenes (LME)

The LME is crucial for assessing the effectiveness of the learning module since it facilitates comprehensive data collecting from participants. This instrument is utilized for many different purposes, including assessing user experience, evaluating comprehension and effectiveness, identifying strengths and weaknesses, understanding the context of use, gathering qualitative data for module enhancement, and measuring student engagement. The establishment of this LME enables contemporary researchers to gather more pertinent and precise data, enhancing the significance and efficacy of the study.

In this instrument, three constructs and three items (refer to Table 3) were employed to evaluate the effectiveness of the MyPreScience Learning Module.

Table 3

Constructs and Items in LME

No.	Construct	Item
1.	Experience	Appropriateness
2.	Insights	Effectiveness
3.	Evaluation	Usability

After the researchers completed the post-test study between the two groups of children, the interview session was conducted with a teacher from the treatment group. In order to ensure that the interview session was conducted well, the researchers used a semi-structured interview where the participants freely gave their views on the questions asked.

Procedure

The study consisted of four parts: pre-test week, intervention weeks, post-test week, and interview session

Pre-Test Week

The methodology for executing a pre-test study at two distinct preschools encompassed numerous essential steps to ensure the dependability of the data obtained. Prior to the deployment of the CTSA instrument in the actual study, it underwent validation by a subject matter expert. Subsequent to the review, the researchers sought consent from the State Education Office, the District Education Office, and the Preschool Headmaster to conduct this study. Upon receiving approval, the researchers initiated the study by disseminating the research instrument to the respondents (teachers from both groups) for completion. To guarantee the precision of the recorded data, the researchers convened a discussion with the study participants to elucidate each component of the produced instrument. On the other hand, children's names were not used to protect their data and privacy. Instead, their names were represented by certain codes, such as numbers, based on their list of names. The test was conducted in two preschools on separate dates and days. Data obtained from the CTSA was documented and preserved for analysis.

Intervention Weeks

The intervention week in the study denotes a designated timeframe during which a planned program, activity, or technique (intervention) is executed on the target group as part of the research. This phase is crucial as it seeks to assess the direct or indirect impacts of the intervention on the study variables. The duration of this trial was 8 weeks, during which the treatment group engaged in science education utilizing the MyPreScience Learning Module. Conversely, the control group employed autonomous ways for science learning and was not constrained by traditional approaches. Continuous monitoring was implemented to guarantee both groups could effectively perform the tasks. The participants' development was rigorously documented in order to assure the intervention was executed as intended. Electronic resources, such as cameras, were employed to keep track of the learning process and facilitation carried out by both groups. The the timeline of intervention weeks can be referred to *Table 4*.

Table 4

The Timeline of Intervention Weeks

Week		Date	Time		Date	Time
1		16/7/2024	9.00 am – 10.00 am		19/7/2024	9.00 am – 10.00 am
2		23/7/2024	9.00 am – 10.00 am		25/7/2024	9.00 am – 10.00 am
3		30/7/2024	9.00 am – 10.00 am		2/7/2024	9.00 am – 10.00 am
4	**Control Group**	6/8/2024	9.00 am – 10.00 am	**Control Group**	8/8/2024	9.00 am – 10.00 am
5		13/8/2024	9.00 am – 10.00 am		15/8/2024	9.00 am – 10.00 am
6		20/8/2024	9.00 am – 10.00 am		22/8/2024	9.00 am – 10.00 am
7		27/8/2024	9.00 am – 10.00 am		29/8/2024	9.00 am – 10.00 am
8		3/9/2024	9.00 am – 10.00 am		5/9/2024	9.00 am – 10.00 am

Post-Test Week

Administering a post-test in the study was a crucial measure to assess the impact of the implemented intervention. Researchers executed this investigation one week subsequent to the successful implementation of intervention weeks for both groups. The researchers employed a uniform research instrument, specifically the CTSA. The researchers underscored the necessity of elucidating the post-test's aim to the study participants, which was to assess the program's or intervention's efficacy, rather than to evaluate them personally. A coding system instead of naming system was implemented to ensure meticulous data collection and maintain continuity between pre- and post-tests. After the data was meticulously collected and documented, researchers compared the post-test findings with the pre-test to discern any alterations.

Analysis

IBM SPSS Statistics

IBM SPSS Statistics was used to evaluate quantitative data to answer research questions RQ1 and RQ2. The Paired t-Test and the Independent Samples t-Test were the two primary statistical tests utilized. The Paired t-Test enabled researchers to determine whether there was a significant difference between two sets of related data, such as pre-test and post-test scores obtained by the same group, addressing the first research question. Analyzing the results of the Paired t-Test made it possible to identify significant differences between pre-test and post-test scores. For answering RQ2, the Independent Samples t-Test was employed. This test assessed whether there was a statistically significant difference in the post-test scores of two distinct groups. The results of the Independent Samples t-Test determined if there was a significant difference in post-test scores between the two groups.

ATLAS.ti 9

Researchers used ATLAS.ti9 software to address RS3. This software enabled users to systematically organize, analyze, visualize, and present qualitative data results effectively. Researchers employed thematic analysis as a method to uncover, analyze, and report patterns (themes) within qualitative data. This strategy was advantageous in qualitative research for organizing and interpreting intricate material by deconstructing it into significant themes. This analysis was adaptable and applicable to several forms of qualitative research, including interviews. It enabled researchers to acquire a profound understanding of the subject matter and to articulate the findings of the investigation in a coherent and systematic manners.

Results

The mean score of treatment group before and after the use of MyPreScience Learning Module (RQ1)

The study employed a Paired t-Test to compare the mean scores of the pre-test and post-test within the same group. Before conducting the test, researchers documented the test scores for each participant, with scores ranging from 1 to 5. A score of 1 indicated that the child's creative thinking skills were severely restricted and required the teacher's

assistance to address a problem. A score of 2 indicated that the child's creative thinking skills were somewhat open yet needed the teacher's supervision in problem-solving. A score of 3 indicated that the child's creative thinking skills were somewhat open; however, they required some encouragement from the teacher while addressing challenges. A score of 4 indicated that the child's creative thinking skills were much advanced and required no teacher assistance when addressing problems. A score of 5 indicated that the child's creative thinking skills were highly critical and did not require the teacher's motivation when addressing any topic. *Table 5* and *Table 6* illustrate the difference in scores between the two groups. *Table 5* provides a detailed comparison of the pre-test scores, while Table 6 presents the post-test scores. The analysis of these tables demonstrated any significant changes in the scores following the intervention, highlighting the effectiveness of the program in enhancing the creative thinking abilities of the children in the study.

Table 5

Pre-Test Scores for the Treatment Group

Code	IT1	IT2	IT3	IT4	IT5	IT6	IT7	IT8	IT9	IT10	IT11	IT12	Total
1	2	2	3	3	2	2	3	3	3	3	2	2	30
2	3	3	3	3	2	3	2	3	3	3	3	2	33
3	3	3	3	3	2	3	2	3	3	3	3	2	33
4	3	3	3	3	2	3	3	3	3	3	3	2	34
5	3	3	3	3	3	3	2	3	3	3	3	2	34
6	3	3	3	3	2	3	2	3	3	3	3	2	33
7	3	3	3	2	2	3	2	3	3	3	3	2	32
8	3	3	3	3	2	3	2	3	3	3	3	2	33
9	3	3	3	2	3	2	3	3	3	3	2	2	32
10	2	2	3	3	2	3	2	3	3	3	2	2	30
11	3	3	3	3	2	3	2	3	3	3	3	3	34
12	3	3	3	3	2	3	3	3	3	3	3	2	34
13	3	2	3	2	3	3	3	3	3	3	2	2	32
14	3	3	3	3	2	3	2	3	3	3	3	2	33
15	2	2	3	3	2	2	3	3	3	3	2	2	30
16	2	2	3	3	2	2	3	3	3	3	2	2	30
17	3	3	3	3	2	3	3	3	3	3	2	2	33
18	3	3	3	3	2	3	2	2	3	3	3	2	32
19	3	3	3	3	2	3	2	3	3	3	3	2	33
20	3	3	3	3	2	3	2	3	3	3	3	3	34
21	3	3	3	3	3	3	3	3	3	3	3	2	35
22	3	3	3	3	2	3	2	3	4	3	3	3	35
23	3	3	3	3	3	3	3	3	3	3	2	2	34
24	3	3	3	3	2	3	2	2	3	3	3	2	32
25	3	3	3	3	2	3	2	3	3	3	3	2	33

Table 6

Post-Test Scores for the Treatment Group

Code	IT1	IT2	IT3	IT4	IT5	IT6	IT7	IT8	IT9	IT10	IT11	IT12	Total
1	5	5	5	5	5	5	5	5	4	3	3	5	55
2	5	5	5	5	5	4	5	5	4	3	3	5	54
3	5	5	5	5	3	5	5	5	4	3	5	5	55
4	5	5	5	5	5	5	5	5	5	5	3	5	58
5	5	5	5	5	5	5	5	5	5	3	3	5	56
6	5	5	5	5	5	5	5	5	4	5	3	5	57
7	5	5	5	5	5	5	5	5	4	3	3	5	55
8	5	5	5	5	5	5	5	5	5	3	5	5	58
9	5	4	5	4	5	5	5	5	4	3	3	4	52
10	5	5	5	5	5	5	5	5	4	3	3	3	53
11	5	5	4	5	5	5	5	5	4	3	3	5	54
12	5	5	5	5	5	5	5	5	4	3	3	5	55
13	4	5	5	5	5	5	5	5	4	3	3	4	53
14	5	5	5	5	5	5	5	5	4	4	5	5	58
15	5	5	5	5	5	5	5	5	5	4	5	5	59
16	5	5	5	5	5	5	5	5	4	3	3	4	54
17	5	5	5	5	5	5	5	5	4	3	3	5	55
18	5	5	5	5	5	5	5	5	4	3	4	5	56
19	4	5	4	5	5	5	4	4	4	3	3	4	50
20	5	5	5	5	5	5	5	5	4	3	3	5	55
21	5	5	5	5	5	5	5	5	5	3	5	5	58
22	5	5	5	5	5	5	5	5	4	4	5	5	58
23	5	5	3	5	5	5	5	5	4	3	3	5	53
24	5	5	5	5	5	5	5	5	4	3	3	4	54
25	5	5	4	5	5	5	5	5	4	3	3	5	54

After the intervention period, researchers analyzed the mean scores of both the pre-test and post-test. Table 7 illustrates the mean difference between the pre-test and post-test scores for the treatment group, highlighting the impact

of the intervention on the participants' performance.

Table 7
The Difference Between Mean Scores of Pre-Post Tests

Item	Question	Mean	
		Pre-Test	Post-Test
1.	Children can generate ideas to solve problems in science activities in preschool.	2.84	4.92
2.	Children can propose various actions during science activities.	2.80	4.96
3.	Children show an active attitude in solving problems related to science concepts.	3.00	4.80
4.	Children can come up with ideas to answer various questions related to science activities.	2.88	4.96
5.	Children can identify problems from different perspectives during science activities.	2.20	4.92
6.	Children can present their ideas in different ways during science activities.	2.84	4.96
7.	Children can provide new ideas in solving problems during science tasks.	2.40	4.96
8.	Children can empower others' ideas during science activities.	2.92	4.96
9.	Children can add or refine ideas to improve the quality of their thoughts.	3.04	4.20
10.	Children can determine the truth in solving problems during science activities.	3.00	3.28
11.	Children can develop creative ideas to implement science activities.	2.68	3.52
12.	Children have the potential to be trusted to achieve consensus during science activities.	2.12	4.72

Table 6 presents the pre-test and post-test mean scores evaluating children's problem-solving abilities and creativity in science activities during preschool. The analysis reveals clear improvements in these competencies, attributable to the intervention. Based on general observations, all items show increases in mean scores, indicating that the intervention positively influenced children's problem-solving, creativity, and ability to contribute during science activities. Many items, such as proposing various actions, answering questions, and empowering others' ideas, reached a mean of 4.96, signifying a near-universal enhancement in these skills.

The intervention yielded significant improvements in critical thinking and collaborative skills among children. This is evidenced by the substantial increase in scores for identifying problems from different perspectives (Item 5), which rose from 2.20 to 4.92, and trust to achieve consensus (Item 12), which jumped from 2.12 to 4.72. Consistently high post-test scores in proposing actions (Item 2), presenting ideas (Item 6), and empowering others' ideas (Item 8), all reaching a maximum of 4.96, highlight the intervention's success in promoting diverse and dynamic thinking. However, there was only marginal improvement in determining the truth in problem-solving (Item 10), from 3.00 to 3.28, and moderate progress in developing creative ideas (Item 11), from 2.68 to 3.52. This underscores the need for additional focus on fostering analytical reasoning and higher-level creativity.

In addition, based on *Table 8*, the data highlights a marked improvement in performance from the pre-test to the post-test. This suggests that an intervention conducted between the two tests may have positively influenced the participants' outcomes. The relatively low standard error values indicate reliable estimates of the population mean. Specifically, the average score for the pre-test is 32.60, while for the post-test, it is 55.16.

Table 8
Cumulative Mean Score for 12 Items in Pre-Post Tests

Test	N	Mean	Std. Error Mean
Pre-Test	25	32.60	0.316
Post-Test	25	55.16	0.442

In conclusion, the intervention significantly enhanced the holistic development of ideas among children. This is reflected in substantial gains in their ability to present ideas in different ways and add or refine ideas, demonstrating improved creativity and flexibility in thought. Additionally, notable advancements in consensus-building and empowering others' ideas indicate a marked increase in social and teamwork skills, fostering collaboration and empowerment. However, while creativity-related aspects showed robust improvements, areas such as determining truth and creative implementation require further emphasis to strengthen critical thinking and higher-order creative capabilities.

The difference in the mean score of creative thinking skills between the treatment and control groups (RQ2)

Figure 5.13 below presents the "Independent Samples Test," which demonstrates that the difference in post-test scores between the control and treatment groups was evaluated using the t-test for Equality of Means. The t-value, assuming equal variances, is -33.659 with degrees of freedom (df) = 48. The p-value (Sig. 2-tailed) is less than 0.001, indicating high significance. The disparity in post-test scores between the control and treatment groups is statistically significant. Given that the p-value is substantially below 0.05, we reject the null hypothesis, determining that the treatment group exerted a significant influence on the scores. The average difference between the control and treatment

groups is -21.230. This signifies that the treatment group's post-test results exceed those of the control group by an average of 21.23 points.

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
						Significance		Mean	Std. Error	95% Confidence Interval of the Difference
		F	Sig.	t	df	One-Sided p	Two-Sided p	Difference	Difference	Lower	Upper
Posttest_Score_2	Equal variances assumed	.086	.770	-33.659	48	<.001	<.001	-21.320	.633	-22.594	-20.046
	Equal variances not assumed			-33.659	47.970	<.001	<.001	-21.320	.633	-22.594	-20.046

Figure 2: Independent Sample T-Test Result for Creative Thinking Skills

The findings indicate a statistically significant disparity between the post-test scores of the control and treatment groups. The treatment group exhibited a mean score that exceeded 21.23 points. Levene's test validates the equal variances assumption, thereby confirming that the treatment significantly enhanced performance. A p-value below 0.001 signifies that this outcome is exceedingly improbable to have arisen by chance.

In conclusion, one reason for the elevated creativity developments of children in the treatment group compared to the control group after 8 weeks of intervention is the greater variety of resources utilized in the MyPreScience Module activities. The treatment group had access to many learning materials, including natural items, scientific instruments, and digital resources, which may have afforded them greater possibilities to investigate diverse methods and solutions. Innovative thinking frequently emerges when individuals utilize various instruments to investigate novel ideas.

The effectiveness of MyPreScience Learning Module (RQ3)

To address this RQ3, only an teacher from the treatment group (E2) were interviewed. *Figure 3* is a flowchart illustrating the relationships between different aspects of the effectiveness of the MyPreScience module. The flowchart includes elements such as "Appropriateness," "Effectiveness," and "Usability," connected by causal links indicating that appropriateness, effectiveness, and usability contribute to the overall effectiveness of the MyPreScience Learning Module.

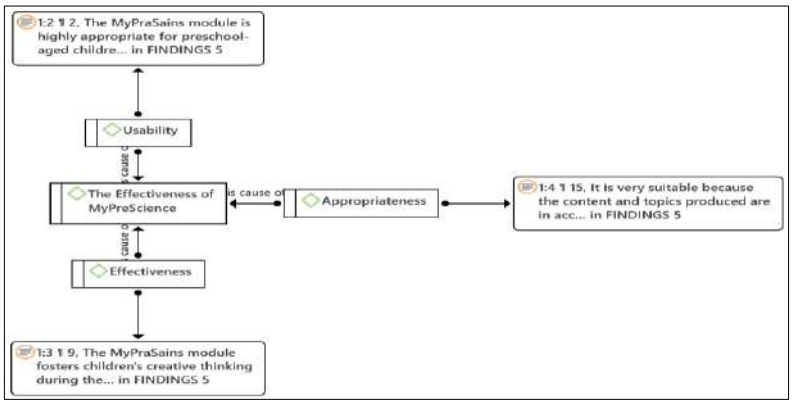

Figure 3: The Results from Content Analysis

Exploring the suitability of the MyPreScience Learning Module, E2 believes that the module serves as an essential educational tool that not only meets national curriculum standards but also provides a fun, interactive, and enriching way for young children to engage with science. This ensures that they develop foundational skills and a curiosity about the world around them, setting the stage for future learning. This is evidenced by the teacher's statements below:

> *"You know what that this module is highly appropriate for preschool-aged children. The projects presented in this module are exemplary. It provides children with early science activity experiences aligned with the competencies of the National Preschool Standard Curriculum, coordinated at the preschool level. Please explain this sentence in deeper elaboration."* – E2

The statement above highlights that E2 believes the suitability of this module lies in its design, which is

specifically tailored for preschool-aged children, typically between 4 to 6 years old. This developmental stage is crucial for early childhood, where children are naturally curious and eager to explore their surroundings. The MyPreScience module addresses this curiosity by introducing simple science concepts through hands-on and experiential learning, aligning with their cognitive and developmental needs.

In addition, regarding the module's effectiveness in enhancing children's creativity, E2 believes that the MyPreScience module is a comprehensive educational tool designed to enhance preschool children's creative thinking skills through engaging, project-based activities. By providing resources and encouraging contemplation of outcomes, the module helps children develop critical thinking and problem-solving abilities. The feedback received upon project completion further reinforces their learning and fosters continuous improvement. This is evidenced by the teacher's statements below:

> *"I believe that MyPreScience module fosters children's creative thinking during the early years of preschool by providing resources in a project that stimulates contemplation of subsequent outcomes. Upon the project completion, they will receive feedback based on their implementations." – E2*

Next, considering the usability of this module, E2 believes the module is highly suitable as its content and topics align with the elements established in the National Preschool Standard Document 2017. It is considered useful for use across all levels of kindergarten and preschool education. This can be evidenced by the teacher's statements below:

> *"It is very suitable because the content and topics produced are in accordance with the elements formed in the National Preschool Standard Document 2017. In my view, this module is very suitable for use at all levels of kindergarten and preschool." –* E2

In summary, MyPreScience Learning Module is recognized by E2 as an essential and highly suitable educational tool for preschool-aged children (5–6 years old). It effectively supports early science education by combining hands-on, experiential learning with curriculum alignment to the National Preschool Standard Curriculum. Key aspects of its suitability include fostering curiosity, critical thinking, and creativity through project-based activities, as well as promoting foundational scientific skills in a fun and engaging manner. In addition, E2 emphasizes the module's ability to enhance children's creative thinking by encouraging them to explore, analyse outcomes, and reflect on feedback, which further solidifies their learning. Additionally, the module's content and topics align with the National Preschool Standard Curriculum, making it a valuable resource for use across all kindergarten and preschool levels. These attributes are evidenced by E2's positive feedback, underscoring the module's relevance and effectiveness in early childhood education.

Discussion

Summary of results

Children's Creative Skills before and after using MyPreScience

Children demonstrate better performance after using science learning modules like MyPreScience compared to conventional learning methods due to several critical factors, including pedagogical approaches that are more relevant to the developmental needs of children. This is because active and interactive learning approaches through project-based activities (TPBL) stimulate the development of children's creativity when solving tasks. As evidence, Dai et al. (2023) explain that the integration of technology in classrooms enhances the effectiveness of project-based learning approaches, potentially leading to improved student engagement and learning outcomes based on the creative actions empowered by them while doing activities. This supports the notion that such modules not only align with children's natural learning processes but also foster a more engaging and effective educational environment.

Furthermore, children exhibit positive creative development throughout the execution of 8 projects based on the module because it is relevant to their developmental stages. The MyPreScience module is specifically designed based on the cognitive and social developmental stages of preschool children, in accordance with Vygotsky's theory, which emphasizes that children learn better through experiences with their social environment. In a previous study, researchers argued that Vygotsky's theories offer valuable insights into the role of social interaction and cultural tools in cognitive development. They also highlighted the relevance of these theories in contemporary educational practices, suggesting that teachers can use Vygotsky's ideas to create more effective and culturally responsive learning environments (Kozulin et al., 2003). This study is evidenced by how teachers provide opportunities for children to participate transparently in the classroom through their creative ideas, as shown in *Figure 4* below:

Figure 4: Children Did a Volcano Activity Based on Their Own Idea

Based on the figure above, before children developed their creative ideas to solve problems in Science Education Project 1: Exploring Volcano Eruptions, they first gathered initial ideas through a technology-based activity and observed a simulation by the teacher. Subsequently, they were given open opportunities and freedom to make decisions on exploring the eruption based on their ideas, which could be refined through the various activities they observed earlier.

Children's Creative Skills based on Post-Test's Result from 2 Different Group

The differing outcomes between the treatment and control groups indicate that 21st-century learning using the TPBL approach (Meng et al., 2023) is highly impactful in contemporary education. The independent t-test scores reveal that the treatment group achieved higher scores because the children were empowered to openly demonstrate their creative ideas, unlike the children in the control group, who primarily followed their teachers' instructions when making decisions to solve the given tasks. Muhamad and Seng (2019) explain that one key difference between conventional and contemporary learning is that conventional teachers focus more on what children remember, whereas contemporary teachers, aligning with educational trends, place greater emphasis on the learning process where learners work collaboratively with peers and teachers. *Figure 5* illustrates the differences in how children from the control and treatment groups approach the same science activity topic of exploring the chicken cycle.

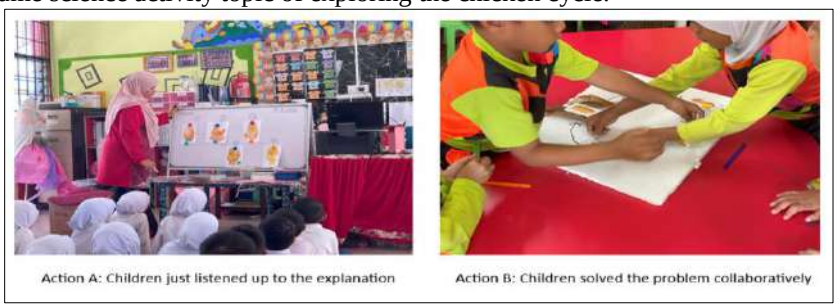

Figure 5: Different Style of Learning between Control (Action A) and Treatment Group (Action B)

Based on Figure 5, it can be observed that teachers from the control group employ teacher-centered learning strategies, whereas the strategy used by teachers from the treatment group is student-centered learning (Cummins, 2009). Teacher-centered learning is a traditional approach in education where the teacher serves as the primary authority figure in the learning process. In this approach, the teacher fully controls the teaching activities, while children act as passive recipients of information. The main focus is on content delivery, achieving curriculum objectives, and mastering basic skills by students (Garrett, 2008). In contrast, student-centered learning is an educational approach that places children at the core of the learning process. This approach prioritizes the needs, interests, talents, and experiences of the children, with the teacher acting as a facilitator or guide rather than the primary source of information. It aims to provide children with opportunities to explore, think critically and creatively, and learn practically (Murphy et al., 2020).

Therefore, this study demonstrates that the implementation of teaching and facilitation activities in science education should prioritize the learning process over learning outcomes. To ensure the continuity of this process, it is appropriate for teachers to adopt a student-centered learning approach (Morel, 2021). In addition, Kerimbayev et al. (2023) highlight the importance of student-centered learning, especially when integrated with modern technologies in distance learning environments. Their systematic review suggests that student-centered approaches foster greater engagement, motivation, and active participation among learners. By placing students at the core of the learning process, these methods encourage autonomy, critical thinking, and collaboration, which are essential skills for the 21st century. The review also emphasizes that student-centered learning can lead to more meaningful and personalized educational experiences, ultimately enhancing overall learning outcomes.

The Effectiveness of TPBL Learning Module

The use of the MyPreScience Learning Module is a modern teaching and facilitation method that emphasizes

experiential learning, exploration, and problem-solving with the aid of technology. The TPBL (Technology-Integrated Project-Based Learning) approach in science education supports various aspects of child development, including cognitive, social, and technical skills, making it highly relevant for the educational needs of the 21st century (Akgun, 2013). One of the key benefits is that it empowers children to demonstrate their creativity when solving given tasks. This is because the project approach involves children in solving real-world problems through research, experimentation, and collaboration. Additionally, the use of technology, such as educational videos and creative software, helps children to find information, analyze data, and produce innovative solutions. Jani (2021) explains that the most effective way to integrate technology and project aspects practically is through the flipped classroom method, as studied by Nouri (2016). This can be achieved by introducing technology-based activities for brainstorming and practical project implementation activities for problem-solving. The impact of integrating technology in PBL lies in the role of technological materials used in the classroom as facilitators. These tools nurture the learning and facilitation processes by providing opportunities for designing and implementing science projects, thereby enhancing the overall learning experience (Akgun, 2013).

Implications

The incorporation of the TPBL approach in educational practices has significant ramifications for children, educators, and the educational system overall. This approach provides considerable advantages but also requires modifications in pedagogical tactics and budget allocation. A significant aspect is the improvement of 21st-century abilities in children. The TPBL approach to science education encourages learners to address real-world challenges, necessitating the application of critical and creative thinking skills (Mabe et al., 2022). For example, when children undertake a study project to rebuild a terrarium, they have to analyze data using educational videos, collaborate with peers in designing and building of the terrarium, and use their own ideas in its creation. Such activities refine their cognitive abilities and offer an opportunity for independent problem-solving.

Additionally, the application of TPBL in education significantly affects educators, notably regarding their duties and responsibilities in the classroom (Muzana et al., 2021). Educators are no longer mere transmitters of knowledge; they must evolve into more dynamic roles as facilitators of learning. This transition entails not only acquiring new competencies but also transforming the planning and execution of more participatory and successful educational activities. In this approach, educators no longer merely teach directly; rather, they enhance the learning process of the pupils. Educators, as facilitators, must cultivate a learning environment that fosters discovery, autonomous learning, and collaboration among students, and it should be aligned with 21st century learning (Lapcharoen, 2021). They must create an environment that allows children to take the initiative in learning, investigate novel concepts, and address challenges through their projects.

Next, the final implication pertains to the educational system. TPBL significantly influences the entire educational system. This approach provides multiple advantages for improving learning quality, although it necessitates substantial modifications in infrastructure and support within the educational system (Meng et al., 2023). A fundamental implication is the necessity for sufficient technology infrastructure to facilitate the seamless and efficient execution of this method. For technology to be effective in PBL, schools must have reliable internet access. Dependable internet access is essential for utilizing technology tools in education, particularly for tasks necessitating online research or collaboration with external entities. In the absence of stable internet connectivity, children may encounter challenges in obtaining essential information, engaging in online activities, or interacting with their peers and educators. Consequently, educational institutions must guarantee that the internet connectivity across the campus is adequate and capable of facilitating uninterrupted technological utilization.

Conclusion

The TPBL in early science learning has shown a significant positive impact on children's creative thinking skills. This approach transforms the traditional teacher-centered learning environment into a dynamic, interactive space where children engage in real-world problem-solving through research, experimentation, and collaboration. The use of technological tools enhances the learning experience by providing access to diverse resources, facilitating data analysis, and enabling the creation of innovative solutions. As demonstrated in the study, this method not only increases children's engagement and motivation but also fosters critical and creative thinking. The transition from passive information receivers to active participants in the learning process empowers children to take initiative, explore new ideas, and develop problem-solving skills, thereby preparing them for future educational and life challenges. These findings underscore the importance of integrating technology and PBL into educational practices to nurture essential 21st-century skills in young learners.

Acknowledgements

This study was conducted collaboratively between University of Technology Malaysia, University of Cape Town, and preschools under the administration of the Ministry of Education Malaysia. We would also like to express

our deepest appreciation to the ones that participated in this study for their invaluable participation and support throughout the research process. Furthermore, we acknowledge the financial support provided by the UTM Nexus Scholarship. We are grateful for the funding that enabled us to pursue this important study.

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Appendix A: The Approval of Conducting a Research Issued by the Ministry of Education Malaysia

MINISTRY OF EDUCATION MALAYSIA EDUCATION POLICY PLANNING
AND RESEARCH DIVISION LEVELS 1-4, BLOCK E8 GOVERNMENT
COMPLEX PARCEL E FEDERAL GOVERNMENT ADMINISTRATIVE
CENTRE 62604 PUTRAJAYA

TEL : 0388846591
FAX : 0388846579

Our Ref. : KPM.600-3/2/3-eras(20219)
Date : May 12, 2024

MUHAMMAD NUR AZAM BIN GHAZALI
IC. NO.: 960518****

D/A KG PERMATANG PASIR, GUNUNG 16090 BACHOK KELANTAN Sir, CONDITIONAL APPROVAL TO CONDUCT A STUDY: THE EFFECTIVENESS OF A PROJECT-BASED LEARNING SCIENCE MODULE TO PROMOTE SOCIAL INTERACTION, CREATIVITY AND LEARNING MOTIVATION AMONG PRESCHOOL CHILDREN

The above is referred to.

2. Please be informed that your application to conduct the study as below has been approved with the following conditions:

" THIS APPROVAL IS DEPENDENT ON THE PERMISSION OF THE DIRECTOR OF THE NPR AND THE DISCRETION OF THE SCHOOL ADMINISTRATOR. DATA COLLECTION SHOULD NOT INTERFERE WITH THE TEACHING AND LEARNING ACTIVITIES OF THE STUDENTS. THE RESEARCHER MUST OBTAIN WRITTEN PERMISSION FROM THE PARENTS OF THE STUDENTS INVOLVED IN THIS STUDY. SCHOOL ADMINISTRATORS NEED TO RESEARCH THE SUITABILITY OF THE MODULE DEVELOPED BEFORE USING IT BY THE STUDENTS. THE NAME ITEM ON THE INTERVIEW INSTRUMENT SHOULD ISSUED TO PROTECT RESPONDENTS' PERSONAL DATA. "

3. Approval is based on the research proposal paper and research instruments submitted by you to this section. However, this approval depends on the permission of the State Education Department and the relevant Principal/Headmaster.

4. This approval letter is valid for use from 1 July 2024 to 25 December 2024

5. You are required to submit a copy of the final study report in hardcopy form along with a softcopy in pdf format on a CD to this Division. You are also reminded to obtain prior permission from this Division if part or all of the study findings are to be published in any forum, seminar or announced to the mass media.

That's all for your information and further action. Thank you.

"SERVING FOR THE COUNTRY"

I am the one who carries out the trust,
Principal Senior Assistant Director, Policy Research and Evaluation Sector, Director of the Educational Policy Planning and Research Division, Ministry of Education, Malaysia

copy to:-
KELANTAN EDUCATION DEPARTMENT

* THIS LETTER IS COMPUTER GENERATED AND NO SIGNATURE IS REQUIRED *

Appendix B: The Approval of Conducting a Research Issued by the Kelantan State Education Department (Malay Language Version)

THE MINISTRY OF EDUCATION MALAYSIA
Kelantan State Education Department
Bandar Baru Tunjong,
16010 Kota Bharu, Kelantan

Tel : 09-7418000
Fax : 09-7482554
Website: jpnkelantan.moe.gov.my

Ref. Us: JPNKN.600-1/1/2 Vol.2(20)
Date : 27 May 2024

MUHAMMAD NUR AZAM BIN GHAZALI
NO. K / P: 960518-03-6103

D / A KG RIDGE SAND, MOUNTAIN
16090 BACHOK
KELANTAN

Sir / Madam,

PERMISSION TO CONDUCT STUDIES IN SCHOOLS, TEACHER EDUCATION INSTITUTIONS, STATE EDUCATION DEPARTMENTS AND DIVISIONS OF THE MINISTRY OF EDUCATION

It is with great respect that I refer to your letter of request regarding the above.

2. Permission letter from the director of Education Policy Planning & Research Division, Ministry of Education Malaysia, reference: Moe.600-3/2/3 - eras (20219) dated May 12, 2024 related.

3. The State Department of Education has no control over research: "the EFFECTIVENESS of PROJECT-BASED LEARNING MODULE TO PROMOTE SOCIAL INTERACTION, CREATIVITY AND LEARNING MOTIVATION AMONG PRESCHOOL CHILDREN."approved.

4. This list is based on the number of studies / submitted to this department for the period from 1 July 2024 to 25 December 2024.

5. The schools involved are: primary schools in the state of Kelantan.

6. You are advised to talk to the principal first schools prior to the study.

That's all, thank you.

"MALAYSIA MADANI"

"SERVING THE COUNTRY"

I run the trust,

(HJ. MOHAMAD BIN ABD. WAHAB B.S.K., A.S.K.)
Deputy Director Of Education
PPD planning and management sector
b.P Director of Education
Kelantan State Education Department

s.k.:
i. Director Of Education Kelantan.
ii. Director, Education Policy Planning & Research Division, Ministry Of Education Malaysia.
iii. District Education Officer: PPD concerned.
iv. The Principal / Principal of the school

"QUALITY EDUCATION AND A HEALTHY ENVIRONMENT"

FWU Journal of Social Sciences, Spring 2025, Vol.19, No.1, 76-90
DOI: http://doi.org/10.51709/19951272/Spring2025/7

Fostering Sound Skill Development: An Examination of Staff Training Methods as Means of Knowledge Transfer

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Reward Utete
University of Johannesburg, South Africa

Although various studies cover staff training, no empirical study to date has investigated the effectiveness of various training methods in facilitating the transfer of knowledge. Hence, the study sought to shed light on the effectiveness of different employee training methods on knowledge transfer in the hospitality industry. The study employed a correlational research design and a quantitative approach. Using empirical data from 118 employees in five subsidiaries of a big-scale hospitality company in Zimbabwe, multi-regression analysis was used to assess the impact of each training method on knowledge transfer. While different training methods can transfer knowledge, the findings of this study indicated that mentoring and coaching were the most effective training methods for transferring knowledge. On the contrary, out of six key training methods at the workplace, role-play was found to be the least effective training method in facilitating knowledge transfer. Thus, the study yielded several policy-relevant findings, particularly to inform training policies in the organisation. The primary limitation of this research is that it focused on organisations in Zimbabwe, hence the results may not be generalised to other nations unless they share similar setting .

Keywords: skill development; Knowledge transfer; training methods; capacity building; human resource development

Although staff training methods have been thoroughly studied (Amrik, 2014; Chukwuemeka & Endurance, 2022; Elsafty & Oraby, 2022; Gan & Yusof, 2019), there is a lack of studies about their effectiveness in transferring knowledge. Due to the rapid dynamic competitive landscape, organisations increasingly focus on advancing new skills and knowledge of their employees. Human capital has become various organisations' fulcrum to gain a competitive edge in the business environment. Nevertheless, poor selection of the appropriate training methods is a critical daunting challenge which retards efforts of upskilling employees in hospitality organisations. Various organisations face pressure to upskill their employees to develop ingenious solutions to upheavals of inefficiencies and a severe competitive environment. The scrutiny of training methods has come to the forefront due to poor results from employees experienced by organisations after offering them training (Ju & Li, 2019; Kandampully, Zhang & Jaakkola, 2018). Despite the importance and salient of the issues associated with training methods, to date, no empirical study has been conducted to establish the influence of every training method towards knowledge transfer. This paper gives a first examination of the level of effectiveness of every training method on knowledge transfer. Numerous organisations choose the training method based on the cost associated with the method (Gan & Yusof, 2019; Aboramadan & Karatepe, 2021) and the time spent on the training using the method. Most organisations prefer to utilise less costly training methods despite their ineffectiveness in transferring knowledge. Similarly, the management tends to opt for methods that take less time to complete the training. In this matrix, the knowledge transfer effectiveness of the training method is often overlooked. Alexander, Martin, Manolchev and Miller (2020) define knowledge transfer as the focused and unidirectional dissemination of knowledge among organisations, departments or employees, such that the recipient of knowledge acquires sufficient comprehension and proficiency in implementing the acquired knowledge. Research by Coculʼová (2017) examining the factors that influence the decision to select training methods established that organisations tend to opt for approaches that require minimal financial and time investment. Similarly, a study by Majovski and Davitkovska (2016) on skill development during difficult periods revealed a general decline in training expenditures, with companies prioritising in-house, job-specific training for their employees. Transferring tacit knowledge to trainees is invaluable, and not all training methods can effectively transfer it. Lamb and Sutherland (2010) indicate that once trainees acquire such knowledge, they become golden workers.

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Some training methods do not perfectly transfer noble skills, resulting in knowledge transfer disintegration (Mota-Veiga, Figueiredo, Ferreira & Ambrósio, 2021; Vezi-Magigaba & Utete, 2023). The prevailing knowledge economy, the intellectual capacity of employees is increasingly valued over physical strength, as it is believed to be a key driver of organisational success. Tacit knowledge is associated with experience and skills built on the job (Gou, Li, Lyu, Lyu & Zhang, 2019; Ali & Majid, 2020).

According to Duvivier, Peeters, and Harzing (2019), knowledge transfer can enable organisations to convert knowledge into valuable assets and establish a culture of continuous learning. Knowledge transfer enables an organisation to disseminate valuable experiential skills and information internally throughout the company. Osabutey and Jackson (2019) state that implementing effective knowledge transfer procedures can facilitate the dissemination of crucial knowledge from teams and individuals within an organisation. According to Romanyshyn, Sheketa, Pikh, Poteriailo, Kalambet and Pasieka (2019), this can enhance the utilisation of employees possessing relevant information at the appropriate time. The advantages of effective knowledge transfer include a reduction in reliance on individual knowledge champions, the implementation of employee incentive programmes, a decrease in the need for redevelopment, and a reduction in monitoring requirements. ldohyan, Al-Rawashdeh, Sakr, Rahman, Alfarhan and Salam (2019) observe that seasoned employees, typically trainers, are reluctant to transfer their knowledge to emerging professionals. Iddy (2021) emphasises that seasoned employees are apprehensive about losing their job worth when they transfer their knowledge. Certain employees believe that acquiring and retaining knowledge is the sole means by which they can earn authority and respect. Coetzee et al., (2009) assert that certain workers may be paired with seasoned workers who lack the skills to train others effectively. The effectiveness of staff training depends on the presence of mechanisms for transferring acquired knowledge to improve job performance.

Zvobgo and Chivivi (2014) assert that a low employee retention rate and a significant labour-intensive set-up characterise the hospitality industry. According to Rothwell (2010), a conspicuous indication of the necessity for knowledge transfer and distribution arises when there is a decline in employee retention. To easily facilitate the transference of knowledge from tacit to explicit, it is crucial to have access to suitable structures, language, culture, technology, and processes that enable its acquisition and utilisation within the organisation. Trequattrini, Massaro, Lardo, and Cuozzo (2019) state that organisations' poor management of explicit knowledge can result in conflicts and disruptions in their daily operational processes. Therefore, it is crucial for the organisation to cultivate a sense of safety among its workforce, incentivise them to enhance their motivation, provide them with training and delegate authority to enable effective transfer of knowledge. However, a study by Mubarik, Chandran and Devadason (2018) focused on human capital and found that experience is more important than qualification and education. Given the concerns about knowledge transfer, the study sought to examine the effectiveness of different staff training methods in transferring knowledge to employees. Despite the seemingly logical effectiveness of training methods on knowledge transfer, no study has empirically or theoretically tested how much each training method contributes to knowledge transfer. Drawing on this research gap in the staff training and knowledge transfer literature, the paper sought to answer the identified research questions: i) How effective are staff training methods in transferring knowledge? and ii) Is the knowledge transfer institutionalised in hospitality organisations? Hence, this paper filled the research void.

Literature Review

Theoretical Framework

The study is guided by human capital theory and adult learning theory. These theories complement each other in interpreting and explaining how effectively each staff training method transfers knowledge. Human capital theory was first introduced by Mincer (1958). The human capital theory assumes that formal training is highly invaluable and essential to stimulate the productive capacity of employees (Fagerlind & Saha, 1997). Human capital theory strives to prove that the staff training of employees is essential in enhancing the skills of an employee through knowledge transfer (Mouallen & Analoui, 2014). This entails a necessity to invest in human capital through employing different training methods to transfer knowledge to the employees. Training methods are essential for transferring knowledge to the employees. However, the most effective staff training method for transferring knowledge has yet to be discovered. The theory purports that there are different staff training methods, and their effectiveness in knowledge transfer differs from one method to another. Human capital accumulation is increased through training methods. Across the entire occupational strata within the organisation, training methods are required as the essential mediums of knowledge transfer to fill the skills gap of employees. The adult learning theory was propounded by Knowles (1973). Adult learning theory is derived from organisational development and is regarded as a manner of providing employees with the necessary tools to perform optimally at the workplace. Adult learning theory combines action learning, experiential, self-directed and project-based (Conlan, Grabowski & Smith, 2003). The adult learning theory emerged after traditional pedagogical models failed to fit well into the workplace training space. Adult learning is more than cognitive processing as it requires tailored instructional strategies that foster adults to learn. The strategy

of dialogue and reflection, whether with a group, another or self, is encouraged to enable learning. Nevertheless, learning to reflect is a critical developmental process required in the adult learning environment. Critical reflection is critical for developing brain capacity, politics in workplace learning, confronting power, and transformative learning. In this study, training methods emphasise reflections and dialogue differently; hence, their effectiveness in transferring knowledge differs.

The concept of staff training

Employee training is vital at all levels within an organisation, as it enables the proper implementation of a structured learning framework while aligning with corporate goals that emphasise knowledge sharing. Training can take place in proximity to the job, directly on the job, or externally (Blackman, DiGennaro-Reed, Erath, & Henley, 2022; Khan et al., 2015). However, the hospitality sector primarily relies on two key training methods: off-the-job training and on-the-job training. As noted by Brixiová, Kangoye, and Said (2020), off-the-job training occurs outside the workplace. Due to the industry's high work demands, this approach is rarely utilised. Instead, employers opt for on-the-job training for operational staff, where employees learn under the guidance of consultants, supervisors, or experienced colleagues and receive certification upon completion. This form of training takes place within the workplace, allowing employees to develop skills while performing their job duties. On-the-job training is recommended by Chukwuemeka and Endurance (2022) as the best type of training for keeping staff members with current developments in the hospitality sector. Nevertheless, usually, on-the-job training is associated with minimum theoretical knowledge, which is detrimental to the expectations of the trained staff (Elsafty & Oraby, 2022; Deery & Jago, 2015; Utete, 2024). For the overall professional growth of managers, seminars, workshops, and conferences are the preferred methods of training conducted in close proximity to the workplace. In contrast, on-the-job training remains the most widely used approach for the development and skill enhancement of non-managerial employees. Every situation may call for a distinct training approach because there is no one type of staff training that is appropriate for all circumstances (Gan & Yusof, 2019; Ahmed, Fiaz, & Shoaib, 2015). While specific objectives can be achieved using just one method, others demand different methods. Understudy, job rotation, mentoring and coaching are the five main methods of staff training in the hospitality sector (Jeni & Al-Amin, 2021). Although on-the-job training occurs outside the workplace, the training venue resembles a workplace environment. Role-playing and simulations are vital methods of near-on-the-job training. According to Ju and Li (2019), near-on-the-job training for employees can include part-time studies that lead to externally accredited qualifications. In addition, the intranet is being increasingly utilised as a platform for both on-the-job and near-on-the-job training, particularly for improving technical competencies and knowledge.

The concept of knowledge transfer

Bustelo, Ferguson, and Forest (2019) explain that knowledge transfer serves as a process through which specialised expertise is shared from an individual or group to others. This concept incorporates both the viewpoint of the knowledge provider and that of the recipient. Thus, knowledge transfer is seen as transmitting expertise from the latter to the former, aiming to enable the latter to gain and utilise the knowledge. According to Fischer, Guerrero, Guimón and Schaeffer (2021), the prevailing approach is to facilitate knowledge exchange among staff. The process of knowledge transfer involves the dissemination and application of knowledge that has been selected from either internal or external sources within an organisation. According to D'Andreamatteo, Ianni, Rangone, Paolone and Sargiacomo (2019), effective knowledge transfer depends on the willingness of individuals who possess knowledge to share and communicate it. The two primary classifications of knowledge are explicit knowledge and tacit knowledge. According to Dahiyat, Khasawneh, Bontis, and Al-Dahiyat (2023), individuals acquire both tacit and explicit knowledge through active participation in their professional activities. However, fully converting tacit knowledge into an entirely explicit form is considered impractical. Giuri, Munari, Scandura, and Toschi (2019) further suggest that explicit knowledge can be categorised into two main types: rule-centered and object-centered. The term "object-centred" refers to knowledge that has been formalised into formulae, numerical representations and written documents. The acquisition of rule-based knowledge occurs through codifying knowledge in the form of rules, instructions and guidelines.

Shao and Ariss (2020) describes explicit knowledge as documented information that is reflected in symbols, figures and texts and may be expressed in writing and stored. The acquisition of explicit knowledge is facilitated through classroom manuals, textbooks, procedures, policies and process-flow documents. Systematising and codifying procedural knowledge, such as work procedures and processes, into data format is imperative. According to Khoirunnisa and Almahendra (2022), codifying and transferring explicit knowledge using electronic databases and documents is possible. Codification of explicit knowledge can produce tangible information. Knowledge recipients can access it upon being codified as it becomes available for distribution (Sun, Ren & Anumba, 2019; Bharwani & Talib, 2017; Ahmad, Malik, & Anwar, 2018). Explicit knowledge is characterised by its impersonal nature and lack

of attachment to social beliefs and individual ideologies. Amir, Okimoto, and Moeller (2020) describe tacit knowledge as the expertise held by employees that is challenging to formally document or articulate. Tacit knowledge refers to the knowledge possessed by staff members which shapes their cognitive processes and behaviours but cannot be fully articulated. This type of knowledge is embedded within the skills and expertise of an employee in performing job-related tasks. According to Racko, Oborn and Barrett (2019), tacit knowledge holds significant value, particularly when an employee is faced with a novel and unanticipated task. Tacit knowledge refers to the skills and expertise possessed by employees that are not formally recorded or explicitly articulated. This type of knowledge encompasses implicit regulations, methodologies, and approaches to resolving issues. Manville, Karakas, Polkinghorne and Petford (2019) state that the tacit aspect is based on the state of mind, intellect and experiences within a specific context, encompassing both cognitive and technical components. Milagres, Rosileia and Burcharth (2019) state that the technical aspect pertains to a comprehensive understanding and proficiency that can be implemented in a specific setting, while the cognitive aspect pertains to an individual's cognitive processes, values, ethics and viewpoints. This concept pertains to transferring knowledge and experiences across different contexts.

Development of research hypotheses

While previous research has examined staff training methods and knowledge transfer separately, the connection between these two aspects has not yet been explored. Silva, Silva and Martins (2019) studied the association between knowledge transfer and staff turnover and found that knowledge transfer greatly influence staff turnover. Hallin and Marnburg (2008) conducted a study on knowledge management in the hospitality industry and found that there is still low generalisation on the concept of management of knowledge. Murase (2021) studied tacit knowledge transfer and educational practice in global hotel chains and found that a close relationship between tacit knowledge transfer and educational practice. Ma and Chang (2013) studied training transfer in the Taiwanese hotel industry and the results indicated that training motivation is positively related to training transfer. Shaw and Williams (2009) conducted a study on knowledge transfer and management within tourism organizations, highlighting the significance of knowledge transfer in the sector. Similarly, El-Said, Al-Hajri, and Smith (2020) carried out an empirical investigation into the factors influencing training transfer in hotels, revealing that the key factors are the chance to perform and motivation to transfer. All the previous studies which include Silva, Silva and Martins (2019), Hallin and Marnburg (2008), Murase (2021), Ma and Chang (2013), Shaw and Williams (2009), and El-Said, Al-Hajri and Smith (2020) fail to explicitly show the impact of staff training methods on knowledge transfer. Hence, the current fills the gap by investigating the relationship between staff training methods and knowledge transfer.

Lan, Wong, and Wong (2022) investigated knowledge sharing during the socialisation of new hotel employees, and their findings indicated that those in the experimental group demonstrated a greater sense of value and attachment to the service principles. According to Marano et al., (2020), mentoring involves pairing a seasoned and proficient employee with a novice and junior employee to offer guidance and equip them with the prerequisite competencies to assume more significant responsibilities. The practice of formal mentoring has gained significant traction recently, owing to its perceived advantages for both the employer and the employee. A study by Gul, Akbar and Jan (2012) on the role of capacity development in Pakistan identified managerial mentoring as a training approach that helps develop skills and retain valuable employees. Additionally, research by Hobson, Doyle, Castanheira, Csigas, and Clutterbuck (2016) on the Mentoring Across Professions (MAP) project explored international best practices in employee mentoring and coaching. The study found that mentoring is highly operative and yields lucrative outcomes for organisations, mentors, mentees, and especially when a mentoring coordinator oversees the program. Van et al., (2018) conducted a multilevel study on career mentoring within different contexts, examining both differentiated career mentoring and the overall career mentoring climate. Their findings indicated a positive correlation between career mentoring climate and an individual's likelihood of promotion. However, the effectiveness of mentoring in knowledge transfer in comparison with other training methods has yet to be discovered. In line with the argumentation identified, the subsequent hypothesis was developed:

H1 Mentoring is the most effective method for facilitating knowledge transfer.

Another crucial sub-independent variable mentioned in this study is coaching, which has recently received attention in the training and development area. Coaching relates to the professional association between an employee and their direct supervisor to enhance their competencies and augment their work output. A study by Wang, Yuan, and Zhu (2017) on coaching leadership and employee voice behavior found that coaching leadership was positively associated with employee voice behaviour. Likewise, Kamunya and Nzulwa's (2020) conducted a study on coaching. They found that coaching can take place either spontaneously and without prior planning in the employee's workplace, or in a more formal and structured manner through scheduled coaching sessions held at a designated location within

the workplace. Nevertheless, the effectiveness of coaching in knowledge transfer compared to other training methods is still being determined. Based on the discussion mentioned above, the following hypothesis was developed:

H2 Coaching is the most effective method for facilitating knowledge transfer.

Erasmus, Loedoff, Mda and Nel (2010) define job rotation as transferring employees from one job position to another in that particular organisation. Typically, the duration of an assignment spans six months. Research by Cocuľová (2017) on the factors affecting the choice of employee training methods found that job rotation plays a significant role in facilitating organisational change, being frequently utilised due to its lower cost and time demands. Similarly, a study by Ali-Mohammadi and Ramezani (2017) evaluating the effectiveness of the job rotation system in Tabriz City concluded that job rotation is both effective and impactful in driving organizational change. The practice of job rotation can equip a seasoned manager with a comprehensive comprehension of the vision and mission of the organisation. However, the effectiveness of job rotation in knowledge transfer compared to other training methods is unknown. The following hypothesis was developed:

H3 Job rotation is the most effective method for facilitating knowledge transfer.

According to Erasmus et al., (2010), the term 'understudy' relates to a person who supports a senior staff member. Daily, the apprentice carries out tasks under the guidance and direction of the senior staff member to acquire knowledge of how the job is executed. Generally, in areas that are not deemed critical, the apprentice can assume the responsibilities of the senior staff member in the event of his or her absence. According to Prasetyo, Aliyyah, Rusdiyanto, Tjaraka, Kalbuana and Alam (2021), an understudy assumes specific duties of a superior, thereby facilitating the acquisition of specific competencies related to the superior's work responsibilities. However, the effectiveness of 'understudy' in knowledge transfer compared with other training methods is still unknown. The following hypothesis was developed:

H4 Understudy is the most effective method for facilitating knowledge transfer.

Jashapara (2011) explains that simulation is a training technique that mimics real-life situations, where the decisions made by trainees result in outcomes that closely resemble those that could occur in a professional environment. Simulation offers a valuable chance for trainees to gain insight into the consequences of their decisions in a risk-free setting. Simulation is employed to showcase anticipated proficiencies in the realm of hospitality service procedures. The simulator emulates the authentic equipment utilised by the labour force during his or her employment. According to Rahayu, Rasid and Tannady (2019), the prevalent techniques for simulation are in-basket exercises and role-play games. The trainee gains insight into the consequences of their actions and participates in role-playing activities that involve a two-person scenario, where each participant assumes supporting and character roles related to case studies. However, the effectiveness of simulation in knowledge transfer in comparison with other training methods has yet to be discovered. The following hypothesis was developed:

H5 Simulation is the most effective method for facilitating knowledge transfer.

Workshops and seminars are essential to enhance knowledge and skills. Onwujekwe, Mbachu, Etiaba, Ezumah, Ezenwaka, Arize, Okeke, Nwankwor, and Uzochukwu (2020) examined capacity building in health sector of Nigeria and discovered that workshops equipped employees with new competencies and skills. Similarly, a study by Cocuľová (2017) on the factors affecting the selection of methods of employee training found that workshops are among the highly demanding methods, as they are relatively inexpensive and do not require extensive time for implementation. Furthermore, Saira, Mansoor, Ishaque, Ehtisham, and Ali (2021) highlighted that workshops and seminars encourage two-way communication by promoting dynamic participation and offering attendees the opportunity to exchange viewpoints and feedback.

However, the effectiveness of workshops in knowledge transfer compared with other training methods is unknown. The following hypotheses was developed:

H6 Workshop is the most effective method for facilitating knowledge transfer.

Method

Research design

The study followed a quantitative approach and correlational design. The study applies a quantitative research methodology to assess the effectiveness of staff training methods in promoting knowledge transfer. This study employed closed-ended questionnaires to collect primary data (Truong, Xiaoming Liu & Yu, 2020). Pandey and Pandey (2021) state that the utilisation of a questionnaire confers advantages to research endeavours by allowing

participants ample time to contemplate their responses before finalisation. The target population of this study encompasses all employees, excluding senior management, from the five subsidiaries of the prominent hospitality company in Zimbabwe. Therefore, the target population consisted of a total of 240 employees. The study utilised a probability sampling method, and the systematic sampling technique to select the sample. Patel and Patel (2019) argue that the probability sampling method guarantees each member in the population has an equal likelihood of being chosen for the sample. Mukherjee (2019) explains that systematic sampling entails choosing every nth individual from the sampling frame. The method employed in this study involves the selection of the sample by utilising a systematic approach of choosing every odd-numbered element from a list of 240 employees' names. The Head Office of the five subsidiaries provided a comprehensive list of all targeted employees.

Questionnaire design and measurements

The questionnaire's initial section focused on collecting biological data, namely, educational level, age, experience and gender. The earlier studies developed and validated research instruments utilised for data collection and met acceptable validity and reliability. The scores are indicated under the 'results' section. Furthermore, the gathered data confirmed its validity and reliability. Both studies proved that the scale of the item is valid in management settings. All survey items were weighed on a 5-point Likert scale, range from 1 = "strongly disagree" to 5 = "strongly agree". Furthermore, reliability and validity were examined and confirmed by the data.

Staff training methods

Staff training methods were assessed by the research instrument that was already developed and validated. The items for the staff training methods construct were adapted and revised from the research conducted by Chiang, Back, and Canter (2005). According to Thomas (2021), a reliability coefficient of 0.60 or higher is considered "acceptable" for a recent developed construct. Employee training variable constituted 25 items and 7 subscales: mentoring, coaching, job rotation, understudy, simulation, role-play and workshop. Average Cronbach's alpha for all items was $\alpha = .73$, and for the subscales, it was as follows: mentoring $\alpha = .76$, coaching $\alpha = .74$, job rotation $\alpha = .73$, understudy $\alpha = .77$; simulation $\alpha = .70$; role-play $\alpha = .71$; and workshop $\alpha = .70$. Prior to conducting regression analysis, exploratory factor analysis (EFA) and tests for convergent validity were carried out to validate the data. The analyses were performed using SPSS version 29. Bartlett's Test of Sphericity and the Kaiser-Meyer Olkin (KMO) measure were utilised to evaluate sampling adequacy. The findings revealed a Kaiser-Meyer-Olkin (KMO) value of 0.766, along with an approximate Chi-square of 541.343, 66 degrees of freedom, and a significance level of $p<0.000$. These results confirmed the adequacy of the sample for conducting exploratory factor analysis. Consequently, factor analysis was performed using Varimax rotation, which reached convergence after seven iterations. The analysis accounted for 73.103% of the total variance. Additionally, three items were excluded due to cross-loading.

Knowledge transfer

Knowledge transfer was assessed by the research instrument developed and validated. Knowledge transfer constructs were adopted and modified from a study carried by Khachlouf and Quélin (2018). The knowledge transfer variable is comprised of 13 items. The average Cronbach's alpha for all items was $\alpha = .70$. The analyses were performed in SPSSVR version 29. The study utilised Bartlett's Test of Sphericity determine, and Kaiser-Meyer Olkin (KMO) measure to sampling adequacy. The findings revealed a Kaiser-Meyer Olkin (KMO) value of 0.826, an approximate Chi-square of 324.421, 45 degrees of freedom, and a p-value of less than 0.000, indicating that the sample was adequate for exploratory factor analysis. To analyse the data, factor analysis was performed using Varimax rotation, which reached convergence after seven iterations. The results accounted for 71.03% of the total variance, confirming the validity of all items.

Sample

By employing the systematic sampling method, 120 participants were chosen for the sample. Systematic sampling is justified because it ensures a structured and evenly distributed selection of participants, reducing the risk of clustering and enhancing representativeness (Patel & Patel, 2019). According to Sileyew (2019), conducting a pilot study can aid researchers in assessing the validity and reliability of the data obtained from a questionnaire. The preliminary survey instrument was distributed to a sample of twenty (20) respondents who were not part of the sample but were from the same five subsidiaries. The researcher personally distributed all questionnaires. The feedback obtained from the pilot testing phase was utilised to revise the questionnaires and eliminate any potential ambiguities. Subsequently, the refined questionnaire was distributed to the entire cohort of 120 sample participants within the chosen company. The instrument comprised 40 statements covering the methods of training and knowledge transfer. The items were rated on a scale, with '5' indicating strongly agree and '1' indicating strongly disagree. According to Thomas (2021), internal consistency reliability measures the extent to which a given instrument yields consistent outcomes when applied multiple times under the same conditions. In this study, Cronbach's Coefficient Alpha was

utilized to evaluate reliability. The data analysis incorporated both descriptive and inferential statistics. The most recent version of the Statistical Package for Social Sciences (SPSS), version 28 for Windows, was used to collect and statistically analyze the data (Gupta & Gupta, 2022).

Procedure

Prior to the collection of data, the institutional faculty committee approved the research proposal. Gatekeeper permission was obtained from the head of the five divisions of the leading hospitality organisation in Zimbabwe. Before participating in the study, individuals were given a detailed explanation of its objectives, and informed consent was obtained from each individual, along with instructions on how to complete the survey. Furthermore, participants were notified that their participation was entirely voluntary. Furthermore, the participants were guaranteed confidentiality and anonymity. The survey took approximately 15 to 20 min to complete. The questionnaires were administered to 120 participants.

Data Analysis

The data gathered was analysed utilising version 29.0 of the SPSS. Initially, standard deviations and means were calculated. After the validation of the research instrument, a regression analysis was tested to evaluate the hypothesised relationships and the effectiveness of sub-constructs, namely mentoring, coaching, job rotation, understudy, simulation, role-play and workshop in transferring knowledge.

Results

The preliminary data were analysed using descriptive statistics in the form of frequencies and tables. Using SPSS, descriptive statistics focusing on biographical data were first analysed. All 120 respondents received the structured questionnaire. Since most of the statements on two questionnaires went unanswered, only 118 returned questionnaires were considered for analysis. Consequently, a 98.3% response rate was attained. The analysis revealed that male employees made up 93.20% of the respondents. The results indicated that 56% of the respondents had only nine (9) years or less of experience. Most respondents (96.7%) were Black Africans. A big chuck of the respondents who were between the ages of 20 and 35 had a maximum length of service of 9 years, whilst those aged 40 and older had 15 years. The analysis revealed that secondary school (Ordinary level) was the highest level of education obtained by the most respondents (55.90%).

Descriptive statistics

The second objective of paper examines the institutionalisation of knowledge transfer in the organisation. Mean calculations were utilised to measure whether organisational knowledge transfer was institutionalised.

Table I

Institutionalisation of knowledge transfer

Statement	N	Mean	Std. Deviation
Whenever I get trained, my organisation encourages me to utilise new skills that l have gained in my work.	118	3.06	1.235
I always see that my organisation uses the old systems even if l am trained to use new systems.	118	3.57	1.033
All the knowledge that l get from training is documented within the organisation.	118	3.06	1.056
I am demotivated when the organisation uses previous work systems when l gained skills for the new system.	118	4.31	1.121
My superiors share their work experiences and written manuals with me.	118	2.68	1.124
It is usual at my organisation that one team adapts other team's knowledge to solve their problems.	118	2.98	1.054
My organisation disseminates information about management activities to me.	118	2.00	1.205
Experts in my organisation freely share information relevant to my work to me.	118	2.67	1.206
I feel I have no hurdles to share knowledge with my superiors in my organisation.	118	2.70	1.135
The staff training at my organisation enables me to feel adequately skilled for my present job.	118	2.81	1.109
I discuss the new developments in work-related activities with my co-workers.	118	3.89	.941
I can only apply a little part of the knowledge l get from training at my workplace.	118	3.53	1.107
Valid N (listwise)	118		

As shown in Table I, the respondents agreed (mean score 3.57) that their organisation continues to use outdated systems, even after they have been trained on new ones. However, they expressed a neutral view (mean score 3.06) when asked whether their organisation encourages them to apply the new skills they gain during training in their daily tasks. Similarly, they remained neutral (mean score 3.06) regarding whether all the knowledge they acquire from training is documented within the organization. In Table I, respondents also confirmed (mean score 4.31) that they felt demotivated when the organisation continued using older systems despite their training on new ones. They were somewhat neutral (mean score 2.68) about whether their superiors shared their work experiences and written manuals

with them. Interestingly, the respondents again took a neutral stance (mean score 2.70) when asked whether one team utilises another team's knowledge to solve organisational problems. Additionally, as shown in Table I, the respondents disagreed (mean score 2.00) that the organisation disseminates information about management activities to them. The respondents could neither agree nor disagree (mean score 2.67) when asked whether experts in their organization freely share relevant work-related information. Furthermore, they expressed a neutral opinion (mean score 2.70) regarding whether they faced no barriers to sharing knowledge with their superiors. Once again, the respondents were neutral (mean score 2.81) when asked if the staff training at their organisation helps them feel adequately skilled for their current roles. They agreed (mean score 2.89) that they discuss new developments in work-related activities with their colleagues. As shown in Table I, the respondents acknowledged (mean score 3.53) that they apply only a small portion of the knowledge gained from training in their workplace.

Inferential statistics

Inferential statistics

The first objective of the study assesses the impact of staff training methods on knowledge transfer. Multiple regression analysis was employed to statistically evaluate the extent to which staff training methods influence knowledge transfer.

Table 2

Impact of staff training methods on knowledge transfer

					Change Statistics		
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	R Square Change	F Change	df1
1	.550[a]	.703	.297	4.624	.303	50.426	1

ANOVA[a]

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	1078.003	1	1078.003	50.426	.000[b]
	Residual	2479.827	116	21.378		
	Total	3557.831	117			

a. Dependent Variable: Knowledge transfer

b. Predictors: (Constant), Staff training methods

		Unstandardized Coefficients		Standardized Coefficients	
Model		B	Std. Error	Beta	Sig.
1	(Constant)	28.287	2.096		.000
	Mentoring	.407	.057	.550	.000
	Coaching	.389	.078	.520	.000
	Understudy	.371	.089	.485	.000
	Job rotation	.362	083	.434	.000
	Simulations	.353	.092	.410	.000
	Workshops	.295	.095	.350	.000
	Role-plays	.269	.098	.298	.000

a. Dependent Variable: Knowledge transfer

As shown in Table II, staff training methods have a statistically significant impact on predicting knowledge transfer, as indicated by an adjusted R-squared value of 0.703. This suggests that staff training methods account for 70.3% of the variance in knowledge transfer. The remaining 29.7% (100% - 70.3%) of the variation in knowledge transfer can be attributed to other factors not explored in this study. It can be concluded that there are additional independent variables not considered in this study that may play a crucial role in explaining knowledge transfer. In other words, staff training methods are linked to knowledge transfer.

As shown in Table II, the test revealed a statistically significant F calculated value of 50.426, which is above the minimum critical F value 2.51304. This means the generated regression equation by this study significantly and perfectly predicts the dependent variable. This is also supported by a p-value in which $p=0.000<0.05$. This indicates that the observed p-value (0.000) falls below the standard significance threshold of 0.05. The test results confirm that

the chosen regression model is well-suited for the analysis, making it a reliable tool for forecasting knowledge transfer based on the staff training methods examined in this research.

Table II presents an analysis of the coefficients, allowing for a comparison of the seven sub-independent variables (coaching, mentoring, workshops, understudy, job rotation, role-plays, and simulations) in terms of their contribution to the variation in knowledge transfer. To facilitate comparisons, Beta standardized coefficients were used. The results revealed that mentoring was the strongest predictor, contributing the most to the variation in knowledge transfer ($\beta = 0.550$; $p = 0.000$). As a result, hypothesis 1 was confirmed and accepted. The following variables, in order of contribution, were coaching ($\beta = 0.520$; $p = 0.000$), understudy ($\beta = 0.485$; $p = 0.000$), simulations ($\beta = 0.410$; $p = 0.000$), job rotation ($\beta = 0.434$; $p = 0.000$), workshops ($\beta = 0.350$; $p = 0.000$), and role-plays ($\beta = 0.289$; $p = 0.000$). Hypotheses 2 to 7 were rejected.

Discussion

The results revealed that mentoring is the most effective method of transferring knowledge. This means that hypothesis 1- mentoring is the most effective method in facilitating knowledge transfer, was accepted. This implies that mentoring is the most crucial training method in the hospitality workplace setting. The results of this study are supported by earlier studies, which established that mentoring imparts skills, retains productive employees, and is positively related to promotability (Gul, Akbar & Jan, 2012; Van et al., 2018). However, Asiya et al., (2012), Hobson et al., (2016), and Van et al., (2018)s' studies did not explicitly indicate the effectiveness of mentoring in facilitating knowledge transfer. Hence, the findings of the current study contribute new knowledge. Results from the study also indicated that coaching is the second most effective method of transferring knowledge. Hence, hypothesis 2 - coaching is the most effective method in facilitating knowledge transfer, is rejected. This is affirmed by a similar study done by Wang, Yuan and Zhu (2017), who found that coaching leadership was positively related to employee voice behaviour. However, the study by Wang et al., (2017) did not demonstrate the effectiveness of coaching in facilitating knowledge transfer. As a result, the present study contributes further to the existing body of knowledge. The findings revealed that understudy and job rotation are the third and fourth effective methods supporting knowledge transfer. This means that hypothesis 3, job rotation is the most effective method in facilitating knowledge transfer, is rejected. This is validated by earlier studies done by Cocuľová (2017), and Ali-Mohammadi and Ramezani (2017), who found that job rotation is influential in bringing organisational change and is regularly used as it is considered less costly and less time-consuming. However, Cocuľová (2017) and Ali-Mohammadi and Ramezani (2017) studies did not clearly indicate the effectiveness of job rotation in facilitating knowledge transfer. Hence, the results from the current study contribute new knowledge.

The findings evidence that simulation is the fifth most effective method of transferring knowledge. The findings of this study align with Clapper's (2010) research on role play and simulation, which discovered that although simulation is increasingly used across various professions to enhance understanding and skill development, the broader training community has yet to fully adopt this essential learning approach. This means hypothesis 5, simulation is the most effective method in facilitating knowledge transfer, is rejected. However, Clapper's (2010) study did not reveal the effectiveness of simulation in facilitating knowledge transfer. Hence, the findings from the current study contribute new knowledge. The findings revealed that a workshop is the sixth effective method that encourages the transfer of knowledge. This means hypothesis 6, that workshop is the most effective method in facilitating knowledge transfer, is rejected. This is incongruent with what was found earlier in other studies (Onwujekwe, Mbachu, Etiaba, Ezumah, Ezenwaka, Arize, Okeke, Nwankwor and Uzochukwu, 2020; Cocuľová, 2017). However, Onwujekwe et al., (2020) and Cocuľová (2017) studies failed to disclose the effectiveness of workshops in transferring knowledge. Thus, the findings from the current study contribute new knowledge. The findings showed that role-play is the seventh effective method of transferring knowledge. The results are in agreement with Jamaludin et al., (2009)’s study on promoting argumentative knowledge development through active role play, which found that trainees appreciated the immersive experience provided by the virtual environment. Additionally, Gillespie et al., (2015) carried out a qualitative examination of a role-play bullying-simulation and discovered that role-plays serve as an active learning method to disseminate knowledge about bullying in nursing practice. The studies of Jamaludin et al., (2009) and Gillespie et al. (2015) did not explicitly indicate the effectiveness of role-play in facilitating knowledge transfer. Thus, the findings from the current study contribute new knowledge.

Regarding the second objective, which sought to explore the institutionalisation of knowledge transfer within the organisation, the results revealed that knowledge transfer was not effectively institutionalised. These findings are consistent with Boh's (2007) study on knowledge-sharing mechanisms in project-based organisations, which discovered that most institutionalised knowledge-sharing methods lack formality and integration into organisational routines and structures. However, Boh's (2007) research did not specifically focus on the institutionalisation of knowledge transfer, making the current study's findings a valuable contribution to the field. The findings indicated

that supervisors were reluctant to disclose their work experiences, limiting employees to applying only a minimal fraction of the knowledge acquired from training in their workplaces. Additionally, employees expressed frustration with the continued use of outdated systems despite having acquired skills for newer ones. Similarly, Santoro and Gopalakrishnan's (2000) study on the institutionalisation of knowledge transfer in industry-university collaborations found that knowledge transfer activities are more effective in stable, direction-oriented organisational cultures. However, their study did not address the challenges involved in knowledge transfer, meaning the current study provides new insights into this area.

Conclusion

This study represents a valuable contribution to the field of organizational learning and knowledge management, particularly within the hospitality sector. By providing empirical evidence on the relative effectiveness of training methods, it offers organizations actionable insights to refine their training programs. However, the study's limitations highlight the need for further research to generalize its findings and deepen our understanding of effective knowledge transfer practices on a global scale. The primary objective of this study was accomplished, as substantial evidence was provided demonstrating varying levels of effectiveness among different training methods. The results identified mentoring and coaching as the best training methods. Hence, managers may channel resources towards training methods in order to realise optimum knowledge transfer. The void identified by this study has been filled. Regarding the second objective, which sought to explore the institutionalisation of knowledge transfer within the organisation, the findings revealed that knowledge transfer had not been effectively institutionalized. The contemporary instabilities and scarce resources in the business environment require managers to invest in training methods which bring the best output in terms of knowledge acquisition. The study contributes to research by providing a more nuanced degree of effectiveness of each training method in facilitating knowledge transfer.

Practical implications

It is imperative for contemporary hospitality managers to foster a culture of knowledge transfer throughout the organisation, especially regarding self-management skills, problem-solving, conceptual, analytical and interpersonal skills. Furthermore, management must provide a platform for knowledge transferees to apply their acquired knowledge and furnish them with essential tools to expedite the knowledge transfer process. The managers should communicate to their subordinates that they will not administer disciplinary action for errors committed during work. The managers must foster positive interpersonal connections and interactions among employees across all hierarchical levels within the organisation. In addition, organisational management must foster an environment that promotes open communication among employees, free from negative attitudes and interpersonal conflicts, and consistently implement actionable strategies. In this scenario, senior executives should furnish knowledge providers with a comprehensive agenda of subjects and corresponding checklists delineating post-transfer responsibilities. This approach facilitates the transfer of skills from the transferor to the recipient. The managers must establish a decentralised and open work environment that fosters employee empowerment and encourages sharing knowledge as a valuable resource rather than hoarding. The management must offer incentives to trainees, coaches and mentors who effectively apply newly acquired competencies in the workplace. The findings are integral to policymakers to rehash policies by incorporating the methods that stimulate knowledge transfer. The study helps managers strengthen their level of understanding and shines a light on methods to prioritise when contemplating conducting training in the organisation. The managers should increase the use of coaching and mentoring to obtain optimum results.

Theoretical implications

This paper makes a significant contribution to the literature on employee training methods by linking and evaluating their effectiveness in promoting knowledge transfer. The research expands the existing body of research on employee training. The findings offer valuable insights into the effectiveness of staff training programs within organisations, potentially improving their competitive advantage. The findings provide substantial benefits for the organisation, its employees, and the broader academic community. The findings offer a foundation for organisations to enhance their performance by understanding which staff training methods positively influence knowledge transfer. This study’s results contribute to the existing knowledge base, and they offer a point of comparison for future research, fostering the advancement of knowledge in this field.

Limitations

Although the focus on Zimbabwe yields valuable localised insights, the study acknowledge significant limitations. The results may not be applicable to other countries or industries due to variations in cultural, economic, and organizational contexts. In addition, the study is based on data from only five subsidiaries of a single company. This limited scope may constrain the generalizability of the findings, even within Zimbabwe's hospitality industry. While the study assesses the effectiveness of training methods, it overlooks other factors that may influence knowledge

transfer, such as organizational culture, employee motivation, and technological tools. The findings have significant implications for organizational training strategies. They emphasize the necessity of designing training programs that utilize mentoring and coaching, which facilitate experiential learning and personalized feedback. For practitioners, the study offers evidence-based guidance to optimize training investments. For researchers, it highlights the need for further studies in diverse geographic and industrial contexts to validate and expand upon these findings. Future research studies should incorporate qualitative data to complement quantitative findings, providing a richer understanding of employee experiences. In addition, examine the factors that affect the efficacy of training methods, such as technology integration or trainer expertise. In addition, future research should broaden its geographic focus to encompass diverse cultural and organisational settings.

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FWU Journal of Social Sciences, Spring 2025, Vol.19, No.1, 91-101
DOI: http://doi.org/10.51709/19951272/Spring2025/8

Text and Context in Understanding and Interpreting a State's Preferences through Text-mining of the UN General Assembly Speeches

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This research paper explores India's speeches in United Nations General Debate (UNGD) sessions to investigate the nation's priority settings and challenges faced during the last five decades. The study adopted Latent Dirichlet Allocation (LDA), a computational linguistics technique to uncover hidden topics in a selected corpus. The data were accessed from the United Nations General Debate Corpus. The research underpins Computational Grounded Theory, which relies on the computational exploration of the text. The results reveal that world peace, nation-building, poverty eradication, economic development, women empowerment, dialogue to resolve issues, and terrorism as the global threat are the main issues and challenges faced by India. Through topic modeling and word clustering, it becomes clear that India wants to eradicate poverty and terrorism through the joint effort of the whole world .

***Keywords*:** topic modeling, natural language processing, computational grounded theory, UNGA Speeches, Poverty Eradication

The UN General Debate (UNGD) session is a reliable forum where all the countries express issues and concerns. It is a forum to resolve global matters through negotiations (Baturo et al., 2017). All the member countries bring their commitments and concerns to this platform to inform the world and to find possible solutions through common consensus (Peterson, 2006). The study has been delimited to the UN general assembly speeches of India that have been investigated to discover the hidden topics to understand the nation's priority setting. The statements made during the General Debate (GD) sessions are an invaluable and untapped source of information on the government's policy preferences across various issues over time (Baturo et al., 2017).

The rationale for selecting the time frame from 1970 to 2018 is that multiple new developments took place during this time, especially in the context of South Asia. The conflict between Afghanistan and Russia rose, especially after 1970 (Arnold, 1985; Sajad, 2022). The existence of a new neighboring country in the form of Bangladesh resulted in strenuous relations with the other neighboring country, Pakistan (Bose, 2005). The Cold War lasted for multiple decades and affected international relations (Gordon, 1995). In 1990, the fall of the USSR and the government of the Taliban also brought new challenges to many South Asian countries (Lamb et al., 2014). Lastly, the waves of terrorism and the event of 9/11 brought multiple new narratives (Ashraf, 2007). The common challenges faced by South Asian countries may be summed up as poverty, unemployment, malnutrition, unplanned urbanization, and illiteracy (Malhotra, 2011). India is the biggest and economically better country compared to the other countries in South Asia, and it has a vital role in the world (Wagner, 2016). From this point of view, it is indispensable to understand the preferences and issues conveyed to the World by Indian leaders through the platform of UN General Assembly sessions. The strategic socio-economic and demographic position of India makes it the centre of attention for other countries in the world (Crane, 1966; Kapur, 2010).

On the other hand, topic modeling is a novel approach to exploring hidden topics from a corpus. It relates to specific words occurring in any document (Stoica et al., 2020). In social sciences, topic modeling helps find the hidden topics from a selected corpus spanned over a specific time (Ahmed, et al., 2022; Ahmed, et al., 2022). Likewise, topic modeling is a machine learning technique that scans a set of documents by detecting the word and phrase pattern. It automatically forms a word cluster defining a document set (Reisenbichler & Reutterer, 2019). Therefore, this approach combines similar ideas and presents them in one topic from a large corpus (Jacobs & Tschötschel, 2019). This study uses topic modeling to investigate the hidden topics in speeches delivered from 1970 to 2018.

The study is significant because it provides a country's priority settings, including its issues and concerns raised at the world's highest forum. Various researchers have investigated the UN General Debate sessions using machine learning techniques (Baturo et al., 2017; Gurciullo & Mikhaylov, 2017) to investigate the priority settings and policy

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preferences of all the UN member countries. Compared to these studies, the present study focuses on the priority settings regarding one country (i.e., India). It is helpful because it provides the priority settings and preferences of the Indian government.

Literature Review

The analysis of speeches usually involves discourse analysis. In simple words, discourse analysis is the analysis of language use that focuses on co-textual relations in the language (Brown et al., 1983; Widdowson, 2007). Discourse analysis encompasses the language used and the proper context in which it reveals meaning (Boréus & Bergström, 2017). It is a widely used research method to analyze political discourse, whether spoken or written (Bonyadi, 2019). Different studies have been conducted to analyze political discourses (Chen, 2018; Latupeirissa et al., 2019; Mohammadi & Javadi, 2017).

Various researchers have conducted the discourse analysis of the UN speeches, which is important to review at this stage. These studies normally include a comparison of speeches from two or more leaders looking at the aspects of discourse to study their ideologies (Rababah & Hamdan, 2019; Shah & Alyas, 2019; Sharififar & Rahimi, 2015; Zhu & Wang, 2020). These studies primarily focus on the polarization of "Self" and "Other", power relations, and discourse ideologies. Discourse analysis helps identify intertextualities such as speech preferences and persuasiveness on the speaker's part. It is vital to notice that traditionally the studies in discourse analysis have focused more on the aspect of intertextuality concerning a limited number of leaders who delivered their speeches at the UN General Assembly forum (Aman et al., 2020; Najarzadegan et al., 2017; Shakoury, 2018). However, an analysis of speeches delivered by a single state at the UN General Assembly is yet to be conducted to investigate a state's preferences and priority settings irrespective of individual personalities who delivered speeches at the UN General Assembly forum.

On the other hand, machine learning approaches provide a robust analysis to analyse the larger chunk of textual data. Topic modeling, in this respect, is a novel text-mining tool for analyzing a large corpus through unsupervised machine learning, automatically discovering thematic information (Aziz & Ahmed, 2024; Khan et al., 2022; Obeidat et al., 2024). Topic modeling is based on probabilistic models that unveil how much a portion of a specific document relates to a particular topic (Blei et al., 2003). It helps in lessening the complexities within the large corpora by assigning specific topics to the whole text (Jacobs & Tschötschel, 2019). Topic modeling has multiple advantages, and firstly, it can deal with a large corpus of text. Secondly, it can deal with a text prolonged over a span of time to understand the process of meaning-making in a larger context, and thirdly, the group texts into 'topics' that are truly thematically coherent with a mixed degree of success, (Brookes & McEnery, 2019). Due to these advantages, topic modeling has been used for discourse analysis to investigate media framing (Ahmed & Khan, 2022; Ahmed, Mubeen, et al., 2022; Heidenreich et al., 2019), mining ethnicity (Viola & Verheul, 2020), climate change (Rabbani & Ahmed, 2025) contrastive perspectives (Stine & Agarwal, 2020), and economic dynamics(Ahmed, Nawaz, et al., 2022; Shahid & Shaikh, 2019). In addition, topic modeling has been equally beneficial in revealing policy analysis (Hagen et al., 2015; Isoaho et al., 2021; Valdez et al., 2018).

Topic modeling, especially Latent Dirichlet Allocations (LDA) uses unsupervised machine learning methods which are near to Grounded Theory in approach (Hannigan et al., 2019). In unsupervised machine learning, the researcher is blind and uses the data-driven approach (Baumer et al., 2017). The data drives research toward the meaning-making process rather than making prior assumptions or hypotheses (Jiang et al., 2021). Grounded Theory has been extended as Computational Grounded Theory (CGT) which is similar to GT in the process of meaning-making but may differ in data collection. Baumer et al. (2017), explaining the similarity between GT and CGT, regard it as 'extreme divergence" or "unlikely convergence". CGT involves three main steps; pattern detection (i.e. using computational techniques to reduce complicated messy text into a simpler list of words), pattern refinement (i.e. re-engagement with the data through a computationally guided data), pattern confirmation (i.e. the validity of the inductively identified patterns) (Nelson, 2020). CGT bridges the gap between social sciences and other disciplines for a collaborative step to understand political and social matters through the lens of new and emerging methods, such as topic modeling, to gain an insight into matter through the use of technology (Ophir et al., 2020). In this context, various researchers have highlighted the role of computer-assisted communication concerning the Grounded Theory which opens new avenues of research and data analysis (Carlsen & Ralund, 2022; Pospiech & Felden, 2013).

Method

Topic Modeling

Topic modeling reveals patterns in large datasets by finding the word clusters that are more habitual in a text. These word clusters often occur together, and these occurrences carry traces of meaning (Ylä-Anttila et al., 2018). These word clusters appear in topics modeling as keywords in a group. Hence topic modeling helps in the meaning-making process. In the case of the present study, the meaning-making process focused on the challenges and the priority settings through the UN General Assembly speeches delivered by Indian leaders from 1970 to 2018.

We extracted these speeches from the UN General Debate Corpus (Jankin Mikhaylov et al., 2017). This corpus provides speeches delivered by country leaders. Later, we extracted the speeches delivered by the Indian leaders at the UN General Assembly forum. We thoroughly read some of the speeches to analyze how divergent these speeches were. These speeches consisted of multiple paragraphs. A paragraph reflects a specific topic of the larger discussion, we analyzed each paragraph as a case in topic modeling. A total of 1615 paragraphs were extracted as cases to investigate the prevalent topics from the corpus. Tang et al., (2014) recommend documents of at least 100-200 words in length, while the number of documents needs to be at least 1000. As we have taken paragraphs that vary in size, the number of documents in the form of paragraphs is well enough for the recommended value.

Preprocessing

Preprocessing of the data is a crucial step because it influences the final results and interpretability (Isoaho et al., 2021; Vijayarani et al., 2015). We extracted the data from the UN General Debate Corpus (Jankin Mikhaylov et al., 2017). The textual data was divided into paragraphs, as explained earlier. The preprocessing of the data was conducted in steps.

In the first step, all the paralinguistic features were removed. Paralinguistic features include hyperlinks, file headers, markups, and metadata (Schuller & Batliner, 2013). All the text was converted to lowercase. These features make the data noisy, which later affects the results. In the second step, the process of tokenization was conducted. Tokenization is the process of defining the word and sentence boundaries to convert the text into meaningful elements (Kannan et al., 2014; Vijayarani et al., 2015). The third step of preprocessing involved stemming. In stemming, all the words were brought back to their root forms. In addition, the stop words were removed. These words contribute less to meaning-making and are removed before the final analysis (Yao & Ze-wen, 2011). The stop words include prepositions, articles, conjunctions, etc. In addition, the names of people, places, and cities were also added to the list of stop words as they make the data noisy. In the last step, the bigram and trigrams were treated as single terms. The terms that appeared more than 100 times together as a word cluster of two or three words have been treated as a single term. The benefit of using bigrams and trigrams is understanding the local context and avoiding real-world errors (Samanta & Chaudhuri, 2013).

Validation

We applied the Latent Dirichlet Allocations (LDA) method of topic modeling and followed the validation process, including statistical validation, semantic validation, and predictive validation (DiMaggio et al., 2013). Statistical validation involves running the different parameters and finding better values for the number of topics. All this process helps find the right number of topics which is part of statistical validation. In the case of the present study, keeping in view the length and number of documents, we ran the model several times to decide upon the right number of topics. We decided to limit the number of topics to 7 as it seemed more appropriate for the study. Secondly, the semantic validation was conducted keeping in view interpretability and plausibility. The group of keywords was given appropriate themes to interpret a given situation more aptly. This also involved going back to the original data and reading it out thoroughly to analyze a more plausible theme. Grimmer and Stewart (2013) recommend that social sciences researchers review the original text to interpret the matter under discussion better. Finally, the predictive validation process involves confirming the model reflects a relevant collection of external information (Ahmed, 2025). The external events confirm what the topics predict in the model.

Computational Grounded Theory

The present study underpinned Computational Ground Theory for its theoretical framework (Nelson, 2020). It is the extended form of Grounded Theory," a theory derived from data systematically gathered and analyzed through the research process" (Morse et al., 2016). The grounded theory proposes that the meaning is entirely grounded in the text. It cannot be found from external links or other theories. Data guides the researcher to get to the core of the real problem (Charmaz & Thornberg, 2020). CGT almost follows the principles as explained by the Grounded Theory, but differs from it on the grounds of data collection to meet the contemporary challenges due to the involvement of technology. CGT has

also taken a shift from the qualitative to the quantitative method in dealing with the data. It follows three main steps; pattern detection, pattern refinement, pattern confirmation mainly done through computation (Nelson, 2020).

The present study comes under the umbrella of CGT in the sense that it has accessed the data from the UN General Debate Corpus (Jankin Mikhaylov et al., 2017). Later the data is processed through the computer to change it to a simple list of words for data analysis (i.e. pattern detection). Later on, LDA was applied to generate topics from the text (i.e. pattern refinement). Lastly, the topics have been labelled and confirmed by going back and forth to the original data (i.e. pattern confirmation).

Data Analysis

The topics have been inferred from the given keywords to understand all the keywords' meanings. The results obtained through LDA and the suggested titles of extracted keywords are given below.

Table 1

Extracted Keywords along with Suggested Topics and Explanations

Keywords	Suggested Topics
[(0, '0.048*"terrorism" + 0.032*"international" + 0.030*"must" + 0.027*"peace" + ' '0.016*"security" + 0.014*"today" + 0.013*"begin" + 0.013*"state" + ' '0.013*"world" + 0.013*"include"'),	World Peace
(1, '0.031*"nation" + 0.027*"need" + 0.025*"also" + 0.020*"would" + ' '0.017*"effort" + 0.017*"new" + 0.014*"time" + 0.013*"people" + 0.013*"many" ' '+ 0.013*"work"'),	Nation Building
(2, '0.042*"action" + 0.029*"address" + 0.027*"poverty" + 0.022*"place" + ' '0.022*"india" + 0.022*"adopt" + 0.021*"long" + 0.018*"policy" + ' '0.017*"launch" + 0.016*"go"'),	Poverty Eradication
(3, '0.071*"country" + 0.051*"develop" + 0.044*"development" + 0.031*"economic" ' '+ 0.027*"reform" + 0.017*"sustainable" + 0.016*"process" + ' '0.016*"financial" + 0.016*"like" + 0.015*"poor"'),	Economic Development
(4, '0.028*"must" + 0.023*"issue" + 0.021*"make" + 0.018*"goal" + ' '0.018*"programme" + 0.017*"provide" + 0.016*"woman" + 0.015*"nature" + ' '0.014*"achieve" + 0.012*"technology"'),	Women Empowerment
(5, '0.043*"talk" + 0.031*"fight" + 0.024*"hope" + 0.018*"victim" + ' '0.017*"agree" + 0.017*"pain" + 0.017*"role" + 0.016*"find" + ' '0.015*"resolve" + 0.014*"contribute"'),	Dialogue to Resolve Issues
(6, '0.043*"world" + 0.038*"terrorist" + 0.032*"year" + 0.029*"challenge" + ' '0.024*"become" + 0.020*"change" + 0.019*"global" + 0.014*"ask" + ' '0.014*"even" + 0.013*"meet"')]	Terrorism as a Global Threat

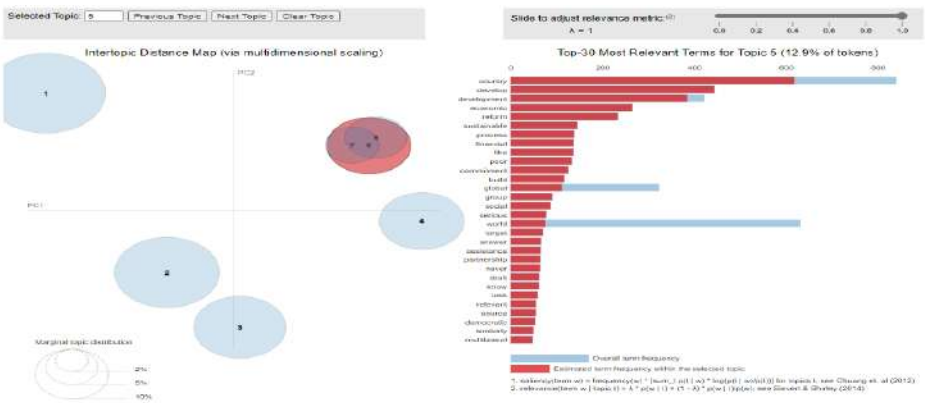

Figure 1: LDA Topic Visualization

The first set of keywords highlights the issue of terrorism (0.048) and the importance of peace (0.027) and security (0.016) in the world. The world (0.013) needs a joint effort to eradicate terrorism and all states (0.013) should be included (0.013) in this campaign. The weight of 'terrorism' is higher than the weights of other keywords in the respective set, therefore, it points towards the need for dialogue to fight against terrorism.

The second set of keywords suggests the need (0.027) to combine effort (0.017) to involve people (0.013) and work (0.013) together for the sake of the nation (0.031). The word' nation' has the highest weightage of 0.031, which points toward nation-building.

The third set of keywords reflects the issue of poverty (0.027) eradication. The world should take strong action (0.042) to address (0.029) the issue of poverty and to place (0.022) India (0.022) in a better position. India needs to adopt (0.022) long-standing (0.021) policy measures to combat the issue of poverty.

The fourth set of keywords encompasses the economic (0.031) development (0.044) of the country (0.071), which is the backbone of any country. The set of keywords also suggest that there is a need to reform (0.027) the policies and to introduce sustainable (0.017) political process (0.016). The word' economic development' has the highest weightage of '0.031 and 0.044' respectively. Therefore, it points towards the importance of economic development in controlling poverty.

The fifth set of keywords suggests that a country needs to set a vision to upraise the situation of women (0.016). This is one of the core issues (0.028), so there should be a proper dialogue to resolve these issues (0.023). Women's empowerment can be achieved by providing them the technological (0.012) knowledge. A proper program (0.018) must be launched to make (0.021) women independent and empowered. The word 'goal' has a weightage of 0.018, which shows a tendency to reach the goal of women's empowerment to stabilize a nation.

The sixth set of keywords talks about the need for dialogue (0.043) to resolve (0.015) the national and international issues. The words' fight' and 'pain' have 0.031 and 0.017 weights respectively, which shows that the pain and suffering of the victims (0.018) can be reduced by giving them hope (0.024) and suggesting measures to have a peaceful country. This goal can be achieved by dialogue. The word 'talk' has the highest weightage of 0.043, which means that the issues can easily be resolved if the nation talks (0.043) about them.

The last set of keywords points toward the global (0.019) threat of terrorism (0.038). It has become (0.024) the biggest hindrance to global development in the last few years. Terrorism is a challenge (0.029) that needs to be ended to bring a positive change (0.020) in the world (0.043). The word 'world' has the highest weightage as compared to other keywords in the set, which shows that the whole world is chained by terrorism.

Figure 2: Word Cloud of Keywords Extracted Through Topic Modeling

The keywords extracted through the process of topic modeling (using LDA) are shown in Figure 2. The font size of the keywords represents the weightage of words that helped assign the topics to the keywords in Figure 2. From the weightage of the keywords suggested in each group, the topics are mostly related to international support, nation's security, terrorism eradication, women empowerment, and eradication of poverty.

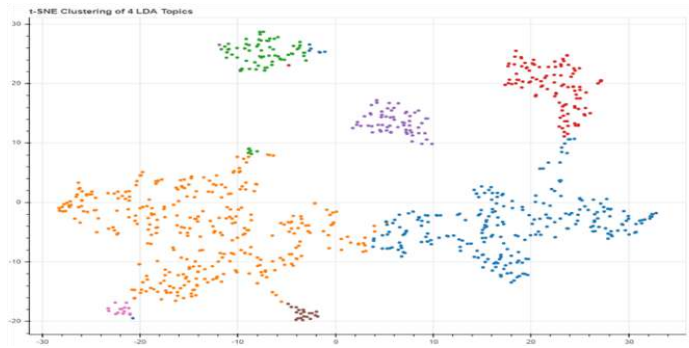

Figure 3: A t-SNE distribution of Topics Conducted through Topic Modeling

The t-SNE distribution of topics clarifies the position of topics in relevance to other topics. Figure 3 shows that the topics are distributed. This distribution shows how the topics are distributed and which of the topics overlap with one another.

Exogenous Validity

Exogenous validity refers to the external factors or the ground realities that endorse the findings of the study. It involves where the study can be generalized or extended to real-world settings (Nowlin, 2016; Quinn et al., 2010). India's UN speeches have been validated according to the topics explained in Table 1. Moreover, the speeches in the UN General Assembly sessions reflect the state's narrative. Hence exogenous validity has been seen through the measures taken by the Indian parliament as it also brings the state's practical approach towards the claims echoed at the UN General Assembly forum.

The range of topics in Table 1 explains that topics 0, 5, and 6 relate to peace and security. Regarding peace and security, various acts have been passed through Indian parliaments, such as the Armed Forces (Special Powers) Act, 1958 (AFSPA), the National Security Act, 1980 (NSA), and the Unlawful Activities (Prevention) Act, 1967 (UAPA) to deal with internal security threats. These measures reflect the government's focus on peace and security in the country. AFSPA was enacted to deal with internal security threats. However, research on AFSPA reveals that AFSPA, in the name of security, emerged as 'draconian' or 'colonial' (Kikon, 2009). "AFSPA operates, the armed forces are alleged to have committed one of the world's least-known abuses of human rights but revel in legal impunity" (Bhattacharyya, 2018). NSA and UAPA also aim to maintain peace and harmony within society and prevent terrorism. However, other views are that 'these laws are least used to serve their intended purpose and have mostly been abused by the governments to silence the dissenters' (Saxena, 2023).

Topics 1, 2, and 3 in Table 1 relate to nation-building, poverty eradication, and economic development in India. In this regard, Mahatma Gandhi National Rural Employment Guarantee Act, 2005 (MGNREGA) and National Food Security Act, 2003 (NFSA) are some measures to improve people's quality and standard of living in India. MGNREGA was introduced in 2005 to uplift the social status of rural areas with a focus on inclusiveness, rural labor markets, and agriculture (Nair et al., 2013; Reddy et al., 2014). Another act regarding basic food essentials is NFSA which is a significant step in fighting against hunger and protecting the rights of the people for food. However, among the main challenges are the increasing population, lack of infrastructure, and operational inefficiencies in implementing this program fully (Sengupta & Mukhopadhyay, 2016; Tanksale & Jha, 2015).

Another topic that emerged through LDA topic modeling belongs to women's empowerment, as explained in Table 1. The Protection of Women from Domestic Violence Act, 2005 (PWDA), the Prevention of Sexual Harassment at Workplace Act, 2013 (PSHWA), The Criminal Law (Amendment) Act, 2013 (CLAA), The Maternity Benefit (Amendment) Act, 2017 (MBAA), and the Women's Reservation Bill seeks to reserve 33% of seats in the Lok Sabha and state legislative assemblies for women validate the topic of women empowerment in India. PWDA provided women with the protection to go against domestic violence and empowered them with a legal weapon to fight against it (Bhattacharjee & Pal, 2016; Mukhopadhyay, 2018). However, the ground reality is that the above-counted measures need to be implemented in true letter and spirit (Karanjawala & Chugh, 2009). Similarly, CLAA includes stronger provisions against sexual offences (Bhattacharyya, 2015). Another significant progress is The PSHWA relates to what can be tantamount to sexual harassment and how workplaces need to be proactive about ensuring that they protect the dignity of a woman (Bothra, 2014; Gupta & Garg, 2020). The Maternity Benefit Amendment Act 2017 enhances leave maturity for working

women. Lastly, the Women Reservation bill seeks to reserve 33% of seats in the Lok Sabha and state legislative assemblies for women. All these measures relate to women's empowerment in India which leads to the direction of nation-building (Sharma, 2020).

Discussion

The study analyzed the Indian UN General Assembly Speeches of almost five decades (1970-2018) to discover hidden topics using text mining. For this purpose, LDA was used. This method helps extract the topics from a large corpus of data. The main purpose of the LDA analysis was to highlight the issues and their priority setting set by the Indian government. The study followed Computational Grounded Theory which relies on the principle that the data under consideration drives toward the topic's nature (Nelson, 2020). The overall themes extracted from the corpus revolve around peace, security, and nation-building through poverty eradication, women empowerment, and economic development. All the generated themes advance the understanding of the topics through words like "international", "terrorism", "nation", "action", "country", "reform", "talk" and "terrorist".

The extracted speech data is modeled by the LDA application, which frames the topics mentioned in Table 1. Figures and tables reveal a quantitative description of the data. However, a qualitative description must understand the core issues and priority setting from India's lens. Seven topics emerged from the data. These topics can be divided into two major categories depending on their relevance to the nature of problems.

The first category of topics relates to peace and security. Out of the seven suggested topics in Table 1, three of them relate to peace and security. It reveals the stress on peace and the challenges faced by the nation to overcome the menace of terrorism. Terrorism has been a threat in the region for a longer time (Subramaniam, 2012). The previous studies stress revamping policy on terrorism on the part of the Indian state (Mann, 2001; Narain & Rajakumar, 2016). India focuses on world peace and for achieving that, the stress is given to dialogue. A proper dialogue is needed to resolve the issues that are a hindrance to achieving world peace. Terrorism is a threat to national security and driving attention to peace and security is the only way to move forward (Kamath, 2001). As a result, India's priority on peace is evident in speeches at the UN General Assembly forum.

The second category of suggested topics comes under the umbrella of nation-building. India focuses on nation-building to maintain peace and security in the world. A total of four topics point toward nation-building out of the seven extracted topics. Therefore, India is more inclined toward building a nation. India links nation-building with poverty eradication and women empowerment. If women are empowered, the nation will be lifted automatically (Habrich et al., 2021). Moreover, two-thirds of the Indian population lives in poverty. More than 66.5% of the population lives on approximately $2 per day (Mishra, 2020). To build a nation, the government must ensure that no one is left behind. People should not be below the average poverty line to maintain a life balance (Singh & Chudasama, 2020). On the other hand, the soft image through nation-building is the primary purpose where the world gets the impression of emerging India (Biswal, 2020). The topic of 'women's empowerment is an evident example of conveying the message of soft image (Mokta, 2014).

It is essential to mention that the extracted two categories overlap with each other. It is evident from the topics that peace and security are linked with nation-building and vice versa. In other words, when women are empowered, and poverty eradicates, the nation can stand on its own. Similarly, peace and security lead to the stability of a country. A nation cannot focus on all the problems simultaneously.

Another indication through the text is essential to discuss that these 49 years of speeches may indicate India's priority setting and policy shift in the future. This priority setting and policy shift may focus on nation-building and improving peace and security as a prime tool in the country. The other reason for raising these points at the UN General Assembly forum is to convince the world of the state's policy and to get moral and diplomatic support on multiple issues related to peace and security.

The study underpinned Computational Grounded Theory which guided the structure of the study. CGT mainly focuses on three main steps; pattern detection, pattern refinement, and pattern confirmation (Nelson, 2020). The pattern detection phase helped in conducting the analysis and identifying the significant latent topics from the corpus. The pattern refinement phase guided the study in refining the themes from topic models. Lastly, the pattern confirmation, phase guided the study in confirming the emerged themes through exogenous validity by confirming the research results from the external sources. In addition, it guided in exploring how data unveils the reality by adopting the data-driven approach where the main point in CGT is that the data drives what the reality. CGT, as compared to traditional Grounded Theory,

provides space to confirm the results from external sources where results and generalizability is observed and text is analyzed concerning context (Boréus & Bergström, 2017).

Conclusion

Based on analysis and discussion, the study concludes that world peace, nation-building, poverty eradication, economic development, women empowerment, dialogue to resolve issues, and terrorism as a global threat are India's leading issues and challenges. The primary focus is on nation-building and economic development that can be achieved by eradicating poverty and terrorism and empowering women. Moreover, India focuses on dialogue to resolve issues and have a peaceful and secure nation. However, through the exogenous validity, it is evident that the steps taken to improve security concerns are criticized on political grounds where the main concern seems to use these laws as a weapon against their opponents and to strengthen their territorial control. The exogeneous validity reveals that research works based on laws passed by the Indian parliament regarding security concerns have been termed as 'draconian' or 'colonial' (Kikon, 2009).

Natural language processing with topic modeling and LDA helps determine the challenges and issues India has discussed in the annual UNGA sessions for two decades. Through topic modeling and word clustering, it becomes clear that India wants to eradicate poverty and terrorism through the joint effort of the whole world. LDA is a robust a viable way to look for a country's preferences and priority settings in the arena of both national and international relations.

The study has been delimited to the UNGA sessions with respect to the focus of a single country to investigate the nations' priority settings. The second delimitation relates to the timeframe from 1970 to 2018. This timeframe provided an overall analysis of the country's priority settings regardless of a specific government agenda. The study has been delimited to the revealed topics. There may be some other topics which have not been touched upon due to the limitation of the study as the study only analyzed the data based on speech corpus.

The study possesses implications for policymakers in determining the right course of future directions. It may be helpful for text analyzers to understand how text can guide the possible understanding of a specific phenomenon. In addition, from the perspective of linguistics, it may be helpful for researchers to understand the relation between text and context as text without context may not be able to bring the right interpretation. Lastly, the study has also implications for text analysts as it provides a guideline on how to deal with text and confirm the results from inside the corpus and from external resources.

Last but not least, text and context in combination provide valuable insights for researchers and policymakers to understand how to understand a nation’s priorities. Text, devoid of context, may not be able to bring to the fore an in-depth understanding of the phenomenon under investigation. From this point of view, the study proposes to take into account the contextual factors to validate the textual insights emerging from rhetoric.

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FWU Journal of Social Sciences, Spring 2025, Vol.19, No.1, 102-112
DOI: http://doi.org/10.51709/19951272/Spring2025/9

Exploring the N-Shaped Nexus between Financial Inclusion and Environmental Management in Nigeria: Evidence from the STIRPAT and DARDL Framework

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This study assesses the interplay between digital financial inclusion (DFI) and environmental sustainability (ENV) in Nigeria, considering the role of industrialization (IND), urbanization (URB), and energy consumption (EC). While DFI enhances financial access and green investments, its environmental impact remains uncertain. Extant studies predominately use indirect proxies, ignoring the direct indicators that capture its breadth and depth. Adopting the direct DFI indicators: mobile money accounts per capita (NMM), mobile money transactions (MMT), active digital accounts (ADA), and volume of mobile transactions (VMM). The study investigates whether DFI fosters ENV through renewable energy (REN) adoption or contributes to ENV degradation through increased energy consumption (EC). Using the Dynamic Autoregressive Distributed Lag model within the extended STIRPAT framework. Results confirm an N-shaped Environmental Kuznets Curve (EKC), where inclusive economic growth (IEG) initially degrades ENV (0.362 to 0.843), improves at higher income levels (-0.559 to -0.912) but rebounds again at very high incomes (0.341 to 0.592). IND reduces emissions (-0.518 to -0.682) except for VMM (0.112), indicating the environmental costs of DFI infrastructure. Trade openness (TOP) initially increases emissions (0.230) but lowers them in the long term (-0.536 to -0.741). Foreign direct investment (FDI) reduces emissions (-0.210 to -0.619), while REN initially decreases ENV (0.820) but improves ENV in the long term (-0.901). Error correction terms (-0.833 to -0.922) confirm rapid convergence to equilibrium. Policy recommendations include strengthening green financial regulations, promoting energy-efficient digital infrastructure, balancing TOP with ENV protection, and accelerating clean energy transitions to ensure sustainable IEG .

Keywords: CO2 emissions, digital financial inclusion, classical financial inclusion, environmental sustainability, Nigeria, STIRPAT, EKC,

Balancing economic inclusivity with environmental sustainability (ENV) remains a strategic challenge and goal for both emerging and developed economies. In emerging markets like Nigeria, the realization of this goal is particularly challenging due to the heavily dependent on carbon-intensive industries, and over-prioritization of inclusive economic growth (IEG) without concern for ENV often leads to ENV degradation. The lax enforcement of ENV regulations, coupled with insufficient financial capacity to invest in sustainable infrastructure, further exacerbates the challenge. Nigeria's development model presents a dilemma between promoting IEG and sustaining ENV.

Financial inclusion (FI), encompassing both traditional (TFI) and digital (DFI) approaches, has been globally acknowledged as a pivotal driver of IEG. By expanding access to financial services, FI empowers individuals, households, and businesses to save, invest, and engage in productive economic activities (Udo et al., 2023; Samuel et al., 2023; Samuel et al., 2018). While DFI, enabled by mobile and internet technologies, enhances access to financial services, TFI, facilitated by physical branches, ATMs, and paper-based banking, remains essential in some regions. Thus, leading to a geometric increase in FI from 24% in 2008 to 64% in 2023, demonstrating the growing role of DFI in economic transformation. However, its environmental impact remains ambiguous.

DFI facilitates investments in renewable energy (REN), promotes eco-friendly consumption, and green entrepreneurship, and reduces reliance on cash-based transactions. It also mitigates financial exclusion stemming from

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poverty, income inequality, and systemic market failures and enables sustainable industrialization (IND) and urbanization (URB) by enhancing financial literacy and supporting green projects such as REN adoption and carbon credit trading (Udoh et al., 2024; Inim et al., 2024). However, despite DFI and TFI's significant contribution to FI and IEG, it also poses significant environmental risks.

The environmental impact of FI especially through DFI channels has becomes a growing concern. As such the proliferation of energy-intensive infrastructure such as data centers, mobile networks, and digital platforms exacerbates CO_2 emissions and e-waste accumulation. The International Energy Agency (IEA) reports that data centers account for 1% of global electricity demand, with potential increases as DFI expands. Additionally, Bitcoin mining alone generates over 22 megatons of CO_2 emissions annually (Onat et al., 2025). The rapid expansion of 5G networks in emerging economies, required to support DFI, further increases energy consumption (EC) through the proliferation of connected devices.

Nigeria's lack of adequate e-waste recycling infrastructure further degrades ENV, as millions of discarded digital devices such as digital kiosks, point-of-sale (POS) systems, ATMs, and mobile phones contribute to landfill pollution. The Global E-Waste Monitor 2020 report revealed that only 17.4% of the 53.6 million metric tons of global e-waste is properly recycled. The environmental costs associated with maintaining physical banking network infrastructures contribute to ENV degradation, as such the Agricultural Bank of China, reported emitting CO_2 emissions exceeding two million tonnes in 2022. The growing concern associated with DFI is that, while it enhances access to sustainable investments, its environmental costs may outweigh the benefits in Nigeria, like other emerging economies, already grappling with rapid IND, URB, and a growing reliance on fossil fuels. These concerns raise a critical question: can DFI effectively balance IEG with ENV, or does its environmental footprint undermine its economic benefits?

To assess this question, this study employs the Environmental Kuznets Curve (EKC) hypothesis, which posits that the IEG-ENV nexus follows an inverted U-shape. Initially, IEG and IND increase ENV degradation. However, as the economy evolves beyond a certain income threshold, ENV is prioritized as an increase in income level enables a shift toward more sustainable practices and the adoption of stringent ENV regulations (Inim et al., 2024; Udo et al., 2024; Wang et al., 2024; Balsalobre-Lorente et al., 2021).

However, contemporary literature proposed an alternative N-shaped curve, where ENV degradation resurges at very high-income levels due to higher consumption and scale effects (Shaheen et al., 2022; Gyamfi et al., 2021). This alternative trajectory challenges the traditional EKC model and raises concerns about whether Nigeria's rising DFI adoption will follow an inverted U-shaped or N-shaped pattern. Additionally, this study explores two competing hypotheses within the trade (TOP) and investment framework: The Pollution Haven Hypothesis (PHH) posits that emerging economies with lax ENV regulations attract pollution-intensive foreign direct investment (FDI), which deteriorate ENV (Emmanuel et al., 2023). As a result, DFI-facilitated TOP could degrade ENV unless strict ENV regulations are enforced. Pollution Halo Hypothesis (PH) argues that FDI can improve ENV through the adoption of cleaner technologies, promoting energy-efficient industries (Zaidi et al., 2021), and adopting DFI direct channels such as mobile money accounts per capita (NMM), mobile money transactions (MMT), active digital accounts (ADA), and volume of mobile transactions (VMM) to enhance sustainable growth through financial access to green investments.

Studies empirically assess how DFI adoption directly influences ENV outcomes in Nigeria. Using the DFI indirect indicators such as mobile network coverage and broadband access (Ruba, 2023; Nur Yuliany et al., 2021), these studies ignored the direct measures of DFI's impact on the environment. This gap spurs the need for more precise metrics like the NMM, VMM, MMT, and ADA, to capture DFI access, usage, and penetrations that directly impact both IEG and ENV. This study explores whether Nigeria's rising DFI adoption follows the inverted U-shaped or N-shaped pattern, and also examines its dual impacts on IEG and ENV to provide insights into the complex interplay between DFI and ENV.

This study also explores the potential synergy between DFI and REN. The integration of REN into DFI infrastructure presents a direct pathway for reducing the environmental burden of DFI and simultaneously supporting IEG. Studies by Abner et al., (2021); Udo et al., 2024; and Udoh et al., (2024) reveal that transitioning from fossil fuels to cleaner energy sources such as solar and wind power can mitigate the EC associated with DFI and enhance the sustainability of FI efforts.

Given these theoretical foundations, this study aims to:

1. Assess the direct effects of DFI indicators on ENV in Nigeria.
2. Investigate how population, affluence, and technology influence the DFI, REN, and ENS nexus.
3. Test whether Nigeria's DFI-driven growth follows an inverted U-shape or N-shape EKC trajectory, and determine whether DFI can effectively balance IEG and ENV.

This study contributes to the literature by directly quantifying the environmental impact of DFI, an area largely ignored in previous studies. By adopting NMM, VMM, MMT, and ADA as direct measures of DFI usage, access, and penetration, this study offers more granular insights compared to previous studies relying on indirect proxies.

By employing the Dynamic Autoregressive Distributed Lag (DARDL) model within the Stochastic Impacts by Regression on Population, Affluence, and Technology (STIRPAT) framework. The STIRPAT model decomposes ENV drivers into population, affluence, technology, and additional factors like URB, DFI, and REN, providing a comprehensive perspective on the complex dynamics between IEG, DFI, and ENV.

By integrating the EKC hypothesis, PHH, and PH, this study provides a multi-dimensional assessment of whether DFI supports both IEG and ENV in Nigeria, offering valuable policy insights for achieving sustainable financial and environmental goals.

Literature Review

FI and ENV Link

DFI enhances ENV by promoting access to financial services that support cleaner technologies, reduce cash-based transactions, and lower carbon emissions (Samuel et al., 2023; Wan et al., 2021; Inim et al., 2024). Studies reveal that DFI accelerates REN adoption and green technologies, improving ENV in diverse contexts (Zaidi et al., 2021; Udo et al., 2024). In OECD countries, DFI facilitated REN adoption by enhancing financial accessibility (Zaidi et al., 2021). Udo et al., (2024) further revealed that DFI accelerates green technology adoption to improve ENV. Additionally, Sun et al., (2022) noted that fintech-driven green credit promotes eco-friendly businesses, yet cautioned that unregulated digital transactions could increase EC and carbon footprints, particularly in emerging economies. Despite these benefits, the rapid expansion of DFI introduces environmental risks through increased EC and e-waste from data centers, blockchain, and digital platforms. These technological infrastructures create an environmental burden, potentially offsetting DFI's environmental advantages. However, Inim et al., (2023) recommend that effective regulatory frameworks can help align DFI with climate policies.

Similarly, TFI characterized by brick-and-mortar banking, degrades ENV. Expansions in physical banking infrastructure, such as bank branches, ATM galleries, and financial centers, increase EC, contributing negatively to ENV (Wan et al., 2021). Amin et al., (2022) attributed TFI's adverse environmental impacts to lax environmental policies and unregulated credit expansion. Other studies (Udoh et al, 2024; Le et al., 2020; Ali et al., 2019; Ahmad et al., 2022) linked TFI's negative environmental impact to resource overexploitation and limited environmental awareness.

Non-linear DFI-ENV Nexus: Revisiting the EKC Hypothesis

Studies exploring the EKC hypothesis propose a non-linear DFI-ENV nexus with varied perspectives. Qin et al., (2021), Hung et al., (2018), and Renzhi and Baek (2020) observed an inverted U-shaped nexus between financial development and ENV, where financial development initially degrades ENV before improvement occurs beyond a certain financial development threshold. Expanding these insights, Grossman and Krueger (1995) proposed that the DFI-ENV nexus could follow an N-shaped trajectory, where DFI initially enhances ENV, then deteriorates it, and stabilizes it at a higher level of financial development. Sun et al., (2022), in supporting this N-shaped pattern, emphasized its under-exploration in emerging economies, underscoring the need for country-specific analyses. Addressing this gap, this study investigates whether DFI in Nigeria follows an N-shaped trajectory, providing insights into how DFI influences ENV amidst high financial exclusion and fossil fuel dependence. The study hypothesizes:

H_1: There is an N-shaped nexus between DFI and ENV in Nigeria.

To assess DFI's influence on ENV, this study integrates the Solow-Swan growth model, which emphasizes capital, labour, and technology in sustainable growth, and the STIRPAT model, which assesses the impacts of population, affluence, and technology on ENV. By incorporating DFI and REN adoption, this approach provides a comprehensive analysis of the DFI-ENV nexus, bridging gaps in existing research.

Research Gap and Contribution

Despite growing interest in the DFI-ENV nexus, key gaps remain:

1. Limited focus on the N-shaped DFI-ENV nexus: Most studies explore the linear or inverted U-shaped links, neglecting the potential N-shaped nexus, especially in emerging economies.

2. Underrepresentation of direct DFI indicators: Extant studies predominantly used indirect indicators such as financial depth and access, which do not accurately capture DFI's operational intensity.
3. Methodological limitations**:** Extant studies by (Zaidi et al., 2021; Zhao et al., 2021) relied on cross-sectional or static models, which cannot capture evolving DFI-ENV dynamics over time.

This study addresses these gaps by employing the DARDL model to capture the short- and long-run dynamics of DFI-ENV interactions in Nigeria. Using direct DFI indicators such as NMM, and VMM. ADA and MMT. By integrating STIRPAT and Solow-Swan models, the study offers a robust analysis, advancing the understanding of DFI's environmental role and informing policy frameworks that support sustainable development.

Theoretical Framework

EKC and STIRPAT Models:

The EKC framework proposed by Grossman and Krueger (1995) proposes an inverted U-shaped link between IEG and ENV, where IEG is driven by IND degrades ENV due to material output prioritization and lax ENV regulations, but higher income levels, combined with robust ENV regulatory frameworks, shift economies toward cleaner technologies, enhancing ENV. Despite the EKC heuristic value, the hypothesis is heavily criticized for oversimplification, assuming a uniform path for all countries, and ignoring institutional, regional, and sectoral differences. It also ignores factors such as energy sources, technology innovation, and regulatory quality, which significantly influence ENV outcomes. Given Nigeria's reliance on fossil fuels, limited financial access, and lax regulatory frameworks, the DFI-ENV trajectory may deviate from EKC's U-shape pattern, and potentially follow an N-shaped pattern, due to persistent structural constraints, rising energy demands from DFI infrastructure, before potentially stabilizing with sustainable policies.

To address EKC's limitations, the STIRPAT model proposed by Dietz and Rosa, (1994) refines the deterministic and non-stochastic nature of IPAT ($Impact = Population \times Affluence \times Technology$) which ignores variations over time and across contexts. The STIRPAT model introduces stochastic elements, allowing for empirical flexibility and the assessment of non-linear DFI-ENV nexus, including potential N-shaped patterns.

The STIRPAT model: $I = a_{it}P^{b1} \times A_{it}^{c2} \times T_{it}^{d3} \times \varepsilon_{it} \ldots\ldots\ldots\ldots\ldots\ldots (1)$

To facilitate analysis using the DARDL model, the STIRPAT equation is transformed into a log-linear form:

$$InI = Ina + b_1 InP + c_2 InA + d_3 InT + \varepsilon \ldots\ldots\ldots\ldots\ldots\ldots (2)$$

Where: I = environmental impact, P = population, A = affluence (PGDP), T = technology, and ε = error term.

This study extends the STIRPAT model by incorporating DFI metrics, along with REN, URB, IND, EC, FDI, and TOP. This approach assesses Nigeria's ENV dynamics, evaluating EKC validity while addressing its limitations.

Table 1

Digital Financial Inclusion Indicators

Indicators	Measures	Justification
Mobile money accounts per capita (NMM)	Access	Reflects financial access by showing how many people can use formal services via mobile. Indicates true financial inclusion.
Volume of mobile money transactions (VMM)	Usage	Reflects active service use and economic integration, signifying both FI and digital payment adoption.
Active digital accounts (ADA)	Penetration and Usage	Shows sustained use of financial services beyond account ownership, indicating effective financial inclusion.
Mobile money transactions (MMT)		Reflects a mature ecosystem, indicating both FI and broader economic participation.

Source; Authors (2024)

Data and Methodology

This study examines the DFI-ENV nexus in Nigeria from 1999 to 2023, using the DARDL model within the STIRPAT framework to capture both short- and long-term dynamics. Data sources are presented in Table 2.

Table 2
Variable Descriptions and Units.

Variables	Indicators	Justifications	Expected Sign
Carbon Footprint (CO_2emissions)	Environmental Sustainability (ENV)	Measures environmental degradation.	Dependent Variable
Urbanization (URB)	Urban Population	Has dual effects: enhances energy efficiency but may increase emissions due to increasing energy demand (Zhao et al., 2019).	+/−
Industrialization (IND)	Manufacturing, value added (% of GDP)	Boosts growth but increases emissions unless green technologies are adopted. (Udoh et al., 2024).	+/−
GDP per capita (constant $ 2015) (PGDP)	Inclusive Growth	It captures economic growth's impact on ENV, reflecting EKC dynamics, population effects, and sustainability transitions through green policies and technology adoption.	+
Trade Openness (TOP)	Trade (% of GDP)	Expands industrial output and emissions via trade-related activities.	+
Foreign Direct Investment (FDI)	Net inflow (% of GDP)	Promotes green tech transfer.	-
Energy Consumption (EC)	Fossil fuel energy consumption (% of total energy)	A major source of CO2 emissions.	+
Renewable Energy (REN)	Renewable energy consumption (% of total final energy consumption)	Lowers fossil fuel reliance.	-
Mobile money accounts per capita (NMM)	Digital Financial Inclusion Strategies (DFI)		+/−
Volume of mobile money transactions (VMM)			-
Active digital accounts (ADA)			+/−
Mobile money transactions (MMT)			+/−

Source: Author's Compilation (2024)

EKC Model Specification

The EKC hypothesis is tested using the following equation:

$$CO_2 = \beta_0 + \beta_1 IEG + \beta_2 IEG^2 + \beta_3 IEG^3 + X + \varepsilon \ldots\ldots\ldots\ldots (5)$$

Where: PGDP = GDP per capita, reflecting income levels and X = control variables influencing ENV.

EKC Interpretation:

$\beta_1 > 0 =$ higher IEG initially increases CO_2 emissions.

$\beta_2 < 0 =$ At higher income levels, CO_2 emissions decline as cleaner industries and green policies take effect.

$\beta_3 > 0 =$ a rebound in emissions after a certain threshold, due to increased IND, URB, EC, from IEG, and the environmental costs of DFI. The turning point (IEG*) is calculated as IEG* $= -\frac{\beta 1}{2\beta 2}$.

DARDL Model Application

The DARDL model captures both short- and long-run dynamics, addressing potential structural breaks in Nigeria's financial and environmental landscape. Unlike the ARDL, it accommodates evolving DFI-ENV interactions and mixed orders of variables integration (I(0) and I(1)). Compared to FMOLS and VECM, DARDL flexibility is crucial for analysing Nigeria's dynamic economic environment, where shifts in policy, technology adoption, and market conditions significantly influence the DFI-ENV nexus.

H_0: Digital Financial Inclusion (FI_{digit}) on Environmental Sustainability.

$$\Delta CO_{2t} + \propto_0 + \sum_{j=1}^{p} \propto_i \Delta CO_2 + \sum_{j=1}^{k1} \propto_1 \Delta DFI_{t-1} + \sum_{j=1}^{k2} \propto_2 \Delta REN_{t-1} + \sum_{j=1}^{k3} \propto_3 \Delta IND_{t-1} + \sum_{j=1}^{k4} \propto_4 \Delta EC_{t-1} + \sum_{j=1}^{k5} \propto_5 \Delta FDI_{t-1} + \sum_{j=1}^{k6} \propto_6 \Delta TOP_{t-1} + \sum_{j=1}^{k7} \propto_7 \Delta IEG_{t-1} + \sum_{j=1}^{k8} \propto_8 \Delta IEG^2{}_{t-1} + \sum_{j=1}^{k9} \propto_9 \Delta IEG^3{}_{t-1} + \sum_{j=1}^{k10} \propto_{10} \Delta URB_{t-1} + \delta_1 CO_{2t-1} + \delta_2 FDI_{digit}{}_{t-1} + \delta_3 REN_{t-1} + \delta_4 URB_{t-1} + \delta_5 IND_{t-1} + \delta_6 FDI_{t-1} + \delta_7 TOP_{t-1} + \delta_8 \Delta IEG^2{}_{t-1} + \delta_9 \Delta IEG^3{}_{t-1} + \delta_{10} IEG_{t-1} + \varepsilon_{it} \dots\dots\dots (6)$$

ECM specification

$$\Delta CO_{2t} + \phi_0 + \sum_{j=1}^{k} \phi_1 \Delta CO2_2 + \sum_{j=1}^{k} \phi_1 \Delta DFI_{t-1} + \sum_{j=1}^{k} \phi_2 \Delta REN_{t-1} + \sum_{j=1}^{k} \phi_3 \Delta IND_{t-1} + \sum_{j=1}^{k} \phi_4 \Delta EC_{t-1} + \sum_{j=1}^{k} \phi_5 \Delta FDI_{t-1} + \sum_{j=1}^{k} \phi_6 \Delta TOP_{t-1} + \sum_{j=1}^{k} \phi_7 \Delta IEG_{t-1} + \sum_{j=1}^{k8} \propto_8 \Delta IEG^2{}_{t-1} + \sum_{j=1}^{k9} \propto_9 \Delta IEG^3{}_{t-1} + \sum_{j=1}^{k10} \propto_{10} \Delta URB_{t-1} + \gamma_1 ECM_{t-1} + \varepsilon_{it} \dots\dots\dots (6b)$$

where $\propto_1 - \propto_{10}$; $\infty_1 - \infty_2$ and $\delta_1 - \delta_{10}; \varphi_1 - \varphi_{10}$ =regression coefficients; $\propto_0 - \infty_0$ =constant; ε_{it} = error term; ECM_{t-1}=lagged error term; and (γ_1) = speed of convergence from short-run shocks to long-run equilibrium (negative and significant). The diagnostic test results consisted of autoregressive conditional heteroscedasticity (ARCH), the Breusch–Godfrey (BG) test for serial correlation, and the Jarque–Bera (JB) test for normality. A bound test was conducted to assess the presence of a long-run link among the series.

Unit Root Test and Co-integration Tests

The stationarity of the series was tested using the Augmented Dickey-Fuller (ADF) test and the Zivot and Andrews (1992) test to account for structural breaks not captured by the ADF, the results are presented in Table 4 (Panels A, B, and C). The Bound test results confirmed long-run nexus if the *F*-statistics is (>) the upper critical value at a 5% level of significance. The series was also assessed for potential multicollinearity issues and model selection relied on the Akaike Information Criterion (AIC) the lower value of AIC was the selected result (Table 5).

Results and Discussions

Table 3

Descriptive Statistics

	Mean	Std. Dev.	Skewness	Kurtosis
CO2	2.45	0.72	0.58	2.91
EC	60.23	15.34	0.75	3.12
NMM	18.45	5.67	0.48	2.87
VMM	12.78	4.89	0.62	2.95
ADA	10.34	3.45	0.54	3.01
MMT	8.56	2.98	0.67	2.83
FDI	4.12	1.34	0.71	3.15
IEG	3500.45	950.23	0.63	2.89
IND	24.78	7.89	0.59	2.92
REN	15.67	5.12	0.55	2.88
TOP	45.34	12.45	0.7	3.1
URB	35.67	10.23	0.66	2.96

Source: Author's (2024)

The results in Table 3 highlight an N-shaped relationship between DFI and ENV in Nigeria, analyzed through the STIRPAT and DARDL models. The mean CO_2 emissions (2.45) and standard deviation (0.72) suggest stable yet significant environmental degradation. Positive skewness (0.58) indicates occasional spikes, mainly due to fossil fuel reliance and industrial activities. A kurtosis value of 2.91 suggests a near-normal distribution, reinforcing the need for integrating REN and regulating EC in financial inclusion strategies. Nigeria's high energy consumption (mean: 60.23) reflects a strong dependence on fossil fuels, with positive skewness (0.75) and kurtosis (3.12) showing demand spikes linked to industrialization and urbanization. Policies promoting REN are essential to balance DFI growth with environmental sustainability. DFI indicators (NMM: 18.45, VMM: 12.78, ADA: 10.34, MMT: 8.56) indicate growing but uneven financial inclusion. Positive skewness (0.48–0.67) and kurtosis (2.83–3.01) suggest normal distribution.

However, the gap between access (NMM) and usage (MMT) implies that unless DFI integrates energy-efficient infrastructure, its environmental impact may follow an N-shaped trajectory. Macroeconomic indicators (IEG: 3500.45, IND: 24.78, TOP: 45.34, URB: 35.67) suggest economic growth but with environmental trade-offs. Limited REN adoption (mean: 15.67) underscores the need for green financing to align DFI expansion with sustainability.

Unit Root and Multicollinearity Tests

The ADF test results in (Table 4, Panel A) confirm stationarity at I(0) and I(1), but not I(2) justifying the use of the DARDL model, in analysing the DFI-ENV nexus. To enhance robustness, the Zivot and Andrews test results (Panel B) further validate stationarity while identifying structural breaks aligning with key financial and energy reforms in Nigeria, including banking consolidation (2004–2005), mobile banking adoption (2009–2012), fintech expansion (2015–2023), and renewable energy policies (2017–2023). The VIF test (Panel C) confirms no multicollinearity (all values <10), ensuring robust estimations. These results highlight DFI's role in FI, reducing carbon reliance, and promoting ENV.

Table 4

Augmented Dickey-Fuller (ADF) Unit Root Test Results

	ADF-Stat	Critical Values 5%	Order of Integration	ZAU Stat	Critical Value (%5)	Break Date	Order of Integration	Multicollinearity
	Panel A: Trend and Intercept			Panel B: Trend and Intercept				Panel C: VIF
CO2	-5.563	-2.345	I(1)	-7.52	-5.08	2016	I(1)	5.112
EC	-6.012	-3.812	I(0)	-6.78	-4.50	2017	I(1)	5.362
NMM	-5.231	-2.301	I(1)	-5.93	-4.36	2015	I(1)	5.240
VMM	-6.562	-3.510	I(0)	-4.93	-2.50	2022	I(1)	5.221
ADA	-6.431	-2.421	I(0)	-6.90	-3.72	2015	I(1)	5.151
MMT	-6.821	-4.052	I(1)	-6.92	-4.26	2012	I(1)	4.310
FDI	-9.011	-5.010	I(0)	-7.44	-3.62	2020	I(0)	5.713
IEG	-6.101	-4.134	I(1)	-7.03	-2.45	2017	I(1)	6.205
IND	-6.214	-3.452	I(0)	-6.22	-406	2022	I(0)	4.300
REN	-7.145	-3.104	I(1)	-7.21	-4.69	2015	I(1)	5.001
TOP	-7.774	-3.052	I(1)	-7.01	-4.61	2020	I(0)	5.011
URB	-5.201	-3.221	I(0)	-5.50	-3.02	2020	I(1)	4.301

Source: Author's (2024)

Co-integrating Bound Test Results

The bound test results (Tabel 5, Panel A) confirm a long-run nexus, with F-statistic (8.334, 9.312, and 18.091) exceeding the 5% critical bounds, indicating DFI enhances ENV by supporting green investments and REN financing while reducing fossil fuel reliance. On the premise of co-integration, the ECM estimates show a convergence from short-run deviations to long-run equilibrium. Diagnostic test results in (Panel B) confirm model robustness: the BG–LM test (>0.5) indicates no autocorrelation, BPG confirms homoscedasticity, and Ramsey RESET validates correct model specification. While DFI improves ENV long-term, short-term trade-offs arise from infrastructure gaps, digital energy demands, and transitional frictions.

Table 5

Autoregressive Distributed Lag (ARDL) Cointegration Test Results

Variables:	Model	Test Statistics (5%)			Panel B: Diagnostic Tests (*p* values of the *F*-statistics)			
DP: CO_2		F-stat	I (0)	I (1)	BG LM	BPG	ARCH Test (I)	Ramsey RESET test
MIU	2,2,2,1,0	8.334	2.730	4.163	0.642	0.440	0.431	1.201
MMT	3,3,3,0,3	9.312			0.500	0.548	0.512	2.111
VMB	3,3,3,3,3	18.091			0.423	0.361	0.600	1.128

Source(s): The author's computation using E.views 13

Table 6

ARDL Long and Short Run Model Estimate

Variables: **DP = CO_2 Emissions**	**Model 1** **NMM**	**Model 2** VMM	**Model 3** ADA	**Model 4** MMT
		Long Run		
IEG	0.362**	0.701**	0.618**	0.843**
IEG^2	-0.782**	-0.782**	-0.559**	-0.912**
IEG^3	0.592 **	0.418 **	0.341 **	0.342**
IND	-0.682**	0.112**	-0.518**	-0.541
URB	-0.7180**	0.680**	-0.614**	-0.664**
TOP	0.230*	-0.536**	-0.718**	-0.741**
FDI	-0.619**	-0.210**	-0.417**	-0.418**
EC	0.602**	0.332**	0.702**	0.699**

REN	0.820**	0.521**	-0.901**	-0.892**
Short Run (ECM)				
CointEq (–1)	-0.910**	-0.833**	-0.922**	-0.912**
IEG	0.545**	0.911**	0.903**	0.844**
IEG^2	-0.880**	-0.544**	-1.036**	-1.063**
IEG^3	0.521 **	0.372 **	0.411 **	0.429**
IND	-0.305**	0.300*	-0.3590**	-0.402**
URB	-0.230	----------	----------	-0.245
TOP	-0.432**	-0.702**	-0.522**	-0.546**
TOP(1)	----------	0.672**	0.602**	0.603**
FDI	--------	0.372	0.607	0.537
EC	0.489*	0.432**	0.742**	0.784**
EC(1)	0.933**	0.802	0.388**	0.473**
REN	0.909**	0.587	0.650	0.621**
REN(1)	0.171**	0.491**	0.770**	0.756**
Other Parameter Estimate				
DW Star	2.00	1.73	1.644	1.568

Source(s): Author's (2024)

Discussion

The results in Table 6 reveal the impacts of various factors on ENV in Nigeria, analysed through four DFI channels: NMM, VMM, ADA, and MMT. This result integrates insights from the EKC hypothesis and the STIRPAT model highlighting DFI's dual role in promoting IEG and affecting ENV.

IEG's positive influence on ENV (0.362 to 0.843) implies industrial expansion and EC initially degrades ENV ($IEC > 0$), aligning with the Grossman and Krueger (1995) EKC hypothesis. IEG^2 negative (-0.559 to -0.912) effect on ENV indicates a turning point where higher income levels improve ENV, thus reflecting a structural shift towards cleaner technologies and more efficient energy use ($IEG^2 < 0$), aligning with the inverted U-shaped EKC hypothesis. IEG^3 positive effect (0.341 to 0.592) confirms the N-shaped nexus ($IEG > 0$) indicating a resurgence of ENV degradation at very high-income levels due to increased consumption and scale effects, aligning with Shaheen et al., (2022). This implies that IEG alone is insufficient for long-term ENV. Promoting green financing, and eco-friendly policies is essential to leverage the EKC turning point effectively. Incentives for REN and sustainable practices are crucial to mitigate the N-shaped resurgence of emissions. IND's mixed results reveal that less fossil-fuel-dependent industries improve ENV (68.2%, 51.8%, and 54.1%) through NMM, ADA, and MMT. However, VMM's positive impact (11.2%) reveals that energy-intensive sectors relying on digital financial services still contribute to ENV degradation, due to the environmental costs of supporting high transaction volumes, dependent on EC for data centers and digital infrastructure. This highlights the need for energy-efficient digital infrastructure and green industrial policies and also aligns with results by (Inim et al., 2024; Udo et al., 2023; Samuel et al. 2023; Zaidi et al., 2021; Sun et al., 2022). Nigeria's reliance on fossil fuels and limited financial access led to a deviation from the inverted U-shaped EKC pattern, potentially following an N-shaped trajectory reported by (Shaheen et al., 2022). These results reveal that green industrialization policies and investment in energy-efficient technologies are needed to balance industrial growth and ENV. URB's negative impact (-0.614 to -0.718) suggests that DFI-enabled urban investments in clean energy and sustainable infrastructure can improve ENV. However, VMM's positive impact (0.680) reflects urban sprawl and increased EC for digital infrastructure. This implies that the environmental benefits are contingent upon sustainable infrastructure investments and regulatory frameworks to manage the risks associated with DFI expansion (Abner et al., 2021; Zaidi et al., 2021).

TOP's dual effect shows that trade openness initially increases emissions (0.230*) but reduces them in the long run (-0.536** to -0.741**) through technology transfer, aligning with the Pollution Haven Hypothesis (PHH). The PHH posits that TOP may attract carbon-intensive industries to Nigeria due to lax ENV regulations (Emmanuel et al., 2023). While TOP may attract carbon-intensive industries, it also facilitates cleaner production practices, emphasizing the need for environmentally friendly trade policies. FDI's negative impact (-0.210** to -0.619**) supports the Pollution Halo Hypothesis (PH), indicating that FDI enhances ENV by enabling cleaner technology transfers. However, without stringent ENV regulations, FDI could lead to degradation. Policies should focus on green FDI and regulatory frameworks. To balance the dual impact of TOP, it is essential to implement trade policies that incentivize environmentally friendly technologies and practices. EC's positive impact (0.332** to 0.702**) confirms that higher EC increases CO_2 emissions, necessitating a shift to cleaner energy sources.

REN mixed effect on ENV shows that the positive impact Model 1 (0.820**) indicates the initial carbon costs of deploying REN increase emissions. This implies that limited grid infrastructure and financing challenges hinder the large-scale adoption of REN in Nigeria. Long-term adoption reduces emissions (-0.901 to -0.892). DFI through NMM, ADA, and MMT supports REN investments, but VMM's environmental cost (11.2%) suggests the need for energy-

efficient digital infrastructure and e-waste recycling policies, aligning with findings by (Udo et al., 2024; Inim et al., 2024, Udoh et al., 2024; Zaidi et al., 2021; Shahbaz et al. 2020).

Short-Run ECM Results

The CointEq (–1) values (-0.910, -0.833, -0.922, and -0.912) are negative and significant, confirming a rapid convergence to long-run equilibrium within 4 to 5 months after an economic or environmental shock. This finding highlights DFI's stabilizing role in economic, and environmental interactions. The confirmation of the N-shaped EKC hypothesis in both the short and long run indicates that Nigeria's current economic and environmental policies are insufficient to sustain long-term emission reductions. IEG^3 implies that without sustained green investments, Nigeria's industrial expansion and energy demand could reverse environmental progress. To counter this, stringent ENV regulations, REN adoption, and circular economy practices are necessary. IND mixed results, (-0.305 to -0.402, positive in VMM at 0.300) indicate that some energy-intensive industries still contribute to emissions, particularly those relying on VMM. Regulations targeting high-emission industrial sectors are essential. URB's negative impact suggests DFI-enabled smart city initiatives can enhance sustainability, though their benefits need optimization to maximize environmental benefits. The dual impact of TOP implies in the short run, TOP reduces emissions (-0.432 to -0.702) by facilitating access to green technologies. The positive TOP(1) results (0.672 to 0.603), indicate that industrial expansion driven by trade increases emissions. FDI positive and non-significant results in VMM (0.372) and MMT (0.607) indicate that, in the short run, FDI favours polluting sectors before facilitating technology transfer. This study recommends FDI screening mechanisms to ensure investments align with sustainability goals from the outset. EC's positive impact (0.432 to 0.784) reinforces the need for energy-efficient DFI infrastructure. REN positive and non-significant results in some models (0.587 to 0.909**) reveal that transition costs initially increase emissions. REN(1) positive and significant results (0.171 to 0.770) indicate that inefficiencies in Nigeria's energy grid hinder REN's full benefits. The initial carbon costs of REN integration must be addressed through improved grid infrastructure and financial incentives.

Conclusion and policy implications

This study examines the interplay between DFI, and ENV within the EKC framework, using direct DFI indicators such as NMM, VMM, ADA, and MMT for a more precise analysis. Employing the DARDL model within an extended STIRPAT framework, the study evaluates both short- and long-term effects of DFI on ENV incorporating key structural factors IND, URB, EC, REN, FDI, and TOP to capture the broader economic and structural dynamics influencing ENV outcomes.

The results confirm an N-shaped EKC, where initial IEG degrades ENV ($IEG > 0$), at higher income levels, and adoption of greener technologies ENV improves ($IEG^2 < 0$), but rebound at very high-income levels due to intensified IND and financial globalization ($IEG^3 > 0$). IND reduces emissions in three models (-0.518 to -0.682) but increases emissions in the VMM model (0.112), indicating that energy-intensive digital finance services contribute to CO_2 emissions. URB significantly reduces emissions in most models (-0.614 to -0.718), except in VMM (0.680), where urban sprawl and increased energy use from digital infrastructure drive emissions. (TOP) initially increases emissions (0.230), in the long run, it reduces emissions (-0.536 to -0.741) through technology transfer. (FDI) significantly reduces emissions (-0.210 to -0.619), supporting the Pollution Halo Hypothesis. EC increases emissions in all models (0.332 to 0.702), emphasizing the need for cleaner energy sources. REN's initial adoption increases emissions (0.820,) in the long-term it reduces them (-0.901 to -0.892). ECM confirms a rapid convergence to long-run equilibrium, with CointEq(-1) values between -0.833 and -0.922, indicating that environmental shocks stabilize within 4-5 months. However, challenges such as limited digital infrastructure, low digital literacy, and transaction inefficiencies hinder its full potential. To align DFI with climate policies the government must promote green digital finance through incentivizing carbon-neutral banking, digital payments for green investments, and mobile finance for REN projects. Ensure FDI inflows support low-carbon industries while enforcing stringent ENV standards for trade and industrial activities. Leverage DFI to mobilize investments in clean energy infrastructure and ensure widespread awareness and adoption of sustainable digital finance solutions.

Recommendations

Given the N-shaped EKC, Nigeria should promote sustainable finance mechanisms, such as green bonds, carbon taxes, and investment in eco-friendly industries to prevent emissions resurgence at higher income levels. Policies should align IEG with strict ENV regulations to sustain long-term emission reductions. VMM's positive impact on emissions indicates that energy-intensive DFI operations contribute to ENV degradation. Policymakers should incentivize energy-efficient data centers, green fintech solutions, and e-waste recycling to reduce emissions from the digital finance sector. The short-run increase in emissions from REN adoption shows that grid inefficiencies and high transition costs hinder immediate benefits. The government should invest in smart grids, and decentralized REN systems, and provide subsidies for green energy investments to enhance REN's long-term effectiveness. While TOP initially increases emissions, long-run reductions indicate that green technology transfer is crucial. Trade policies should enforce environmental standards for imports and exports, ensuring industries adopt cleaner production methods. Since FDI

reduces emissions in the long run, green FDI policies should be implemented to attract environmentally friendly investments.

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FWU Journal of Social Sciences, Spring 2025, Vol.19, No.1, 113-121
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Democratic Disconnect in E-government Policy Initiatives of Khyber Pakhtunkhwa

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The government of Khyber Pakhtunkhwa has initiated several reform measures that have been extensively discussed in the media, policy-making circles, political arenas, and academia. Some of the policy initiatives are published in the form of policy documents, e.g. KP Youth Policy (2016), KP Industrial Policy (2016) and KP ICT policy (2015-2016), etc. These published documents give us a good idea of the government's vision, strategy framework, and understanding of relevant concepts and terminologies. This paper explores policy documents related to the e-government initiatives of Khyber Pakhtunkhwa, i.e., 'Khyber Pakhtunkhwa ICT Policy 2015-2016' and 'The Integrated Development Strategy (2014-2018)'. Through an examination of policy design, this paper investigates the Khyber Pakhtunkhwa government's vision for e-government as articulated in its policy documents. It elucidates how this understanding addresses the issue of citizens' participation in governance through information and communication technologies (ICTs). The policy documents are analysed through the e-government models, i.e. managerial, consultative and participatory (Bellamy, 2000; Chadwick & May 2003). This paper argues that the way the concept of e-governance is interpreted, goals set, claims made, and strategies devised in these policy documents, the government appears to be unequivocally restricting e-governance to managing citizens through Information provision and service delivery. In this managerial tradition, the government eschews public consultation and citizen input through ICTs, which creates a democratic deficit.

***Keywords*:** e-government, democratic deficit, ICT policy, Khyber Pakhtunkhwa, Pakistan

The contemporary world is distinctive for its dynamism primarily because of the unprecedented, rapid and profound transformation. The profound change has affected multiple aspects of our lives. The rapid spread and use of Information Communication Technologies (ICTs) in the contemporary world is the cause and effect of such a transformation. Information Communication Technologies (ICTs) have modified our socioeconomic and political lives in multiple ways. Within the domain of politics, ICT has conspicuously reshaped political participation. ICT, in general, and the Internet in particular, has provided new forms and ways of political participation in democratic politics worldwide. Notably, citizens' participation in governance is also transforming. Citizens worldwide are demanding their governments hear them out through these newly invented means of communication. Governments are changing how they govern in response to such demands. These changing governance trends have more profound implications for representative democracy worldwide.

Representative democracy has been increasingly under attack in modern times due to the waning relationship between citizens and the government. This issue stems from citizens' declining interest in politics and the government's apathetic attitude towards engaging them in the governance process. Nonetheless, a vigilant citizenry is essential to representative democracy. In a democracy, citizens must actively participate in politics and governance. This requires a responsive government that adequately addresses its citizens' demands. Furthermore, citizen participation encompasses access to government-related information and government services, providing feedback on policy issues, political campaigning, mobilising, and fostering political debates. ICTs play a crucial role in facilitating citizens worldwide in all these forms of citizen engagement. As a result, ICTs are tackling a significant issue facing representative democracy in the modern world and promoting good governance.

In the contemporary world, citizens have become 'digital citizens'. They engage in politics and connect with their governments more frequently through ICTs. Given the noticeable impact of ICTs on democratic governance, it is essential to investigate how the Khyber Pakhtunkhwa government (Pakistan) has shaped policies that reflect the

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democratic ethos and aim to improve governance by utilising ICTs for citizens' engagement in the policy-making processes.

In the backdrop of the above utility of ICTs, the provincial government of Khyber Pakhtunkhwa has made a noticeable effort from the outset towards e-government. These initiatives include publishing ICT policy documents, efforts towards efficient service delivery, and open online access to information related to government services. It is striking that despite such discernible change in Khyber Pakhtunkhwa government policies, with a few exceptions (Aman, 2022: Aman & Jan 2022), there has been no cogent effort on the part of the scholars to probe Khyber Pakhtunkhwa policy-making initiatives in the domain of e-government. Moreover, recently, some scholars have argued that there is a lack of a 'leader-focused' and 'people-centric' approach in policymaking at all levels of government in Pakistan (Jabeen et al.., 2016: 420). Therefore, there is a need to look into promoting democracy (see Ali et al., 2015 for democratic challenges to Pakistan) through such e-governance policy initiatives in Pakistan. This paper aims to do so primarily by inquiring how the Khyber Pakhtunkhwa government envisions e-government in its policy documents. And *how such understanding addresses the issue of citizens' participation in governance through ICTs.*

This paper first highlights two specific theoretical explanations (models) related to citizens' participation in governance through ICTs and explicates how these models provide a theoretical premise. The second section offers methodological details to demonstrate how this study was conducted. The sections following methodology include discussions based on content analysis and findings of this study. A brief conclusion is added at the end of the paper.

Citizen-government Interaction Through ICTs: Theoretical Underpinning

The question of public participation through ICTs in contemporary democracies is approached differently by various scholars. Some scholars have developed models that explain the democratic interaction between citizens and government through ICTs (Bellamy, 2000; Chadwick & May, 2003). These models provide valuable insights into how and why various governments use ICTs to reach citizens. Christine Bellamy has made a prominent effort in this direction (Bellamy, 2000). Bellamy (2000) has proposed a distinctive classification (models) of democracies in the information age. These models are *consumer democratic, demo-elitist, neo-republican* and *cyber-democratic*. Bellamy contends that the *Consumer Democratic* model presupposes the inherent value and effectiveness of existing representative institutions. They recognise the growing influence of contemporary state governments and bureaucracies and advocate for increased awareness among citizens regarding the intricacies of interacting with these administrative entities. It focuses more on the service-consumer relationship and emphasises public service delivery. By doing so, it aims at the adequate flow of information to consumers *(Bellamy, 2000; 40-41)*. Consequently, they envision citizens as more active, informed, and purposeful users of public service information through ICTs.

The demo-elitist model posits that public opinion's primary function is to "constrain and legitimize government" rather than to "direct policy." *(Bellamy, 2000, 42).* The central argument of this model revolves around the role of Information and Communication Technologies (ICTs) in bridging the gap between governing elites and civil society organisations. It underscores the vertical flow of information between voters and their representatives, as well as between the government and representative institutions (Bellamy, 2000).

The *new republican model* focuses more on the quality of citizen participation at the micro level of politics. This model advocates for organic and community-oriented citizenship, which emphasizes the cultivation of civic virtue through the active participation of citizens in decision-making processes and the restoration of emancipatory civil society *(Bellamy, 2000, 46).* The new republican model posits the potential of Information and Communication Technology to establish a virtual public sphere where political dissent and emancipation can transpire.

The *cyber-democracy model* assumes that ICTs can form post-modern virtual communities that are capable of *'sustaining new emancipatory politics of identity'* (Bellamy, 2000). Within these virtual communities, individuals can construct new identities in a liberating manner rather than being subjected to stigmatized or marginalized identities imposed upon them by external entities. Members of these communities can actively participate in novel forms of identity politics, thereby enriching and broadening their communities' capacity for pluralism and tolerance towards diverse perspectives (Bellamy, 2000).

In the footsteps of Bellamy, Chadwick and May have also developed their models of citizen-government interaction through ICTs (Chadwick & May, 2003). They contend that three distinct models of citizen-state interaction form the foundation of e-government practices: managerial, consultative, and participatory. (Chadwick & May, 2003). The managerial model proposes that Information and Communication Technologies (ICTs) are primarily a quantitative enhancement over preceding technologies. It focuses on efficient service delivery to customers, improved information

flow to citizens and government, and improved efficiency of government officials. The consultative model strongly emphasises citizens' input and opinions, fostering effective communication between the government and citizens. It also emphasizes the importance of citizen input in policymaking to enhance the quality of policy formulation. Finally, the participatory model posits a more intricate interplay between citizens and the state, wherein the latter is viewed as a facilitator among multiple stakeholders in the governance process. It underscores the importance of meaningful interactions, deliberations, and discussions among citizens in guiding the policy formulation. It advocates for a genuinely participatory democracy by applying Information and Communication Technologies.

These models serve as the guiding framework for our study, enabling us to comprehensively understand the evolving dynamics of the citizen-government relationship through the utilization of Information and Communication Technologies (ICTs). They also explain how citizen-government interaction may shape the future. Taking insights from these models, we would analyse the policy documents of Khyber Pakhtunkhwa to see if they show managerial, consultative, or participatory tendencies in their approach and understanding of e-government.

Besides the theoretical literature on the use of ICTs in governance, the scope of this study suggests that a succinct theoretical discussion is engaged around the area of policy analysis. The most relevant literature to this study in the broader policy analysis area is policy design. This is because the paper identifies and problematises how the Khyber Pakhtunkhwa government designs the policy related to E-governance.

Scholars of public policy (Birkland, 2015; Dye, 2012) have identified goal setting as a key element of policy design and as a process; it is guided by a 'problem' concerning public affairs (Birkland, 2015). A problem *'can be defined as a condition or situation that produces needs or dissatisfaction among people and for which relief or redress by governmental action is sought'* (Anderson, 2003). After identifying the problem, means are identified to address those problems (Aguiar, et al., 2022). This paper investigates the problems identified, goals set and means adopted by the Khyber Pakhtunkhwa ICT policy documents. It suggests that the problem of poor governance is recognised as a problem, and efficiency in governance is a goal. We already know from the literature that achieving efficiency in governance is a central goal that guides a policy design (Stone, 2012). Efficiency is defined as *'getting the most output for a given input'* (Stone, 2012). Moreover, in these policy documents, the government adopts the ICTs to achieve the goal of efficiency in governance. The paper suggests that by choosing efficiency over public engagement through ICTs, the e-government policies of Khyber Pakhtunkhwa represent a democratic deficit.

Method

This study primarily derives its findings from a research project conducted by the author with the support of the Higher Education Commission of Pakistan, carried out between 2015 and 2017. The decision to select Khyber Pakhtunkhwa was mainly due to the absence of comprehensive research on e-government policy initiatives in the province. To the author's knowledge, no study has yet investigated the democratic aspect of e-government in Khyber Pakhtunkhwa. The author chose Khyber Pakhtunkhwa because of the substantial media and academic discourse surrounding the governance of Pakistan Tehreek-i-Insaf (PTI), which ardently advocated for a paradigm shift in Pakistan's governance practices. Furthermore, the Khyber Pakhtunkhwa government has been explicit about employing technologies in governance from the outset, as reflected in its reported slogan, *"Technology Hamari Nae Pahchaan Hai"* (Technology is our new identity).

Key policy documents available online and in print were chosen for the above purpose. Published. These include the Khyber Pakhtunkhwa ICT policy 2015-16 (Government of Khyber Pakhtunkhwa, 2016). This comprehensive document explicitly outlines the ideological leanings, vision, and strategies of the Khyber Pakhtunkhwa government to foster the development and promotion of information technology within the province. The second document is the Integrated Development Strategy 2014- 2018. The government also regards this document as vital for its overall governance and development strategy. Lastly, the paper identifies the manifesto of Pakistan Tehreek-i-Insaf (PTI), which encapsulates the party's political vision that has governed the province since 2013 (Government of Khyber Pakhtunkhwa, 2014). Understanding that the manifesto is not a policy document, it is still an important text that elucidates the context and assists us in deciphering the embedded goals, discourses, and values contained within other policy texts issued by the PTI government. Notably, the paper does not include the digital policy 2018-2023. This study extensively reviews policy texts published by the Khyber Pakhtunkhwa government regarding the use of ICTs in government, drawing conclusions about the citizen-government engagement priorities outlined in Khyber Pakhtunkhwa's policy documents.

Methodological tools such as the 'goal mining process' are used by various scholars (Anton & Earp 2004, Vlas & Lee 2016) to understand the embedded goals in policy documents, particularly IT-related policy documents (Vlas & Lee 2016). These studies systemically do goal mining through a process involving goal identification, goal classification,

and goal refinement. This is mainly done by analysing the text of the policy documents. In some ways, this is identical to the content analysis technique to identify goals in the text (Vlas & Lee 2016). This study also follows the technique holistically without the systematic rigour involved in the procedure adopted by these studies. This is broadly for two reasons: first, the study intends to focus on one primary objective, and that is, the 'democratic aspect' of ICT-related policy, and second, this study goes beyond just goals but looks into the embedded values and discourses of democratic governance in the text of policy documents published by Khyber Pakhtunkhwa. As such, the text of the policy documents is analysed to identify goals first (goal identification), followed by sifting of the goals to see if there is a visible democratic aspect (goals classification) and finally, analysing the goals to reflect on the nature of these goals, the embedded values and discourses for democratic content.

Policy Documents and E-government in Khyber Pakhtunkhwa: Content Analysis

Policy analysis encompasses a diverse range of approaches, but our primary focus here lies in analyzing the content of policies. This entails examining the underlying values, assumptions, and ideologies that shape the policy process (Codd, 1988). We undertake this research because existing studies have demonstrated that the apparent rapid pace of e-governance reforms is frequently rooted in institutional values and discourses that provide a specific ideological framework for these initiatives (Chadwick & May 2023). Therefore, it is vital to analyse the types of claims made and the discourses influencing policy initiatives to comprehend such a change. It is also essential to recognise that policy documents are guiding texts for government actions. As such, they can be considered textual interventions in the practice of governance (Stephen & Ball, 1993). Consequently, the necessity to analyse policy is also motivated by the wish to examine the actions and reforms inherent in policies. We have selected three policy documents that provide us with a clear understanding of what the provincial government aims to achieve.

Khyber Pakhtunkhwa ICT Policy 2015-16

Khyber Pakhtunkhwa ICT Policy 2015-16 is a 30 pages long document. Political executives, such as the Chief Minister and the Minister of IT, reflect the policy maker's political vision through their messages in the document. These messages illustrate the government's comprehension of e-governance and its role in fostering citizen engagement. Furthermore, one can observe evident ideological inclinations and values in these interpretations. These messages unequivocally utilise and interpret the concepts of 'e-government', 'the relationship between citizens and government', 'good governance', 'efficiency and transparency', and 'active citizens' concerning efficient 'service delivery'.

Interestingly, there is no single instance where the term "democracy" is explicitly mentioned or associated with either Information and Communication Technologies (ICTs) or governance. However, the terms 'development' and 'good governance' are repeated multiple times in the draft. It is pertinent to ascertain whether the application and interpretation of various concepts within the text are influenced by the neoliberal ideology shaping governance principles in numerous developing countries.

In his message, the Chief Minister of the Province states that e-government is the use of ICT to deliver public services in a more 'convenient, customer-oriented, and cost-effective way' (Government of Khyber Pakhtunkhwa, 2016). He recognizes the utility of ICTs for service delivery and emphasises that the Khyber Pakhtunkhwa government is going towards citizen-centric services through ICT use. (Government of Khyber Pakhtunkhwa, 2016).

Mr. Shahram Khan, the Minister of Science and Technology and Information Technology, concurs with the view above. In his message, he recognised the role of ICTs in socio-economic development and good governance. He discerned that good governance is an ultimate goal aimed at improving the living standards of citizens, while technological advancements provide them with quick, adequate, and timely services. (Government of Khyber Pakhtunkhwa, 2016). He adds that e-governance is not merely about providing computers but about transforming the mindset of the people and improving government procedures (Government of Khyber Pakhtunkhwa, 2016).

The policy (Government of Khyber Pakhtunkhwa, 2016) states the government's objectives, responsibilities, and operational procedures in a consumer-centric and business/corporate language. The terms "improved business continuity" and "making transactions with the government" are repeated throughout the text. It occasionally employs development language such as 'socio-economic revolution', 'socio-economic development', 'economic uplift', 'economic growth', and so forth.

The text of the policy document outlines five key components of its ICT policy: governance, citizen services, business, ICT literacy, and research and development. Out of these key component the three most relevant to this study are elucidated below.

1. Governance: It is interesting that the IT policy associates governance with efficient service delivery. The IT policy describes governance as one of its central elements. Moreover, it explains that the government uses ICT to improve efficiency and transparency. (Government of Khyber Pakhtunkhwa, 2016). The interventions pursued through this policy component encompass both the promotion of Information and Communication Technologies (ICTs) within government departments (to enhance coordination and efficiency) and engagement with the public (citizens) outside government institutions (to achieve transparency).

2. Citizen Services: The IT policy incorporates citizen services as a component and emphasises that the government intends to utilise ICT to improve direct interaction with citizens to deliver services to them (Government of Khyber Pakhtunkhwa, 2016). This component seeks to engage the public and government through innovative ICT solutions effectively. The primary objective of this engagement is to provide citizens unrestricted access to government information and services. (The concept of 'Open Government' has gained global recognition and is widely recognised as a catalyst for facilitating the accessibility of vital government information). The document indicates that the government intends to provide access and simplify the 'transaction' between itself and citizens by offering government services through widely used platforms such as mobile phones. Interventions in this area include the automation of government departments, the creation of a user-friendly web portal, and the establishment of complaint redressal mechanisms, the deployment of internet kiosks for citizen services, the creation of mobile applications for services and information, the utilization of local languages in ICTs, and the provision of support for individuals with disabilities (Government of Khyber Pakhtunkhwa, 2016; 14).

This policy document explains the government and citizens' engagement in a narrow way by restricting it to engagement for efficient public service delivery. The citizen-government interaction is limited only to citizens' feedback on government services. It envisions a *'citizen-driven government'* where feedback is solicited on government services using ICT (Government of Khyber Pakhtunkhwa, 2016;13).

3. ICT Literacy: A significant addition to the policy document is 'ICT literacy'. The policy aims to enhance citizens' capacity building and IT skill development by introducing courses at all levels of education and training programmes. Nevertheless, these interventions aim to construct a workforce suitable for the job market inside and outside Pakistan (Government of Khyber Pakhtunkhwa, 2016;19-21). The policy lacks a comprehensive strategy to enhance citizen ICT skills, thereby enabling them to participate and actively contribute to more productive policy interventions.

The involvement of two consultancy firms, Arcana Info and Expert Systems, in the design of the policy document suggests a government inclination towards public management through consultancy services. The provincial government notified to invite a consultant for any government project valued at over Rs. 100,000 to enhance transparency (Information & Public Relations, 2017) despite the criticism of the opposition parties of that time. Interestingly, this policy document is unavailable on the internet or any government website. Consequently, it remained inaccessible to citizens. However, the document can be produced on request as it is available with the directorate and Ministry of IT. During my inquiries from public officials other than the ST and IT departments, virtually no one explicitly stated that they possessed the document. However, they had either encountered it in some location or had received information about its existence.

2. Integrated Development Strategy 2014- 2018

The government document about the reform initiatives in Khyber Pakhtunkhwa (Reforms Implementation Cell, 2014; 11) claims that The Integrated Development Strategy is an 'overarching strategic' policy document that lays down a guiding framework for sustainable development through coordination of all government priorities in the province (Reforms Implementation Cell, 2014). Like the ICT policy, this document commences with a message from the province's chief minister. In this message, the Chief Minister acknowledges that "good governance" is the "most significant challenge." (Reforms Implementation Cell, 2014;4).

The main text of the policy document identified priorities such as 'good governance', transparency', 'efficiency' and 'service delivery'. There is a significantly greater emphasis on fostering a strong relationship between citizens and the government, which is crucial for building trust. Citizen-government engagement is primarily envisioned through providing local government services and the inclusion of citizens in local decision-making processes. (Reforms Implementation Cell, 2014). Furthermore, the relationship between citizens and the state concerning transparency and accountability in governmental affairs is also elucidated. It is claimed in the document that these objectives will be achieved through the Right to Information Act and the Right to Service Act. It aims to digitalise government departments such as land records and audits, along with several other e-governance initiatives (Reforms Implementation Cell, 2014).

A notable feature of this strategy document is its strong emphasis on the citizen feedback mechanism. Furthermore, it underscores the need to implement a citizen feedback mechanism (CFM) to enhance the citizen-state relationship. The CFM has been operationalized and piloted, and it is intended to improve the capacity of CFM personnel. (Reforms Implementation Cell, 2014:75).

This mechanism is designed to gather feedback from the public regarding government services. While it provides an opportunity for the public to express their satisfaction or dissatisfaction with any service, it does not facilitate citizen engagement through comprehensive policy input. Furthermore, it is encouraging to note that the Punjab Government implemented a more efficient feedback mechanism before the Khyber Pakhtunkhwa (Bhatti, 2015).

In summary, like ICT policy, this document interprets e-governance as a means of efficient and transparent service delivery. However, unlike ICT policy, it emphasises citizen feedback mechanisms related to service delivery. Consequently, the Integrated Development Strategy 2014- 2018 also fails to provide a precise mechanism for meaningful citizen interventions in the policy-making process.

3. PTI Manifesto

The PTI manifesto, which was released before the 2013 elections, dedicated a specific section to the topic of e-governance. This emphasis suggests that e-governance has been prominently featured in the PTI reform agenda. However, the explanation of e-governance and the emphasis on its components suggest that the main aim is to attain efficiency in service delivery. It is also noteworthy that the entire manifesto is replete with developmental terminology. While transparency and efficiency are clearly emphasized, there is a notable absence of any reference to democratic governance. This negligence also reflects the priorities established by the PTI for its provincial government in Khyber Pakhtunkhwa.

The policy documents discussed above suggest that the concept of efficient service delivery is the predominant theme in the government's policy discourse on e-governance. A noticeable lack of the democratic aspect of meaningful citizen participation is apparent, which can be suitably addressed through a comprehensive range of actions. These actions include practical policy consultations, encouraging the development of citizen capacity to engage effectively with the government, dismantling the power monopolies of political and administrative executives, and so on. However, there is no incremental strategy in these policy documents that aims at achieving the broader objectives of democratic e-government. However, such inclusion would require a clear and compelling vision to promote democracy through increased citizen participation in government operations. This vision could have been effectively communicated had the government presented the ICT policy in the provincial assembly for deliberation. Because discussions were restricted to cabinet meetings, the provincial government's intentions were clearly lacking in democratic spirit. Despite this failure, we must acknowledge the provincial government's commendable initiative to incorporate an explicit e-government strategy within a well-defined and distinctive IT policy.

We also assume that the above-discussed policies guided e-government interventions, mainly because '*policies do not normally tell you what to do; they create circumstances in which the range of options available in deciding what to do are narrowed or changed'* (Stephen & Ball, 1993).

Democratic Deficit in E-Government Policy of Khyber Pakhtunkhwa.

The above analysis shows that the design of the Khyber Pakhtunkhwa government's E-government policies identifies problems, sets goals, and suggests ways to address the problem. These documents identify weak service delivery as a problem to be addressed by bringing efficiency to service delivery, and efficacy is sought using ICTs. The entire policy design represents a lack of focus on meaningful citizen engagement through the e-government policies of Khyber Pakhtunkhwa. This aspect is referred to as democratic deficit in the study. The following paragraphs explicate the phenomena in detail.

From the above critical view of the policies, it is proposed that the provincial government's policy documents demonstrate a managerial form of e-government, as explained by Chadwick and May (2003). The following sections explain how policy documents manifest characteristics of a managerial interaction model between citizens and the state.

1. The cornerstone of the Khyber Pakhtunkhwa government's e-governance policy is transparency, accountability, and efficiency in public service delivery. Chadwick and May assert that these efficiencies are achieved through advancements in previously employed technologies within the managerial model. Therefore, similar trends can be observed in Khyber Pakhtunkhwa.

2. The provincial government treats citizens as 'customers'- passive recipients of government services- rather than as partners in governance. The policy documents mentioned above often refer to citizens as customers. The ICTs are occasionally utilized to solicit citizen feedback on government services or complaint redressals regarding government services. The idea of citizens as customers is the critical aspect of Chadwick and May's managerial model
3. The policy documents place great emphasis on information provision. This is often thought to ensure transparency in governance. Government websites provide information about government services. However, if necessary, citizens can obtain further information via the Right to Information Act. Notably, the information that the government highlights is generated through formal processes within established government institutions. The government does not anticipate the creation of discursively produced information through interactions between citizens and the government
4. As outlined in policy documents and official discourses, the government's role remains that of a manager overseeing the relationship between citizens and the government. The state primarily assumes the steering role in this matter. While civil society engagement is encouraged, even the government governs such engagement. Consequently, the relationship between citizens and the government is directly governed by the government
5. The Khyber Pakhtunkhwa government is implementing changes to create an information society. These changes are abundant and varied, yet they are being introduced gradually.
6. This emphatic and exclusive understanding of the citizen-government relationship leads to the view that citizens' participation is limited to utilising the services provided by the government and obtaining the information they need through ICTs. Despite this, a thorough analysis of government policy documents and a comprehensive examination of government websites reveal a conspicuous absence of any direct involvement of citizens in the governance process by the government. Government actions in this regard are confined to gathering feedback on the services provided and conducting occasional opinion polls, which are not systematically analysed or reported.

Through these findings, this study adds to the limited yet growing literature on E-governance policies in Pakistan (Kayani, 2011; Hassan & Lee, 2015; Khan, 2020) more broadly and in Khyber Pakhtunkhwa particularly (Aman, 2022; Aman & Jan, 2022; Amin et al., 2021; Bahadur et al., 2021; Ud Din et al., 2017).

Conclusion

There has been a recent surge in direct and meaningful participation of citizens in the governance process. This has been done through ICTs around the world. Governments worldwide have been taking noticeable initiatives to improve governance through citizens' input. All this is done through e-government initiatives. Therefore, there is a discernible understanding of e-government as a mechanism through which citizens formulate policy. However, the e-government understanding reflected in the policy documents issued by the Khyber Pakhtunkhwa government lacks such democratic content. The policy design of the e-government policies adopted by the Khyber Pakhtunkhwa government shows that lack of citizen engagement in governance is not identified as a problem. Therefore, the ICT policies set goals and adopt means representing a democratic deficit. In these policies, E-government is seen exclusively as providing information and delivering service to citizens. It is not envisioned as a conduit through which citizens are engaged in meaningful deliberations on policy issues. Such deliberative input from the citizens through ICTs is reckoned crucial for democratic governance in the contemporary world. On the above grounds, this study suggests that the government design ICT policies focusing more meaningfully on citizen-government engagement. Such an engagement can include citizen input in every step of policy formulation and adoption and consistent and systematic analysis of feedback gathered from citizens.

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