BSU Journal of Pedagogy and Curriculum

2025; 4(7): 51-78

https://bsujpc.journals.ekb.eg/

ISSN: 2812-5851 (Print); ISSN: 2812-586X (Online)

Regular Article

A Neural Network Analysis of Climate Change Awareness in Egyptian Society

Mahmoud Ali Moussa, Associate Professor of Educational Psychology, College of Education, Suez Canal University, Egypt, mahmoud_muhanna@edu.suez.edu.eg, ORCID ID: 0000-0002-5611-1792, Correspondent author

Abdul Nasser ElSayed Amer, Professor of Educational Psychology Department, Faculty of Education, Suez Canal University, Ismailia, Egypt, abdelnaser_amer@edu.suez.edu.eg

APA Citation: **Mahmoud Ali, Abdul Nasser ElSayed**. (2025). A Neural Network Analysis of Climate Change Awareness in Egyptian Society, BSU Journal of Pedagogy and Curriculum, 2025; 4(7): 51-78

Received**: 6/3/2025;** Accepted**: 19/4/2025 ;** Published**: 01/01/2025**

Abstract

This study investigates the internal structure of climate change awareness within Egyptian society. It uses neural network analysis to explore its relationships with demographic factors such as gender, academic level, residence, and age. Data were collected from 433 participants through social media platforms like WhatsApp and Facebook, offering a diverse population representation. Advanced statistical analysis, including neural network analysis, t-tests, ANOVA, and Pearson's correlation, was applied to comprehensively understand the results. The neural network revealed 14 interconnected nodes, encompassing climate change awareness items and demographic variables, organized into three distinct clusters. Key mediators identified in the network included gender, belief in deforestation as a significant cause, and the recognition of climate change as a real phenomenon. The study highlighted the strongest relationships centered on the global need for coordinated action to address climate change. While no significant differences were found across gender, academic level, or residence, a positive correlation between age and climate change awareness was identified, with older participants showing a more profound understanding of the issue. The findings suggest that tailored interventions for younger demographics and incorporating climate change education into academic curricula are crucial for nurturing environmental awareness. The study also emphasizes the importance of inclusive strategies and diverse sampling methods in future research to broaden climate change awareness across Egyptian society, thereby fostering more effective engagement with the topic.

Keywords: Climate change awareness, place of residence, environmental consciousness, climate change education, policy development.

Introduction

Climate change has emerged as one of the most critical global challenges of our time, exerting profound and far-reaching impacts on human health and ecosystems. It involves significant disruptions to environmental systems, including phenomena such as global warming, floods, earthquakes, storms, and droughts, all of which have triggered devastating consequences on a global scale. Defined as long-term alterations in climate patterns driven directly or indirectly by human activities, climate change represents a complex and multifaceted issue. A consensus among scientists indicates that human actions are responsible for approximately 97% of climate change effects (Cook et al., 2016), which manifest as observable and persistent shifts in climate and weather conditions.

In recent years, the interdisciplinary study of climate change has gained prominence, particularly within the field of environmental psychology, as societies grapple with the escalating consequences of this phenomenon. A crucial initial step toward addressing and mitigating the adverse effects of climate change lies in assessing individuals' awareness of its existence, causes, and potential solutions. This awareness serves as the foundation for fostering environmentally supportive behaviors aimed at minimizing climate change impacts. Alvi et al. (2020) highlighted that sustained awareness efforts, such as workshops and educational programs, play a pivotal role in achieving long-term success in mitigating the effects of climate change.

Despite the global importance of climate change, awareness remains disproportionately low in many developing countries, both at the institutional and individual levels. This lack of awareness presents significant challenges, especially in regions like Africa, where the impacts of climate change are often felt more acutely. Lee et al. (2015) highlighted that developed countries typically exhibit higher levels of climate change awareness, while in many developing nations, immediate economic and social concerns take precedence over environmental issues. To address this disparity, educational institutions must play a central role in fostering climate literacy. By equipping individuals with the knowledge and skills needed to understand and mitigate the effects of climate change, these institutions can empower communities to respond effectively to the growing climate crisis.

Understanding climate change is not merely an academic pursuit but a practical necessity for developing strategies to adapt to and cope with its current and future challenges. Guided by the Theory of Planned Behavior, which posits that an individual’s actions are shaped by their understanding of an issue and its perceived consequences, awareness becomes a catalyst for meaningful action. This awareness underscores the critical need for collaborative and sustained

efforts to empower communities and foster adaptive behaviors that safeguard the planet for future generations.

As a developing country, Egypt faces significant climate change challenges, notably experiencing increasingly severe summer heatwaves and harsh winter conditions. The government has implemented proactive measures to raise public awareness and disseminate critical information about this global crisis. These initiatives include integrating climate change topics and their adverse consequences into the national educational curricula, from primary to higher education. Furthermore, Egypt has demonstrated its commitment to combating climate change by hosting prominent international climate events, such as the United Nations-led Climate Conference in Sharm el-Sheikh. Climate change is universally acknowledged as one of the most severe existential threats to humanity, with perceptions of its risks, such as global warming, varying considerably among individuals based on personal and contextual factors.

This study stands out in its effort to address the pressing need for robust measures of climate change awareness, a field notably lacking comprehensive assessment tools, as highlighted by Gönen et al. (2023). It employs a cutting-edge psychometric approach—neural network analysis—to investigate the internal structure of psychological constructs. This innovative method delves into the dynamic, reciprocal relationships among the components of a concept, enabling the identification of core elements that are pivotal in defining and shaping the construct.

Individuals' perceptions and awareness of climate change are profoundly shaped by their environmental values and beliefs, developed through their interactions with various environmental factors. These perceptions play a critical role in fostering awareness and, ultimately, motivating individuals to adopt proactive behaviors that mitigate the risks and impacts of climate change. Understanding these interconnections offers valuable insights for designing targeted interventions to enhance climate change awareness and promote sustainable actions.

Literature review

African Societies

In Nigeria, Agboola and Emmanuel (2016) investigated climate change awareness among university students, reporting that 97% of participants believed in climate change, with 78.2% attributing it to human activities. Notably, gender differences in awareness were found to be insignificant. Similarly, Olaniyi (2020) observed high awareness among adult students in Niger, with 95% acknowledging climate change and identifying human activities as the primary cause. In Kenya, Ajuang et al. (2016) conducted a study across 11 regions, revealing that 90.9% of respondents had noticed climate-related changes in weather patterns. Their generalized linear model

analysis highlighted that demographic factors such as gender, educational attainment, and age significantly influenced awareness levels.

The European Bank Investment (2023) and Mertens & Thiemann (2023) surveyed residents across 10 Middle Eastern countries, including Egypt, and found that 92% of Egyptians felt climate change affected their daily lives. Salem et al. (2022) identified that 71.1% of adults aged 18 and older were aware of global warming, with 48.2% understanding its impacts and 78.3% attributing it to human-induced factors like emissions from vehicles and factories. Ghanem (2023) focused on students across different educational levels, reporting that 88.3% were aware of climate change, 84% linked it to human activities, and 30% recognized its effects on Egypt.

Asian Societies

Al-Buloshi and Ramadan (2015) examined climate change awareness in Oman and found a moderately high level of awareness among residents in six provinces. However, gaps persisted in understanding causes and prevention measures. A nationwide study in China by Wang et al. (2017) revealed limited knowledge, with 92.7% of respondents knowing little about climate change and 7.1% entirely unaware of it. Nevertheless, 94.4% believed climate change was real, and 66% attributed it to human activities.

In the Philippines, Magulod (2018) reported a high degree of awareness among university students, including comprehensive knowledge of causes, occurrences, and impacts. Interestingly, females exhibited significantly higher levels of awareness. Similarly, Nggole et al. (2019) in Indonesia identified strong awareness of phenomena like seasonal variations, rising temperatures, and major contributors such as gas emissions and waste. Respondents also demonstrated an understanding of adverse effects like floods, droughts, and forest fires. In Malaysia, Liwan et al. (2022) noted that while 70% of participants were aware of climate change, awareness of green products and governmental policies remained low, with 52.33% attributing the issue to excessive natural resource usage. Mohsin et al. (2022) in Pakistan found moderate awareness among university students in Lahore, with 72.3% aware of climate change and 79.5% perceiving it as directly impacting their lives.

European Societies

Poortinga et al. (2019) conducted a comprehensive survey spanning 22 European countries, discovering that most Europeans believed in climate change and primarily attributed it to human activities. However, concern over its negative effects was moderate, with perceptions varying across demographic groups. For instance, men displayed lower concern levels than women but were more

aware of negative impacts, particularly in Northern Europe. Younger individuals expressed greater concern and perceived more negative effects than their older counterparts. Education level emerged as a significant predictor of awareness in most countries, but values such as conservatism versus openness to change showed inconsistent effects.

In Turkey, Turkmen (2021) explored climate change awareness among residents of Bilecik Province, reporting that 96% believed in climate change, 87% viewed it as a threat to human life, and 83% identified vehicle emissions as the leading cause.

Climate change awareness reflects a widespread global acknowledgment of environmental transformation; however, this awareness varies significantly in depth, attribution, and demographic influence across African, Asian, and European societies. In African countries such as Nigeria and Kenya, most individuals recognize climate change and attribute it to human activities. While gender differences appear minimal, factors like age and education have a more pronounced impact on awareness levels. In the Middle East and North Africa, including Egypt, awareness is generally high, yet understanding of specific causes and consequences remains inconsistent, revealing a gap between recognition and comprehension. Asian societies present a striking contrast: countries like the Philippines and Indonesia demonstrate high and nuanced awareness, particularly among university students and women, whereas in China, belief in climate change is widespread but accompanied by limited understanding of its underlying mechanisms. In Europe, acknowledgment of anthropogenic climate change is nearly universal, though levels of concern and perceived urgency vary by age, gender, and political orientation. Notably, education consistently emerges as a key predictor across all regions, underscoring the transformative role of formal learning in fostering informed environmental consciousness. Collectively, these findings illustrate that, while global recognition of climate change is strong, disparities in understanding and engagement persist. This underscores the urgent need for context-sensitive, inclusive educational and policy initiatives aimed at closing knowledge gaps and empowering communities to take informed, proactive steps toward climate resilience.

Neural Network Analysis:

The development of the scale encountered a notable methodological limitation, as the authors employed traditional techniques in evaluating the psychometric properties of the climate change awareness test. However, in behavioral science, psychological traits are typically conceptualized as latent variables—abstract constructs that are not directly observable but manifest through measurable behaviors. This distinction is critical, as latent variables reflect the deep-seated psychological dimensions responsible for variations in observable behavior. In the absence of

behavior-specific influences, these latent traits account for much of the variance and shared patterns among observed indicators (Abdelrahman et al., 2025; Moussa & Elnersh, 2025).

To move beyond the limitations of traditional approaches, a more contemporary and nuanced method—neural network analysis—has gained traction. This approach does not rely on the assumption of a single underlying latent trait; instead, it maps the complex web of interrelations among observable items, identifying which components are most central or influential within a network. In the context of climate change awareness, neural network analysis provides a powerful tool for uncovering the most impactful elements of awareness (Abdelrahman et al., 2025). These core items, once identified, can be experimentally targeted to optimize educational interventions and policy strategies. Such a shift not only enhances the precision of psychological measurement but also deepens our ability to influence and manage large-scale social phenomena like climate change.

This study employed a neural network approach to uncover complex interconnections among scale items. Unlike traditional factor analysis, which emphasizes latent structures and variance explanation, network analysis visualizes item dynamics descriptively using a graph-based framework. This methodology features nodes (variables/items) and edges (partial correlations/interactions), offering an intuitive representation of the relational dynamics among variables (Epskamp & Fried, 2018).

Neural networks excel in exploring variable interactions without assuming latent factors or local independence, akin to exploratory factor analysis but distinct in focusing on direct interactions. Node relationships are depicted via weighted edges, where edge thickness denotes interaction strength and color signifies directionality (e.g., green/blue for positive correlations and red for negative ones). These weights can be estimated for cross-sectional, longitudinal, and time-series data, allowing for dynamic insights into variable interplay (Amer, 2024).

Aims and significance:

The objective of this study was to develop a scale to measure climate change awareness, assess the psychometric properties of the climate change awareness scale, and analyze the internal structure of climate change anxiety using neural networks. Additionally, the study aimed to determine the level of climate change awareness among university students and to identify the differences in climate change awareness related to gender, educational level, and place of residence.

The significance of the study stems from the necessity to assess the level of climate change awareness among university students to gauge their perception of the current climate situation. This awareness is crucial for fostering environmentally friendly behaviors that can help mitigate the

effects of climate change. The study also highlights the importance of educational institutions and environmental protection organizations organizing courses and seminars to raise climate change awareness among university students.

Methodology

Participants: A tool of the study was sent to the students of the Faculty of Education at both the undergraduate and graduate levels at the Suez Canal University (Ismailia Governorate) and the Suez University (Suez Governorate) via WhatsApp groups in collaboration with faculty members. Additionally, the link was shared with WhatsApp groups for middle and high school students in Ismailia Governorate through teachers. The survey was also distributed to various WhatsApp and Facebook groups, representing a snowball sampling (Amer, 2024). The participants were 433 (male and female), with ages ranging from 13 to 75 years (mean age = 24.59 and SD = 9.23). The demographic breakdown of the sample is as follows:

Table 1. Demographic Distribution of the Study Participants (N = 433).

Variable	Number	Percentage
Gender		
Male	56	12.9%
Female	377	87.1%
Place of Residence		
Small City	157	36.3%
Large city	172	39.7%
Rural	104	24%
Educational Level		
Middle school	18	4.2%
High school	55	12.7%
Undergraduate university students	146	33.7%
Graduate/Postgraduate	214	49.4%
Age		
≤ 20	110	26.1%
> 20	311	73.9%
Total participants	433	100%

A discrepancy was observed in Table 1 regarding the age categories variable, where the total number of students in the "above 20" and "below 20" age groups adds up to 421 instead of 433. This suggests the presence of missing data in the age categories variable. This issue may be linked to the sample bias, as most participants are female, which could have influenced the distribution of age data.

Climate Change Awareness Scale:

In developing the Climate Change Awareness Scale, the study followed a systematic process, outlined as follows:

1. **Reviewing Previous Studies:** The study began by examining prior studies focused on measuring climate change awareness. Notably, the work of Gönen et al. (2023) identified two primary dimensions: climate change awareness and the denial of its effects, referred to as "climate change recklessness" (e.g., the belief that "climate change does not cause droughts in my country"). The study also analyzed other scales assessing climate change awareness, such as those by Ajuang et al. (2016) and Nggole et al. (2019), which incorporated three key elements: recognition of climate change occurrences, understanding its causes, and awareness of its negative environmental impacts. This framework aligns with the concept of "Climate Change Risk Perception," a cognitive construct highlighted by Sjöberg et al. (2011). Further refining the understanding, Poortinga et al. (2019) described climate change awareness as comprising four dimensions: belief in the phenomenon's existence, understanding its causes, awareness of its consequences, and emotional concern for its impacts. The scale developed by Gönen et al. (2023) for high school students in Turkey consisted of 17 items, focusing on two major dimensions. Its validity was confirmed through exploratory and confirmatory factor analyses, yielding satisfactory fit indices (CFI = 0.93, NFI = 0.82, RFI = 0.88, GFI = 0.90, RMSEA = 0.045).
2. **Constructing the Scale:** The study developed the Climate Change Awareness Scale based on two critical components: 1) awareness of the climate change phenomenon and recognition of its existence, and 2) understanding the causes behind it.
3. **Conducting Interviews:** To deepen the understanding of local perceptions, the study conducted interviews with ten undergraduate students from the Faculty of Education in Ismailia. These discussions centered on the harmful impacts of climate change on the environment and human life. Six of the students demonstrated moderate awareness, indicating that they had been aware of climate change for approximately five years within the Egyptian community. Among the various factors contributing to climate change, students identified pollution from factories, pesticide use, fires, deforestation, and other environmental issues.
4. **Item Development:** Drawing from the qualitative insights of the interviews and the findings of previous studies, the study developed 10 items aimed at measuring climate change awareness.

5. **Expert Validation:** The 10 items were evaluated by five experts specializing in environmental psychology, science education, and psychometrics. All experts unanimously agreed on the relevance and suitability of the items for measuring climate change awareness. The items were presented without predefined dimensions, and the agreement coefficient among the experts ranged from 80% to 100%.
6. **Scale Scoring:** The final scale was designed with the following response options: "Not at all (0), Slightly (1), Moderately (2), Greatly (3)." The four-point scale was selected to eliminate the neutral response, as it fails to capture genuine awareness and instead reflects uncertainty. This approach ensures a more precise measurement of participants' awareness and understanding.

Data Collection:

Data for the study were collected using a digital survey developed through Google Forms, comprising the main research instruments and a set of demographic items. To maximize reach and accessibility, the survey link was disseminated via WhatsApp groups associated with the Faculty of Education at Suez Canal University and Suez University, as well as through several school-related groups. Additionally, the survey was shared on Facebook to engage a broader and more diverse respondent pool. The data collection period spanned from March to mid-May 2023.

Participants were informed that disclosing their names was entirely optional to preserve their anonymity and ensure a comfortable response environment. They were further assured that all data would be treated with strict confidentiality and used exclusively for academic research, per the ethical standards outlined in the Helsinki Declaration and approved on No. 70 Date 22 April 2025. Demographic variables were systematically coded to enable precise, structured, and efficient statistical analysis.

Ethical approval:

Research No. 70 received ethical approval on 22 April 2025 from the Ethics Committee of Ismailia College of Education, ensuring compliance with ethical standards for research involving human participants.

Statistical Analysis:

To meet the study’s objectives, we first assessed the normality of the data using skewness and kurtosis indices. A distribution is considered normal if both skewness and kurtosis values fall within the range of -2 to 2 (Field, 2018). An exploratory factor analysis (EFA) was conducted to explore the underlying factor structure of the Climate Change Awareness Scale. An item was

considered to have a significant loading on a factor if its factor loading exceeded 0.32 (Tabachnick & Fidell, 2013). Varimax rotation was applied during the factor extraction to ensure optimal item grouping.

Subsequently, a confirmatory factor analysis (CFA) was performed using maximum likelihood estimation based on the normal distribution indicated by the skewness and kurtosis values, alongside an adequate sample size. The goodness-of-fit for both the CFA model and structural equation modeling (SEM) was evaluated using various fit indices. These included RMSEA (where values ≤ 0.06 indicate good fit), chi-square statistics (non-significant p-values > 0.05 indicate acceptable fit), Comparative Fit Index (CFI), and Tucker-Lewis Index (TLI). A CFI and TLI value ≥ 0.95 was deemed a good fit, whereas values between 0.90 and 0.94 were considered acceptable (Hu & Bentler, 1999; Amer, 2018).

To analyze the relationships between scale items, psychometric network analysis was employed. This allowed for the estimation of the centrality of each item within the network, utilizing several key centrality measures (Costantini et al., 2015; Epskamp et al., 2018; Epskamp & Fried, 2018):

1. **Node Degree:** This measure indicates the centrality of an item based on the number of direct connections it shares with other items in the network. A higher degree signifies the item's greater importance within the construct.
2. **Node Strength:** Represented by the thickness of edges in the network's graphical layout, node strength quantifies the intensity of relationships between items, reflecting the likelihood of one item activating others and its significance in the overall network.
3. **Closeness Centrality:** This measure evaluates the proximity of an item to other items in the network, indicating how central the item is to the network's overall structure.
4. **Betweenness Centrality:** This metric captures how often an item lies on the shortest path between any two other items. A betweenness value of zero suggests that the item does not influence the relationships between other items, while a value greater than zero indicates that the item plays a crucial role in connecting different parts of the network.

Bayesian network analysis was used to estimate these centrality measures, accounting for the correlations between item pairs while controlling for other items' effects based on their variances. Data analysis was conducted using SPSS (version 29) and MPLUS (version 7), while psychometric network indices were calculated using JASP (version 18.2).

Results

Normality Check: The skewness coefficients of the Climate Change Awareness Scale items ranged from -2.50 to -0.03, while the kurtosis values varied from 5.50 to 0.32. According to West et al. (1997), a data distribution is considered approximately normal if the skewness is greater than 0.30

and the kurtosis exceeds 7.00. Based on these criteria, the distribution of the Climate Change Awareness Scale items can be regarded as approximately normal.

Psychometric Properties of the Scale: The scale's psychometric properties were examined through an evaluation of its validity and reliability, as outlined below:

Construct Validity: To assess the construct validity, principal component analysis (PCA) with Promax rotation was performed. The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy was 0.859, indicating that the correlation matrix was suitable for factor analysis. Bartlett's test of sphericity yielded a chi-square value of 1572.203 (p = 0.00), confirming the appropriateness of factor analysis at the 0.01 significance level. The PCA identified two factors, both with eigenvalues greater than 1.00. The results are summarized in the table below:

Table 2. Results of Principal Component Analysis for the Climate Change Awareness Scale (N = 433).

Item	Statement	Factor 1	Factor 2	Communalities
Aw1	I believe that human activities are the main cause of climate change.	.640		.420
Aw2	I believe that the activities of industrialized countries are the main cause of climate change.	.624		.411
Aw3	All countries should make more efforts to reduce climate change.	.754		.586
Aw4	Countries should help each other to reduce the negative impacts of climate change.	.769		.565
Aw5	Climate change has negative effects on the entire world.	.735		.529
Aw6	I believe that deforestation and the destruction of forests are major causes of climate change.	.658		.419
Aw7	I believe that climate change is real and present.	.799		.614
Aw8	I see climate change as an urgent issue and a threat to the world.	.757		.627
Aw9	I read about climate change issues.		.874	.778
Aw10	I talk with others about the effects of climate change on the environment.		.887	.772

Eigenvalues: Factor 1 (4.45) and Factor 2 (1.38).

Explained Variance: Factor 1 (43.45%) and Factor 2 (13.77%).

As indicated in the table, the PCA identified two distinct factors. The first factor, associated with eight items related to the causes and solutions for climate change, showed strong loadings exceeding 0.70, a threshold considered indicative of significant factor strength (Comery & Lee, 1992). This factor accounted for 43.45% of the total variance in environmental awareness. The second factor, which focused on the reading and discussion of climate change topics, explained an

additional 13.77% of the variance. Together, these two factors explained 57.22% of the total variance, reflecting a substantial portion of the scale's construct.

Confirmatory Factor Analysis (CFA): The CFA model, which posited two factors, showed a satisfactory fit to the data. The fit indices were as follows: $\chi^2 = 117.938$, $p = 0.00$, RMSEA = 0.076, CFI = 0.974, TLI = 0.965, WRMR = 0.977. The model's robust fit indices confirm the reliability of the two-factor structure of the Climate Change Awareness Scale.

Figure 1. Confirmatory factor analysis of the climate change awareness scale.

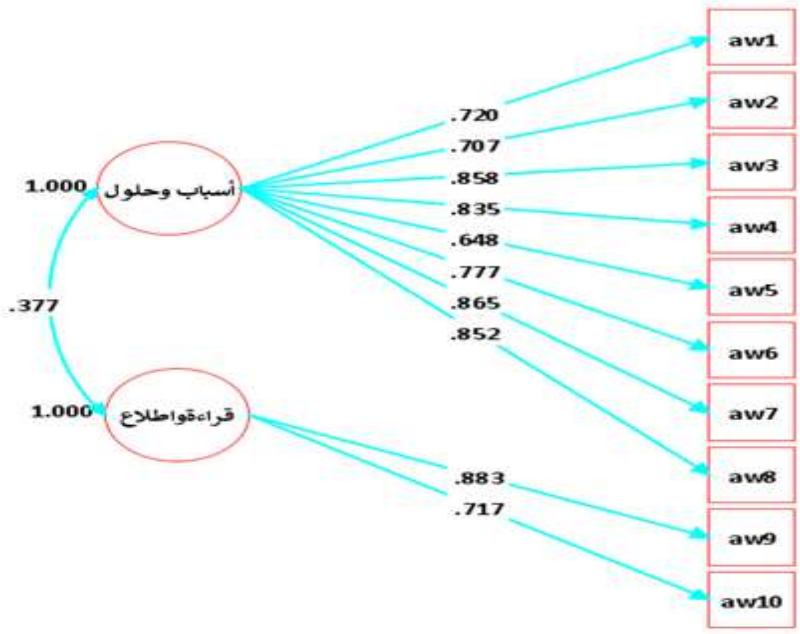


Figure 1 demonstrates that the standardized loadings for all items in both factors exceeded 0.70, indicating a high loading coefficient, according to Comery & Lee (1992). This suggests adequate convergent validity of the items, as evidenced by satisfactory loadings. Furthermore, the correlation between the two factors was found to be 0.40, indicating a reasonable degree of internal consistency between the two dimensions of the scale. Upon further analysis, the average variance extracted (AVE) for the first factor was 0.433, and for the second factor, it was 0.568. This indicates adequate convergent validity for the second factor. However, the first factor does not meet the recommended AVE threshold of 0.50 (Fornell & Larcker, 1981), as its value fell below this cutoff. The Heterotrait-Monotrait (HTMT) ratio was approximately 0.365, suggesting the presence of discriminant validity between the two factors.

Reliability of the Scale: The Omega squared reliability coefficient for the first dimension was 0.851, for the second dimension was 0.723, and for the entire scale, it was 0.861. These reliability coefficients are considered good, providing strong evidence of the scale's reliability.

Neural Network Analysis: A Bayesian Neural Network (BNN) analysis was performed to explore the relationships among the ten items of the scale in conjunction with selected demographic variables, including gender, age, academic stage, and place of residence. The constructed network comprised 14 nodes, representing both scale items and demographic variables, interconnected through 32 active (effective) weighted connections. These connections reflect the strength and direction of associations inferred from the Bayesian learning process. The table below presents the weighted correlation matrix illustrating the interdependencies among the network's nodes:

Table 3. Weighted Correlation Matrix for Items or Nodes in the Neural Network.

Variable	w1	w2	w3	w4	w5	w6	w7	w8	w9	w10	Gender	Residence	Age	Academic Stage
w1	0.00	0.38	0.21	0.00	0.21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
w2	0.38	0.00	0.09	0.00	0.00	0.05	0.00	0.20	0.00	0.00	0.00	0.00	0.00	0.051
w3	0.21	0.09	0.00	0.37	0.09	0.00	0.09	0.22	0.00	0.05	0.00	0.15	0.00	0.000
w4	0.00	0.00	0.37	0.00	0.00	0.19	0.29	0.00	0.00	0.00	0.00	0.00	0.12	0.00
w5	0.21	0.00	0.09	0.00	0.00	0.17	0.17	0.00	0.00	0.00	0.09	0.00	0.00	0.00
w6	0.00	0.05	0.00	0.19	0.17	0.00	0.26	0.16	0.00	0.00	0.22	0.00	0.00	0.00
w7	0.00	0.00	0.09	0.29	0.17	0.26	0.00	0.29	0.00	0.00	0.00	0.00	0.00	0.13
w8	0.00	0.20	0.22	0.00	0.00	0.16	0.29	0.00	0.12	0.00	0.00	0.00	0.00	-0.06
w9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.12	0.00	0.53	0.00	0.00	0.00	0.000
w10	0.00	0.00	0.05	0.00	0.00	0.00	0.00	0.00	0.53	0.00	0.13	0.00	0.09	0.00
Gender	0.00	0.00	0.00	0.00	0.09	0.22	0.00	0.00	0.00	0.13	0.00	0.31	0.00	0.42
Residence	0.00	0.00	0.16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.31	0.00	0.00	0.000
Age	0.00	0.00	0.00	0.12	0.00	0.00	0.00	0.00	0.00	0.09	0.00	0.00	0.00	0.467
Academic Stage	0.00	0.05	0.00	0.00	0.00	0.00	0.13	-0.06	0.00	0.00	0.42	0.000	0.47	0.000

A graphical illustration of the correlations among the variables in the neural network is presented as follows:

Figure 2. The Neural Network Between Study Variables

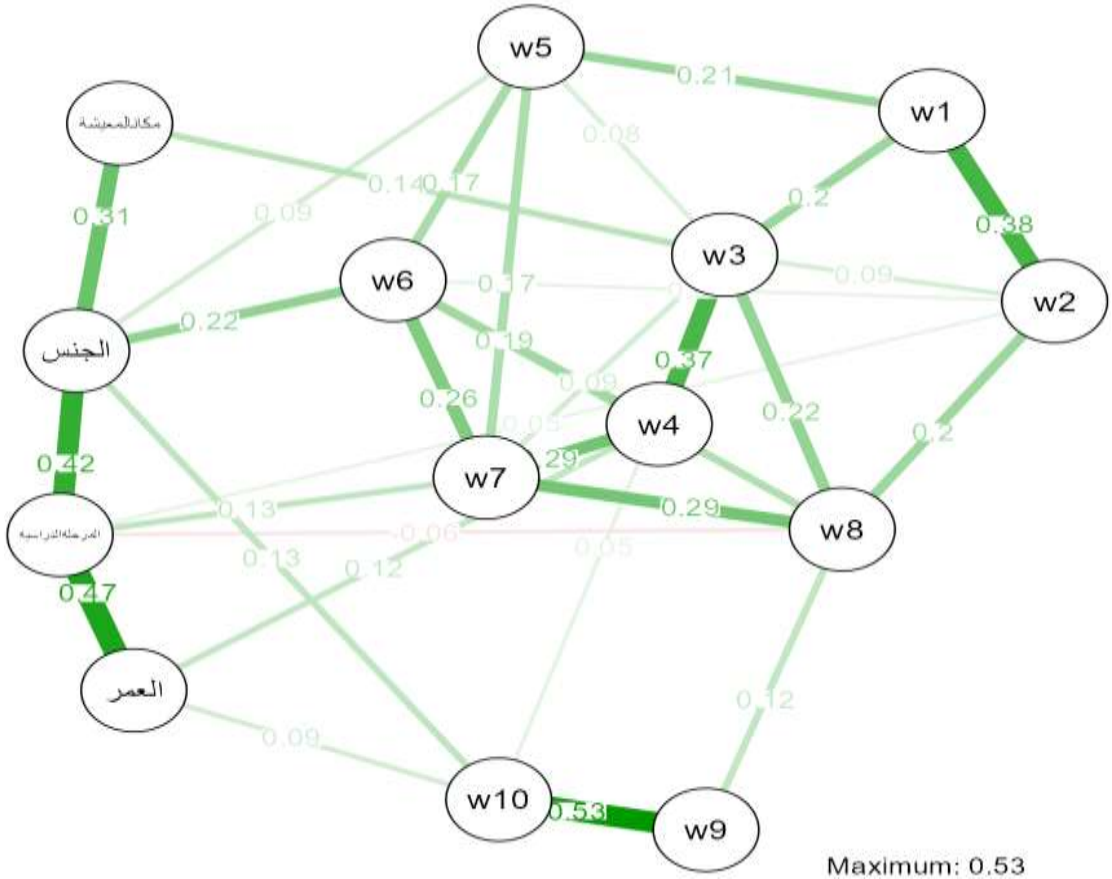


Figure 2 illustrates the structure of the neural network, comprising 14 variables interconnected by green lines of varying thickness. The thicker green lines indicate strong positive relationships between specific node pairs, most notably between (w2, w1), (w4, w3), and (w10, w9)—suggesting robust associations among these variables. Additionally, moderately thick green lines, such as the one connecting (w6, w7), reflect moderate positive relationships. Overall, the predominance of green lines among the items of the climate change scale signifies a high degree of internal consistency, reinforcing the scale's structural coherence within the network.

Concerning gender-related connections in the network, a positive relationship is evident between gender and the item "I believe that deforestation and forest removal are major causes of climate change." This suggests that females are more aware and perceptive of this cause of climate change than males. A weak relationship is observed between gender and the item "I talk to others about the effects of climate change on the environment," implying that females are more likely to discuss climate change with each other compared to males. There is also a weak relationship between gender and the item "Climate change has negative effects on the whole world," meaning that females are more aware of the negative impacts of climate change than males.

Regarding age, a positive relationship is found between age and the items "Countries should help each other to reduce the negative impacts of climate change" and "I talk to others about the effects of climate change on the environment." This suggests that older individuals are more likely to recognize the need for countries to collaborate in mitigating climate change and are more inclined to engage in discussions about climate change issues.

For the educational level, a positive relationship is observed with the items "I believe climate change is real and happening" and "I believe that industrialized countries are the primary cause of climate change." This indicates that individuals with higher educational levels acknowledge climate change as a reality and see industrial activities in developed countries as the primary driver of this phenomenon. In contrast, there is a negative relationship between educational level and the item "Climate change is an urgent issue that poses a threat to the world." This suggests that while more educated individuals accept the existence of climate change, less educated individuals may perceive it as a serious global threat. This could be attributed to the study participants, who include students from various educational stages (secondary, preparatory, and university levels) who are studying climate change and are more aware of its risks.

Regarding the place of residence, a positive relationship exists between the place of residence and the item "All countries must make more effort to address climate change." This indicates that urban dwellers are more likely to advocate for efforts to mitigate climate change, feeling more personally affected by its impacts compared to rural residents.

As shown in the figure, the network produced three clusters: the first includes eight items related to climate change awareness, the second includes the pair (w9, w10), and the third includes demographic variables. This is consistent with the results of the exploratory factor analysis. Thus, the neural network provided insights into the importance of variables in shaping the concept, as well as grouping these variables into dimensions or sub-clusters.

Table 4. Centrality Indicators for Neural Network Variables

Variable	Betweenness	Closeness	Strength	Expected Impact
w1	-0.419	-0.811	-0.420	-0.363
w2	-0.810	-0.935	-0.720	-0.671
w3	-0.028	0.865	1.412	1.549
w4	-0.615	0.614	0.316	0.403
w5	-0.615	-0.673	-0.802	-0.756
w6	0.950	1.320	0.584	0.687
w7	0.559	1.354	1.230	1.344
w8	1.733	1.105	0.562	0.140
w9	-0.224	-1.373	-0.763	-0.735
w10	-0.419	-1.454	-0.608	-0.559
Gender	2.124	0.828	1.028	1.142
Residence	-1.006	-0.132	-1.899	-1.928
Age	-1.202	-0.618	-0.903	-0.862
Education	-0.028	-0.089	0.984	0.609

Analysis of Betweenness Index: The betweenness index indicates the importance of a node in mediating relationships between any two other nodes in the network. According to Table 3, the variable with the highest betweenness is gender, followed by the item "I believe that deforestation and forest removal are major causes of climate change" (w6) and the item "I believe climate change is real and happening" (w7). This is supported by Figure 2, where these variables play central roles in mediating relationships between other variables in the network.

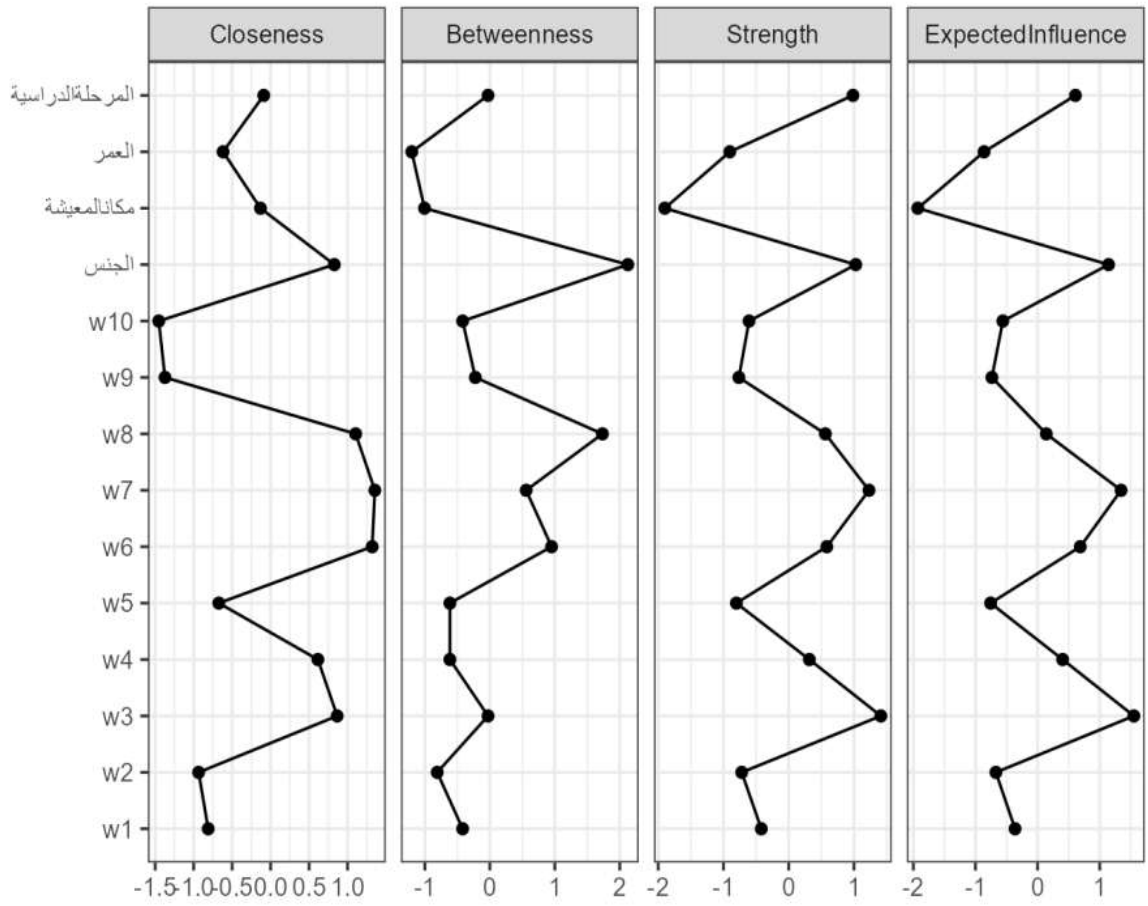
Analysis of Closeness Index: The closeness index measures how closely a node is connected to other nodes within the network. The variables with the highest closeness include the items "I believe climate change is real and happening" (w7) and "I believe deforestation and forest removal are major causes of climate change" (w6), as well as the items (w3, w8). These items demonstrate a high level of interconnectedness, indicating their significant influence on other aspects of climate change awareness.

Analysis of Strength Index: The strength index quantifies the intensity or magnitude of the relationships between a specific node and others within the network. The item "All countries must make more effort to address climate change" (w3) exhibits the strongest connections in the network, followed closely by "I believe climate change is real and happening" (w7). These items play a pivotal role in activating and influencing other nodes in the network, underscoring their centrality in shaping overall climate change awareness.

Analysis of Expected Impact Index: The expected impact index evaluates the potential influence a variable has on the network. The item "All countries must make more effort to address climate change" (w3) is projected to have the greatest impact on promoting sustainable behavior, followed by "I believe climate change is real and happening" (w7), as well as demographic variables such as gender and educational level. These variables are crucial in shaping attitudes and behaviors related to climate change awareness and sustainability.

These centrality indices and indicators provide a comprehensive understanding of how different variables interact within the climate change awareness network, as visualized in the figures and supported by the centrality measures.

Figure 3. Visualization of Centrality Indicators within the Neural Network.



The vertical axis in this figure represents the network variables, while the horizontal axis displays the standardized scores for various metrics, such as betweenness, closeness, and expected impact. The analysis highlights the central position of items (f5, f6, f7, f8) in shaping the conceptual framework of sustainable behavior, underscoring their importance in this network.

Descriptive indices for the Climate Change Awareness

Participants' responses were evaluated using a declarative statement to measure the degree of climate change awareness. The table below summarizes the means and standard deviations for the items in the climate change awareness scale:

Table 5. Means and Standard Deviations for the Climate Change Awareness Scale Items (N = 433).

No.	Items	Mean	Standard Deviation
W1	I believe human activities are the primary cause of climate change.	.958	2.26
W2	I believe the activities of industrialized countries are the primary cause of climate change.	.964	2.28
W3	All countries should make greater efforts to combat climate change.	.743	2.68
W4	Countries should collaborate to mitigate the negative effects of climate change.	.750	2.68
W5	I believe deforestation and forest removal are major contributors to climate change.	.862	2.42
W6	Climate change has a global negative impact.	.717	2.64
W7	I believe climate change is real and happening.	.701	2.67
W8	I view climate change as an urgent threat to the world.	.855	2.48
W9	I read about environmental issues.	.833	1.46
W10	I discuss the impacts of climate change with others.	.924	1.54
Overall weighted mean of Climate Change Awareness = 2.31		--	--

The table reveals that many respondents exhibit moderate levels of awareness regarding climate change. However, certain items reflect higher awareness, such as W3 ("All countries should make greater efforts to combat climate change"), W4 ("Countries should collaborate to mitigate the negative effects of climate change"), W6 ("Climate change has a global negative impact"), and W5 ("I believe deforestation and forest removal are major contributors to climate change"). Conversely, item W9 ("I read about environmental issues") displays relatively low levels of awareness. Overall, climate change awareness among the participants is at a moderate level.

To further assess climate change awareness, participants were asked, "What is your level of awareness and knowledge about climate change?" The frequency distribution showed that 102 participants (23.6%) reported having no awareness of climate change, while 331 participants (76.4%) indicated they were aware.

Climate Change Awareness and Demographic Variables:

To examine the role of gender in shaping climate change awareness, an independent samples *t*-test was conducted ($T(431) = 0.519$, $p = .60$), revealing no statistically significant difference in

awareness levels between male and female participants. Similarly, a one-way ANOVA was employed to assess the impact of academic level ($F(3, 429) = 2.403$, $p = .07$), which showed no significant differences in climate change awareness across different academic stages. Regarding place of residence, another independent *t*-test ($T(431) = 0.070$, $p = .10$) indicated no significant disparity between urban and rural participants. However, Pearson's correlation analysis uncovered a statistically significant positive relationship between age and climate change awareness ($r(421) = .23$, $p < .01$), suggesting that older individuals tend to exhibit greater awareness of climate change and its associated risks.

Delimitations:

A notable delimitation of this study concerns its data collection strategy, which primarily relied on participant recruitment via WhatsApp and Facebook. Although these digital platforms enabled wide dissemination and ease of access, the use of non-probability sampling inherently introduces the risk of selection bias. This limitation may affect the generalizability of the findings, as the sample may not accurately represent the wider population. Consequently, the results should be interpreted with caution, recognizing that they may reflect the characteristics of a self-selected group rather than broader demographic or attitudinal trends.

Discussion:

Climate change is one of the most pressing global challenges, profoundly affecting both human societies and natural ecosystems through rising temperatures, floods, droughts, and increasingly severe storms. Defined as a long-term shift in climate patterns, primarily driven by human activities, it has become a focal point for scientific research and policymaking. With approximately 97% of climate change effects attributed to human-induced factors (Cook et al., 2016), addressing this crisis requires a multifaceted, interdisciplinary approach. Among these approaches, environmental psychology plays a crucial role in understanding human behavior and promoting eco-conscious actions. Raising awareness about climate change—its causes, consequences, and potential solutions—serves as a foundation for fostering collective action. Alvi et al. (2020) emphasized that sustained educational efforts, such as workshops and awareness campaigns, are essential for building climate-resilient communities that are both informed and proactive.

Despite its global urgency, awareness of climate change varies significantly across regions, often reflecting deeper socio-cultural and economic disparities. In many developing countries, particularly across Africa, immediate socioeconomic concerns frequently take precedence over

environmental issues, leading to lower levels of climate awareness (Lee et al., 2015). Research in Nigeria (Agboola & Emmanuel, 2016) and Kenya (Ajuang et al., 2016) has shown that while general recognition of climate change is widespread, awareness is strongly shaped by demographic factors such as age, education, and gender. These findings highlight the transformative potential of targeted educational initiatives, particularly within schools and universities, to enhance climate literacy and empower communities to respond effectively.

The Asian context presents a similarly complex picture. Studies in Oman (Al-Buloshi & Ramadan, 2015) and China (Wang et al., 2017) suggest moderate to low awareness levels, particularly regarding the causes of climate change and preventive measures. Conversely, research from the Philippines (Magulod, 2018) and Indonesia (Nggole et al., 2019) points to relatively higher awareness, with respondents identifying key contributors such as greenhouse gas emissions and poor waste management. However, a common challenge persists: a significant gap between awareness and meaningful environmental action. Even in countries with higher awareness levels, such as the Philippines, proactive behaviors remain inconsistent. Notably, gender differences have emerged in several studies, with women often demonstrating greater awareness and concern. This suggests that sociocultural influences play a crucial role in shaping environmental engagement and warrant further investigation.

In Europe, climate change awareness is generally more widespread, yet still exhibits variation across demographic groups. Poortinga et al. (2019) analyzed climate concern across 22 European nations, finding that age, education, and gender significantly influence awareness. Younger generations and individuals with higher education levels tend to express greater concern, reflecting broader societal shifts toward environmental consciousness among youth. In Turkey, Turkmen (2021) found that the public overwhelmingly acknowledged climate change, frequently citing vehicle emissions as a primary cause. These findings underscore the role of education and cultural values in shaping public perceptions and responses to climate change.

As a developing country with unique environmental vulnerabilities, Egypt faces distinct challenges in fostering widespread climate awareness. Studies by Salem et al. (2022) and Ghanem (2023) suggest that awareness levels are moderate to high, particularly regarding the human-driven nature of climate change. The government's proactive stance is reflected in initiatives such as incorporating climate topics into school curricula and hosting international climate forums. However, significant disparities in climate awareness remain among different demographic groups, underscoring the need for more inclusive and targeted strategies to enhance climate literacy. A 2022 survey by Mertens & Thiemann (2023) revealed that while 92% of Egyptians report experiencing the effects of climate change in their daily lives, many still lack a comprehensive understanding of

its causes and long-term implications. Addressing this knowledge gap requires continued educational efforts and accessible public awareness campaigns that not only inform but also empower individuals to take meaningful action.

This study introduces an innovative approach by applying neural network analysis to investigate the complex interrelationships among the various components of climate change awareness. Unlike traditional factor analysis, which often identifies linear relationships, neural network modeling can capture intricate, dynamic interactions between variables. This allows for a deeper understanding of the underlying mechanisms that influence environmental beliefs and behaviors. This advanced analytical method responds to recent calls for the use of more sophisticated tools in evaluating psychological constructs related to climate change (Gönen et al., 2023). By pinpointing the key drivers of climate awareness, neural network analysis offers valuable insights that can inform the development of targeted interventions, ensuring that climate awareness is not only widespread but also deeply ingrained in public consciousness and daily decision-making.

Conclusion

Understanding climate change extends beyond acknowledging its existence; it involves recognizing how diverse groups perceive and respond to it. This study explores the evolving climate change awareness within Egyptian society, shedding light on how demographic factors—such as age, education, gender, and place of residence—shape individuals' understanding of this global issue. Through the application of neural network analysis, we reveal the intricate ways these factors interact, pinpointing the key influences that drive public engagement with climate change. Interestingly, while gender, academic level, and residence show no significant impact on awareness levels, our results highlight a notable trend: older individuals tend to exhibit a deeper understanding of climate change. This finding suggests a generational shift in environmental consciousness, indicating that awareness may increase with age due to accumulated experiences and exposure to long-term environmental changes.

These findings challenge the assumption that climate change awareness is uniform across all populations. Instead, they underscore the need for targeted, audience-specific interventions that recognize the diverse ways people engage with climate issues. Younger generations could benefit from early exposure to well-designed climate education and tailored awareness programs. Incorporating climate change topics into school and university curricula is not merely a suggestion—it is an essential step toward fostering a deeper understanding of environmental challenges. However, effective education should do more than impart facts; it must cultivate

curiosity, encourage critical thinking, and motivate active participation in sustainability efforts. This holistic approach can empower individuals to become proactive agents of change in addressing climate issues.

This study advocates for a more inclusive approach to climate change research. To gain a comprehensive understanding of climate change awareness, it is crucial to consider the varied cultural, economic, and educational backgrounds that influence how individuals in Egypt engage with environmental issues. By broadening research methods to capture this diversity, we can obtain a more holistic view of how climate change awareness evolves across different segments of society. Such an approach will enable the development of more effective, context-sensitive strategies for fostering greater public engagement and action on climate change.

Ultimately, climate change is not merely an individual issue—it is a collective challenge that demands action at every level. Governments, universities, and community organizations must join forces to cultivate a society that is well-informed, actively engaged, and prepared to take meaningful steps toward sustainability. By promoting a deeper and more widespread understanding of climate change, this research adds to the global dialogue on environmental responsibility. The future is shaped by the choices we make today, and only through collaboration and unwavering commitment can we build a more resilient, climate-conscious world for future generations.

Practical Implications

This study sheds light on how climate change awareness takes shape across different demographics, revealing a largely consistent understanding across gender, academic level, and place of residence. This suggests that climate awareness campaigns can be broad, reaching a wide audience without needing to be overly segmented. However, the finding that older individuals tend to have greater climate awareness presents an opportunity to focus on younger generations. By fostering climate literacy early in life and encouraging sustainable behaviors from an early age, we can nurture a generation that is not only informed but also actively engaged in tackling environmental challenges.

Beyond simply raising awareness, this study highlights the importance of age-sensitive climate education. The way we talk about climate change should resonate with different life stages. For older generations, messaging might focus on the immediate, tangible effects—how climate change is already impacting their communities, health, and livelihoods. Meanwhile, younger individuals may connect more with discussions on the long-term consequences and their role in shaping a sustainable future. By tailoring climate education to different audiences, we ensure that the message is not only heard but also inspires action.

One limitation of this study lies in its reliance on social media platforms, such as WhatsApp and Facebook, for data collection. While these platforms offer extensive reach and ease of access, they may not fully capture the diversity of perspectives across Egyptian society. This digital approach could inadvertently exclude individuals who have limited access to or familiarity with these platforms, potentially skewing the sample and reducing its representativeness. To address this limitation, future research should consider integrating more inclusive sampling methods, such as random sampling or outreach through educational institutions, community organizations, and local networks. Expanding beyond digital channels will help ensure a more diverse and comprehensive view of climate change awareness across different segments of society.

Additionally, the study's sample shows a pronounced gender imbalance, with a significantly higher number of female participants (377) compared to male participants (56). This discrepancy may influence the generalizability of the findings, particularly about gender differences in climate change awareness. The overrepresentation of female participants introduces potential bias, limiting the study's ability to provide equitable insights into gendered perceptions of climate change across the broader population. To strengthen the validity and applicability of future studies, efforts should be made to achieve a more balanced gender distribution, ensuring that conclusions drawn are more representative of the entire population.

Another significant insight from this study is the unexpected similarity in climate awareness between urban and rural populations. This finding challenges the common assumption that city dwellers are more attuned to environmental issues than their rural counterparts. While the results suggest that climate programs do not necessarily need to be location-specific, rural communities can still benefit from initiatives that integrate local knowledge and address region-specific challenges. By tailoring climate solutions to the lived experiences of rural populations, we can foster deeper engagement and drive more meaningful action.

Author Contributions: All authors contributed equally to this work. They were involved in conceptualizing the study, developing the methodology, conducting the research, analyzing the data, and drafting and revising the manuscript. All authors have read and approved the final version of the manuscript and agree to be accountable for all aspects of the work.

Conflicts of Interest: The authors declare that there are no conflicts of interest associated with this study.

Funding: This study received no financial support from any funding agency or organization.

Availability of Data: The data that support the findings of this study are available upon reasonable request from the corresponding author. The data were collected through social media platforms, including WhatsApp and Facebook, and are accessible in the form of survey responses.

References:

Abdelrahman, R. M., Fakhrou, A., Moussa, M. A., & Roshan, M. (2025). Psychometric Properties and Network Analysis of the Arabic Version of Reinforcement Sensitivity Theory of Personality Scale-Short Version in Patients with Anxiety Disorders. *Psychiatric Quarterly*, 1-23. https://doi.org/10.1007/s11126-024-10109-3.

Agboola, O. S., & Emmanuel, M. (2016). Awareness of climate change and sustainable development among undergraduates from two selected universities in Oyo State, Nigeria. World Journal of Education, 6,70-81.

Ajuang, C. O., Abuom, P. O., Bosire, E. K., Dida, G. O., & Anyona, D. N. (2016). Determinants of climate change awareness level in Upper Nyakach Division, Kisumu County, Kenya. *Springer Plus, 5*:1015. https://doi.org/10.1186/s40064-016-2699.

Al- Buloshi, A. S., & Ramadan, E. (2015). Climate change awareness and perception amongst the inhabitants of Muscat governorate, Oman. *American Journal of Climate Change*, *4*(04), 330. https://www.scirp.org/html/3-2360264_58890.htm

Al Buloshi, A. S., & Ramadan, E. (2015). Climate Change Awareness and Perception amongst the Inhabitants of the Muscat Governorate, Oman. *American Journal of Climate Change, 4*, 330- 336. https://doi.org/10.4236/ajcc.2015.44026

Alharbi, B. A., Ibrahem, U. M., Moussa, M. A., Abdelwahab, S. M., Radi, B. A., & Diab, H. M. (2024). Leadership development through interactive e-training: the impact of gender and learning style. *Interactive Learning Environments*, 1-19. https://doi.org/10.1080/10494820.2024.2361373

Alvi, S., Jamil, F., Roson, R., & Sartori, M. (2020). Do farmers adapt to climate change? A macro perspective. *Agriculture*, *10*(6), 212. https://doi.org/10.3390/agriculture10060212

Amer, A. A. (2018). *Structural equation modeling for psychological and social sciences: Foundations, applications, and issues* (Part one). Riyadh: Naif Arab University for Security Sciences Publishing.

Amer, A. A. (2024). Artificial neural network analysis of smartphone application addiction scale and its prevalence among Egyptian adolescents. *Journal of Educational Research and Studies in Kuwait, 4*, 158-193.

Amer, A. A. (2024). Quantitative, qualitative, and mixed methods research methodologies: Design, measurement, analysis, and scientific writing (part one). Available at Amazon Arabic Digital Book Publishing: https://www.amazon.com/dp/B09K5MYLRF.

Comery, A. L., & Lee, H. B. (1992). *A first course in factor analysis* (2nd ed.). Hillsdale, NJ: Erlbaum.

Cook, J., Oreskes, N., Doran, P., & Anderegg, W.L. R. (2016). Consensus on consensus: A synthesis of consensus estimates on human-caused global warming. *Environmental Research Letters, 11*:048002. https://doi.org/10.1088/1748-9326/11/4/048002

Costantini, G., Richetin, J., Borsboom, D., Fried, E.I., Rhemtulla, M., & Perugini, M. (2015). Development of indirect measures of conscientiousness: combining a facets approach and network analysis. *European Journal of Personality, 29*, 548–567. https://doi.org/10.1002/per.2014

Epskamp, S., & Fried, E. I. (2018). A tutorial on regularized partial correlation networks. *Psychological Methods, 23*, 617–634. https://doi.org/10.1037/met0000167/wps.20375

Epskamp, S., Borsboom, D., & Fried, E. I. (2018). Estimating psychological networks and their accuracy: A tutorial paper. Behavior Research Methods, 50, 195–212. https://doi.org/10.3758/s13428-017-0862-1

Field, A. (2018). *Discovering Statistics Using IBM SPSS Statistics* (5th ed). Sage Publications, Ltd.

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

Ghanem, A. (2023). Assessment of Knowledge, Perception, and Behaviors Towards Climate Change among University Youth in Egypt. Athens Journal of Mediterranean Studies, 9, 69-84. https://doi.org/10.30958

Gönen, Ç., Deveci, E. Ü., & Aydede, M. N. (2023). Development and validation of a climate change awareness scale for high school students. *Environment, Development and Sustainability*, *25*(5), 4525-4537. https://doi.org/10.1007/s10668-022-02213-w

Lee, T. M., Markowitz, E. M., Howe, P. D.,Ko, C- Y., Leiserowitz. (2015). Predictors of public climate change awareness and risk perception around the world. *Nature Climate Change*, 5, 1014–1020. https://doi.org/10.1038/nclimate2728

Liwan, A., Surianshah, S., & Yau, J. (2022). Level of public awareness on climate change in Sabah. *IOP Conference Series Earth and Environmental Science*, 1103,012001. https://doi.org/10.1088/1755-1315/1103/1/012001

Magulod, G. (2018). Methods and patterns of integrating environmental values in teaching science among pre-service elementary teachers. *Journal of Biodiversity and Environmental Sciences (JBES),* 12, 293-301. Available at SSRN: https://ssrn.com/abstract=3382600

Mertens, D., & Thiemann, M. (2023). The European Investment Bank: the EU's climate bank?. In *Handbook on European Union climate change policy and politics* (pp. 68-82). Edward Elgar Publishing. https://doi.org/10.4337/9781789906981.00016

Mohsin, A., Shehzad, A., Bilal, F., Imran, F., Akhtar, S., & Fatima, S. A. (2022). Assessment of Awareness on Climate Change among Public and Private Universities of Lahore. *Indonesian Journal of Innovation and Applied Sciences (IJIAS)*, *2*(1), 80-87. https://doi.org/10.47540/ijias.v2i1.439

Moussa, M., & Elnersh, H. (2025, April). Data Analysis Errors and Limitations in Educational Research. *International Journal of Research in Educational Sciences, 8*(2), 293- 330. Retrieved from http://www.iafh.net/index.php/IJRES/article/view/499

Nggole, S., Tyas, W. P., & Pradoto, W. (2019). The Level of Climate Change Awareness among Citizens of Bitung City, Indonesia. *Jurnal Wilayah dan Lingkungan*, *7*(1), 38-51. https://core.ac.uk/download/234033120.pdf

Olaniyi, F. O. (2020). Perception and level of awareness of climate change among Adult learners on attendance and performance in literacy centers, Ondo State, Nigeria. *Randwick International of Education and Linguistics Science Journal, 1*, 261–273. https://doi.org/10.47175/rielsj.v1i3.136

Oruonye, E. O. (2011). An assessment of the level of awareness of the effects of climate change among students of tertiary institutions in Jalingo Metropolis, Taraba State, Nigeria. *Journal of Geography and Regional Planning, 4*, 513-517. http://www.academicjournals.org/JGRP

Poortinga, W., Fisher, S., Bohm, G., Steg, L., Whitmarsh, L.,& Ogunbode, C. (2018). *European attitudes to climate change and energy*. ESS Topline Results Series no.9.

Poortinga, W., Spence, A., Whitmarsh, L., Capstick, S., & Pidgeon, N. F. (2011). Uncertain climate: an investigation into public skepticism about anthropogenic climate change. *Glob. Environ. Change, 21*, 1015–1024. https://doi.org/10.1016/j.gloenvcha. 2011.03.001

Poortinga, W., Whitmarsh, L., Steg, L., Böhmd, G., Fisher, S. (2019). Climate change perceptions and their individual-level determinants: A cross-European analysis. Global Environmental Change, 55, 25- 35. https://doi.org/10.1016/j.gloenvcha.2019.01.007

Salem, M. R., Hegazy, N., Thabet, M. A. A., Mahrous, H. E., Saad, A. M. M., & Zein, M. M. (2022). Climate change-related knowledge and attitudes among a sample of the general population in Egypt. *Front. Public Health, 10*.1047301. https://doi.org/10.3389/fpubh.2022.104730

Sjöberg, K., Gunnarsson, G., Pöysä, H., Elmberg, J., & Nummi, P. (2011). Born to cope with climate change? Experimentally manipulated hatching time does not affect duckling survival in the mallard Anas platyrhynchos. *European Journal of Wildlife Research*, *57*, 505-516. https://doi.org/10.1007/s10344-010-0459-9

Stern, P. C. (2000). Toward a coherent theory of environmentally significant behavior. *J. Soc. Issues, 56*, 407–424. https://doi.org/10.1111/0022-4537.00175.

Tabachnick, B. G., & Fidel, L. S. (2013). *Using multivariate statistics (6th ed)*. Boston: Allgn & Bacon.

The European Bank Investment. (2023). *Climate survey (5th ed.)*. https://www.eib.org/en/surveys/climate-survey/5th-climate-survey/index

Turkmen, B. A. (2021). The Analysis of Climate Change Awareness at the Local Level. *European Journal of Science and Technology, 25*, 457- 462. https://doi.org/10.31590/ejosat.890865

Wang, B., Shen, Y., & Jin, Y. (2017): Measurement of public awareness of climate change in China: based on a national survey with 4,025 samples. *Chinese Journal of Population Resources and Environment, 15*(4), 285- 291, https://doi.org/10.1080/10042857.2017.1418276

West, J. J., Hope, C., & Lane, S. N. (1997). Climate change and energy policy: the impacts and implications of aerosols. *Energy Policy*, *25*(11), 923-939. https://doi.org/10.1016/S0301-4215(97)00086-4

تحليل الشبكات العصبية للوعي بتغير المناخ في المجتمع المصري

الملخص:

تهدف هذه الدراسة إلى استكشاف البنية الداخلية للوعي بتغير المناخ داخل المجتمع المصري، وذلك من خلال تحليل الشبكات العصبية لفحص علاقاته بالعوامل الديموغرافية مثل النوع الاجتماعي، والمستوى الأكاديمي، ومكان الإقامة، والعمر. تم جمع البيانات من ٤٣٣ مشاركًا عبر منصات التواصل الاجتماعي مثل "واتساب" و"فيسبوك"، مما أتاح تمثيلاً متنوعًا للعينة. واستخدمت الدراسة أساليب إحصائية متقدمة شملت تحليل الشبكات العصبية، واختبارات ت، وتحليل التباين الأحادي، ومعامل ارتباط بيرسون، بهدف تحقيق فهم شامل للنتائج. وكشفت الشبكة العصبية عن ١٤ عقدة مترابطة، شملت مفردات الوعي بتغير المناخ والمتغيرات الديموغرافية، وتم تنظيمها في ثلاث مجموعات متميزة. وقد تم تحديد متغيرات وسيطة داخل الشبكة من بينهم النوع الاجتماعي، والاعتقاد بأن إزالة الغابات سبب رئيسي لتغير المناخ، والاعتراف بواقعية ظاهرة التغير المناخي. وأبرزت الدراسة العلاقات الأقوى التي تمحورت حول الحاجة العالمية للعمل المنسق لمواجهة تغير المناخ، وعلى الرغم من عدم وجود فروق ذات دلالة إحصائية تبعًا للنوع الاجتماعي أو المستوى الأكاديمي أو مكان الإقامة، فقد تم الكشف عن علاقة ارتباط إيجابية بين العمر والوعي بتغير المناخ، حيث أظهر المشاركون الأكبر سنًا فهمًا أعمق لقضية تغير المناخ. وتشير النتائج إلى أهمية التدخلات الموجهة نحو الفئات العمرية الأصغر، وضرورة دمج تعليم تغير المناخ ضمن المناهج الأكاديمية لتعزيز الوعي البيئي. كما تؤكد الدراسة على أهمية الاستراتيجيات الشاملة وطرق انتقاء عينات متنوعة في الدراسات المستقبلية لتوسيع قاعدة الوعي بتغير المناخ داخل المجتمع المصري، بما يسهم في تحقيق تفاعل أكثر فاعلية مع هذه القضية.

الكلمات المفتاحية: الوعي بتغير المناخ، محل الإقامة، الوعي البيئي، تعليم تغير المناخ، تطوير السياسات.