A SYSTEMATIC RESEARCH REVIEW AND META-ANALYSIS OF ENVIRONMENTAL SCIENCES AND MANAGEMENT MODELS

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Highlight

This article integrates management models, environmental sciences, and a thorough meta-analysis.

Abstract

This research advances the comprehension of the processes behind individuals' environmentally friendly behavior using a comprehensive approach. A questionnaire addressed intrapersonal, motivational, relationships, and educational aspects, with environmental science as the primary catalyst for green behavior within a complete theoretical structure.The method is the CADMIACA approach, which is founded on Comprehensive Action Determining Modeling (CADM), together with various Motivational and Interpersonal (MI) theories and the Activity Competence Algorithm(ACA). This framework encompasses various control factors relevant to comprehensively characterizing the factors influencing environmentally friendly behavior, including climate change, energy conservation, recycling, sustainable buying, and contamination.The findings were gathered in the A Coruña metropolitan region to experimentally evaluate the causal relationships among the parameters that formed the framework utilizing Structural Equation Modeling (SEM). Findings show that environmentalscience serves as an effective instrument for fostering eco-friendly behavior among residents. The extensive CADMIACA model aligns well with the information since all components incorporated in the framework (intrapersonal, inspiring, social, and institutional) are pivotal in shaping green conduct.Environmental instruction and intrapersonal variables emerged as the primary predictors of green conduct, but social and motivational variables were less prevalent in influencing such behavior. The findings suggest that human conduct plays a vital role in environmental protection.

Keywords

Meta-analysis;environmental sciences; management; review.

Introduction

Many people are talking about how climate change might affect movement worldwide [1]. New waves of massive migration, like the Syrian refugee crisis in 2015 and the "migrant group" from Central America to the US in 2018, were partly caused by terrible weather in those regions. There may be links between environmental changes and movement seen in other parts of the globe [2]. The amount to which natural factors cause economic and social problems and affect migration has been the subject of heated debate in the academic world [16]. Let's say that the claim that bad weather causes people to move is valid. If the global mean

temperature rises two or more degrees above pre-industrial values, many more people will move around in the future [3][19].

In the last ten years, many more scientific studies have looked at how temperature and other outside conditions affect movement. There is a need for more agreement on how these factors influence movement and how much they affect it. Changes in the surroundings have been linked to more people moving, but in some cases, they have had no effect or even caused fewer people to move [4]. The actual results are all different. They depend on the outside variables that were looked at, the amount of information collected, the scale of the study, the method used, and the places studied. Assessments of the scope and trajectory of environmental movement trends vary a lot, even among the same research [5].The different types of proof make it harder for policymakers to deal with the problems that come with the idea that future environmental change could cause more people to migrate worldwide [32]. The study uses a " meta-analysis "method to combine the findings of 30 scientific papers written between 2018 and 2024 [20]. These papers statistically look at how different natural factors affect movement.

The investigations are mostly large-scale ones that try to guess what effects movement has by looking at changes over time and across nations using continuous data [6]. The investigations are primarily about natural factors affecting the environment, like changing weather, heavy rain, and heavy storms. They use different modeling methods, country sampling, and criteria to create separate predictive models that look at the effects of various ecological variables and other factors that cause people to move [21].

This essay suggests using a meta-analysis to look at green behavior by looking at many different factors and using a combined approach to see how they relate [7]. This broad method is called CADMIACA, and it is built on the ideas of Activity Competence Approach (ACA) [23], Comprehensive Action Defining Modeling (CADM) [33], and Motivational and Interpersonal (MI) [9]. Because where people live, their level of training, gender, age, or where they live play a significant role in how they act in the surroundings, the initial investigation concentrates on the community of A Coruna [8]. Compared to the control illnesses, this broad green behavior plan lets us look at how things like knowledge, attitudes, social contact, education, energy utilization, reuse, green buying, and global warming change when the research changes things like these [30]. The research needs to answer the following study issues:

- Does the complete modeling approach give a good picture of what affects people's green behavior in their daily lives?
- Which essential factors in the model change when the study's proposed control conditions are used? If so, what variables are they?
- Does ecological research change how strong the links are between the model factors or the model's shape?

This study aims to use the suggested complete CADMIACA approach to explain which paths and control circumstances lead to more green solid conduct.In a broad sense, this study helps us understand what makes people act in environmentally friendly ways. The study shows how vital (casual) environmental science is for understanding green or environmentally friendly behavior.

Materials and Methods

Figure 1 illustrates the overarching screening processes and the methodology for detecting publications. Initially, 1250 records were identified: 70 from Google Scholar (utilizing sophisticated search techniques) [11], 1035 from ScienceDirect [31], and 145 from Scopus [13]. Following the exclusion of literary works, including abstracts, speeches, books, non-English papers, and inaccessible materials, the total was diminished to 470 articles selected for subsequent title review [12]. One hundred twenty-five papers met the qualifying requirements for additional review of their abstracts [10]. After reviewing the abstract, only 108 papers remained for the primary text examination [24]. Eighty-nine publications were evaluated and were downloaded for additional screening procedures. During the primary review, redundant publications and articles needing explicit ecosystem service evaluation methodologies were systematically eliminated [22]. Seventy papers met all the inclusion requirements published in this analysis.

The compilation of pertinent research was obtained for subsequent study. The items selected for further examination constituted 6.1% of library original papers. This review utilized a larger sample size, including 0.8% and 3.1% of the documents in the records. The requirements for finding and the aims of the review dictate the sample dimension of the papers used in the evaluation. The quantity and variety of databases used for publishing searches influence the sample dimension utilized for assessment. Most research publications needed more open access, limiting the number of released papers available for further evaluation.

The bibliographic evaluation and material analysis approaches were the principal techniques employed to fulfill the objectives of this research. Prior bibliometric investigations have often adhered to a defined analytical methodology. The investigation was conducted following these specific stages: (1) A quantitative evaluation was executed to delineate the cross-disciplinary domains and source publications of 530 papers; (2) a co-authorship evaluation was undertaken to ascertain the most prolific nations and areas; (3) a citation evaluation was carried out to pinpoint the seminal papers; and (4) keyword overlap and additional content evaluation took place to reveal the principal topics, predominant methodologies, ancillary factors, incorporated concepts, specific demographics, and control factors.

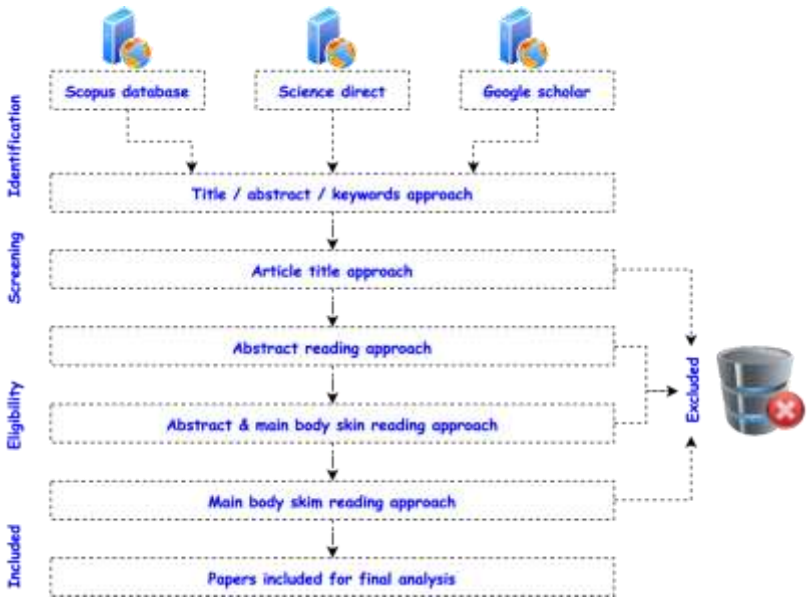

Figure 1. Workflow of the proposed literature analysis

A thorough commentary will be provided based on the preceding research.Figure 2 illustrates the comprehensive research methodology.

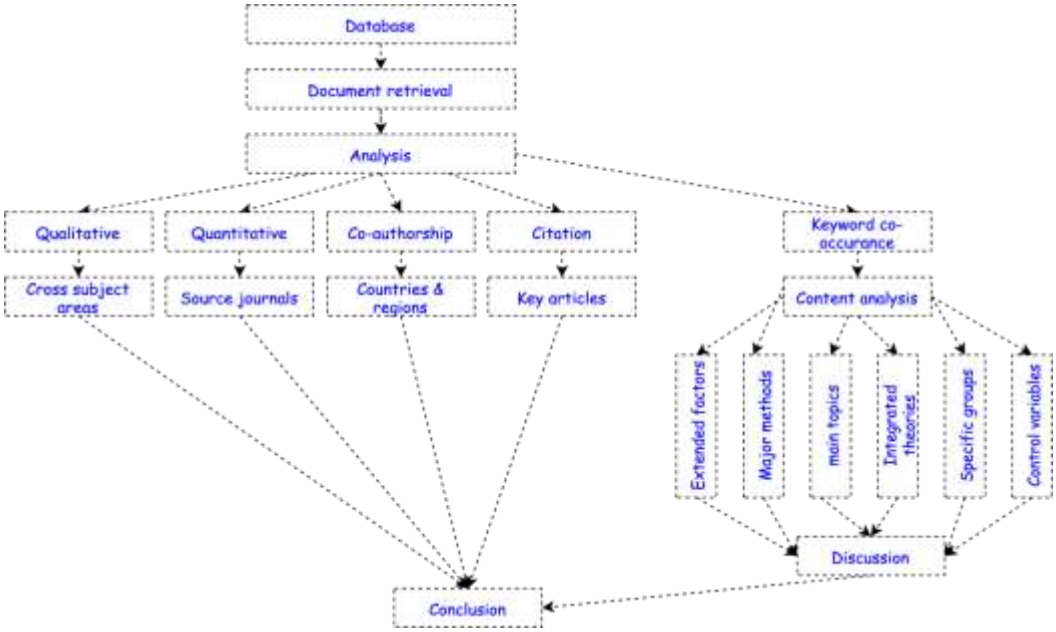

Figure 2. Comprehensive research methodology

The subsequent part of this research involves administering a survey to validate the causal link among many elements influencing environmental science and to ascertain the reliability and accuracy of the comprehensive meta-assessment [14]. A study is necessary to elucidate the influence of these elements on environmentally sustainable activities. The sample and instrumentation are delineated, and the strategy for this investigation is presented utilizing Structural Equation Modeling(SEM) [25].

Literature Analysis

The organization of ideas employed in the study necessitated the integration of many methodologies, elements, and judgments.The necessity of incorporating emotional and objective environmental aspects to comprehend green behavior comprehensively has been consistently emphasized. Despite the myriad characteristics of broad pro-environmental theories, the research categorizes them by their primary methods to establish a more complete structure to explain Pro-Environmental Behavior(PEB). The four methods were intrapersonal, inspiring, social, and institutional (Figure 3).

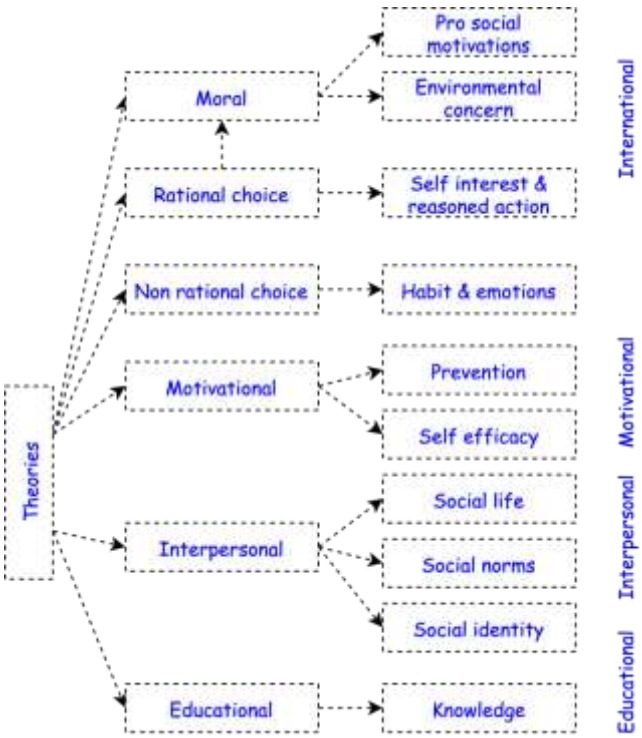

Figure 3. Relationship among environment and management models

Intrapersonal Approach

Most studies examine intrapersonal variables' impact on Pro-Environmental Behavior(PEB) [15]. This methodology is classified into three theoretical categories: ethical, logical option, and non-rational decision. The initial collection was characterized by ethical theories, with the Value-Belief-Norm (VBN) Theory being the most prominent.

VBN is regarded as a complete moral framework in which ethical principles primarily motivate pro-environmental conduct as spontaneous reactions. This theory emerged from synthesizing the Newer Environmental Pedagogy (NEP) and Normative Activation Theories (NAT), grounded in elements associated with pro-social analysis. Proponents of NAT believed that altruistic motives were the impetus for PEB. The standards established via awareness of repercussions and attribution of accountability were a significant impetus for ecologically sustainable conduct. VBN examined the impact of beliefs alongside the ecological perspective to stimulate self-responsibility and the outcomes of activities, which could additionally impact their environmentally friendly activity.

The category pertained to rational concepts, primarily characterized by the Theory of Planned Behaviour (TPB), which elucidated PEB via the lens of self-interest and sensible choices [31].The fundamental premise argued that PEB necessitated intention, which wasanticipated by favorable views toward environmentally friendly actions [26]. This theory proposed two mechanisms for attaining PEB: subjective standards, reflecting the standards of significant others or peer pressure, and perceived behavioral regulation, which denotes the individual's sense of capability to execute the desired action.

The third category pertained to non-rational choice concepts, wherein habit formed the basis of routinized conduct. Theories of Interpersonal Action (TIP) acknowledge the irrationality of action. They expanded the TPB to encompass emotional factors and habits across four categories: motive, impact, routine, and enabling situations [17]. In this context, the action was shaped by moral convictions. Emotional impulses and cognitive constraints tempered these effects.

The multifaceted nature of PEB, as represented by those above three theoretical categories, can be synthesized within the CADM, encompassing NAT (ethical concept), TPB (rational option concept), and TIP (routine, the non-rational element).The CADM paradigm directly included purposeful and normative factors, whereas contextual and habitual impacts were indirectly added through individual and societal norms. With robust scientific proof, it has been effectively implemented across several investigations in distinct behavioral fields, including recycling, transport mode selection, and energy-efficient investing behavior.

Motivational Approach

In addition to the previously described intrapersonal elements, motivational frameworks elucidate general PEB. Protection Motivation Theories (PMT) posit that views about global warming mitigation—specifically perceived seriousness, reaction efficiency, and self-efficiency—areforecasters of inclinations to participate in various PEBs [27]. The Cognitive Theories of Strain (CTS) posit that perceiving environmental stressors, such as warming temperatures or contamination, as threats and self-efficacy might elucidate PEB [18].

Interpersonal Model

The area investigated the influence of interpersonal elements on PEB, encompassing Structure Theories, Focus Research on Normative Behavior, and Self-Identity Research.The concept of Structure posits that the repetitive acts of humans reproduce social structures—such as customs, organizations, and moral codes—and allow for their transformation through varying behaviors of individuals. Regarding environmental conduct, she asserted that individuals actively engage with institutional perceptions of ecological concerns through communications.It established linkages between many types of knowledge related to everyday and experience contexts. The Focus Theories of Standard Behaviour (FTSB) explicitly examines the impact of social conventions on PEB within interaction frameworks.It posited two norms: describing the impression of typical conduct and acceptanceand concerning moral principles and recommendations. Social conventions functioned by offering exemplars of appropriate behavior and direction. The hypothesis of the interpersonal method is the Self IdentificationTechnique (SIT). Social identification refers to the sensation of belonging to an organization (in-

group), which serves as a source of pleasure, perhaps exacerbating prejudice or bias against those not adhering to that community (out-group) to bolster one's self-imagine. This perspective has been utilized in PEB, indicating that it substantially determines specific pro-environmental actions.

Educational Approach

Certain writers proposed that the answer lies in the delivery of data and the diffusion of information via learning and instruction, which are aimed at modifying behavior in response to the awareness of environmental challenges, therefore contributing to their resolution. The Action Competence Model (ACA) posited the essentiality of experiential knowledge and empirical data for ecologically sustainable actions.The enhancement of environmental learning in schools and awareness campaigns in mass media have been implemented to inform the general population.

Previous studies demonstrated a limited comprehension of the influence of psychological elements on green behavior in everyday life from a general viewpoint. This investigation employed a complete psycho-sociological model, integrating those mentioned above, yielding insights into the causes of sustainable conduct via CADMIACA. This comprehensive framework encompasses the primary determinants of PEB, derived from the theories above: knowledge, mindsets, motivation, motivation, social conventions, and environmental science.

Materials

The data evaluation, by the characteristics of qualitative studies, was conducted in three phases: data evaluation, classification, and discovery of linkages among groups.The initial step involves collecting data and delineating the overarching characteristics of environmentally conscious behavior. The factors associated with this phenomenon were analyzed and categorized, followed by the selection and designation of subcategories.This study's survey was based on the previously described conceptual framework CADMIACA. A multiple-choice exam was employed as the data collecting instrument utilizing the Likert scale (1-5). The survey questions were derived from prior research. The sample target population comprised anonymous people in A Coruña. The survey has seven primary groups: energy conservation behavior, knowledge of global warming, eco-friendly conduct, ecological, social engagement, informal environmental awareness, and ecological views. For topic validity, each question in this exam was chosen based on the persons instructed within environmental learning.Every action intended for measurement was incorporated into the data gathering.In light of the validity of this prior research, field experts assessed the understanding of the assertions presented in the inquiries.

In the distribution of the inquiries, particular emphasis was placed on ensuring that every topic was addressed by just one topic and that the phrasing of every query did not offer hints for the answers to other issues.The acquired data were synthesized in the second phase to ascertain causal links among categories. This method, known as "paradigm modeling, " entails elucidating transparent relationships between groups to comprehend the associated green conduct.This research addresses psycho-social factors, evaluating aspects that cannot be measured directly. Such variables are termed "latent factors," indicating their unmeasurable nature. Following the suggested CADMIACA theoretical approach, an evaluation was conducted to find sub-classes within the inquirycorresponding to the hidden variables in this model.This research utilized the methodology above to investigate ecologic conduct.This investigation attempted to build a CADMIACA framework for sustainable behavior by utilizing understanding, views, motivation, environmental instruction, and intentionality as endogenous factors, social standards as an external factor, and green conduct as a dependent factor.

Environmental instruction and purpose are essential indicators of green behavior, while mindsets, customs in society, and knowledge additionally influence the variable in question.The most recent factors are, thus, the drivers of intention, with just two of them (sociological standards and mindsets) impacting the teaching of the environment.Motivation is influenced by ecological learning.The latent parameters—derived from their inherent character as unobservable constructs formed by measured variables—collaborate to establish a comprehensive theoretical model for forecasting environmentally conscious behavior. Each latent parameter is elucidated by moreobjects derived from the survey based on the many investigated variables, including climate change, energy conservation, recycling, eco-friendly shopping, and contamination.The questions were given as declarations, with respondents indicating their level of agreement on a scale from 1 (hardly) to 5 (constantly).A factorial approach determined the detected indicators constituting the latent factors.

The final phase is choosing and detecting the main class (in this instance, green conduct) and itssystematic correlation with other categories. It entails verifying linkages and enhancing and elaborating on such groups or sub-categories. The subsequent sub-section does a quantitative study utilizing SEM.

Procedure

The combined CADMIACA theory is executed using SEM by assessing the multiple regression framework with a different correlation system, per the aforementioned qualitative research methodology. SEM is a multidimensional statistical method that assesses hidden variables or concepts that are not immediately observable via component evaluation.This strategy facilitates the establishment of causal linkages and the simultaneous assessment of multilevel connections among components.The applied research approach enables the identification of the primary factors that influence and elucidate those mentioned concealed variables (Knowledge, Perspectives, Environmental Studies, Intention, Inspiration, and Social Standards) in the context of green conduct.These hidden factors (the invisible) are delineated from the objects exhibiting importance in the survey employed in the investigation (the observed). The SEM enables the assessment of causal linkages articulated in the framework, akin to a regression study.All these relationships and interactions are depicted in Figure 4. The relationships are shown in Equations (1) to (6).

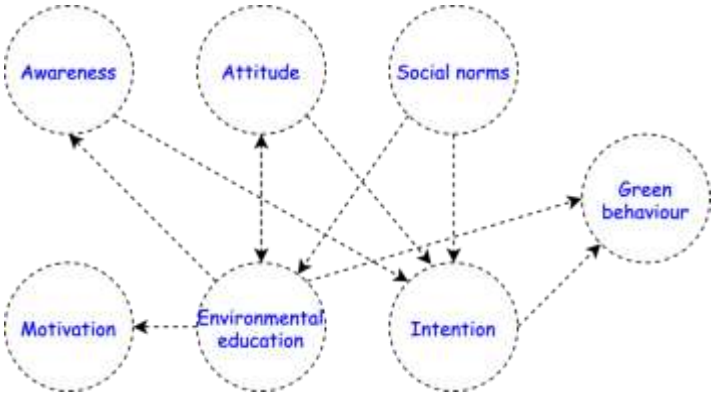

Figure 4. Relationship and interactions between environmental science and management

$$n_1 = b_{14}n_4 + c_1 \quad (1)$$

$$n_2 = b_{24}n_4 + c_2 \quad (2)$$

$$n_3 = b_{34}n_4 + c_3 \quad (3)$$

$$n_4 = b_{42}n_2 + y_4c_1 + c_4 \quad (4)$$

$$n_5 = b_{51}n_1 + b_{52}n_2 + y_5c_1 + c_5 \quad (5)$$

$$n_6 = b_{64}n_4 + b_{65}n_5 + y_5c_1 + c_6 \quad (6)$$

The elements are denoted n_i, the biasing is denoted b_i, weight is denoted c_i, and the scaling factor is denoted y_i.

Results and Discussions

This section includes a complete meta-analysis examining the influence of the previously described latent factors on environmental conduct and their interrelationships. The data collected from the survey demonstrate statistical significance in elucidating the exogenous factor (Social Conditions, 51) and the intrinsic latent parameters (Knowledge, 1; Perspectives, 12; Inspiration, 73; Environmental Learning, 4; and Goals, such as the principal parameter Green conduct, n6, with a p-value < 0.001 in all instances), were designated as signs.

Furthermore, it is essential to consider that the model's concealed variables encompass a wide array of control illnesses, including global warming (sample 19), energy conservation (item 7), reusing (samples 21, 24, and 25), green procurement (samples 22, 27, 28, and 32), and contamination (sample 18). The study of the liability of latent factors reveals that the estimates for most listed signals exhibit substantial internal agreement with

established research.The internal dependability, mainly assessed using Cronbach's alpha factor, showed values over 0.8, with the sole exception being Motivation, which remained satisfactory.The overall model fit assessed is likewise elevated (0.87).

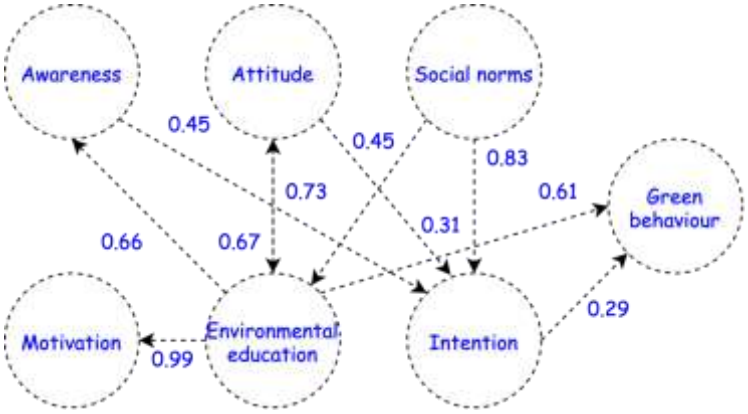

Figure 5. Finalized values for relationship elements

The causal linkages identified in this investigation are illustrated in Figure 5. Given the cross-sectional strategy, it is essential to consider that the link among the latent factors should be understood as strongly associated rather than causative. The primary parameter, Green Conduct, is directly influenced byAspiration (0.29) and Ecological Learning (0.61), with the latter exerting a significantly more significant impact. It is demonstrated that environmental instruction significantly impacts Knowledge (0.66), Perceptions (0.73), and particularly Determination (0.99). Ecological learning is an effective instrument for fostering environmentally responsible behavior among residents. Environmental science pertains to learning through media, network utilization, and sociological interactions. Therefore, while it is anticipated that ecological instruction (including academics and other education) will provide comparable impacts, this model needs to facilitate the establishment of a direct link. The findings suggest that policymakers implementing compulsory pro-environmental topics in schools enhance green habits in contemporary society. Subsequent investigations on this topic elucidate the relationship between educational institutions and environmentally sustainable behavior.

For environmental legislation to succeed, it needs a suitable framework and uniformity sincePEB demands shared accountability from government officials, citizens, and businesses.The equilibrium between mathematical concepts and methodologies isintegrated with suggestions to guarantee acceptance along the progression of initiatives ("inspiration").This will be contingent upon the reversibility of behavioral modification. Governments should provide formal environmental instruction at all levels to prevent environmentally detrimental practices and foster a pro-environmental attitude among children.

Conclusion

This study utilizes a thorough meta-analysis methodology to examine the behavioral and psychological elements that elucidate ethical conduct, categorizing the primary theoretical methods in the existing literature. An integrated framework is provided, accompanied by a particular empirical evaluation of these ideas utilizing an example from northwest Spain, differentiated by gender, age, and educational degree.This neighborhood was selected due to the burgeoning environmental consciousness among its residents, facilitated by the particular initiative "SmartCity," aimed at promoting sustainable development.

This paper's innovation comprehensively addresses the social issue surrounding green behavior, while most existing research only provides a fragmented perspective by separating socio-demographic elements from psychological components. This framework encompasses various control conditions relevant to comprehensively characterizing the determinants of environmentally friendly behavior, including rising temperatures, power conservation, recycling, sustainable buying, and contamination.The objective of the article was dual. The examination of characteristics associated with environmental science that affect pro-environmental conduct, as shown by current research, demonstrates that understanding, views, intentions, inspiration, ecological instruction, and social expectations are the primary determinants of pro-environmental

behavior. The extensive empirical meta-analysis utilizing SEM aims to assess how socioeconomic variables (consciousness, customs, environmental schooling) and mental variables (views, purpose, inspiration) influence changes in sustainable behavior.Data affirm that environmental instruction serves as an effective instrument for fostering eco-friendly behavior among residents. Ecological instruction and intrapersonal characteristics emerged as the primary predictors of green conduct, whereas interpersonal and motivational variables were less prevalent in influencing such behavior. Human conduct plays a crucial role in preserving the environment.

This comprehensive paradigm for sustainable behavior in daily life emphasized both prevalent results and novel ideas derived from examining the evaluated literature. Understanding the factors influencing PEB is crucial for formulating new policies. Policymakers affect long-term cultural and behavioral modifications regarding green practices by shaping attitudes, understanding, intentions, inspiration, social norms, and sustainability teaching through legislation, media dissemination, and market-based tools. Be aware that the baseline variables included in the questionnaire for this particular geographical region alter the magnitude of core factors. Further study should incorporate instances across many geographical areas to ascertain if green behavioral practices aimed at these factors provide the globally anticipated impact.

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