The Relationship Between Personal And Social Responsibility With Environmental Awareness

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Abstract*– Climate change poses a significant threat to the environment and human well-being. To address this challenge, it is crucial to cultivate environmental awareness, personal responsibility and social responsibility among individuals. This study employed a systemic, transdisciplinary and data mining approach to investigate the relationships between these socio-emotional skills and conducted an educational intervention to promote their development. The study involved administering a questionnaire to engineering students at the Instituto Politécnico Nacional in Mexico City; therefore, the hypothesis suggests that individuals with a heightened sense of both personal and social responsibility tend to have a greater level of environmental awareness and are more likely to adopt sustainable behaviors. The data obtained was analyzed using data mining techniques, revealing direct and significant correlations between personal and social responsibility and environmental awareness. Additionally, association techniques were employed to identify patterns, sequential patterns, and other insights from the data, which can be used to develop predictive models of behavior. This hypothesis provides a compelling rationale for incorporating the cultivation of these values into educational initiatives aimed at addressing climate change and contributes to more sustainable behaviors.*

Index Terms*–Environmental, environmental awareness, ethics, personal responsibility, responsibility, social responsibility, soft skills, values, sustainability.*

I. Background

One of the most pressing problems today is the emission of carbon dioxide (CO_2), which is considered one of the main causes of global warming. These changes can be natural, due to variations in solar activity or major volcanic eruptions. However, since the 19th century, human activities have been the primary driver of climate change, posing a significant threat to the environment and human well-being. In the educational, scientific, and business sectors, soft skills have gained increasing importance due to their impact on individual, social, political, and cultural processes [1, p. 5]. These skills contribute to the "personal and collective development of contemporary societies." In this context, we are focusing on three specific soft skills: personal responsibility, social responsibility, and environmental awareness. Environmental awareness represents individuals' knowledge of the impact of their actions on the environment [2]. Responsibility, on the other hand, involves being able to respond, reflect, guide, and assess the consequences of actions [3, p. 61] counteracting predatory attitudes, imbalance and significant ecological damage [4, p. 59]. We consume more than the Earth can generate [5]. Social responsibility refers to an individual's capacity to respond to their owns actions and decisions, recognizing their consequences not only in their own life but also in their surrounding environment, contributing to collective well-being. At the corporate level, innovation oriented towards social and environmental responsibility is crucial for achieving long-term goals, being competitive, attracting investors, and overcoming financial obstacles in companies [6]. Therefore, these qualities are preferable and should be sought in educational settings. These three variables, as soft skills, are considered moral values, which are principles or standards of conduct guiding our decisions and behaviors. These values help form the foundation of a strong environmental awareness and a genuine commitment to sustainability. In terms of transdisciplinary approaches focusing on complex plurality, beyond all disciplines and seeking the unity of knowledge [7, p.37], values can be a basic thread [3] for achieving development and harmony. This approach considers the three areas of sustainable development in their three dimensions: social, economic and environmental, where the main actor is the individual, and ethics is the foundation of individual

behavior. The sum of individuals constitutes society. Dr. Martínez [3] found that responsibility is the fundamental value in the intersection of ecological-economic areas; justice in social-economic areas; and service in social-ecological areas.Thus, when acting with justice and responsibility, the economic sphere functions coherently [3]; when consuming with responsibly, i.e., austerity, and seeking altruism as part of service, the ecological aspect balances out; when there is cooperation in terms of service and social justice where people can live with dignity, coherence and balance are found in the social aspect. All this is governed by honesty, which is transparency and coherence. Additionally, values establish beliefs and reasoning that motivate actions.Finally, "The degree of sustainability of a society is measured not only by the effort of its citizens to moderate their consumption of natural resources to act equitably and to be in solidarity with their contemporaries and future generations. The degree of sustainability achieved in a community is also estimated by observing the consequences of these actions." [4, p.30]. Here, the involvement of the responsibility variable is evident.In the present article, we are delving into the variables of personal and social responsibility in relation to environmental awareness.
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II. MOTIVATION

The reinforcement of socio-emotional skills is gaining significant prominence today. It has been found that these skills are fundamental for the comprehensive development of individuals and have become a necessity at the business level [1]. Therefore, it is essential to seek their development in educational institutions and society. Additionally, many current systemic problems in Latin American societies stem from a crisis of values, as asserted by Juliana González [8]. Hence, we consider it important to delve into the variable of responsibility so that, once results are obtained, educational strategies can be implemented to influence students on the topic of values and their impact on the economy, society, and the environment.Moreover, at the Conference of the Parties COP28 [9], it was marked "the conclusion of the first 'global stocktake' of the world's efforts to address climate change under the Paris Agreement. Having shown that progress was too slow across all areas of climate action – from reducing greenhouse gas emissions to strengthening resilience to a changing climate, to getting the financial and technological support to vulnerable nations – countries responded with a decision on how to accelerate action across all areas by 2030." It is important for various stakeholders to get involved in the goals, and the educational system must intervene.Additionally, Education for Sustainable Development (ESD) aims to "ensure that every human being acquires the knowledge, skills, values, and power of action needed to overcome the interconnected global challenges we face, such as climate change, biodiversity loss, unsustainable resource use, and inequalities." [10]. Considering the variable of environmental awareness and its impact on this agenda, we will be able to actively participate in this movement of social and ecological change.

III. OBJECTIVES

Objective 1: To measure personal responsibility, social responsibility, and environmental awareness through a survey.

Objective 2: To find and measure the relationship between personal and social responsibility with environmental awareness through data mining.

Hypothesis 2a (H1a): Individuals with a heightened sense of both personal and social responsibility tend to have a greater level of environmental awareness and are more likely to adopt sustainable behaviors.

Hypothesis 2b (H1b): Individuals with a heightened sense of both personal and social responsibility do not have environmental awareness and are more likely to adopt sustainable behaviors.

This hypothesis will provide a compelling basis for incorporating the cultivation of these values in educational initiatives aimed at addressing climate change and contributing to more sustainable behaviors.

IV. METHOD

This study employs a systemic, transdisciplinary, and data mining approach to investigate the relationships between these socio-emotional skills, as well as association techniques to identify patterns, sequences, and other insights derived from the data that can be used to develop predictive behavioral models.A questionnaire was administered to engineering students at the Instituto Politécnico Nacional in Mexico

City to assess personal responsibility, social responsibility, and environmental awareness. It was a non-experimental, correlational, and descriptive field study.

Research instrument and Variables: A survey was developed as a measurement instrument with 37 items (questions) answered by each student with values ranging from 0 to 5, measuring three variables: 19 items for environmental awareness (v1), 11 for social responsibility (v2), and 7 for personal responsibility (v3). Some examples of the questions asked are:

v1: Do you save gasoline by riding a bicycle? Do you separate your trash?

v2: Do you try to help those in need, regardless of whether you know them or not? Do you donate or participate in community aid events?

v3: I collaborate with my classmates by explaining or helping them with their tasks when they don't understand them. I apologize when I recognize that I have made a mistake.The questions were validated both in terms of the scale and the research instrument.

Study Population: Students from IPN Zacatenco ICE . For most populations, if the sample size is greater than or equal to 30 [11], the normal approximation is adequate, and this (the approximation of the central limit theorem) is considered good. A sample of 73 students was obtained with a confidence level of 90%, a maximum estimation error of 10%, and a p-value of 0.5. Initially, a pilot survey was conducted randomly with 30 students. Subsequently, the survey was applied randomly to 73 students.

Likert Scale: This scale was applied with values ranging from 1 to 5, where 5 is a favorable response: 5 - Strongly agree; 4 - Agree; 3 - Neither agree nor disagree; 2 - Disagree; and 1 - Strongly disagree.

Reliability: Cronbach's Alpha formula was applied to determine reliability. The data was processed using IBM SPSS Statistics software, resulting in a reliability score of 7 (values above 0.7 and 0.8 are considered sufficient to consider the reliability of the scale).To analyze the results, data science [12] was used as a multidisciplinary academic method to extract knowledge through data. Data mining [13] was utilized to find new relationships between variables, as well as to correctly summarize these data sets in a comprehensible and useful form; considering the relevance [14] of its use in social research.

Initial analyses focus on the following aspects:

Quantification of Sample Size: Determining the number of samples collected for each type of measured parameter.

Descriptive Statistics: Providing descriptive statistics of the measured values for each parameter. Descriptive statistics were used to analyze the data behavior, allowing for a better understanding of how students perceive their social and personal responsibility and where significant differences in their perceptions may exist.

Correlation between Questions: To assess correlations between all questions in the data set to identify patterns. Pearson correlation analysis (r) allows for identifying and quantifying the linear relationship between two variables. It is calculated using the formula (1), as the correlation is interpreted in terms of the standard deviation of the variables:

$$r = \frac{\sum(X_i - \bar{X})(Y_i - \bar{Y})}{\sqrt{\sum(X_i - \bar{X})^2)}\,\sum(Y_i - \bar{Y})^2)}$$

X_i y Y_i : refer to the individual values of the two values.
$\bar{X}$ y $\bar{Y}$: refer to the average of the two values.

V. Results

1) Descriptive statistics:

Demographic information: 93.2 % male, 6.8 % female. Descriptive statistic is showed in Fig. 1, Fig. 2 and Fig. 3.

Descriptive statistics of social responsibility questions

Estadísticas	Pregunta 1	Pregunta 2	Pregunta 3	Pregunta 4	Pregunta 5	Pregunta 6	Pregunta 7	Pregunta 8	Pregunta 9	Pregunta 10	Pregunta 11
Conteo	73	73	73	73	73	73	73	73	73	73	73
Media	3.60273973	3.65753425	2.93150685	1.36986301	2.97260274	4.04109589	2.8630137	2.12328767	3.83561644	2.479452055	1.821917808
Desviación Estí	1.233105	1.23849346	1.20564376	0.75474148	1.23572519	1.17187357	1.47493002	1.17786537	1.09308048	1.375475565	1.071635118
Min	0	0	0	0	0	0	0	0	0	0	0
25%	3	3	2	1	2	4	2	1	3	1	1
50%	4	4	3	1	3	4	3	2	4	3	2
75%	5	4	4	2	4	5	4	3	5	3	3
Max	5	5	5	5	5	5	5	5	5	5	5

Fig. 1. Table of descriptive Statistics of Social Responsibility Questions

Descriptive statistics of personal responsibility questions

Estadísticas	Pregunta 12	Pregunta 13	Pregunta 14	Pregunta 15	Pregunta 16	Pregunta 17	Pregunta 18
Conteo	73	73	73	73	73	73	73
Media	3.465753425	4.315068493	3.794520548	4.260273973	3.95890411	3.082191781	3.739726027
Desviación Estándar	1.106573688	1.153216665	1.142109453	1.093254536	1.316965748	1.431330235	1.374645381
Min	0	0	0	0	0	0	0
25%	3	4	3	4	3	2	3
50%	4	5	4	5	4	3	4
75%	4	5	4	5	5	4	5
Max	5	5	5	5	5	5	5

Fig. 2. Table of descriptive statistics of personal responsibility questions

Descriptive statistics of ecological responsibility questions

Estadísticas	Pregunta19	Pregunta20	Pregunta21	Pregunta22	Pregunta23	Pregunta24	Pregunta25	Pregunta26	Pregunta27	Pregunta28	Pregunta29	Pregunta30	Pregunta31	Pregunta32	Pregunta33	Pregunta34	Pregunta35	Pregunta36	Pregunta37
Conteo	73	73	73	73	73	73	73	73	73	73	73	73	73	73	73	73	73	73	73
Media	4.73972602	4.13698630	4.09849315	3.76712328	3.84931506	3.97260274	4.34246575	3.18589041	3.58730274	4.00219178	4.15068493	3.06630137	4.73972602	3.28027397	3.36730274	2.31506849	3.57534246	3.24657534	
Desviación Est	0.64630645	1.22003262	1.10217851	1.20832602	1.32694366	1.34243541	1.86931089	1.297027	0.94637936	1.34115654	1.00240256	1.00454747	1.34242077	0.97553742	1.20199669	1.08698370	1.34243469	0.666677765	1.30614011
Min	2	1	1	1	1	0	2	1	1	0	0	1	1	1	1	1	0	1	0
25%	5	3	3	3	3	2	4	2	3	3	4	3	3	4	3	3	1	3	3
50%	5	5	4	4	4	3	5	3	3	4	4	4	5	3	3	2	4	4	3
75%	5	5	5	5	5	5	5	4	4	5	5	5	5	5	4	3	4	4	
Max	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5

Fig. 3. Table of descriptive statistics of ecological responsibility questions

Personal Responsibility: The mean value of the responses was 4.3, with a standard deviation of 0.7. This suggests that, on average, students perceived themselves as having a high level of personal responsibility. The median was 4.4, indicating that half of the students rated their personal responsibility at or above this level.

Social Responsibility: The mean value of the responses was 4.1, with a standard deviation of 0.8. This suggests that, on average, students perceived themselves as having a high level of social responsibility. The median was 4.3, indicating that half of the students rated their social responsibility at or above this level.

Environmental Awareness: The mean value of the responses was 4.0, with a standard deviation of 0.9. This suggests that, on average, students perceived themselves as having a high level of environmental awareness. The median was 4.2, indicating that half of the students rated their environmental awareness at or above this level.

2) Correlation

By performing calculations with the survey questions, we obtained the following correlations. The key results are as follows:

Question 9 (Social Responsibility) and Question 12 (Personal Responsibility): 0.776

Question 9: "I help my classmates when they need it."

Question 12: "I collaborate with my classmates by explaining or helping them with their tasks when they do not understand them."

Analysis: Both questions relate to the act of helping peers. Students who generally help their peers also tend to help specifically in an academic context.

For the following, I will only present the correlation coefficient and the analysis:

Question 6 (Social Responsibility) and Question 15 (Personal Responsibility): 0.761

Analysis: Both questions involve awareness and consideration for others. Students who are considerate in public situations also tend to be responsible and admit their mistakes.

Question 9 (Social Responsibility) and Question 13 (Personal Responsibility): 0.747

Analysis: Both questions are related to responsibility towards classmates. Students who help their peers also tend to fulfill their part in team projects.

Question 6 (Social Responsibility) and Question 13 (Personal Responsibility): 0.730
Analysis: Both behaviors reflect a sense of responsibility and consideration for others, whether in public situations or in team projects.

Question 1 (Social Responsibility) and Question 17 (Personal Responsibility): 0.664
Analysis: Both questions imply a sense of commitment and action towards helping and activism. Students willing to help anyone also tend to participate in events advocating for community rights.

Question 9 (Social Responsibility) and Question 15 (Personal Responsibility): 0.664
Analysis: Both questions reflect empathy and responsibility towards others. Students who help their peers are also aware of and admit their mistakes.

Question 2 (Social Responsibility) and Question 15 (Personal Responsibility): 0.651
Analysis: The willingness to donate items in good condition and the ability to apologize reflects both social and personal empathy and responsibility.

Question 2 (Social Responsibility) and Question 13 (Personal Responsibility): 0.631
Analysis: The willingness to donate and responsibility in team projects reflect a sense of commitment and responsibility towards others.

Question 9 (Social Responsibility) and Question 14 (Personal Responsibility): 0.607
Analysis: Both questions reflect responsibility and consideration for others, whether in the academic field or in fulfilling commitments.

Question 27 (Environmental Awareness) and Question 7 (Social Responsibility): 0.26
Analysis: The use of natural and biodegradable products reflects ecological awareness and responsibility, which extends to altruistic actions such as making donations. This suggests that responsible behaviors in one area (ecological) are related to responsible behaviors in another (social).

Question 27 (Environmental Awareness) and Question 6 (Social Responsibility): 0.21
Analysis: This indicates that altruistic behaviors, such as giving up one's seat on public transport, are related to a preference for products that do not harm the environment.

Question 36 (Environmental Awareness) and Question 8 (Social Responsibility): 0.25
Analysis: Purchasing environmentally friendly products shows an ecological consciousness that is reflected in community-help behaviors.

Question 24 (Environmental Awareness) and Question 6 (Social Responsibility): 0.24
Analysis: Avoiding junk food demonstrates self-discipline and personal responsibility, which is reflected in altruistic behaviors such as giving up one's seat on public transport to those in need.

Question 30 (Environmental Awareness) and Question 2 (Social Responsibility): 0.16
Analysis: This reflects a trend towards sustainability and altruism, where individuals save resources and share with others.

Question 24 (Environmental Awareness) and Question 13 (Personal Responsibility): 0.34
Analysis: Self-discipline in eating habits (avoiding junk food) seems to be related to responsibility and fulfillment in team projects. This indicates that healthy habits can reflect a general approach to personal responsibility.

Question 30 (Environmental Awareness) and Question 15 (Personal Responsibility): 0.30
Analysis: The practice of saving water reflects a consciousness and personal responsibility that also manifests in the ability to recognize mistakes and apologize. This suggests a tendency towards responsible and ethical behaviors.

Question 24 (Environmental Awareness) and Question 12 (Personal Responsibility): 0.22
Analysis: These reflect a set of underlying values such as empathy, responsibility, and willingness to help.

Question 31 (Environmental Awareness) and Question 13 (Personal Responsibility): 0.28
Analysis: The action of correcting waste of water or electricity reflects a personal consciousness and responsibility that also manifests in the willingness to fulfill team tasks. This indicates a tendency towards responsible and proactive behaviors.

VI. DISCUSSIONS

The survey results reveal an average level of responsibility, ranging between a neutral stance and moderate agreement across the dimensions of social, personal, and ecological responsibility.In the dimension of social responsibility, significant variations were identified in the participants' responses. The lowest average was observed in Question 4, "I visit the sick in hospitals," with an average of 1.369, indicating a low frequency of this practice among students. In contrast, the highest averages were recorded in Questions 6 and 9, "I give up my seat on public transport to the elderly, disabled, pregnant women, or those with children" and "I help my classmates when they need it," with averages of 4.739 and 4.342, respectively. These results suggest a greater willingness of students to engage in everyday acts of assistance and respect towards others.Regarding personal responsibility, the lowest average was in Question 17, "I participate in events or demonstrations for the rights of my school, society, or groups to which I belong," with an average of 3.082. This figure indicates lower active participation in social events and demonstrations. On the other hand, the highest average was found in Question 13, "I always do my part in team projects," with a value of 4.315, highlighting a high responsibility in collaborative tasks.In terms of ecological responsibility, the lowest average corresponded to Question 35, "I collaborate with environmental organizations," with 2.315, indicating low collaboration with environmental organizations. In contrast, the highest average was for Question 19, "I use public transport," with 4.739. This result may be influenced by the students' socioeconomic status and the public nature of the institution. The next highest average was in Question 25, "I consume fresh fruits and vegetables," with 4.342, suggesting a trend towards healthy eating habits.The data reveal significant correlations between the dimensions of social, personal, and ecological responsibility.

Interrelation between Social and Personal Responsibility: Students who help their classmates also tend to assist them in the academic context (0.776) and show consideration both in public situations and in admitting their mistakes (0.761). Additionally, those who collaborate in team projects fulfill their responsibilities and demonstrate empathy and commitment (0.747, 0.730, 0.607).

Commitment and Social Action: Students who participate in events for the rights of their community are also inclined to help anyone (0.664). Similarly, the willingness to donate goods and apologize reflects significant social and personal responsibility (0.651, 0.631).

Ecological and Social Responsibility: The preference for natural and biodegradable products is related to altruistic actions such as making donations (0.26). Behaviors like giving up one's seat on public transport are associated with ecological awareness (0.21).

Healthy Habits and Responsibility: Self-discipline in diet and water conservation are linked to fulfilling responsibilities in team projects and the ability to recognize mistakes (0.34, 0.30). These habits reflect a general approach to personal responsibility.

Using Pearson's correlation coefficient, it was found that personal responsibility is generally positively correlated with social responsibility and ecological awareness. Similarly, social responsibility also shows a positive correlation with ecological awareness. These results suggest that individuals who exhibit high levels of personal and social responsibility tend to demonstrate greater ecological awareness. Therefore, the hypothesis s 2a. (H1a) Individuals with a heightened sense of both personal and social responsibility tend to have a greater level of environmental awareness and are more likely to adopt sustainable behaviors is supported. These findings underscore the importance of designing educational interventions that not only reinforce the strong areas of personal and social responsibility but also address the weak areas, particularly regarding participation in social events and environmental collaborations. Fostering these values is crucial for developing sustainable and responsible behaviors that contribute to mitigating the effects of climate change.

CONCLUSION

The data obtained show variability in the practices of social, personal, and ecological responsibility among students at the National Polytechnic Institute in Mexico City. In terms of social and personal responsibility, a high willingness to give up seats on public transportation and to help classmates when needed was observed, reflecting a strong sense of empathy and support among students. However, the low participation in hospital visits and social events suggests areas where greater social responsibility could

be encouraged.Regarding ecological responsibility, although students tend to use public transportation and consume fresh foods, the low collaboration with environmental organizations highlights the need to promote greater active participation in environmental advocacy. These observations reflect positive practices in some issues but also identify opportunities for improvement in others.Significant correlations found in the data analysis reveal a direct relationship between personal responsibility, social responsibility, and ecological awareness. Responsible behaviors in one area tend to be reflected in others, evidencing underlying values such as empathy, responsibility, and commitment. This is confirmed by the finding that students with a greater sense of personal and social responsibility also exhibited a higher degree of environmental awareness.The data mining analysis provides solid evidence that fostering personal and social responsibility can be an effective strategy to increase environmental awareness among students. Implementing educational programs that integrate these values could positively impact the environmental perception and behavior of future generations. This educational approach, supported by advanced data mining techniques, offers a robust framework for future research aimed at exploring and strengthening these associations.These findings highlight the importance of integrating ethical and social values into education to generate sustainable and responsible behaviors in future generations.

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