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# The Relationship Between Research and Environmental Perceptions as a Baseline Study for an Educational Intervention Project

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***Abstract***

*This study sought to analyze the relationship between research and the environmental perceptions of ninth grade students with respect to the problems of the Ciénaga Grande del Bajo Sinú wetland (Colombia). The purpose was to diagnose strengths and weaknesses in order to design and implement pertinent educational intervention strategies. A cross-sectional analytical descriptive design was used. The sample was determined by a stratified proportional probability sampling, with a confidence level of 95%, a margin of error of 0.5 and a probability of 0.5, based on a population of 2,909 students enrolled in 14 educational institutions, resulting in a total of 1,000 students. The results showed a trend in which students with lower scores in research also had a low performance in environmental perception, while higher scores had a more limited distribution. It is concluded that it is important to strengthen pedagogical strategies that integrate both areas of knowledge in response to the needs of the context.*

***Keywords:*** *Environmental Education. Research. Student Perception.*

## Introduction

Faced with the problems and challenges caused by the global climate crisis that threatens life on the planet, education becomes a vital tool to strengthen attitudes, knowledge, and environmental practices that prepare individuals and communities to take comprehensive action to confront it (UNESCO, 2024). However, after an evaluation conducted by UNESCO (2021), which included 50 countries, it was found that only 19% addressed biodiversity, and more than half made no reference to climate change. This highlights questions about the relevance of curricular structures and traditional pedagogical strategies, which hinder comprehensive educational processes—presumably due to the disconnection between knowledge areas and study plans and the real needs and particularities of local contexts, preventing situated knowledge.

In response, the Organization for Economic Cooperation and Development (OECD, 2023) emphasizes the importance of encouraging students to develop an interest and vocation for science, recognizing the need to train critical, participatory individuals in constant dialogue with the problems of their surroundings.

In Colombia, this concern has also been considered. The National Government, particularly the Ministry of Science, Technology, and Innovation (CONPES Document 4069 of 2021; Minciencia, 2020; 2019), has adopted an evolutionary shift in the conception and scope of

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science, technology, and innovation with a differential, territorial, and participatory approach. This aims to contribute to cultural changes that promote a knowledge society by invigorating the production and transfer of knowledge and strengthening research and creative processes, in line with the recommendations of the International Mission of Experts.

As for the responsibility of the education system, this Commission recommended the integration into school curricula—from elementary to postgraduate levels—of topics such as the preservation, protection, dissemination, and appropriation of the environment and culture. This is aimed at long-term consolidation of a scientific community that, through intensive use of knowledge, contributes to solving social problems, economic prosperity, and improving citizens' quality of life, in accordance with the objectives of Law 1549 of 2012, Decree 1860 of 1994, and Decree 1743 of 1994 on strengthening environmental education.

Based on the above, it is considered that environmental education with these characteristics involves developing teaching processes focused on research, as suggested by Karelovic and Kong (2022), who associate this challenge with the need to acknowledge the evident relationship between environmental education and science education. This understanding conceives environmental education as a path that leads to reflection on the impacts caused by the scientific and technological revolution, which in turn reflect the deep contradictions between human beings, the environment, and society, according to Lozano et al., (2019).

Moreover, any intervention proposal in this regard requires a prior evaluation that allows for assessing not only the quality of the curriculum implemented and its relevance to the issues within the context (Jorba & Sanmartí, 1996; Nunziati, 1990), but also the activities, attitudes, beliefs, and notions that students can perform and learn on their own, which indicate their learning potential. These are aimed at identifying the changes that need to be introduced in the teaching process to help them develop their own process of knowledge construction (Vygotsky, 1979).

Based on these conditions, this investigation posed the following question: What relationship might exist between ninth-grade students' investigative and environmental perception regarding the Ciénaga Grande del Bajo Sinú (CGBS) wetland in Córdoba, Colombia, in light of the Institutional Educational Project (PEI) and the curricular standards of the Ministry of National Education?

Therefore, the general objective focused on analysing the degree of association between ninth-grade students' investigative and environmental perceptions regarding the CGBS wetland (Colombia), within the framework of the Institutional Educational Project (PEI) and the standards of Colombia's Ministry of National Education (MEN). Specifically, the study aimed to address, among others, the following questions: i) What degree and type of notions and ideas do students express about the concept of a wetland and its importance or contributions to the region's economic development? ii) What influence can be perceived between the construction of sociocultural identity and the recognition of the CGBS as a strategic ecosystem within the local territory? iii) What degree of association might exist between students' sociodemographic characteristics and their level of knowledge about the CGBS wetland? iv) What is the likelihood that students are familiar with the wetland, in relation to their place of residence and the educational institution they attend? v) What is the level of students' knowledge about research in relation to the curricular guidelines of the PEI? vi) To what extent can students' notions, attitudes, and/or skills related to research be associated with their environmental attitudes, ideas, and behaviours regarding the CGBS?

To this, the following working hypotheses were adopted:

Hypotheses 1. The level of conceptual perception about wetlands influences the level of practical perception of the CGBS.

Hypotheses 2. It´s possible that students who live or study near the CGBS, or whose parents have economic ties to it, have a higher degree of practical perception of the CGBS wetland.

Hypotheses 3. A significant association may exist between the level of perception in research and the level of perception regarding wetlands.

The concept of environmental perception assumed in this research refers to the way individuals interpret and understand the environment and its issues, including their notions, ideas, practices, beliefs, attitudes, and values related to the CGBS wetland (Fernández Moreno, 2008; Rubenstein & Bacon, 1983). Meanwhile, perception of research refers to the ideas, notions, beliefs, attitudes, and skills perceived regarding the research process—its objectives, methods, results, benefits, and the role of researchers.

In this context, multiple studies advocate for and suggest various ways to rethink and redirect learning processes with a research-based and/or sociocultural approach. For example, Meza (2023) highlights the importance of Participatory Action Research (PAR); Angulo (2022) argues that early science education has a positive impact on ways of thinking, being, and doing. Other authors recognize that formative research should be incorporated from early childhood, as this stage of life offers the greatest opportunities to develop, in the future, skills and abilities for critical analysis of reality, civic engagement, and human development (Lara, 2022; Laguado et al., 2023; Castaño et al., 2024).

For their part, Puig, Blanca et al. (2023) argue that addressing the challenges posed by climate change could become a priority for science education by incorporating the Sustainable Development Goals into the curriculum and integrating critical thinking as a cross-cutting element in the development of specific competencies.

At the regional level, although there are significant studies on the CGBS, most of them focus on la the ecological importance of the wetland (Ruiz & Cifuentes, 2021), and the environmental impacts affecting it (Lobo et al., 2024; Mejia et al., 2019). There are also studies on adolescents' perceptions of wetlands and research (Humanez et al., 2023; Valencia et al., 2025). However, to date, little is known about the influence of research perceptions on environmental perceptions as a preliminary evaluation to diagnose strengths and skills that can guide educational intervention strategies based on formative research, as in the present case.

## Methodology

A cross-sectional observational analytical descriptive design was adopted, aiming to establish the degree of association between observable categories and/or variables based on the perception of 1,000 students enrolled in the municipalities of Lorica, Purísima, Momil, and Chimá, located in the subregion of Bajo Sinú in Córdoba, Colombia. The study population consisted of 2,909 ninth-grade students enrolled in 14 educational institutions (Secretaría de Educación Departamental, 2020).

For the sample size, stratified proportional probability sampling techniques were used, applying the following mathematical equation:

$$n = \frac{N*Z^2*p*q}{d^2*(N-1)+Z^2*p*q} \qquad (1)$$

A confidence level of 95% (Z = 1.96), a margin of error (confidence interval) of 2.5% (d = 0.025), and a probability of 0.5 (p = 0.5, q = 0.5) were used. For assigning the sample size to each stratum, proportional allocation was chosen, as there were reasons to assume that the dispersions S_(y_Uh)^2 didn´t differ significantly between the different strata. The number of elements assigned to the various strata was proportional to their representation in the target population.

The categories used to analyse research perception included: ideas, notions, recognition, evaluation, interest, experience, and skills related to research, the scientific method, science, and researchers.

The categories for analysing environmental perception included: notions, ideas, evaluation, commitment, recognition, and practice.

For data collection, a structured questionnaire was used, divided into three sections with a total of 30 items. The first section covered social characteristics, with closed and multiple-choice questions (P1 to P9). The second section consisted of research-related questions (P11 to P20); the third focused on the wetland (P21 to P30). To measure and analyse the associations between the categories defined in the study, an evaluation scale from 1 to 10 was used. Scores were assigned based on the proximity and complexity of each answer, considering the most common literature on the topic, which enabled the establishment of five performance levels:

**Inferior**: Scores below 4 reflect an insufficient level of prior knowledge or perceptions.

**Low:** Scores between 4 and below 5 indicate a low level, requiring significant improvement.

**Medium**: Scores from 5 to below 7 represent an intermediate level of knowledge or perceptions

**High**: Scores from 7 to below 9 show good mastery of the evaluated topics.

**Superior**: Scores between 9 and 10 reflect excellent and outstanding perception.

Informed consent and assent were obtained from the students, with the approval of their parents and school administrators.

The instrument was validated using Cronbach's Alpha coefficient, which yielded a KMO of 0.565 and a Bartlett's sphericity test with a p-value less than 0.05, indicating that the sample used in the study was appropriate and that factor analysis could proceed.

**Procedure**

Initially, an exploratory assessment of the territories was conducted, which allowed for the identification and selection of the key stakeholders (schools, municipal authorities, teachers, and students). Subsequently, a questionnaire was applied to collect the information. The Chi-Square test of independence and Cramér's V were then used to estimate the strength of the associations found between the dimensions of research and environmental perceptions related to the CGBS. Afterwards, a Multiple Correspondence Analysis (MCA) was performed to identify groups of individuals with similar response profiles. Finally, individuals were classified and grouped through cluster analysis.

The data were processed in a Microsoft Excel database from the Office 365 package using the software programs SPSS version 26, R version 4.3.2, and R Studio version 12.0-369 from the year 2023.

## Results

The participants were 1,000 individuals aged between 11 and 19 years, with an average age of 14.34 years. There was a higher representation of male students (50.1%), and approximately 16% of the participants were overage, exceeding the permitted age range (11 to 14 years) established by the Colombian Ministry of Education. Students lived with between 2 and 20 people, averaging 5 individuals per household. Additionally, 80.6% of students had always lived with their families in the municipality where they were surveyed.

The sample distribution by municipality was as follows: Chimá (140 students), Lorica (531 students), Momil (124 students), and Purísima (205 students). The selection of individuals was made by convenience, considering the following inclusion criteria: willingness and interest to participate, gender, school location, and class schedule.

### *Relationship between Perception of the Institutional Educational Project and Research Activity*

After conducting Chi-Square independence tests and assessing the effect size with Cramér's V, it was found that there is an association between knowledge of the Institutional Educational Project (PEI) and participation in some institutional project, study group, or research club. The p-value (0.0) was lower than the significance level of 0.05, indicating a statistically significant but weak association.

Regarding the association between knowing the PEI and understanding what a research objective is, the p-value was 0.029, also below the significance threshold of 0.05. This indicates a statistically significant association, with a Contingency Coefficient of 0.069, reflecting a strong association.

These findings suggest that students who show greater interest in learning about the PEI also tend to participate in associative forms such as research groups or clubs, motivated by their interest in learning the basic concepts of research.

### *Relationship between Perceptions of Wetlands and Practical Perception of the CGBS*

The association between these perceptions yielded a p-value of 0.0 for the concept of wetlands and the importance of the CGBS (Colombia), below the significance level of 0.05, with a moderate degree of significance (Cf. 0.205). Similarly, for wetland recognition in the municipality and the concept of wetlands, the p-value was also 0.0 with a moderate Contingency Coefficient of 0.246.

Regarding whether students knew the contributions of wetlands to the development of nearby communities, the p-value was again 0.0, indicating a statistically significant moderate association (Cf. 0.464). A significant association was also found concerning students' practical knowledge of the CGBS, with a p-value of 0.005 (Cf. 0.089). Regarding whether students had visited the Ciénaga in their municipality and knew its flora and fauna, a p-value of 0.0 and a Cf. of 0.140 were found—weak, but statistically significant.

Concerning whether students engaged in any environmental care activities related to wetlands in their municipality, a weak but statistically significant association was found (p-value = 0.0; Cf. = 0.120). Lastly, regarding whether students believed that wetlands influence cultural and territorial identity and the quality of life, the p-value was 0.0 and Cf. = 0.155—again weak but significant.

***Multiple Correspondence Analysis***

This analysis was conducted to summarize categorical variables and determine the explanatory capacity of the total observed cases, estimating the proportion of variance explained by each dimension.

Table 1 shows that the first dimension accounts for 6.81% of the total variability, and the first fifteen dimensions explain 52.81% of that variability.

| **Dimension** | **Items** | **Statistic** | | **Chi-square** | **P-value** |
|---|---|---|---|---|---|
| | | **Cronbach (α)** | **KMO** | | |
| General | 23 | 0,853 | 0,565 | 473,55 | < 0,05 |
| Scientific research | 6 | 0,727 | 0,529 | 87,99 | < 0,05 |
| Environmental knowledge | 7 | 0,831 | 0,719 | 221,06 | < 0,05 |

Table 1: Cronbach's Alpha and KMO At the General Level and By Dimension of the Instrument Applied

Source. Own elaboration with research data

The results of table 1 indicate that most surveyed students are associated with various response options from the administered test. However, responses such as “Yes” to identifying environmental problems, “Yes” to knowing the contributions of a wetland, “Yes” to caring for the environment or participating in environmental activities, and “Yes” to participating in institutional research projects scored lower. This suggests these responses were less homogeneously distributed compared to other questions and anwser.

To analyse the correspondence between individuals and variable categories in constructing the dimensions, the coefficient of determination $R^2$ and corresponding p-values were estimated. In the first dimension, the most important variables were: knowing the CGBS, having visited the CGBS, the municipality where the survey was applied, and identifying environmental problems of the CGBS—with R-squared values of 0.3798, 0.3798, 0.3746, and 0.2814 respectively. In the second dimension, the most relevant variables were: municipality of the survey, knowing what to do as a researcher when facing a problem, defining what a wetland is, and knowing the starting point for developing a research project—with R-squared values of 0.4499, 0.4195, 0.1772, and 0.1681 respectively.

| **Dimension** | **Own value** | **Percentage of variance** | **Percentage of accumulated variance** |
|---|---|---|---|
| **1** | 0,1269 | 6,8102 | 6,8102 |
| **2** | 0,1009 | 5,4153 | 12,2254 |
| **3** | 0,0783 | 4,2003 | 16,4257 |
| **4** | 0,0707 | 3,7921 | 20,2178 |
| **5** | 0,0660 | 3,5440 | 23,7618 |
| **6** | 0,0605 | 3,2476 | 27,0094 |

| | | | |
|---|---|---|---|
| **7** | 0,0583 | 3,1307 | 30,1401 |
| **8** | 0,0568 | 3,0475 | 33,1876 |
| **9** | 0,0555 | 2,9782 | 36,1658 |
| **10** | 0,0527 | 2,8305 | 38,9962 |
| **11** | 0,0519 | 2,7826 | 41,7789 |
| **12** | 0,0515 | 2,7645 | 44,5434 |
| **13** | 0,0510 | 2,7375 | 47,2809 |
| **14** | 0,0497 | 2,6666 | 49,9475 |
| **15** | 0,0485 | 2,6030 | 52,5506 |

Table 2: Proportion of Variance Retained By Each Dimension

Source. Own elaboration with research data

**Distribution of Perceptions of Research and Wetlands**

Table 3 presents students' perceptions of research and wetlands, organized into five performance categories: inferior, low, medium, high, and superior.

| **Variable** | **Dimension 1 (Wetland)** | | **Dimension 2 (Research)** | |
|---|---|---|---|---|
| | **R2** | **P-value** | **R2** | **P-value** |
| Knows the Ciénega Grande del Bajo Sinú | 0,3798 | 1,17E-105 | 0,0048 | 2,92E-02 |
| Has toured the Ciénaga and knows the fauna and flora | 0,3798 | 1,24E-105 | 0,0082 | 4,12E-03 |
| Municipality | 0,3746 | 4,72E-101 | 0,4499 | 9,46E-129 |
| Identifies the problems of the Ciénaga | 0,2814 | 1,18E-73 | 0,0173 | 2,96E-05 |
| What to do as a researcher when faced with a problem | 0,2581 | 3,98E-63 | 0,4195 | 6,52E-116 |
| Knows the contributions of a wetland for development | 0,1624 | 2,46E-40 | 0,0415 | 7,94E-11 |
| Knows what a wetland is | 0,1582 | 3,04E-39 | 0,1772 | 3,29E-44 |
| Knows what a research objective is | 0,1494 | 5,55E-37 | 0,0601 | 3,78E-15 |
| Performs activities for the care of the environment | 0,1416 | 5,40E-35 | | |
| Wetlands influence the identity and quality of life | 0,1174 | 6,33E-29 | 0,0846 | 6,15E-21 |
| There is a wetland in your municipality | 0,1100 | 4,14E-27 | 0,0928 | 6,26E-23 |
| Considers that wetlands are important wetlands are important | 0,0744 | 1,59E-18 | 0,1359 | 1,55E-33 |
| Have you participated in a project or conducted | 0,0485 | 1,93E-12 | 0,04 | 2,92E- |

| | | | | |
|---|---|---|---|---|
| research | | | 77 | 12 |
| Know the PEI of your school | 0,0392 | 2,73E-10 | 0,02 01 | 6,81E-06 |
| When a research problem may arise | 0,0300 | 4,16E-06 | 0,03 29 | 1,00E-06 |
| Research can be defined as | 0,0217 | 7,01E-05 | 0,12 80 | 2,21E-29 |
| It is NOT a research technique | 0,0185 | 3,36E-04 | 0,02 17 | 7,08E-05 |
| A starting point for developing research would be | 0,0169 | 1,97E-03 | 0,16 81 | 1,47E-38 |
| What is a research problem | 0,0141 | 2,65E-03 | 0,11 43 | 4,93E-26 |
| Have you always lived in the municipality | 0,0066 | 9,91E-03 | | |
| Who can do research | 0,0082 | 4,25E-02 | 0,16 44 | 1,49E-38 |
| Do you belong to a project or study group or research group? | | | 0,03 12 | 1,84E-08 |

Table 3: Correlation Levels of The Variables with the Dimensions

Source. Own elaboration with research data

The data from table 3 shows that 89 students scored in the "Inferior" category for both research and wetlands. In contrast, combinations such as "Superior" in both areas were less common, with only 7 students scoring "Superior research" and 2 in "low wetlands". The obtained p-value of 0.049 indicates a statistically significant association between perception levels in research and wetlands. This suggests that performance in one area is related to performance in the other. Observed frequencies reflect a trend in which students with lower scores in research tend to perform poorly in environmental areas as well. However, scores in higher categories were more limited in distribution, implying that specific areas for improvement are needed to reach higher levels of excellence in both domains. This highlights the importance of strengthening pedagogical strategies that integrate both areas of knowledge.

## Discussion

The study revealed that despite the low levels of perception regarding both research and environmental awareness related to the Ciénaga Grande del Bajo Sinú (CGBS) wetland (Colombia), there was a significant association between the two. Although the purpose of this study was not to evaluate the level of knowledge on the subject, these findings should not be taken out of the national context, as they provide insight into the quality and inequality of education in Colombia—both nationally and territorially, and between the public and private sectors.

For example, according to DANE (2019), internet access and usage for educational purposes in municipal capitals was 30.0%, while in rural and dispersed areas, it was 32.3%. By department, Guaviare led with 42.9%, followed by Nariño (40.1%), Boyacá (39.8%), Chocó (38.8%), Magdalena (38.2%), and Córdoba (33.7%). Similarly, the Colombian Institute for the Evaluation of Education (ICFES, 2022) indicated that Colombia's average score in science dropped from

416 in 2015 to 413 in 2018, with 51% of students failing to meet the minimum expected level in this area compared to OECD countries.

Furthermore, the average results of the 2024 Saber 11 tests in Córdoba were 251 points. In the municipalities of Momil, Chimá, and Purísima, the score was 231—below the national average of 260. This suggests an unequal distribution and access to scientific and technological resources, as well as limited support for social and educational research developed by youth, which affects the social appropriation of knowledge in schools.

Likewise, the findings on environmental perception reflect the current state of environmental education in Colombia and other Latin American countries, which, according to Meza et al. (2023), lacks relevance to local and regional issues. They highlight the absence of an interdisciplinary, cross-cutting project that connects all areas of knowledge and fosters educational community integration. This view aligns with Arévalo (2020), who emphasized the shortcomings in integrating environmental learning strategies into the school curriculum, noting the predominance of theoretical approaches and the scarcity of practical, experiential activities, which are essential for helping students build meaningful connections with their surroundings.

These observations support the argument of a disconnection and lack of contextualization of the PEI and curriculum when it comes to teaching natural and social sciences in relation to the protection of the Ciénaga Grande del Bajo Sinu (Colombia). Such disconnection acts as a barrier to the development of environmental education programs, as suggested by Álvarez et al. (2024).

Similar findings appear in Silva's study (2018), which emphasized the lack of coherence in the theoretical foundation of the PEI and the fragmentation of learning outcomes. Likewise, Karelovic and Kong (2022), referring to the Chilean school system, argue that while environmental education is a cross-curricular learning objective, its implementation largely depends on each institution and is often handled by science or social studies teachers. They call for the exploration of alternatives that promote scientific (SE) and environmental education (EE), enabling citizens to face the challenges posed by socio-environmental issues, particularly climate change.

Surprisingly, the study found a tendency toward empirical knowledge, concepts, attitudes, and skills in students' cognitive structures—more so than reasoning based on inferential-deductive theory or a balance between empirical and theoretical knowledge. This suggests that the environmental and research perceptions surrounding the CGBS may stem more from students' sociocultural context and social interactions than from a structured educational process mediated by effective pedagogical strategies (Junca et al., 2022).

This reality also raises further questions: What is environmental education for? What should environmental education entail? How can environmental components be incorporated into the curriculum—not only by integrating scientific knowledge but also including other forms of knowledge and addressing the issues specific to each context? It´s hoped that this study will spark new research to enrich the discussion and promote alternative environmental education approaches from critical, intercultural, multicultural, and transdisciplinary perspectives. These would empower the school curriculum to form well-rounded individuals capable of addressing the global climate crisis (Santos & Fischer, 2020; Sosa et al., 2022; Rodríguez et al., 2023; Canales, 2022; Martínez et al., 2021; Uskola et al., 2021; Puig et al., 2023), responding not only to biological diversity but also to the ethnic, sociocultural, and economic diversity of the territories (Eschenhagen, 2021; Leff, 2000; Leff, 2011).

Nevertheless, the findings of this study are timely and relevant. As Junca et al. (2022) state, they allow for prompt action based on the results obtained. Moreover, they demonstrate that the environmental and research perceptions identified are tied to the current reality. According to Ausubel (1968), this closeness to reality enables meaningful learning, as the key lies in establishing a substantial relationship between new material and the learner's existing ideas—allowing students to apply their learning in real-life situations.

## Conclusions

Based on the results obtained—and recognizing that they are not yet definitive—it was confirmed that there is a strong disconnection between the Institutional Educational Project (PEI) and the environmental needs and problems of the Ciénaga Grande del Bajo Sinú (CGBS) wetland (Colombia). Furthermore, it was observed that individuals who express greater interest in learning about the PEI also show a tendency to participate in associative groups, such as research clubs or study groups.

The factors most closely associated with levels of environmental perception include: knowledge of the CGBS, having visited the CGBS, the municipality where the survey was conducted, and the ability to identify environmental problems related to the CGBS. On the other hand, regarding the research dimension, the most influential factors were: the municipality where the survey was applied, knowing how to act as a researcher in the face of a problem, knowing the definition of a wetland, and understanding the starting point for developing a research project. A significant association was established between the level of perception in research and the level of perception of wetlands. This indicates that performance in one area is related to performance in the other. Therefore, the findings suggest the need to strengthen pedagogical strategies that integrate both areas of knowledge.

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