



Ecological intelligence and literacy among university students at the Batallas Academic Campus

Inteligencia y alfabetización ecológica en estudiantes universitarios de la Sede Académica Batallas

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ABSTRACT

Introduction: University education is a relevant setting for strengthening knowledge, attitudes, and practices oriented toward sustainability. **Objective:** To analyze perceptions related to ecological intelligence and ecological literacy and willingness toward environmental care among students in the Educational Sciences program at the Batallas Academic Campus. **Methods:** A quantitative, descriptive, non-experimental, cross-sectional study was conducted between January and April 2026. A census approach included the 36 students who comprised the accessible population. A questionnaire with closed and open-ended questions was applied and showed a Cronbach alpha of 0.82. Closed responses were analyzed using frequencies and percentages, while open-ended responses were grouped thematically. **Results:** A total of 94.4% expressed interest in receiving information, training, and participating in environmental activities; the same proportion recognized human beings as a determining factor in environmental impact, and 97.2% considered environmental awareness necessary. Open responses emphasized water care, waste management, recycling, energy saving, pollution reduction, and green-area protection. **Conclusions:** Students showed favorable willingness toward environmental education and an understanding of human responsibility focused on everyday practices. The findings support sustained educational experiences linking ecological knowledge, reflection, and responsible action.

Keywords: ecological literacy; ecological intelligence; environmental awareness; higher education; pro-environmental behavior.

RESUMEN

Introducción: La formación universitaria constituye un espacio relevante para fortalecer conocimientos, actitudes y prácticas orientadas a la sostenibilidad. **Objetivo:** Analizar las percepciones vinculadas con la inteligencia y alfabetización ecológica y la disposición hacia el cuidado ambiental en estudiantes de la Carrera de Ciencias de la Educación de la Sede Académica Batallas. **Metodología:** Se desarrolló un estudio cuantitativo, descriptivo, no experimental y transversal entre enero y abril de 2026. Se trabajó mediante criterio censal con 36 estudiantes que conformaban la población accesible. Se aplicó un cuestionario con preguntas cerradas y abiertas, con alfa de Cronbach de 0,82. Los datos cerrados se analizaron mediante frecuencias y porcentajes y las respuestas abiertas mediante agrupación temática. **Resultados:** El 94,4% manifestó interés en recibir información, capacitación y participar en actividades ambientales; igual proporción reconoció al ser humano como determinante del impacto ambiental, mientras que el 97,2% consideró necesario generar conciencia ambiental. Las respuestas abiertas priorizaron cuidado del agua, gestión de residuos, reciclaje, ahorro energético, reducción de la contaminación y protección de áreas verdes. **Conclusiones:** Los estudiantes mostraron una disposición favorable hacia la formación ambiental y una comprensión de la responsabilidad humana centrada en prácticas cotidianas. Los hallazgos respaldan el fortalecimiento de experiencias educativas continuas que articulen conocimiento ecológico, reflexión y acción responsable.

Palabras clave: alfabetización ecológica; inteligencia ecológica; conciencia ambiental; educación superior; comportamiento proambiental.

INTRODUCTION

The current socio-environmental crisis has increased the demand on higher education institutions not only to contribute knowledge about the ecological problems facing society, but also to ensure students' willingness to address them. The university is a strategic setting because it educates future professionals who will be involved in decision-making and in transforming social practices. University sustainability therefore cannot remain confined to isolated curricular content; it can only be advanced by integrating the relationship among knowledge, attitudes, values, and behaviors from the perspective of society-environment interactions [1,2]. Consequently, concepts such as ecological literacy and ecological intelligence have gained relevance for understanding how students interpret environmental problems and their own everyday behavior.

Ecological literacy is determined by the capacity to understand the basic principles governing how natural systems operate, by recognition of the interdependence between human beings and the environment, and by the ability to interpret the consequences of social activities on ecosystems. From an educational perspective, it suggests moving beyond content memorization and strengthening processes of analysis, appraisal, and practical application. In higher education, evidence shows that students may hold favorable environmental attitudes without these necessarily translating into behaviors. This context confirms a possible gap among knowledge, intention, and action [3,4]. Effective environmental education therefore involves linking what has been learned to observable practices related to water consumption, waste management, energy use, and conservation of natural spaces.

Ecological intelligence complements this perspective by considering a person's capacity to interpret the environmental consequences of decisions and act more responsibly toward the environment. Among university students, environmental behavior has been reported to be explained, at least partly, by relationships among knowledge, attitudes, and willingness to act^{3,5}. Knowledge-attitude-practice models likewise hold that environmental information becomes more relevant when it is transformed into personal appraisals and subsequently into concrete behaviors⁶. In this way, ecological intelligence can be understood as an integrative capacity that combines understanding, sensitivity, and responsible choice.

Research in higher education suggests that environmental education can contribute to the development of pro-environmental behavior when it is systematically incorporated into educational experiences. Exposure to environmental content, the use of participatory strategies, and opportunities to become involved in real-life problems can help increase concern for the environment and strengthen the perception of one's capacity to act⁷. However, behavior is not determined solely by what is learned in the classroom. The theory of planned behavior highlights how attitudes, social norms, and perceived behavioral control influence behavioral intention⁸. Thus, two students with similar levels of knowledge may respond differently depending on how they appraise the problem and the possibilities they believe they have for intervening.

At the institutional level, universities have implemented strategies to promote sustainable practices through curricular programs, awareness campaigns, participatory projects, and science-society engagement activities [9]. However, their results may differ according to the cultural, organizational, and educational context. Comparative studies have shown differences in sustainability consciousness among students from different countries, indicating that environmental practices are shaped by social and educational factors¹⁰. This highlights the need to study the populations targeted by an intervention before designing an institutional intervention expected to produce equivalent results in every context.

Another challenge is how to adequately measure levels of ecological literacy and environmental awareness. Sustainability is recognized as a multidimensional construct that includes knowledge, attitudes, and behaviors; therefore, its assessment requires instruments aligned with these dimensions¹¹. Sustainability literacy tests show that there may be a difference between recognizing the relevance of certain problems and understanding which actions are most effective for addressing them^{11,12}. In addition, recent reviews warn that environmental literacy has no single form of operationalization, because some approaches prioritize knowledge, others attitudes, and still others include behavior [2,13]. These differences mean that each result must be interpreted according to the specific application of the instrument used.

Available evidence also indicates that university students' pro-environmental behavior is conditioned by personal and institutional factors. Variables such as perceived responsibility, social norms, opportunities for participation, and the educational context may help explain why some sustainable behaviors are adopted more easily than others^{14,15}. Institutional policies and practices oriented toward sustainability can reinforce environmental intentions and facilitate their expression

in concrete behaviors¹⁶. Therefore, interest in environmental education is an important starting point, but educational experiences that combine knowledge, participation, and practical application are also necessary.

In the Educational Sciences program at the Batallas Academic Campus, examining these dimensions is relevant both because of the students' future educational role and because of the multiplier effect they may have in other educational settings. Understanding how they perceive human responsibility for environmental impact, their willingness to receive training, and the practices they consider priorities makes it possible to build a contextualized view of their ecological intelligence and literacy. This information may also guide future educational actions without attributing effects that a descriptive design cannot infer. Therefore, the present study aimed to characterize perceptions related to ecological intelligence and literacy, as well as willingness to engage in environmental care practices, among students in the Educational Sciences program at the Batallas Academic Campus during the first four months of 2026.

METHODOLOGY

The research used a quantitative approach, descriptive scope, and non-experimental cross-sectional design. Data collection was conducted between January and April 2026 at a single measurement point and without deliberate manipulation of variables. The design aimed to characterize the environmental perceptions and dispositions of the group studied; therefore, the findings were interpreted descriptively rather than as causal effects of an intervention.

The accessible population consisted of 36 students from the Educational Sciences program at the Batallas Academic Campus. The entire accessible population was included using a census approach. The unit of analysis was each participating student, and the results were limited to this group, without statistical extrapolation to other campuses or institutions.

The data collection technique was a survey. An ad hoc questionnaire was used, consisting of closed and open-ended questions that explored indicators related to ecological intelligence and literacy, recognition of human responsibility for environmental impact, interest in receiving training and information, appraisal of environmental awareness, and practices considered necessary for environmental care. The closed questions used dichotomous yes/no responses. The instrument achieved a Cronbach's alpha of 0.82, a value considered adequate for the descriptive purpose of the study.

Closed responses were organized in a matrix and analyzed using absolute frequencies and percentages. To facilitate comparative interpretation, the relative ranking of indicators according to the percentage of affirmative responses and the percentage-point gap between Yes and No responses were also calculated. These calculations were used only for descriptive purposes.

Open-ended responses were reviewed and grouped according to semantic similarity. This process organized the mentions into six themes: responsible water use, waste management, recycling and reuse, energy saving and pollution reduction, conservation of green areas, and environmental awareness. Frequencies were not assigned to these categories when the available record did not allow an unequivocal individual count; consequently, their presentation is thematic rather than inferential.

RESULTS

Analysis of the closed responses showed a high proportion of affirmative appraisals across the three indicators examined. In every case, more than 94% of students selected Yes. This trend indicates a favorable disposition toward environmental education and substantial recognition of human responsibility, although it does not provide evidence of actual behavior or an estimate of change promoted by an intervention.

The need to receive information and training and to participate in environmental activities was expressed by 34 of the 36 students (94.4%), whereas 2 (5.6%) gave negative responses. The same distribution was observed for the recognition of human beings as a determining factor in environmental impact. The indicator with the highest proportion of affirmative responses was the need to promote environmental awareness, with 35 students (97.2%) responding positively and 1 (2.8%) negatively.

Comparison of the indicators shows little variation. The highest and lowest affirmative percentages differed by 2.8 percentage points. This means that the group displayed a relatively

homogeneous pattern of acceptance across the aspects evaluated. The largest gap between affirmative and negative responses occurred for the need to promote environmental awareness, at 94.4 percentage points, while the other two indicators showed a gap of 88.8 points.

Table 1. Distribution of responses for the environmental indicators evaluated

Indicator	Yes n (%)	No n (%)
Interest in information, training, and environmental activities	34 (94.4)	2 (5.6)
Human responsibility for environmental impact	34 (94.4)	2 (5.6)
Need to promote environmental awareness	35 (97.2)	1 (2.8)

Note. Frequencies and percentages corresponding to 36 students. Authors' own elaboration.

Table 2. Descriptive ranking of indicators according to affirmative responses

Rank	Indicator	Yes (%)	Yes-No gap (pp)
1	Need to promote environmental awareness	97.2	94.4
2	Interest in information, training, and activities	94.4	88.8
2	Human responsibility for environmental impact	94.4	88.8

Note. pp: percentage points. Ranking calculated from the affirmative response percentage. Authors' own elaboration.

The responses went beyond the interpretation of the closed indicators; students associated environmental care with concrete actions closely related to everyday life. Mentions concerning water included saving water, preventing waste, and using water responsibly. Waste management responses included separating waste, reducing waste, and disposing of it properly; recycling and reuse were associated with repurposing materials and producing compost, together with saving electricity, reducing polluting practices, caring for green areas, preventing clearing, and planting trees.

An integrated reading of the results yielded four descriptive dimensions. The first is educational disposition, reflected in interest in receiving training and participating in educational activities. The second is attribution of responsibility, observed in recognition of the human role in producing environmental impacts. The third is declared environmental awareness, which in fact showed the highest percentage of affirmative responses. The fourth is practical orientation, evidenced by the concrete actions identified in participants' open-ended responses throughout the questionnaire. These dimensions are not a statistical result of the questionnaire; they are an analytical synthesis of the findings that were collected.

Table 3. Thematic categories identified in the open-ended responses

Thematic axis	Actions mentioned	Descriptive scope
Responsible water use	Save water, avoid waste, and use the resource responsibly.	Rational use of natural resources.
Waste management	Separate waste, reduce garbage, and dispose of it properly.	Prevention and responsible waste management.
Recycling and reuse	Recycle, reuse materials, and produce compost.	Resource recovery and waste reduction.
Energy and pollution	Save electricity and reduce polluting practices.	Reduction of everyday environmental impact.
Green areas	Care for green areas, prevent tree cutting, and plant trees.	Conservation and recovery of the environment.
Environmental awareness	Inform other people and promote collective support.	Shared environmental responsibility.

Note. Categories are presented without frequencies because of the open-ended nature of the records. Authors' own elaboration.

Overall, the results show high acceptance of environmental education and awareness-raising and a conceptualization of environmental care centered on concrete practices. The proximity of the percentages across the three indicators suggests descriptive consistency among educational interest, recognition of responsibility, and the need for environmental awareness. However, because these are self-reported perceptions, the results do not allow determination of the actual frequency with which students perform the actions mentioned.

Table 4. Analytical summary of the dimensions observed in the results

Dimension	Observed evidence	Descriptive interpretation
Educational disposition	94.4% interested in information, training, and activities.	Favorable openness to environmental education processes.
Environmental responsibility	94.4% recognize the human contribution to environmental impact.	Broad recognition of responsibility for the environment.
Environmental awareness	97.2% consider it necessary to strengthen environmental awareness.	Highest level of agreement among the closed indicators.
Practical orientation	Water, waste, recycling, energy, pollution, and green areas.	Concern is expressed through concrete everyday actions.

Note. Descriptive synthesis constructed from closed and open-ended questions. Authors' own elaboration.

DISCUSSION

Students' high willingness to engage in environmental education is consistent with studies that explain pro-environmental behavior as a process in which knowledge, attitude, and sensitivity become progressively related. Mago et al. showed that environmental knowledge can influence behavior through attitude and sensitivity, while Fu et al. found that connection with nature and a favorable institutional climate are conditions associated with ecological behavior among university students [17,18]. In this study, accepting educational actions is not equivalent to effective behavior, but it is a favorable condition for educational processes intended to translate environmental concern into more stable practices.

Interpretation of the results must take into account the multidimensional nature of ecological literacy. Sanchez et al. state that environmental literacy and sustainability literacy comprise knowledge, attitudes, competencies, and opportunities for action¹⁹. In measurement terms, the Cronbach's alpha of 0.82 obtained for the questionnaire indicates adequate internal consistency for the group analyzed. Saldaña-Almazán et al., in validating an instrument for assessing pro-environmental behavior among Mexican university students, reported an alpha of 0.778 and highlighted the importance of having consistent and understandable measures²⁰. Although the instruments are not equivalent, both results emphasize the need to report reliability and strengthen validity evidence in subsequent studies.

The actions identified in the open-ended responses show that environmental concern is expressed through practices close to everyday experience. Vilca Colquehuanca et al. found waste reduction, water and energy saving, recycling, reuse, and segregation practices among university students in Juliaca²¹. This pattern is similar to the themes identified in Batallas, particularly water, waste, and recycling. Blanco et al. also observed a relationship between environmental education and attitudes toward climate change in a university population²². Taken together, this evidence supports linking environmental content with observable situations and decisions that students can recognize in their own context.

The educational environment also plays a relevant role. Argüero-Fonseca et al. found relationships between expectations regarding teachers' pro-environmental behavior and university students' general ecological behaviors, highlighting the importance of modeling and reference figures within the educational setting²³. From an ethical perspective, Castro-Carpio and Leal-Díaz argue that environmental education should not be reduced to a list of instrumental actions, but should be oriented toward responsible forms of relationship between society and nature [24]. At the Batallas Academic Campus, this means that actions such as water conservation, waste separation, or preservation of green spaces acquire greater pedagogical value when combined with reflection, participation, and collective responsibility.

The systematic inclusion of sustainability in higher education also requires curricular and institutional support. University students' environmental behavior is conditioned by institutional policies, curricular integration, and individual perceptions, according to Roque Paredes and Carcausto Calla²⁵. Ríos Quiñónez et al. also argue for incorporating sustainable and environmental education into university courses in order to foster greater ecological awareness²⁶. Although these studies correspond to different contexts, they agree that student willingness requires ongoing opportunities for learning and participation. Therefore, the Batallas results can be used as a diagnostic basis for organizing contextualized actions, but not as evidence that a specific activity produced behavioral changes.

The study has limitations. First, the accessible population was small and restricted to one

academic campus, so the percentages are purely descriptive for the students analyzed. The design was cross-sectional and does not allow temporal change to be established; moreover, the closed responses address self-reported perceptions rather than observed behaviors. Similarly, the open-ended responses made it possible to construct thematic categories, but did not generate a sufficiently robust individual count to estimate the prevalence of each category. Future research could use validated multidimensional scales, observation of practices, pretest-posttest measurement, and longitudinal follow-up to analyze more precisely the relationship among ecological literacy, attitudes, and behavior.

CONCLUSIONS

Students in the Educational Sciences program at the Batallas Academic Campus showed a highly favorable disposition toward environmental education. A total of 94.4% expressed interest in receiving training or education aimed at improving environmental action. This analysis indicates a favorable basis for strengthening ecological literacy processes at the university; participants' disposition represents an opportunity to consolidate more systematic and contextualized educational activities that connect environmental content with concrete everyday situations, without assuming that this disposition has already translated directly into sustained environmental behavior.

Most respondents linked environmental problems with human activity; specifically, 94.4% considered human beings to be a determining factor in environmental impact. This suggests that students are able to establish a relationship between human behavior and environmental problems, which is significant for the development of ecological awareness. Recognition of responsibility is a fundamental variable for guiding educational processes toward more conscious decisions regarding resource use, waste, and environmental conservation. However, this recognition must be followed by educational practices that promote the transition from perception to concrete and sustained action.

The most widely accepted aspect in the study was environmental awareness, as 97.2% of students considered it favorable for improving environmental conditions. This is an encouraging finding regarding ecological awareness, given that participants demonstrated the need to work on environmental education. In this sense, environmental awareness can become a cross-cutting axis in the education of future education professionals through experiences that integrate knowledge, reflection, and participation. The result also reinforces the relevance of continuing educational actions in the field of sustainability.

The environmental practices described by students concerned responsible water use, waste separation and reduction, recycling, energy saving, pollution reduction, and protection of green spaces. The responses show that the group's ecological literacy is related to everyday behaviors that are readily observable in their immediate environment. Identifying these practices provides a valuable starting point for designing educational experiences contextualized in students' reality. Accordingly, environmental education at the Batallas Academic Campus should be oriented toward strengthening these actions, supporting their continued application, and linking them with family, academic, and community settings.

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