

Ethnobotanical plant awareness among secondary school students of Malaybalay, Philippines

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ABSTRACT

Plant awareness, encompassing attention, knowledge, and attitudes toward plants, are essential for fostering biodiversity appreciation and environmental stewardship. In Bukidnon, where a rich ethnobotanical heritage exists, limited research has explored students' awareness of ethnobotanical plants, potentially undermining local conservation efforts. This study assessed ethnobotanical plant awareness among 320 secondary school students from three schools in Malaybalay, Bukidnon, using a quantitative survey design. A structured survey measured three dimensions of awareness: visual attention, knowledge/understanding, and attitudes. Data were analyzed using descriptive statistics, Mann-Whitney U, Kruskal-Wallis tests, and Spearman's rho correlations to explore differences and relationships across gender and grade levels. Findings revealed a marked preference for animals over plants, with students demonstrating limited visual attention and knowledge regarding local ethnobotanical species. Significant differences in plant awareness were observed across grade levels, while gender differences were less pronounced. Significant relationships were found between visual perception, knowledge, and attitude which describes the multidimensional nature of plant awareness. The results highlight critical gaps in plant awareness, underscoring the need for integrative educational strategies. Incorporating local ethnobotanical knowledge into science, technology, engineering, and mathematics (STEM) curricula may enhance students' engagement, species literacy, and environmental responsibility. Addressing plant awareness disparities among students is vital for effective biodiversity conservation and the development of future environmental stewards in Bukidnon.

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1. INTRODUCTION

The phenomenon of plant awareness disparity, characterized by the tendency to overlook plants in one's environment, poses a significant challenge to comprehensive science education [1]. This oversight has far-reaching consequences, potentially undermining efforts to promote environmental stewardship and a complete understanding of the natural world [2]. Studies show that students exhibit a marked preference for animals, often recognizing and identifying them more readily than plants, which highlights a critical gap in biology education and species literacy. Given this, it is imperative to investigate the extent of plant awareness among learners and use it as a platform to improve learning experiences in the classroom.

The term ‘plant blindness’ was coined by Wandersee [3] describing the phenomenon which was then termed as “plant awareness disparity” due to ableism issues with the use of the term “blind”. Later on, plant awareness disparity was challenged by Pany *et al.* [2], as cited by Dünser *et al.* [4] as the term “disparity” puts highlight to more deficit and negative tones; hence, the term “plant awareness” to focus on a positive goal instead. Various studies have proven the lack of plant awareness. Literature reported a discrepancy in the recollection and visual recognition [5], [6] of plants compared to animals. At the same time, people tend to categorize plants as non-living organisms [7], [8].

Studies show that students exhibit a marked preference for animals, often recognizing and identifying them more readily than plants, which highlights a critical gap in biology education and species literacy [9], [10]. For instance, a study in Spain revealed that despite curricula addressing local flora, students’ knowledge remains inadequate, necessitating improved educational strategies to foster plant awareness [9]. Furthermore, specific assessments in Indonesia found alarmingly low recognition rates of local vegetables among students, emphasizing the urgent need for targeted interventions to combat plant blindness and enhance environmental consciousness [10].

Sustainable development goals could be at risk, since biodiversity knowledge, including plants as an intrinsic part of it is the first step to protect it [8]. School is a very appropriate place for students to foster a sense of care for the environment, where this effort can be made so that student awareness in maintaining environmental aspects is getting higher for the sustainability of future life [10]. When students possess a high level of environmental awareness, they are more likely to actively participate in preserving the environment.

Addressing plant blindness is essential for cultivating a deeper appreciation of biodiversity and promoting environmental stewardship among future generations. Bukidnon, specifically, has several endemic flora and fauna due to its location being a mountainous region, which makes conservations efforts paramount. Several studies [11], [12] reported the ethnobotanical plants used by the Higaonon and the Matigsalug-Manobo Tribes of Bukidnon. The Matigsalug-Manobo utilize a diverse range of edible plants, encompassing 62 species from 50 genera and 33 botanical families [11]. The Higaonons, meanwhile, also utilizes a wide variety of edible plants, encompassing 76 species. This knowledge in ethnobotanical utilization puts forward the value of plant diversity and the need to conserve such plants [12].

Various studies have documented the availability and utilization of the ethnobotanical plants in Bukidnon. However, these studies have been isolated in ethnic communities alone and has no record of being disseminated among its high school students. Furthermore, no studies have been published on the ethnobotanical plant awareness among students in Bukidnon. In response to this gap, the present study aims to assess ethnobotanical plant awareness among secondary school students in Malaybalay, Bukidnon, by examining three key dimensions: attention, knowledge/understanding, and attitude. Each dimension is analyzed according to gender and grade level to identify potential disparities. Furthermore, the study investigates the interrelationships among these dimensions to illuminate the multidimensional nature of plant awareness. Findings from this research are expected to inform the development of targeted, culturally relevant educational strategies that integrate ethnobotanical knowledge into formal curricula, thereby fostering environmental literacy and stewardship among students.

2. THEORETICAL FRAMEWORK

Plant awareness was attributed to three dimensions, which included attention, understanding, and attitudes [4]. Attention measured the ability of the respondents to recognize plants in their environment, and understanding pertained to knowledge about plants, their role in the ecosystem, and their impact on society. Attitudes involved the feelings, values, and beliefs of an individual toward plants. Adapting this framework in assessing learners’ plant awareness provided a holistic view of the students’ plant awareness.

The dimension of attention was measured through visual perception. As emphasized by Pany *et al.* [2], the first step in developing a positive attitude toward plants was to visually perceive them out of the “green background” and to recognize them as living organisms, equal to animals. By looking beyond their aesthetic value, people began to study plants and learn to identify them, contributing to their knowledge of the significant role plants held in the environment and thereby developing positive attitudes toward them.

The dimension of understanding involved both global and local understanding. Global understanding referred to a universal comprehension of plant-related processes, including photosynthesis, pollination, and their contributions to ecosystems and ecosystem services. In contrast, local understanding emphasized knowledge of plants within a specific environment—in this case, Bukidnon. Various subscales were tested, including ethnobotanical staple plants, plant identification, practical knowledge, plants as living organisms, carbon cycle, agriculture, and sustainability. Previous studies [11]–[13] informed the selection of the ethnoplants of Bukidnon that were included in the questionnaire. These subscales also corresponded to the definition of Dünser *et al.* [4], “higher plant awareness means to recognize the needs of plants to grow and thrive, as well as their vital role for all life on Earth, including their impact on human life and culture.”

The dimension of attitudes, on the other hand, measured the students' feelings involving the presence and use of plants, which corresponded to the agreed definition in a Delphi study: "attitudes towards plants are evaluated responses towards plants, such as feeling comfortable or uncomfortable around plants." The dimensions of attention, understanding, and attitudes were shown to be interrelated and were affected by factors including interests, emotions, pedagogical interventions, and mentors [4]. This encapsulated the multidimensional and complex construct involving plant awareness. Investigating these dimensions was especially significant in the context of the ethnobiology of plants in Bukidnon, as plants held an important role in daily life and formed part of its societal and cultural identity.

3. METHOD

3.1. Research design

This study investigated the level of plant awareness among secondary school students and examined the relationship between the domains included in the plant awareness definition. A quantitative research design was used, specifically a survey design utilizing a modified questionnaire from the plant awareness inventory developed by Dünser *et al.* [4]. The study focused on the three plant awareness domains validated by prior studies: attention, knowledge/understanding, and attitude. This approach aligned with ethnobotanical research practices that emphasized measurable insights into local knowledge and attitudes toward plants.

This study included 320 high school students from the Division of Malaybalay across three schools, namely, Bukidnon National High School, Manalog National High School, and Kalasungay National High School, that were chosen purposively representing varying academic strands, socio-economic conditions, and learning environments. Within each school, students were chosen using stratified random sampling, limited to grades 7, 9, and 11, as these were the grade levels commonly permitted for participation by all three schools, taking into account important school activities and national examinations scheduled during the conduct of the survey. The study of plants and the environment was taught in all grade levels in high school. Students had been taught the following competencies from grade 7 to grade 11: basic plant structure and photosynthesis, ecosystems and biodiversity, environmental science, including conservation and climate change, and advanced ecology and sustainability principles [14]. All these aimed to improve environmental awareness, practical skills in plant care, and alignment with global sustainability goals [15]. Detailed figure for the gender and grade level is shown in Table 1.

Table 1. Demographic profile of the participants

Grade level	Male	Female	Total
Grade 7	43	38	81
Grade 9	70	119	189
Grade 11	24	26	50
Total	137	183	320

Proper protocol was followed for the gathering of data, which included securing a research permit from the division office and approval from the school principal. Students were also asked for their consent to participate in the survey through an informed consent form. Data were gathered using a validated questionnaire on ethnobotanical plant awareness.

The data analysis for each dimension in this study was carried out using a combination of descriptive and inferential statistical methods for non-parametric data collected for each dimension of plant awareness. For dimension 1 (visual perception), students' ability to notice plants versus animals was measured by tallying the frequency with which they identified plant and animal items from the illustration shown. The Mann-Whitney U test was used to compare attention scores between plants and animals. Additionally, the Kruskal-Wallis's test assessed differences across grade levels.

For dimension 2 (knowledge/understanding), students' knowledge was evaluated across several subscales, including ethnobotanical knowledge, plant identification, understanding of plants as living organisms, the carbon cycle, and sustainability. Descriptive statistics (means, standard deviations, and availability ratios) were calculated for each subscale. Similarly, Mann-Whitney U test was used to compare gender differences, while the Kruskal-Wallis's test and post hoc pairwise comparisons assessed differences among grade levels. Spearman's rho correlation coefficients were also calculated to examine relationships among the various knowledge subscales.

For dimension 3 (attitude), students' attitudes toward plants were measured using 5-Likert-scale statements addressing emotional, aesthetic, cultural, and environmental perspectives. Descriptive statistics summarized the responses, and the Mann-Whitney U and Kruskal-Wallis tests were used to identify any

significant differences by gender or grade level. Correlations between attitude and the other dimensions were also explored using Spearman's rho correlation coefficients. The knowledge level and attitude level are described in Table 2.

Table 2. Classification of knowledge and attitude level

Score obtained by respondent (%)	Level of knowledge/attitude
80 and above	High
60-79	Average
40-59	Low
Below 40	Very low

4. RESULTS

4.1. Dimension 1: visual perception

Animals like cats (77.71%), horses (77.50%), chickens (66.87%), and dogs (67.19%) were among the most frequently seen, while the highest plant frequencies-trees (51.56%) and bananas (39.37%) were much lower, this indicates a significant gap in the observations between common plants and animals. Many plant types, such as orchids (0.62%), snake plants (0.94%), and gumamela (3.44%), were rarely noticed which highlights a possible gap in students' botanical awareness and ecological literacy. Table 3 shows the frequency recorded for plant and animal items.

Table 3. Frequency table on the visual perception for plants and animals

Plants				Animals			
Common name	Scientific name	Freq.	Availability ratio (%)	Common name	Scientific name	Freq.	Availability ratio (%)
Bamboo	<i>Bambusa vulgaris</i> (L.)	52	16.25	Carabao	<i>Bubalus bubalis carabanesis</i>	138	43.12
Corn	<i>Zea mays</i>	54	16.88	Horse	<i>Equus caballus</i>	248	77.50
Rice	<i>Oryza sativa</i>	18	5.63	Pigs	<i>Sus scrofa domesticus</i>	193	60.31
Banana	<i>Musa sp</i>	126	39.37	Cats	<i>Felis catus</i>	249	77.71
Mango	<i>Mangifera indica</i>	70	21.87	Dogs	<i>Canis lupus familiaris</i>	215	67.19
Gumamela	<i>Hibiscus rosasinensis</i>	11	3.44	Butterfly	<i>Lepidoptera</i>	145	45.31
Sunflower	<i>Helianthus annuus</i>	78	24.37	Monkey	<i>Primates</i>	160	50.00
Weeds	<i>Common grass</i>	74	23.12	Chicken	<i>Gallus gallus domesticus</i>	245	66.87
Guava	<i>Psidium guajava</i>	25	7.81	Duck	<i>Anatidae</i>	206	64.37
Snake plant	<i>Dracaena trifasciata</i>	3	0.94	Fish	<i>Fish</i>	156	48.75
Tomato	<i>Solanum lycopersicum</i>	42	13.13	Birds	<i>Birds</i>	187	58.44
Ferns	<i>Pteridophyta</i>	21	6.56	Humans	<i>Homo sapiens</i>	117	36.56
Orchid	<i>Orchidaceae</i>	2	0.62	Snake	<i>Serpentes</i>	174	54.37
Tree	--	165	51.56				
Total		741		Total		2433	

Out of a total of 741 plant observations and 2,433 animal observations, students noticed animals much more frequently than plants, as in Table 3. The much lower frequency for plants, despite their presence in the illustration, suggests students are less aware of or attentive to plant life which then points out to an apparent "plant blindness". This is further supported by the Mann-Whitney U test shown in Table 4.

Table 4. Mann-Whitney U test results comparing the dimension 1, attention scores between animal and plant visual perception (M=137, F=183)

Dimension 1	Gender	Mean rank	Mann-Whitney U	Asymp. Sig.	Mean rank	Mann-Whitney U	Asymp. Sig.
Plants	Male	162.47	12128.50	0.673	202.34	13390.00	0.001
	Female	158.14					
Animals	Male	166.65	115556.00	0.262	438.66		
	Female	154.99					

The mean rank for animals (438.66) is dramatically higher than plants (202.34), indicating a substantial difference in how frequently these items were perceived. This difference is statistically significant with a p-value of 0.001 ($p < 0.05$). However, results showed no significant difference between the scores of the male and female students in either plant items and animal items. Kruskal Wallis test between grades levels (7, 9, 11) showed no statistical significance for the animal items but a statistical significance of 0.001 ($p < 0.05$) for the plant items. The subsequent pairwise comparison showed a significant difference of

0.001 between grades 7 and 9. These statistics strongly support the earlier observation that students demonstrate plant blindness in terms of visual perception - they consistently notice and identify animals more readily than plants in the same visual field.

4.2. Dimension 2: knowledge/understanding

Table 5 presents students' scores across various subscales related to knowledge and understanding of plants. Results show that students demonstrate an average level of knowledge in identifying ethnobotanical staple plant foods and in plant identification. Their understanding of the carbon cycle and sustainability is also rated as average. However, students display very low levels of knowledge regarding plants as living organisms.

Table 5. Knowledge scores of the subscales for dimension 2 (N=320)

Subscale	M	SD	Availability ratio (%)	Knowledge level	
Ethnobotanical staple plant food	10.25	3.72	68.33	Average	
Plant identification	14.97	3.86	77.20	Average	
Plant as living organisms	Fungi	1.34	1.31	16.75	Very low
	Plant	1.73	1.60	21.63	Very low
	Animals	2.04	1.47	25.50	Very low
Carbon cycle	6.39	2.35	71.00	Average	
Sustainability	4.99	2.02	62.38	Average	

Fungi, plants, and animals are all considered to be living organisms. The “very low” knowledge level means that students were unable to relate these organisms to the characteristics of a living organism. This gap implies that students view plants primarily based on their utilitarian value rather than understanding their role in the ecosystem as a biologically complex organism. This result highlights the need for instructional approaches that emphasize the fundamental biological nature of plants, fostering not only factual recall but also deeper conceptual understanding. Strengthening this area is essential to build students' overall scientific literacy and to support curriculum goals in biology and environmental education.

Further analysis using post hoc pairwise comparisons showed that all 3 groups differed significantly from each other (all $p < 0.001$). Mean scores increased from fungi ($M=1.34$) to plants ($M=1.73$) to animals ($M=2.03$). This points out to students considering plants as “less” of a living organism compared to animals. There is no significant difference in the subscale scores between the genders except for subscale 5 on sustainability ($p=0.024$). With females (170.02) exhibiting higher mean rank scores compared to males ($M=146.68$), as detailed in Table 6. For between grade levels, an independent samples Kruskal Wallis test was run, as shown in Table 7. Significant statistics were found for subscale 1 ($p=0.000$), subscale 4 ($p=0.008$), and subscale 5 ($p=0.001$). Pairwise samples are shown in Table 7.

Table 6. Test statistics for the grouping variable of gender

Test Statistics	S1	S2	S3			S4	S5
			Fungi	Plants	Animals		
Mann-Whitney U	12246.0	11857.0	11510.0	11992.0	12269.0	11782.5	10642.5
Wilcoxon W	28899.0	28510.0	20963.0	21445.0	28922.0	21235.5	20095.5
Z	-0.273	-0.751	-1.235	-0.599	-0.253	-0.850	-2.263
Asymp. Sig.	0.785	0.453	0.217	0.549	0.800	0.395	0.024

Table 7. Pairwise comparison between grade levels

Groups	Subscale 1		Subscale 4		Subscale 5	
	Test statistic	Sig.	Test statistic	Sig.	Test statistic	Sig.
Grades 7-9	-31.336	0.031	-27.921	0.064	-23.321	0.165
Grades 9-11	-42.925	0.010	-21.206	0.433	-40.387	0.016
Grades 11-7	74.261	0.000	49.127	0.008	63.708	0.001

Data suggests that understanding of plants as food staples increases with grade level and similarly trend is observed in subscale 5 (sustainability). Interestingly, subscale 4 (carbon cycle) only showed a significant difference between grades 11 and 7 ($p=0.008$), with no significant differences observed between grade 9 and either of the other grade levels, implying that deeper ecological system understanding may develop later and less uniformly.

4.3. Dimension 3: attitude

This dimension assesses how students emotionally value and relate to plants in various contexts—emotional comfort, aesthetic appreciation, familial/cultural roles, and urban/environmental importance. Table 8 details the test statistics for dimension 3. Students demonstrate a strong positive attitude toward plants, especially in terms of emotional comfort, aesthetic appreciation, and desire for greener urban and home environments. The only relatively lower score (still average) is on the familial role of plants, which may reflect less cultural integration or symbolic emphasis on plant use in celebrations. The lack of significant differences by gender or grade level suggests that these positive attitudes are broadly consistent across the student population. Given this, plant-related attitudes may be shaped more by common environmental exposure, community values, or universal developmental experiences than by individual characteristics such as age or gender. For educators, this consistency indicates that programs promoting plant awareness and appreciation can be designed and implemented uniformly across grade levels and for all learners, without needing to tailor them extensively to specific subgroups.

Table 9 presents the Spearman's rho correlation coefficients between the dimensions and subscales of plant awareness, revealing complex and varied relationships. Visual perception (dimension 1) exhibited weak and statistically non-significant correlations with all cognitive subscales, suggesting that mere exposure to or recognition of plants in the environment does not necessarily translate to deeper cognitive understanding. Ethnobotanical staple plant food showed significant negative correlations with both the carbon cycle ($r=-0.288$, $p<0.05$) and sustainability ($r=-0.301$, $p<0.05$), implying a potential disconnect between local ethnobotanical knowledge and scientific ecological concepts. Notably, the strongest correlation was between sustainability and carbon cycle ($r=0.645$, $p<0.05$), indicating a strong conceptual alignment between students' understanding of these two scientific domains. Attitude toward plants (dimension 3) was only weakly and marginally correlated with the knowledge subscales, with a small but significant relationship with sustainability ($r=0.141$, $p<0.05$). This suggests a potential disconnect between students' affective dispositions and their conceptual knowledge.

Table 8. Test statistics for each statement in dimension 3 for attitudes towards plants (N=320)

Statement	M	SD	Availability ratio (%)	Attitude level	Description	U asymp sig.	Kruskal Wallis sig.
When there are plants around me, I feel...	4.58	0.72	91.60	High	Very comfortable	0.506*	0.247**
I find (most) plants...	4.47	0.82	89.40	High	Very beautiful	0.072*	0.572**
In my family, plants play...role at celebration (e.g. as decoration).	3.90	1.03	78.00	Average	An important	0.430*	0.816**
I would like to have ... trees in my city	4.58	0.77	91.60	High	Much more	0.661*	0.225**
I would like to have ... plants in my immediate surroundings (e.g. at home or at school).	4.45	0.78	89.00	High	Much more	0.523*	0.411**

*Grouping variable for Mann Whitney U – gender

*Grouping variable for Kruskal Wallis – grade level

Table 9. Spearman's rho correlation coefficients for the dimensions of plant awareness (N=320)

Dimension	D1	D2S1	D2S2	D2S3	D2S4	D2S5
Visual perception	Dimension 1					
Knowledge/understanding	Dimension 2					
Ethnobotanical staple	Subscale 1	-0.098				
Plant Identification	Subscale 2	-0.074	0.321*			
Plant as living organism	Subscale 3	0.004	0.175*	-0.028		
Carbon cycle	Subscale 4	0.015	-0.288*	-0.225*	0.018	
Sustainability	Subscale 5	0.069	-0.301*	-0.218*	0.012	0.645*
Attitudes	Dimension 3	0.080	-0.144*	-0.103	0.017	0.123*

*Statistically significant results at $p<0.05$

5. DISCUSSION

5.1. Dimension 1: visual perception

The ability of a person to visually perceive plants in their environment is one of the dimensions considered in this study. Results of this study suggest that students are more readily to remember and identify animals more than plants contributing to apparent plant blindness in terms of visual perception among students. This has been mentioned early in the study of Balas and Momsen [5] and recently in the study of Marcos-Walias *et al.* [9]. The former used an established paradigm in visual cognition, the “attentional blink”, to compare the extent to which images of plants and animals capture attentional resources, finding out that participants are better able to detect animals than plants in rapid image sequences and that visual attention has a different refractory period when a plant has been detected.

Recently, visual perception of plants is considered as one of the factors contributing to the phenomenon of plant blindness [16], [17]. Animals are often more visually obvious due to their movement and behavioral cues. They tend to capture attention more readily than plants, which are typically static and less conspicuous. As Pany *et al.* [16] note, students' ability to perceive and recognize plants is a prerequisite for effective botany education, since unnoticed plants are less likely to be cognitively processed or valued. Similarly, Pany *et al.* [17] highlight that the development of valid instruments to assess plant blindness shows how visual inattention to plants directly influences attitudes, knowledge, and awareness.

Results of the study exhibit significant difference in the plant perception between grades 7 and 9 which agrees that students exhibit a biased perception, recognizing animals more readily than plants across various educational levels [9], [10]. It was notable that the most mentioned among plant items were the banana tree and the term "tree" in general. This implies that students are more likely to recognize plants that are highly relevant to their daily lives, such as those that provide food or other resources, but overall, fails to identify them [18], [19]. The lower frequencies recorded for common plants compared to animals, as in Table 3, reflect this visual perception bias, reinforcing that plant blindness is not merely an attitudinal issue but also a perceptual limitation. Addressing this requires educational strategies that intentionally direct students' attention toward plants, making them more noticeable and salient in both classroom and field learning environments.

Despite various studies claiming that women score higher in plant perception and identification [20], this study suggests that there are no significant differences in plant knowledge between gender. This contradicts prior research stating that women generally possess a broader repertoire of known plant species and demonstrate more connected and cohesive social networks for sharing plant knowledge. Furthermore, this points out to the more varied cultural roles among women such as in agriculture, home gardening, herbal medicine, and food preparation, often resulting in more frequent interactions with plants and a deeper understanding of their uses and properties which could be seen are less pronounced in the current generation of students [21]. This further cements that plant-related knowledge is less tied to gendered responsibilities and more influenced by formal schooling and shared media or technology-based learning environments.

5.2. Dimension 2: knowledge/understanding

The subscales for dimension 2 (knowledge) consistently showed disappointing levels. Specifically, the students struggled to identify plants as living organisms. Students exhibit a limited understanding of plant biology and ecology, often failing to recognize plants as living organisms [2]. This is likely due to plants moving slowly, have no eyes, and are seen as less spectacular, which contributes to the phenomenon of plant blindness, which ties back to the discussion on visual perception. From a cognitive perspective, human attention is naturally drawn to stimuli that are dynamic, animate, or perceived as socially engaging [5]. Animals, with their movement, sounds, and expressive behaviors, therefore capture attention more readily, while plants tend to blend into the background as part of the scenery [2]. This perceptual bias contributes to the phenomenon of plant blindness, where people fail to notice plants, undervalue their ecological importance, or lack the ability to identify them [16], [17].

No significant difference was seen between genders, except for the subscale on "sustainability" with women scoring higher than men. This agrees with research on sustainability and plant awareness reveals clear gender differences in environmental knowledge [22] and sustainable practices, favoring females over males. However, a study in the Philippines found no significant difference in the sustainability practices and knowledge among secondary students [23]. This uniformity is attributed to standardized curricular exposure and equal access to sustainability education regardless of gender., since sustainability concepts are integrated across science, social studies, and values education subjects in the national curriculum [14], [15]. In the Philippine setting, formal schooling appears to level the field by providing equal opportunities for sustainability learning, thereby reducing gender-driven disparities.

What is interesting to note now is the significant differences of plant knowledge between grade levels with the plant knowledge increasing from grades 7 to grade 9 and to grade 11. This shows that although there is no focused approach to improve ethnobotanical awareness of students in Bukidnon, the current curricular exposure provides a scaffold for students to learn about plants [15], [23]. Lessons in science subjects as well as practical learning in agriculture and technology education give students indirect opportunities to encounter plant-related knowledge [15]. These exposures, while not ethnobotanically specialized, allow students to build a foundational understanding of plants' roles in food systems, ecosystems, and sustainability. However, without explicit integration of ethnobotanical content—such as traditional plant uses, cultural practices, and indigenous ecological knowledge—students may develop only a surface-level familiarity, lacking appreciation for the cultural, and social dimensions of plant-human relationships. Integrating scientific [24], cultural [25], and local knowledge to deepen plant understanding and environmental relevance has been highlighted in different studies.

5.3. Dimension 3: attitude

For dimension 3, students exhibit surprisingly highly positive levels of attitude towards plants. Even though students lack the knowledge about plants, they seem to have a high regard for plants and the environment in terms of emotional comfort, aesthetic appreciation, and desire for greener urban and home environments. Plants' colors, shapes, and seasonal changes appeal to students' senses and creativity. This aesthetic appreciation does not require botanical expertise-rather, it taps into universal human responses to beauty and nature's diversity [4]. This suggests that students' positive attitudes may be shaped less by formal scientific understanding and more by everyday experiences and affective connections; enjoying the shade of trees, the beauty of flowers, or the calming presence of greenery in their surroundings. Even without detailed plant knowledge, students may understand the broader importance of plants in sustaining life and combating environmental issues like pollution and climate change. This awareness can fuel their aspiration for greener cities and homes. Such affective responses reflect the biophilia hypothesis [26], which proposes that humans have an innate tendency to seek connections with nature.

The finding that students hold highly positive attitudes toward plants despite limited knowledge underscores the powerful role of emotional and aesthetic connections in shaping human-plant relationships. This positivity is a valuable asset for educators and environmental advocates aiming to deepen botanical literacy and foster sustainable behaviors. Positive attitudes can serve as a motivational gateway to learning [27], since students who already appreciate the beauty, comfort, and value of plants may be more receptive to lessons that connect these feelings with biological concepts and ecological importance. For example, studies using plant sketching [28] and botanical gardens [29] were seen to improve students' environmental behavior and understanding. By nurturing these attitudes alongside scientific knowledge, we can cultivate a generation that not only loves plants but also understands and actively protects them.

Research by Wandersee [3] introduced the concept of "plant blindness", where individuals may see but not truly notice plants, leading to low plant knowledge despite frequent exposure. Similarly, Balas and Momsen [5] showed that increasing visual exposure does not automatically translate to deeper botanical knowledge. The weak correlations between visual perception and most knowledge subscales support these findings. The exception is plant identification, where a modest positive correlation suggests that students who notice plants more may be somewhat better at identifying them, aligning with studies that link observation skills to identification ability [30].

The strong positive correlation between sustainability and carbon cycle knowledge is logical and supported by literature emphasizing the interconnectedness of ecological concepts [31]. Understanding the carbon cycle is foundational to grasping sustainability issues. The negative correlations between carbon cycle knowledge and both plant identification and plant as a living organism are intriguing and less commonly reported. Some studies suggest that compartmentalized teaching can lead to knowledge silos, where students excel in one area but not others [32]. This might explain why students with strong carbon cycle knowledge may not necessarily excel in basic plant identification or organismal biology. In practice, this means that while students can articulate how carbon moves through ecosystems, they may struggle to recognize the organisms that drive these processes. Such a disconnect can weaken ecological literacy, as real-world sustainability challenges require both conceptual understanding and practical awareness of biodiversity. Bridging this gap calls for teaching approaches that intentionally connect global cycles with organismal biology, such as linking carbon cycle discussions to the roles of trees, algae, or local plant species, so that students see how large-scale processes are anchored in everyday biological realities.

The findings of this study contribute to the literature by understanding plant awareness within the ethnobotanical context of Bukidnon, a province with rich but underexplored cultural plant knowledge. Unlike prior studies that primarily documented the ethnobotanical profiles in indigenous communities in Bukidnon [11]–[13], this study extended its focus to secondary school students, revealing how plant blindness manifests in a younger population that has indirect exposure to local flora through formal curriculum but limited cultural integration. The multidimensional analysis of visual perception, knowledge, and attitudes further highlights a pattern of positive attitude towards plants existing alongside low knowledge/understanding; liking plants without really understanding them, particularly regarding their recognition of plants as living organisms. This coexistence of appreciation without deeper comprehension is a finding less emphasized in earlier studies and underscores the need to leverage students' affective connections as an entry point for strengthening botanical literacy.

6. CONCLUSION

This study reveals a pronounced phenomenon of plant blindness among high school students, characterized by a marked tendency to notice and identify animals more readily than plants, even when both are equally present in their environment. While students generally exhibit positive attitudes toward plants-expressing comfort, appreciation, and a desire for greener spaces-their cognitive understanding,

particularly regarding plants as living organisms and their roles in ecological systems, remains limited. Notably, plant awareness and knowledge improve with grade level, suggesting that educational progression plays a crucial role in fostering ecological literacy. However, the weak correlation between visual perception, knowledge, and attitude underscores the multidimensional nature of plant awareness and highlights the need for more integrative educational strategies. To effectively address plant blindness and promote a deeper appreciation and understanding of plant life, future curricula should purposefully connect visual, cognitive, and affective domains, ensuring that students not only see and value plants but also comprehend their vital ecological significance. In addition, future research could investigate how other science topics, aside from the carbon cycle and sustainability, influence the Knowledge dimension and extend to other plant awareness dimensions.

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AUTHOR CONTRIBUTIONS STATEMENT

This journal uses the Contributor Roles Taxonomy (CRediT) to recognize individual author contributions, reduce authorship disputes, and facilitate collaboration.

Name of Author	C	M	So	Va	Fo	I	R	D	O	E	Vi	Su	P	Fu
Doreen Khrystel P. Gonzales	✓	✓			✓	✓	✓	✓	✓	✓	✓			✓
Monera A. Salic-Hairulla	✓	✓		✓			✓			✓		✓		
Vanjoreeh A. Madale	✓			✓						✓		✓		✓

C : **C**onceptualization

M : **M**ethodology

So : **S**oftware

Va : **V**alidation

Fo : **F**ormal analysis

I : **I**nvestigation

R : **R**esources

D : **D**ata Curation

O : **O**riting - **O**riginal Draft

E : **E**riting - **R**eview & **E**ditng

Vi : **V**isualization

Su : **S**upervision

P : **P**roject administration

Fu : **F**unding acquisition

CONFLICT OF INTEREST STATEMENT

Authors state no conflict of interest.

INFORMED CONSENT

We have obtained informed consent from all individuals included in this study.

ETHICAL APPROVAL

The research related to human use has been complied with all the relevant national regulations and institutional policies and has been approved by the authors' institutional review board. All participants were informed of the study's purpose, procedures, and their rights, including voluntary participation and confidentiality. Informed consent was obtained before data collection. There were no conflicts of interest, and participant data was handled with strict confidentiality and anonymity.

DATA AVAILABILITY

The data that support the findings of this study are available from the corresponding author, [DKPG], upon reasonable request.

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