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Research Artikel

PLANT AWARENESS AND RECOGNITION OF PLANTS AS LIVING BEINGS AMONG BIOLOGY PRESERVICE TEACHERS IN BANDUNG, INDONESIA

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Abstract

Humans are highly dependent on the existence of plants; from daily needs to the need to support ecosystems. However, there are some people who are less aware of the existence and importance of plants for life and lead to the phenomenon of plant awareness disparity (PAD). It is important for teachers to have plant awareness and have the awareness that plants are as important as other living things. This study was conducted to reveal the level of PAD of biology pre-service teachers by using PAD-I (Plant Awareness Disparity-Index) developed by Parsley (2022). In addition, this study also explores the recognition of plants as living things in prospective biology teachers by asking them to name living organisms around them. This study used a descriptive cross-sectional method and gathered 35 respondents of biology pre-service teachers from one of the universities in Bandung, Indonesia. The results of the PAD-I score analysis show that preservice biology teachers still have PAD with an average score of 79. In addition, this study also revealed that preservice teachers mostly mentioned living things from the animal kingdom as living things (56%) compared to living things from the kingdom plantae (34%), bacteria (5%), fungi (3%), and protists (2%). From this search, it can be concluded that the biology pre-service teachers still have a tendency to overlook the plant and show a preference for animals. However, there are several approaches that can be taken, such as emphasizing the importance of plants in reducing the impact of climate change and placing plants and animals in the same situation. Through such an approach, it is hoped that students will develop an awareness of plants as a first step toward plant conservation, particularly with native Indonesian plants.

Keywords: *Biology pre-service teacher; living organism recognition; plant awareness disparity; plant blindness.*

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INTRODUCTION

Plants are living organisms that play a major role in human life. Humans are highly dependent on plants—from food, shelter, fuel, and clothing to plantations, landscaping, and inspiration (Hiscock et al. 2019). Not only that, but diverse plants can also have a positive impact on ecosystems, providing useful plant products; oxygen through photosynthesis; fruits and leaves for food; erosion control; resistance to plant invasion; and pathogen regulation (Quijas, Schmid, and Balvanera 2010). This reinforces the fact that plants are not only beneficial to humans directly, but also beneficial to ecosystems, which ultimately benefit humans as well.

Regarding plant diversity, Indonesia is a country with a high number of plants. In a study conducted by Sun et al. (2024), it was revealed that plants in Indonesia represent 8.7% of the world's vascular plants, namely 30,466 species belonging to 2968 genera and 317 families. From these observations, 9289 plant species were found on the island of Java (Sun et al., 2024). These results are also confirmed in other studies, which found that there are 108 plant species living in the Dieng highlands (Damayanti, Nurbambang, and Soeprobowati 2021) and 83 plant species living in the pine forest area of Mount Ciremai, West Java (Supartono et al. 2023).

The high diversity of plants in Indonesia will be threatened if the community lacks awareness of plants. This concern is defined as plant blindness, or the inability of a person to recognize the existence, role, benefits, beauty, and uniqueness of plants, and to consider plants as living beings that are inferior to animals (Wandersee and Schussler 1999, 2001). This term was later updated to plant awareness disparity (PAD), which has the same definition but emphasizes the view that plants are merely a backdrop to animals (Parsley 2020; Parsley, Daigle, and Sabel 2022).

Several studies reveal that the phenomenon of PAD occurs frequently among students, from elementary school students (Amprazis, Papadopoulou, and Malandrakis 2021; Iri and Çil 2020) to high school students (Dünser et al. 2024; Pany et al. 2024). A study revealed that students tend to consider animals as living things more than plants (Pany et al. 2024). Another study revealed that students consider animals more alive than plants (Amprazis et al. 2021), which leads to a lower interest in plants (Dünser et al. 2024). Not only among students, one study revealed that young people often underestimate the importance of plant species richness, which is one of the symptoms of PAD (Panitsa, Iliopoulou, and Petrakis 2021).

The causes of PAD in students, from elementary to high school, can be attributed to various factors. One of them is the method and approach chosen by the science teacher in providing material related to plant diversity and characteristics (Soraya, Nurjhani, and Solihat 2025). In addition, the selection of textbooks used by teachers can also influence teachers' views on teaching plant diversity and characteristics to students. In a study conducted by Brownlee et al. (2023), it was stated that an imbalance in the proportion of images of plants and animals in the books used by students, especially education students, can contribute to an increase in PAD among students (Brownlee 2023; Link-Pérez et al. 2010; Pedrera 2024), considering that students will become teachers in the future.

Based on this, it is important to increase the plant awareness of pre-service biology teachers in an effort to reduce the PAD phenomenon among students (Bobo-Pinilla et al. 2024). This is because pre-service teachers, especially biology and science pre-service teachers, will become teachers in the future and will teach students about plant diversity and characteristics. On the other hand, teachers' interest in and preference for botany or any particular animal can also influence the biology curriculum in particular (Kletečki et al. 2023; Vydra and Kováčik 2025).

However, there have not been many analyses of the PAD phenomenon among pre-service biology and science students, especially in Indonesia. Thus, this study aims to analyze the level of PAD among pre-service biology teachers with the following research questions: 1) How is the level of PAD among pre-service biology teachers? 2) How do pre-service biology teachers recognize plants as living things? 3) What are the

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preferences of pre-service biology teachers regarding their favorite plants? 4) What are the preferences of pre-service biology teachers regarding their favorite animals?

Through this study, it is hoped that teachers will be able to prepare themselves to take responsibility for fostering students' awareness of plants. In response to this, teachers can work to improve any gaps in their own and their students' understanding of plants as a first step toward plant conservation efforts.

METHOD

This study uses a descriptive cross-sectional method, which is a method that aims to provide a comprehensive overview of a phenomenon that occurs at a certain point in time without manipulating variables (Creswell and Guetterman 2019). The selection of this method allows researchers to obtain an overview of the PAD phenomenon among pre-service teacher.

The population in this study were pre-service biology teachers (PST) at a university in Bandung, West Java. The participants in this study were selected through purposive sampling; they were pre-service biology and science teachers at a university in Bandung, West Java, who had no prior experience teaching at junior high or high schools. Data collection involved 35 respondents who filled out questionnaires from various regions and age groups, although they came from the same university. Research participants who met the specified criteria were then asked to complete an online questionnaire using Google Forms.

Table 1. Respondent Demographic Information

Demographic Category		Frequency	Frequency (%)
Gender	Male	7	20
	Female	28	80
Age	21 Years	5	14
	22 Years	7	20
	23 Years	9	26
	24 Years	4	11
	25 Years	3	9
	26 Years	1	3
	27 Years	3	9
Place of Residence	Bandung	22	63
	Bangka Belitung	1	3
	Bekasi	2	6
	Cianjur	1	3
	Cilegon	1	3
	Cimahi	2	6
	Cirebon	1	3
	Garut	1	3
	Jakarta	2	6
	Serang	1	3
	Sukabumi	1	3

The measurement of PAD levels in pre-service teacher (PST) was conducted by distributing an online questionnaire. The questionnaire in this study adapted the Plant Awareness Disparity-Index (PAD-I) (Table 1) developed by Parsley et al. (2022) and three questions related to living things and students' preferences regarding their favorite plants and animals. The statements in the PAD-I questionnaire contained four indicators, namely attention, attitude, knowledge, and relative interest, while the questions related to the recognition of living things were as follows:

"Name 5 living things around you!"

"Name 3 of your favorite plants!"

"Name 3 of your favorite animals!"

The questionnaire used in this study has not yet been validated or had its reliability tested. This is because the original questionnaire developed by Parsley et al. (2022) has already been valid and tested for reliability. Furthermore, in their original study, Parsley et al. (2022) had tested the questionnaire on undergraduate students, which aligns with the sample in this study; therefore, the translation into Indonesian is considered sufficient for this study.

Table 2. PAD-I Indicators

Aspects	Factor	Statement	
		Item Number	Total
Attention	Attention toward Plants	22, 23, 24,25	4
Attitude	Caring for or Investment in Plants	1, 2, 3	3
Knowledge	Positive Affect toward Plants	17, 18, 19, 20, 21	5
	Necessity of Plants/Importance of Plants	4, 5, 6, 7, 8, 9	6
Relative Interest	Plants Better than Animals	10, 11, 12, 13	4
	Animals Better than Plants	14, 15, 16	3

The data obtained was then processed using descriptive statistics. Demographic data was processed by collecting data according to category—gender, age, and residence. After data collection, age data was then categorized based on age range. In this case, the age range selected was 18–27 years old, which is the average age of pre-service teachers. In the residence data, respondents were asked to write down their residence, and in the processing, grouping was carried out according to the same residence among respondents.

PAD data in this study was also analyzed using descriptive statistics. In processing the questionnaire data, all points from the statements in the questionnaire were added up to show the respondent's final score. In addition, data analysis also includes score analysis based on four PAD-I attributes, namely attention, attitude, relative interest and knowledge.

Following the questionnaire data, this study also asked open-ended questions to see the respondents' recognition of plants as living things and their preferences for plants and animals. The question did not ask respondents to order living things, but only to write down living things around them. However, during data analysis, the order in which they were mentioned was analyzed to see the tendency of recognition of living things. The first living organism mentioned will be categorized in the first order and so on. This order was interpreted as the respondents' primary recognition of living things.

In accordance with the research purpose, the occurrences of living organisms and the number of occurrences of each living organism between sequences will be compared. In this case, the living organism mentioned by the respondents will be categorize into a five-kingdom system—if the respondent mentions a plant species, the answer will be categorized as a plant, and the same applies to animals, bacteria, fungi, and protist. Considering that the respondents are preservice teachers and that high school material on the classification of living things still uses this system, the use of the five-kingdom system is considered most suitable for recognizing living things.

Regarding plant and animal preference data, a similar data analysis was conducted, but the difference was in the grouping. In plant and animal preference data, grouping is based on family; plants

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belonging to the same family group will be grouped together, and the same system applies to animal preferences. After grouping, the number of family occurrences will be counted and compared with other families.

Similarly to the question on recognition of living organisms, the question on preferences for plants and animals does not ask respondents to sort their preferences. However, the order of plants and animals will be categorized based on their number of occurrences. The appearance of plant and animal species in each order will be compared, and the number of appearances will be counted. This is done to see the respondents' tendencies towards plant and animal preferences.

This study was conducted with consideration for the confidentiality of respondent data. Before filling out the questionnaire, it was explained that this study collected data on name, gender, age, and residence. In addition, it was also explained that this data collection was solely for research purposes and would not reveal the respondent's real name to the public, thus ensuring the respondent's privacy. In this regard, the respondents' names were replaced with anonymous names to maintain their privacy. This study did not explicitly request the respondents' consent; rather, it assumed that by completing the questionnaire, the respondents agreed to have their awareness of plants analyzed in this study.

RESULTS AND DISCUSSIONS

Based on data gathered, 35 responses to the questionnaire and open-ended questions were collected. At the end of the data collection, there were 35 questionnaire responses and from the three open-ended questions submitted to respondents, 175 entries were obtained regarding respondents' recognition of plants as living things, 105 entries regarding plant preferences, and 101 entries regarding animal preferences. The difference in the number of preference response entries occurred because some respondents did not answer the questions, as explained in the Research Instrument section.

RQ1: How is the level of PAD among pre-service biology teachers (PST)?

Data analysis of PAD levels was conducted using descriptive statistics. Based on data analysis, it was found that the average score of respondents was 79 with a standard deviation of 6.5 (Table 3). Based on this analysis, it was also found that the lowest score in the questionnaire response was 66 and the highest score was 91. Based on the analysis of each PAD-I attribute, the average score on the attention attribute is 75, on attitude is 82, knowledge is 96, and relative interest is 63 on average (Table 4). A study conducted by Parsley et al. (2022), which also analyzed college students, showed that the average PAD-I score was 82. However, we haven't found any other studies that have used the PAD-I with college students, which makes it challenging to compare these scores.

Table 3. Statistical Analysis of PAD in Biology Preservice Teacher

Analysis	Value
Mean	79
Std. Deviation	6.5
Minimum	66
Maximum	91

Based on the PAD-I attribute analysis, it was found that respondents had the highest score on the knowledge indicator, indicating that respondents had a high level of knowledge about the importance of plants for human life. This is connected to the results of the response trends for the knowledge indicator, in which most respondents agreed with the statement that plants play an important role in human and planetary life.

Table 4. Average Score on Each PAD-I Attribute

PAD-I Attribute Average Score			
Attention	Attitude	Knowledge	Relative Interest
75	82	96	63

Based on the analysis of the average score per indicator, it was found that respondents had the lowest scores on the relative interest indicator. This indicator explored respondents' preferences regarding plants and animals. Based on these results, it can be concluded that respondents have a greater preference for animals than plants. These results are also related to the analysis of response tendencies, which revealed that respondents have a higher interest in learning about animals, whereas it is expected that respondents would have a balanced interest in both plants and animals.

Overall, it was found that there are still pre-service biology teachers who have plant awareness disparity. The analysis results showed that respondents had knowledge and awareness of the importance of plants for human life and the planet. In addition, respondents also had a high attitude towards plants, indicating that they applied their knowledge and appreciated the existence of plants around them. These results are supported by research conducted by Kubiatko et al. (2021), which states that knowledge is very important in forming positive attitudes towards botany and plants.

Based on the questionnaire analysis results, it was found that almost all respondents had a high score on knowledge regarding the importance of plants. This shows that respondents understand that plants play an important role in human life and the planet as a whole. This knowledge is certainly important in shaping a person's attitude, as stated in Kubiatko et al. (2021). Other studies have revealed similar findings, reinforcing the notion that knowledge is a key factor in shaping attitudes towards the environment (Stagg 2025). When someone has sufficient knowledge, both in information processing, conceptual understanding, and skill development (Nantawanit, Panijpan, and Ruenwongsa 2012), their attitude will be influenced to become more positive (Stagg 2025).

Besides knowledge about the importance of plants for human life, this study also shows that respondents understand the urgency of plants in mitigating the effects of climate change. The findings of this study are supported by the statement made by Dünser (2024) in his research, which states that highlighting the role of plants in mitigating climate change provides an opportunity for teachers to utilize plants in the learning environment so that social shifts due to climate change can be facilitated (Amprazis & Papadopoulou, 2020; Dünser, 2024; Thomas et al., 2022). When teachers understand the importance of plants in climate change mitigation, it is possible for them to convey this to students as preparation for facing other possibilities that may occur due to climate change.

Furthermore, based on the questionnaire analysis results, it was found that respondents had an average attention score of 75. There are several factors that may explain the respondents' relatively low level of attention to plants. The human cognitive system prioritizes moving elements, which ultimately trigger emotional reactions in humans, such as fear and vital responses to avoid potential threats (Albuquerque et al. 2025; Nairne et al. 2013). This was also explained by Wandersee and Schussler (1999), who stated that plants do not move as quickly or as much as animals, making them less noticeable to humans.

Alongside the aspect of movement recognition, the human recognition system also responds more quickly to contrasting shapes (Balas and Momsen 2014). In their research, Balas and Momsen (2014) explain that the possibility of humans experiencing a delay in paying attention to plants is due to plants being static and more monotonous. This is further explained by Achurra (2022) that the lack of human attention can be caused by plants that change their visual signals to be more ‘hidden’. Plants change their visual signals to avoid predation, among others, by camouflaging themselves in environments that have the same color so that they are difficult to recognize (Achurra 2022; Niu, Sun, and Stevens 2018). However, some plants also have strong visual signals that attract pollinators, enabling them to reproduce successfully with the help of pollinators (Caro, Allen, and Allen 2017). Based on this, it can be concluded that plants alter their visual signals according to their needs—which ultimately affects our ability to pay attention to plants.

The questionnaire analysis also revealed that respondents had an imbalance of interest in plants, in that they were more interested in animals than in plants. These analysis results are also supported by the statement mentioned in the questionnaire, that

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'*Learning about animals interests me more than learning about plants*', which was agreed upon by almost all respondents. This shows that even though respondents have positive knowledge and attitudes towards plants, they still consider plants to be less interesting to learn about. This may be related to the results of the analysis of respondents' attention, which showed that they paid less attention to plants. This may also be related to the static nature of plants themselves (Achurra 2022; Balas and Momsen 2014), making them less interesting for respondents to study.

This gap in our understanding of plants certainly has implications for learning and pedagogy. As such, a curriculum transformation is needed to raise awareness that both plants and animals are living beings that play a vital role in our lives (Bobo-Pinilla et al. 2024). On the other hand, student activities in natural environments should also be considered as a way to bridge this gap in plant awareness. Hands-on activities in nature and students' direct contact with plants can have a positive impact on their knowledge and at least partially reduce their lack of plant awareness (Borsos, Borić, and Patocskai 2023; Vydra and Kováčik 2025).

RQ2: How do pre-service biology teachers recognize plants as living things?

In addition to analyzing the PAD level of PST, this study also analyzed PST's recognition of plants as living things. This analysis was conducted by giving open-ended questions to respondents to write down five living things around them. The results of the analysis show that respondents recognize animals more as living things, as revealed by the higher number of mentions of animals as living things compared to plants (Figure 1). When grouped according to the order of their mention, animals as living things also show their dominance over plants and other living things such as fungi, bacteria, and protists.

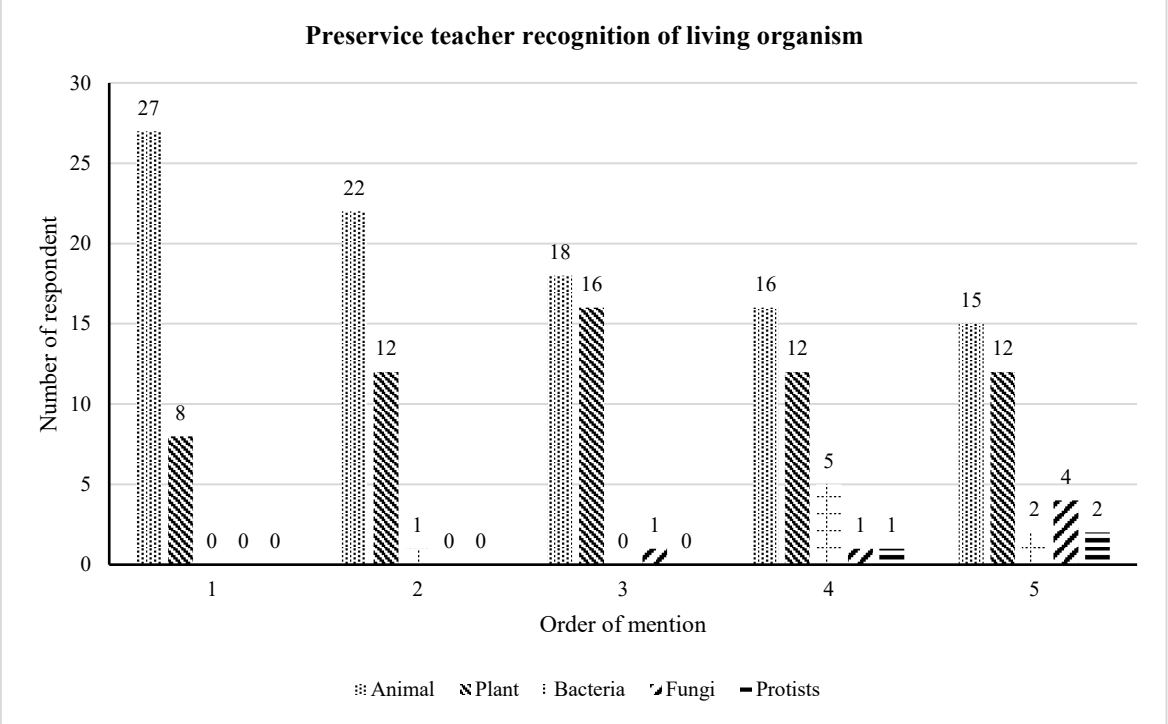

Figure 1. Preservice Teacher Recognition of Living Organism

When analyzing the order of living organism mentioned, it was found that there were variations in the respondents' answers. In the first order, respondents wrote animals in the first place, indicating that animals were the first living things that came to mind for the majority of respondents. In the same order, it was found that there were 8 respondents who mentioned plants as living things in the first place. On the other hand, no respondents mentioned bacteria, fungi, and protists as living things in the first order. Unlike the first order, in the second order, one respondent mentioned

bacteria as a living thing. In the same place, the number of respondents who recognized plants as living things increased—from 8 respondents to 12 respondents, while the number of respondents who recognized animals as living things decreased—from 27 respondents to 22 respondents.

The third to fifth order in the respondents' answers show variations in answers. While the first order shows a predominance of animals as the main recognition, the third order shows that there are respondents who recognize fungi as living things, and in the same order, the number of respondents who recognize plants increases and reaches the highest number of respondents who recognize plants as living things. However, this order also shows that the number of respondents who recognize animals as living things continues to decline, following the previous order.

Furthermore, in the fourth and fifth columns, it was found that respondents began to recognize all kingdoms of living things—although the numbers were uneven. In line with the previous order, the number of respondents who recognized animals as living things continued to decline, and in this order, the number of respondents who recognized plants as living things also declined. The fifth order shows results similar to the fourth, which all kingdoms began to be recognized as living things. However, the number of respondents who recognized plants as living things remained constant with the previous order, while the number of respondents who recognized animals continued to decline.

Based on the overall analysis results, it was found that the majority (56%) of respondents recognized animals as living things (Figure 2). This analysis also found that only 34% of them recognized plants as living things. However, only 5% of respondents recognized bacteria as living things, 3% recognized fungi, and 2% recognized protists as living things. Based on this analysis, it can be seen that respondents are more likely to remember animals as living things than plants, bacteria, fungi, or protists.

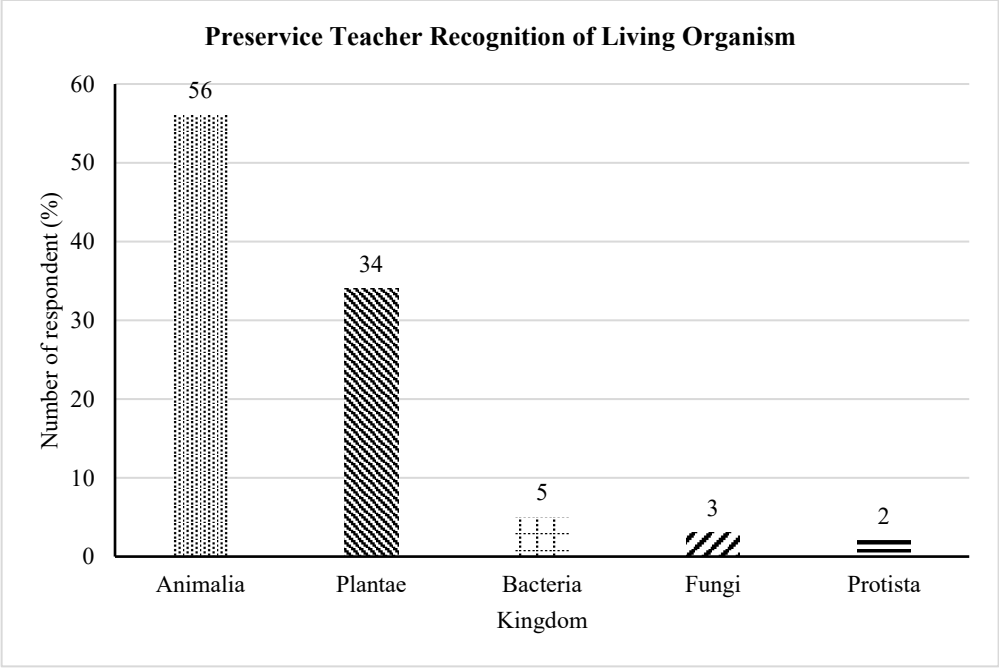

Figure 2. Preservice Teacher Recognition of Living Organism

Although it is a secondary priority, the gap between mentioning plants as living beings is not too wide, indicating hope for equal recognition of plants as living beings alongside animals and other living beings. Not only through familiarization with interacting with plants, other efforts that can be made include using more appropriate and unambiguous words when understanding living beings. As stated by Leddon et al. (2009) linguistic choices can also be one way to avoid bias. In their research, it is mentioned that the use of the word 'alive' to describe living things creates bias—

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students assume that something must be animated or moving to be considered a living thing. Meanwhile, by using 'living things', students can recognize plants better. This can be one of the efforts for the student respondents, as future teachers, to decide on the PAD cycle.

In addition to the animal and plant kingdoms, data analysis revealed that respondents also showed recognition of the fungi, bacteria, and protists kingdoms. However, only a small number of respondents mentioned these kingdoms as living things. Based on the analysis, it was found that bacteria was mentioned as a living thing 8 times (5% of the total mentions of living things), Fungi 6 times (3% of the total mentions of living things), and Protists 3 times (2% of the total mentions of living things). These results indicate that most respondents have a bias towards these three kingdoms of living things. A similar analysis was also revealed by Torres-Porras et al. (2025) who revealed that the majority of pre-service teachers experienced bias towards kingdoms other than animalia and plantae. These results are concerning as they may continue to be one of the causes of PAD in students, considering that they will teach biodiversity to students (Torres-Porras et al. 2025) and the importance of the interconnectedness between kingdoms for the survival of the planet and human well-being (Amprazis et al. 2021).

RQ3: What are the preferences of pre-service biology teachers regarding their favorite plants?

In accordance with the analysis of pre-service biology teachers' recognition of plants as living things, this study also explores respondents' preferences for their favorite plants. Based on the analysis of the answers provided by respondents, 105 entries of plant preferences were obtained. The plants mentioned by respondents are from 29 plant families. In the first order of plant mentioned, respondents mentioned plants from 15 families, while in the second and third order, respondents mentioned plants from 19 families. The families mentioned in each order overlapped with one another—there were several mentions of the same family in same order.

Based on the analysis, it was found that respondents had a strong preference for plants from the Rosaceae family, mainly roses (*Rosa sp.*). This can be seen from the high number of mentions of plants from the Rosaceae family, which were mentioned 20 times in total (Figure 3). Respondents also showed a high preference for plants from the Orchidaceae family; mainly orchid, which were mentioned 10 times in total. However, the analysis results showed that there was a variation in the respondents' answers regarding plant preferences. One of the findings is that there are several respondents who show a preference for plants from the Rubiaceae and Brassicaceae families. Although only mentioned once in total, this shows that respondents do not focus narrowly on a single plant from a particular family.

The high preference for Rosa sp. plants can be attributed to various factors. One of them is the ease of finding plants from the Rosaceae family around respondents, both as ornamental plants (Arif, Alamsyah, and Supriatna 2023) and as plants found in large landscape areas (Cahyanto et al. 2019). other factors that may have influenced respondents were social and environmental factors. This is in line with the statement by Albuquerque et al., (2025) who revealed that a person's perception of plants and the environment is greatly influenced by sociocultural, educational, and environmental factors. This is reinforced by other studies that mention that a person's knowledge and preferences regarding plants can be supported by the accumulation of human history (Zank et al. 2022) which varies based on gender, age, and urbanization factors (Albuquerque et al. 2025; da Silva et al. 2024).

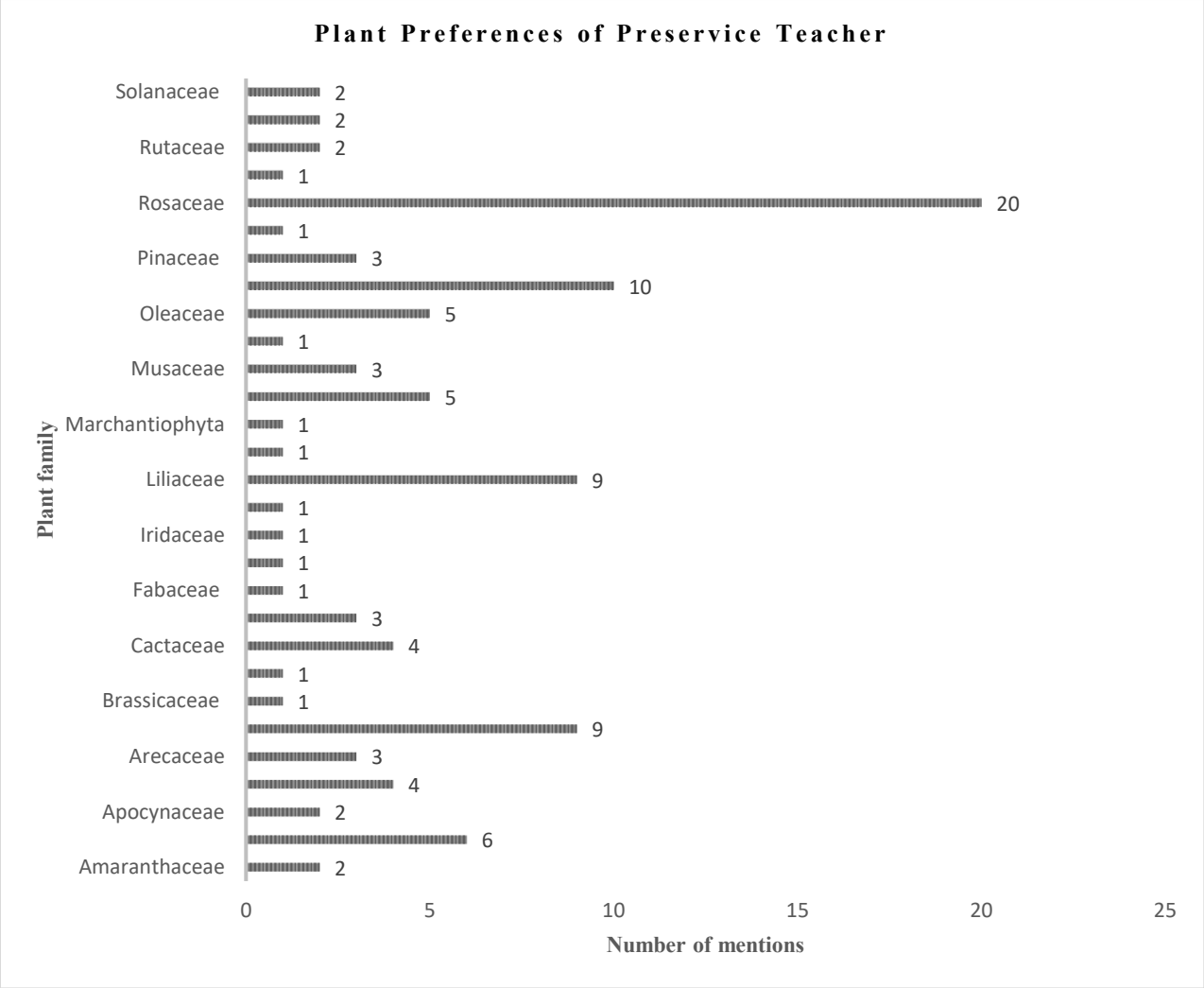

Figure 3. Plant Preferences of Preservice Teacher

The analysis results also revealed that there were several plants that were only mentioned once by respondents, in addition to those mentioned most frequently. Some of these are the noni; *Morinda citrifolia*; from the Rubiaceae family, the paper flower (*Bougainvillea* sp.) from the Nyctaginaceae family, and the butterfly pea (*Clitoria ternatea L)* from the Fabaceae family. These three plants are actually easy to find, such as the Noni; which is a medicinal plant and can be found in various types of environments, including fertile, acidic, alkaline environments (Heryanto et al. 2023); the butterfly pea plant; which is also a medicinal plant that can be used as an eye treatment (Afrianto, TAMNGE, and HASANAH 2020), and the bougainvillea; which is a garden plant (Kastolani et al. 2018). One reason for the respondents' lack of preference for these three plants may be the lack of visibility of the plants themselves.

RQ4: What are the preferences of pre-service biology teachers regarding their favorite animals?

Besides analyzing preservice teachers' preferences for plants, this study also analyzed respondents' preferences for their favorite animals. Based on the data collection, 101 entries were collected regarding respondents' favorite animals. After categorizing respondents' animal preferences, it was found that respondents had preferences for various animals from 29 animal families. In the first order, several animals from 17 families were mentioned, in the second order, several animals from 20 families were collected, while in the third order, various animal species from 22 families were collected. When analyzed in

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terms of animal preference patterns, it was found that animal preferences continued to expand in terms of the number of families. Similar to plant preferences, several families was overlapped, so that some families mentioned in the first order were mentioned again in the second and third order by other respondents.

Based on the analysis that was conducted, it was found that respondents had a high preference for animals from the Felidae family, mainly cats (*Felis catus*). This can be seen from the high number of mentions of Felidae as a favorite animal, which 31 times in total (Figure 4). These results indicate that respondents have a high preference for animals from this family. This may be because cats are popular pets, especially in Indonesia (Nurhayati and Wolff 2025). Several studies mention that some people choose cats as pets to reduce loneliness and as a source of social support (Staats, Wallace, and Anderson 2008). Another reason for respondents' high familiarity with cats is the high population of stray cats in Indonesia (Nugroho Willyarto and Fajar 2021).

In addition, respondents also showed a high preference for Pisces, which was mentioned 11 times in total by respondents, despite not specifying what species of fish. It can be seen from the overall number that there is a significant gap between the number of mentions of animals from the Felidae family and those from other families.

Similar to the number of families in plant preferences, animal preference responses also showed an accumulation of 29 families. This is because some respondents mentioned various animals from different families. For example, there was one respondent who mentioned their preference for owls, which belong to the Strigiformes family. On the other hand, there was one respondent who mentioned their preference for lizards, which belong to the Squamata family.

Upon further analysis, respondents had a high preference for mammals. Based on the 29 families mentioned, 16 of them belonged to the mammal class, such as Ailuridae (e.g. red panda, *Ailurus fulgens*), Bovidae (e.g. cow, *Bos taurus*), and Canidae (e.g. dog, *Canis* sp.). One of the things that could underlie this is the phenomenon of biophilia, also known as the human tendency to have an affinity for certain animals, especially charismatic vertebrates (Albuquerque et al. 2025; Castillo-Huitrón et al. 2020). These results are also linked to the results of the questionnaire analysis, which revealed that respondents considered animals to be more interesting to study.

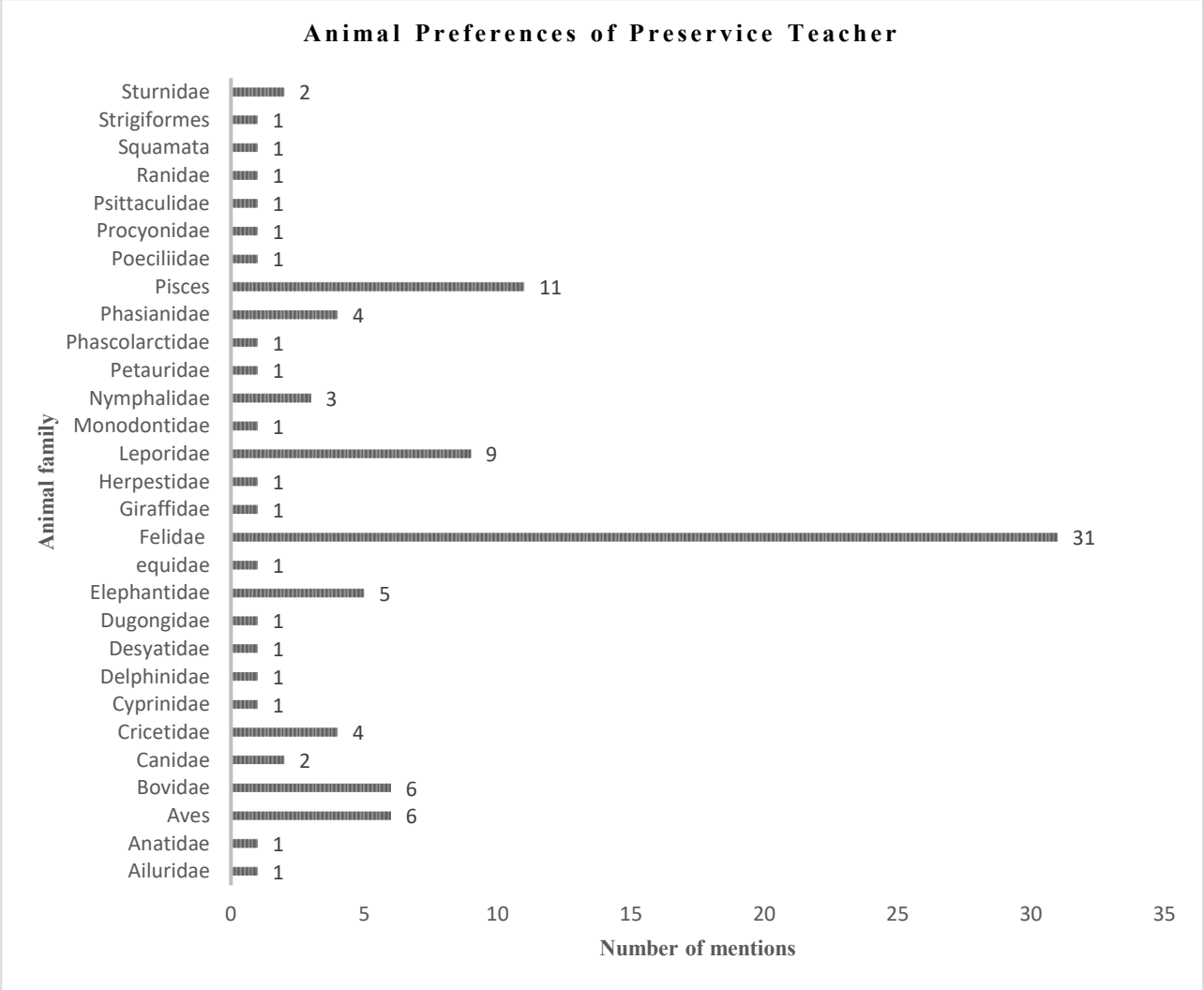

Figure 4. Animal Preference Of Preservice Teacher

In further analysis, it was found that there was only one family of invertebrates mentioned in the respondents' answers, which was Butterflies from the Nymphalidae family, mentioned three times by respondents. These results indicate that respondents have little interest in or aversion to certain animals, also known as biophobia. The phenomenon of biophobia can be caused by a lack of interaction between a person and certain animals, which causes various emotions such as dislike, disgust, fear, and perceived danger (Fukano and Soga 2021; Soga et al. 2020; Vanderstock et al. 2022). In connection with the respondents' preferences for other animals, it can be said that the respondents consider animals, especially those from the mammal class, to be interesting to study.

Implications of Plant Awareness Disparity (PAD) in Pre-service Teachers on Future Students

According to the questionnaire analysis of recognition and preferences regarding plants and animals, a number of respondents still had PAD and showed better recognition of animals than of plants. The preference analysis results also showed that the respondents' favorite animals were mammals. This analysis can certainly have an impact on future learning, considering that the respondents are preservice biology teachers. When teachers have PAD, there is concern that students would also have PAD, thereby reinforcing the PAD cycle itself (Bobo-Pinilla et al., 2024; Torres-Porras, 2024). A similar statement was also conveyed by other studies which revealed that when a botany teacher has less interaction with

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plants, experience-based learning will be less effective in overcoming PAD (Albuquerque et al. 2025).

The other impact that may occur on education in the future is the threat of decreasing awareness of plant conservation (Balding and Williams 2016), especially native plants in Indonesia. This is based on the results of the plant preference analysis mentioned by the respondents, namely that none of the respondents mentioned native plants in Indonesia, such as *Rafflesia arnoldii*, and only a few respondents mentioned *Jasminum sambac* (white jasmine). Although, as mentioned earlier, this may be due to the distribution of plants and the respondents' familiarity with other plants, if a teacher has a bias towards certain plants or between animals and plants, there is a concern that this will reduce plant conservation awareness among students in the future.

The decline in biodiversity is also one of the threats that may occur in the future. Based on the analysis results, it was found that respondents had better recognition of animals than plants, indicating a bias between respondents' concern for plants and animals. This finding is a concern for students in the future, as when teachers have PAD, it is feared that their students will also have PAD. When students have high levels of PAD, it is feared that they will also neglect plants and their diversity (Pedrera et al. 2023). In fact, if we analyze further, plant diversity plays an important role in the stability of ecosystem productivity and ecosystem services that depend on that productivity (Craven et al. 2016; Huang et al. 2025; Isbell et al. 2015).

Despite concerns about PAD among prospective teachers and students in the future, there are several efforts that can be made to reduce it. An effective effort that can be made is to increase it through learning (Achurra 2022; Albuquerque et al. 2025; Jose, Wu, and Kamoun 2019). In response to this, there are several strategies to increase plant awareness through learning based on literature analysis.

a. *Raising awareness of the importance of all living things in contributing to climate change mitigation*. Based on the analysis results, it was found that respondents had a high level of awareness that plants are an important component of human life and the planet's survival. This can be used as an approach that can be given to students, considering that respondents, as prospective biology teachers, already have a high level of awareness of this issue. This implementation also needs to emphasize that although plants play a crucial role in the planet's sustainability, other living things—from microorganisms to the largest living things on earth—also contribute to the planet's sustainability (Amprazis and Papadopoulou 2018; Bobo-Pinilla et al. 2024). In this regard, the analysis also revealed that respondents recognized animals as living things more than plants. Through learning that provides an understanding that plants and other living things contribute to climate change mitigation, it is hoped that teachers can foster equal awareness and perception of all living things—animals, plants, fungi, bacteria, and protists.

b. *Using familiar animals as a medium for learning about plants*. Based on the results of the analysis of recognition of living things, respondents showed the highest recognition of animals than plants. Although this appears biased, the results can actually be used as a way to increase students' awareness of plants. One approach that can be taken is to show the interaction between plants and animals in their surroundings, such as the relationship between plants and pollinators. This has also been revealed in several studies which explain that students' memory and interest in plants tend to increase when animals are involved (Prokop 2025; Prokop and Fančovičová 2023; Zani and Low 2022). In the context of education in Indonesia, teachers can highlight the symbiotic relationship between flowering plants—such as strawberries—and bees as their pollinators. Through this, not only is the relationship between plants and insects observed, but the local context—particularly in Bandung, Indonesia—is also addressed. By presenting animals and plants in the same situation, it is hoped that students will recognize animals and plants simultaneously. This is also expected to be one of the efforts to

increase students' attention to plants so that their conservation awareness increases.

c. *Integration of plants with other dimensions of knowledge*. Based on the analysis results, it was found that respondents already showed a positive attitude towards plants. Through attitude analysis, it was found that respondents enjoyed their time when they were around plants, indicating that they appreciated the plants themselves. In response to this, a positive attitude can be one of the first steps to increase understanding that plants have an important role in life, apart from being agents of climate change mitigation. One approach that can be applied is to connect plants with other dimensions of knowledge, such as environmental, ethical, historical, aesthetic, and medical (Albuquerque et al. 2025). Through the use of multiple dimensions of knowledge as context, it is hoped that students can learn the importance of plants and improve their attitude towards them, from appreciating them to understanding their existence and ultimately realizing their importance in human life—not just as a means of reducing the impact of climate change.

CONCLUSION

Based on the analysis of questionnaire data and open-ended questions, it was revealed that pre-service biology teachers had a tendency to overlook plants. This study also revealed that respondents recognized animals better than plants, fungi, bacteria, and protists. In addition, when asked about their plant preferences, respondents showed a high preference for plants from the Rosaceae family. Regarding animal preferences, respondents also revealed that they had a high preference for animals from the Felidae family.

The bias towards plants, which leads to the PAD phenomenon among prospective teachers, will certainly have an impact on students in the future. There is concern that this will become a continuing cycle and ultimately result in various implications for human life. Some of the implications that may occur are that students have low plant awareness and a lack of awareness of plant conservation, especially native Indonesian plants, which will ultimately lead to a decline in plant diversity in Indonesia. However, several approaches can be taken to reduce the possibility of an increase in PAD among students in the future, such as raising awareness about the importance of plants in reducing the impact of climate change, placing plants and animals in the same situation, and linking them to other dimensions of knowledge.

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REFERENCES

Achurra, Ainara. 2022. "Plant Blindness: A Focus on Its Biological Basis." *Frontiers in Education* 7(October):1–6. doi: 10.3389/feduc.2022.963448.

Afrianto, Whisnu Febry, FADILA TAMNGE, and LAELI NUR HASANAH. 2020. "Review: A Relation between Ethnobotany and Bioprospecting of Edible Flower Butterfly Pea (Clitoria Ternatea) in Indonesia." *Asian Journal of Ethnobiology* 3(2):51–61. doi: 10.13057/asianjethnobiol/y030202.

Albuquerque, Ulysses Paulino, Aníbal Silva Cantalice, Edwine Soares Oliveira, Francisco Igor Ribeiro Santos, Hermeson Carlos Santos, Ingrid da Silva Lima, João Victor Mendes Silva, Letícia Elias1, Marcela Maria Albuquerque-Silva, Maria Vittória Alves de Santana, Paula Thayanne Mata, Rayane Karoline Silva dos Santos, Valdir de Moura Brito Júnior, and Yasmim Antonino Costa Santos. 2025. "Reframing Botanical Blindness and Imperception Through Evolutionary Lenses." *Acta Botanica Brasilica* 39(e20240236):1–15. doi: 10.1590/1677-941X-ABB-2024-0236.

Amprazis, Alexandros, and Penelope Papadopoulou. 2018. "Primary School Curriculum Contributing to Plant

 | p-ISSN 1979-7281 | e-ISSN 2443-1281

Blindness: Assessment Through the Biodiversity Perspective." *Advances in Ecological and Environmental Research* 238–56.

Amprazis, Alexandros, Penelope Papadopoulou, and George Malandrakis. 2021. "Plant Blindness and Children's Recognition of Plants as Living Things: A Research in the Primary Schools Context." *Journal of Biological Education* 55(2):139–54. doi: 10.1080/00219266.2019.1667406.

Arif, Muhammad Fahmi Nur, Muhammad Fahmi Alamsyah, and Ateng Supriatna. 2023. "Inventarisasi Tumbuhan Famili Rosaceae Di Sekitar Kebun Biologi UIN Sunan Gunung Djati Bandung." *International Journal of Engineering, Economic, Social Politic and Government* 1(3):22–28.

Balas, Benjamin, and Jennifer L. Momsen. 2014. "Attention 'Blinks' Differently for Plants and Animals." *CBE Life Sciences Education* 13(3):437–43. doi: 10.1187/cbe.14-05-0080.

Balding, Mung, and Kathryn J. H. Williams. 2016. "Plant Blindness and the Implications for Plant Conservation." *Conservation Biology* 30(6):1192–99. doi: 10.1111/cobi.12738.

Bobo-Pinilla, Javier, Javier Marcos-Walias, Jaime Delgado Iglesias, and Roberto Reinoso Tapia. 2024. "Overcoming Plant Blindness: Are the Future Teachers Ready?" *Journal of Biological Education* 58(5):1466–80. doi: 10.1080/00219266.2023.2255197.

Borsos, Éva, Edita Borić, and Mária Patocskai. 2023. "What Can Be Done to Increase Future Teachers' Plant Knowledge?" *Journal of Biological Education* 57(2):252–62. doi: 10.1080/00219266.2021.1909632.

Brownlee, K. 2023. "An Analysis of Plant Awareness Disparity within Introductory Biology Textbook Images." *Journal of Biological Education* 57(2):422–31. doi: 10.1080/00219266.2021.1920301.

Brownlee, Kristi, Kathryn M. Parsley, and Jaime L. Sabel. 2023. "An Analysis of Plant Awareness Disparity within Introductory Biology Textbook Images." *Journal of Biological Education* 57(2):422–31. doi: 10.1080/00219266.2021.1920301.

Cahyanto, Tri, Muhammad Efendi, Ricky Mushoffa Shofara, Muna Dzakiyyah, Nurlaela, and Prima G. Satria. 2019. "Short Communication: Floristic Survey of Vascular Plant in the Submontane Forest of Mt. Burangrang Nature Reserve, West Java, Indonesia." *Biodiversitas* 20(8):2197–2205. doi: 10.13057/biodiv/d200813.

Caro, Tim, William L. Allen, and William L. Allen. 2017. "Interspecific Visual Signalling in Animals and Plants : A Functional Classification." *Philosophical Transactions of the Royal Society B: Biological Sciences* 372(1724). doi: 10.6084/m9.figshare.4299686.potentially .

Castillo-Huitrón, Nathalia M., Eduardo J. Naranjo, Dídac Santos-Fita, and Erin Estrada-Lugo. 2020. "The Importance of Human Emotions for Wildlife Conservation." *Frontiers in Psychology* 11(June):1–11. doi: 10.3389/fpsyg.2020.01277.

Craven, Dylan, Forest Isbell, Pete Manning, John Connolly, Helge Bruelheide, Anne Ebeling, Christiane Roscher, Jasper van Ruijven, Alexandra Weigelt, Brian Wilsey, Carl Beierkuhnlein, Enrica de Luca, John N. Griffin, Yann Hautier, Andy Hector, Anke Jentsch, Jürgen Kreyling, Vojtech Lanta, Michel Loreau, Sebastian T. Meyer, Akira S. Mori, Shahid Naeem, Cecilia Palmborg, H. Wayne Polley, Peter B. Reich, Bernhard Schmid, Alrun Siebenkäs, Eric Seabloom, Madhav P. Thakur, David Tilman, Anja Vogel, and Nico Eisenhauer. 2016. "Plant Diversity Effects on Grassland Productivity Are Robust to Both Nutrient Enrichment and Drought." *Philosophical Transactions of the Royal Society B: Biological Sciences* 371(1694). doi: 10.1098/rstb.2015.0277.

Creswell, John W., and Timothy C. Guetterman. 2019. "Educational Research : Planning, Conducting, and Evaluating Quantitative and Qualitative Research." Saddle River, New Jersey: Pearson Education, Inc.

Damayanti, Irma, Azis Nurbambang, and Tri Retnaningsih Soeprobowati. 2021. "Plant Diversity of Petungkriyono Forest of

Dieng Plateau, Central Java, Indonesia." *Biodiversitas* 22(8):3497–3507. doi: 10.13057/biodiv/d220849.

Dünser, Benno, Andrea Möller, Valentina Fondriest, Markus Boeckle, Peter Lampert, and Peter Pany. 2024. "Attitudes towards Plants–Exploring the Role of Plants' Ecosystem Services." *Journal of Biological Education* 00(00):1–15. doi: 10.1080/00219266.2024.2308293.

Fukano, Yuya, and Masashi Soga. 2021. "Why Do so Many Modern People Hate Insects? The Urbanization–Disgust Hypothesis." *Science of the Total Environment* 777:146229. doi: 10.1016/j.scitotenv.2021.146229.

Heryanto, R., T. Arlianti, S. Wahyuni, and S. Purwiyanti. 2023. "Observation and Morphological Character of Noni (Morinda Citrifolia L.) in Ciampea, Bogor Regency." *E3S Web of Conferences* 373:1–7. doi: 10.1051/e3sconf/202337303017.

Hiscock, Simon J., Paul Wilkin, Sarah Lennon, and Bennett Young. 2019. "Plants Matter: Introducing Plants, People, Planet." *Plants People Planet* 1(1):2–4. doi: 10.1002/ppp3.14.

Huang, Mengjiao, Peter B. Reich, Shaopeng Wang, Yanhao Feng, Pubin Hong, Kathryn E. Barry, Miao He, Shengman Lyu, Shurong Zhou, Neha Mohanbabu, Forest Isbell, and Yann Hautier. 2025. "Nitrogen and CO2 Enrichment Interact to Decrease Biodiversity Impact on Complementarity and Selection Effects." *Nature Communications* 16(1). doi: 10.1038/s41467-025-62691-0.

Iri, Funda Gül, and Emine Çil. 2020. "Attitudes Toward Plants: Comparing the Impact of Instruction through Writing & through a Botanical Garden Trip." *American Biology Teacher* 82(4):218–26. doi: 10.1525/abt.2020.82.4.218.

Isbell, Forest, Dylan Craven, John Connolly, Michel Loreau, Bernhard Schmid, Carl Beierkuhnlein, T. Martijn Bezemer, Catherine Bonin, Helge Bruelheide, Enrica De Luca, Anne Ebeling, John N. Griffin, Qinfeng Guo, Yann Hautier, Andy Hector, Anke Jentsch, Jürgen Kreyling, Vojtêch Lanta, Pete Manning, Sebastian T. Meyer, Akira S. Mori, Shahid Naeem, Pascal A. Niklaus, H. Wayne Polley, Peter B. Reich, Christiane Roscher, Eric W. Seabloom, Melinda D. Smith, Madhav P. Thakur, David Tilman, Benjamin F. Tracy, Wim H. Van Der Putten, Jasper Van Ruijven, Alexandra Weigelt, Wolfgang W. Weisser, Brian Wilsey, and Nico Eisenhauer. 2015. "Biodiversity Increases the Resistance of Ecosystem Productivity to Climate Extremes." *Nature* 526(7574):574–77. doi: 10.1038/nature15374.

Jose, Sarah B., Chih Hang Wu, and Sophien Kamoun. 2019. "Overcoming Plant Blindness in Science, Education, and Society." *Plants People Planet* 1(3):169–72. doi: 10.1002/ppp3.51.

Kastolani, Wanjat, Iwan Setiawan, Kusnadi, and Beta Paramita. 2018. "Vegetation Dispersion in Green Open Space of Universitas Pendidikan Indonesia." *International Journal of Engineering and Technology(UAE)* 7(3):67–70. doi: 10.14419/ijet.v7i3.32.18395.

Kletečki, Nataša, Dario Hruševar, Božena Mitić, and Andrej Šorgo. 2023. "Plants Are Not Boring, School Botany Is." *Education Sciences* 13(5). doi: 10.3390/educsci13050489.

Kubiatko, Milan, Jana Fančovičová, and Pavol Prokop. 2021. "Factual Knowledge of Students about Plants Is Associated with Attitudes and Interest in Botany." *International Journal of Science Education* 43(9):1426–40. doi: 10.1080/09500693.2021.1917790.

Leddon, Erin M., Sandra R. Waxman, and Douglas L. Medin. 2009. "Unmasking 'Alive:' Children's Appreciation of a Concept Linking All Living Things." *Journal of Cognition and Development* 9(4):461–73. doi: 10.1080/15248370802678463.Unmasking.

Link-Pérez, Melanie A., Vanessa H. Dollo, Kirk M. Weber, and Elisabeth E. Schussler. 2010. "What's in a Name: Differential Labelling of Plant and Animal Photographs in Two Nationally Syndicated Elementary Science Textbook Series." *International Journal of Science Education* 32(9):1227–42. doi: 10.1080/09500690903002818.

 | p-ISSN 1979-7281 | e-ISSN 2443-1281

Nairne, James S., Joshua E. VanArsdall, Josefa N. S. Pandeirada, Mindi Cogdill, and James M. LeBreton. 2013. "Adaptive Memory: The Mnemonic Value of Animacy." *Psychological Science* 24(10):2099–2105. doi: 10.1177/0956797613480803.

Nantawanit, Nantawan, Bhinyo Panijpan, and Pintip Ruenwongsa. 2012. "Promoting Students' Conceptual Understanding of Plant Defense Responses Using the Fighting Plant Learning Unit (Fplu)." *International Journal of Science and Mathematics Education* 10(4):827–64. doi: 10.1007/s10763-011-9297-9.

Niu, Yang, Hang Sun, and Martin Stevens. 2018. "Plant Camouflage: Ecology, Evolution, and Implications." *Trends in Ecology & Evolution* 33(8):608–18. doi: https://doi.org/10.1016/j.tree.2018.05.010 .

Nugroho Willyarto, Mario, and Carolina Fajar. 2021. "TNR to Minimize the Number of Stray Cats/Dogs Population in Indonesia." *ACM International Conference Proceeding Series* (December 2021):315–23. doi: 10.1145/3510309.3510358.

Nurhayati, Hanadian, and Wolff. 2025. "Share of Respondents in Indonesia Who Owned Pets as of June 2018 by Type of Pet." *Statista*. Retrieved September 1, 2025 (https://www.statista.com/statistics/974157/pet-owners-by-type-of-pet-indonesia/).

Panitsa, Maria, Nikolia Iliopoulou, and Emmanouil Petrakis. 2021. "Citizen Science, Plant Species, and Communities' Diversity and Conservation on a Mediterranean Biosphere Reserve." *Sustainability (Switzerland)* 13(17):1–11. doi: 10.3390/su13179925.

Pany, Peter, Florian D. Meier, Benno Dünser, Takuya Yanagida, Michael Kiehn, and Andrea Möller. 2024. "Measuring Students' Plant Awareness: A Prerequisite for Effective Botany Education." *Journal of Biological Education* 58(5):1103–16. doi: 10.1080/00219266.2022.2159491.

Parsley, Kathryn M. 2020. "Plant Awareness Disparity: A Case for Renaming Plant Blindness." *Plants People Planet* 2(6):598–601. doi: 10.1002/ppp3.10153.

Parsley, Kathryn M., Bernie J. Daigle, and Jaime L. Sabel. 2022. "Initial Development and Validation of the Plant Awareness Disparity Index." *CBE Life Sciences Education* 21(4):1–14. doi: 10.1187/cbe.20-12-0275.

Pedrera, O. 2024. "Do Textbooks Provide Opportunities to Develop Meaningful Botanical Literacy? A Case Study of the Scientific Model of Plant Nutrition." *Journal of Biological Education*. doi: 10.1080/00219266.2024.2365679.

Pedrera, Oier, Unai Ortega-Lasuen, Aritz Ruiz-González, José Ramón Díez, and Oihana Barrutia. 2023. "Branches of Plant Blindness and Their Relationship with Biodiversity Conceptualisation among Secondary Students." *Journal of Biological Education* 57(3):566–91. doi: 10.1080/00219266.2021.1933133.

Prokop, P. 2025. "Beauty Bias? Exploring the Influence of Attractiveness on Conservation Intentions for Plants and Their Pollinators." *Diversity* 17(1). doi: 10.3390/d17010071.

Prokop, Pavol, and Jana Fančovičová. 2023. "Enhancing Attention and Interest in Plants to Mitigate Plant Awareness Disparity." *Plants* 12(11):2201. doi: 10.3390/plants12112201.

Quijas, Sandra, Bernhard Schmid, and Patricia Balvanera. 2010. "Plant Diversity Enhances Provision of Ecosystem Services: A New Synthesis." *Basic and Applied Ecology* 11(7):582–93. doi: 10.1016/j.baae.2010.06.009.

da Silva, Nylber Augusto, Ângelo Giuseppe Chaves Alves, Ulysses Paulino de Albuquerque, and Marcelo Alves Ramos. 2024. "Dynamics of Knowledge and Use of Natural Resources in Expressions of Popular Culture in Northeast Brazil: Influence of Urbanization on Biocultural Heritage." *Environment, Development and Sustainability* 26(1):2385–2414. doi: 10.1007/s10668-022-02825-2.

Soga, Masashi, Maldwyn J. Evans, Takahiro Yamanoi, Yuya Fukano, Kazuaki Tsuchiya, Tomoyo F. Koyanagi, and Tadashi Kanai. 2020. "How Can We Mitigate against Increasing Biophobia among Children during the Extinction of Experience?" *Biological Conservation*

242(January):108420. doi: 10.1016/j.biocon.2020.108420.

Soraya, Puan Helwa Rezha, Mimin Nurjhani, and Rini Solihat. 2025. "Identification and Alternative Solutions to Plant Blindness in High School Students." *Assimilation: Indonesian Journal of Biology Education (AIJBE)* 8(1):29–40.

Staats, Sara, Heidi Wallace, and Tara Anderson. 2008. "Reasons for Companion Animal Guardianship (Pet Ownership) from Two Populations." *Society and Animals* 16(3):279–91. doi: 10.1163/156853008X323411.

Stagg, B. C. 2025. "Towards a Model of Plant Awareness in Education: A Literature Review and Framework Proposal." *International Journal of Science Education* 47(4):539–59. doi: 10.1080/09500693.2024.2342575.

Sun, Jing, Bo Liu, Himmah Rustiami, Huiyun Xiao, Xiaoli Shen, and Keping Ma. 2024. "Mapping Asia Plants: Plant Diversity and a Checklist of Vascular Plants in Indonesia." *Plants* 13(16). doi: 10.3390/plants13162281.

Supartono, Toto, Ilham Adhya, Dede Kosasih, and Willy Wildani. 2023. "Tree Species Diversity Adapted to Pinus Merkusii Forests in Gunung Ciremai National Park, West Java, Indonesia." *Biodiversitas* 24(8):4314–23. doi: 10.13057/biodiv/d240813.

Torres-Porras, J. 2024. "The Plant Blindness and the Humans-as-Non-Animals Bias Cycles in the Educational System. The Need to Overcome Them." *Journal of Biological Education*. doi: 10.1080/00219266.2024.2365668.

Torres-Porras, Jeronimo, Jose Joaquin Ramos-Miras, Francisca Castro, and Jorge Alcantara-Manzanares. 2025. "Favourite Animals, Plant Awareness, and the Forgotten Kingdom: Addressing Low Fungal Awareness." *Journal of Biological Education* 00(00):1–17. doi: 10.1080/00219266.2025.2523349.

Vanderstock, Amelie, Cecilia Grandi-Nagashiro, Gaku Kudo, Tanya Latty, Shoko Nakamura, Thomas E. White, and Masashi Soga. 2022. "For the Love of Insects: Gardening Grows Positive Emotions (Biophilia) towards Invertebrates." *Journal of Insect Conservation* 26(5):751–62. doi: 10.1007/s10841-022-00419-x.

Vydra, Marek, and Jozef Kováčik. 2025. "Teacher Characteristics Influencing Plant Biology Education : Age , Perception , and Practical Engagement." *Theoretical and Experimental Plant Physiology* 37(1):1–14. doi: 10.1007/s40626-024-00351-2.

Wandersee, James H., and Elisabeth E. Schussler. 1999. "Preventing Plant Blindness." *The American Biology Teacher* 61(2):82–86.

Wandersee, James H., and Elisabeth E. Schussler. 2001. "Toward a Theory of Plant Blindness." *Plant Science Bulletin* 47(1):2–9.

Zani, Giovanni, and Jason Low. 2022. "Botanical Priming Helps Overcome Plant Blindness on a Memory Task." *Journal of Environmental Psychology* 81:101808. doi: 10.1016/j.jenvp.2022.101808.

Zank, Sofia, Washington Soares Ferreira Júnior, Natalia Hanazaki, Monika Kujawska, Ana Haydeé Ladio, Maria Lucilene Martins Santos, Graziela Dias Blanco, and André Luiz Borba do Nascimento. 2022. "Local Ecological Knowledge and Resilience of Ethnomedical Systems in a Changing World – South American Perspectives." *Environmental Science and Policy* 135(May):117–27. doi: 10.1016/j.envsci.2022.04.018.

 | p-ISSN 1979-7281 | e-ISSN 2443-1281