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International Journal of Curriculum and Instruction 18(1) (2026) 25–44

IJCI
International Journal of Curriculum and Instruction

The Impact of the Contextual Teaching and Learning (CTL) Model on Plant Awareness and Cognitive Learning Outcomes of Seventh Grade Students in Plant Classification Material

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Abstract

This quantitative study aims to evaluate the extent to which the implementation of the Contextual Teaching and Learning (CTL) model influences seventh-grade students' level of plant awareness and cognitive learning outcomes on the topic of plant classification. A quasi-experimental design was employed, involving 60 students divided into two groups: an experimental group and a control group. The CTL model was applied to the experimental group, while the control group received conventional (lecture-based) instruction. Cognitive learning outcomes were measured using pre-tests and post-tests. A visual perception test, utilizing two stimulus images (one focusing on plants and the other on animals), was used to assess visual awareness of plants. The results showed that the CTL model significantly improved students' cognitive learning outcomes. Moreover, students in the experimental group demonstrated increased plant awareness, particularly in categorizing plants as living organisms and visually identifying plant parts. These findings suggest that the CTL model helps students connect scientific concepts to real-life experiences, thereby enhancing conceptual understanding and awareness of plants in their surroundings.

Keywords: *Plant awareness; Contextual Teaching and Learning (CTL); cognitive learning outcomes; plant classification.*

1. Introduction

A generation with a deep awareness of science and the environment is shaped in large part by education (Nugroho, 2022). Science education serves as a strategic discipline with a significant impact on enhancing students' understanding of the natural world and is

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crucial in developing their comprehension of fundamental scientific concepts (Nuai & Nurkamiden, 2022). Through science learning, students gain mastery of concepts relevant to everyday life, including biodiversity and the function of plants in ecosystems (Katili et al., 2021). However, a number of studies show that many students still encounter difficulties in grasping science content, especially when it comes to abstract concepts that are not easily understood directly (Andriyani & Suniasih, 2021; Indrawati & Nurpatri, 2022; Jundu et al., 2020).

One of the primary challenges contributing to students' low retention of science content is the one-way teaching method, where traditional lecturing remains the dominant approach in knowledge delivery. Mindey (2024) highlights that, despite numerous professional development opportunities on student-centered learning, many teachers still rely on less participatory teaching strategies. Across various educational institutions, lectures and storytelling are still the mainstays of instruction, with limited adoption of student-centered approaches. Zakirman et al. (2019) further demonstrate that the dominance of the lecture method in science education is largely due to its perceived effectiveness, practicality, and flexibility, often at the expense of more interactive teaching strategies. Consequently, students' learning outcomes tend to remain low, particularly in cognitive aspects—ranging from recalling (remember) and understanding basic information (understand), applying knowledge (apply), analyzing concepts (analyze), making logical evaluations (evaluate), to creatively designing scientific ideas (create) (Rao, 2020).

In interviews with a science educator at a junior high school in Malang City, Indonesia, it was revealed that one of the most challenging topics in science education is plant classification. This topic focuses on categorizing plants based on specific characteristics, such as morphology, anatomy, and physiology, requiring students to recognize and comprehend the diverse traits of various plant species (Sandepogu & Somineni, 2024). However, in practice, students' understanding of the existence and diversity of plants is often limited (Suriyabutr & Yasri, 2023). This issue is associated with the phenomenon of Plant Awareness Disparity (PAD), which refers to individuals' tendency to overlook or undervalue the presence of plants in their surroundings (Parsley et al., 2022). This concept replaces the earlier notion of Plant Blindness, introduced by Wandersee & Schussler (1999, 2001), which described the inability to recognize or give attention to plants (Parsley, 2020).

Over recent years, there has been growing concern regarding the diminishing ability of students to accurately recognize and identify organisms. Previous studies have confirmed that this issue is more pronounced with plants than with animals. For instance, Batke et al. (2020) conducted an experiment with 88 students to assess whether they could recall more animal images than plant images during a sequence test. The findings showed that students' ability to remember animal images was significantly higher than that of plants. Similarly, a study conducted in Hulu Gurung District by Putriani et al. (2023) found that students' understanding of plants, particularly local vegetables, was alarmingly low. The result of the study showed a significant lack of plant awareness, with local high school and junior high school students scoring only 15% and 4%, respectively. Moreover, Pany et al. (2022) noted that students often fail to recognize plants as living organisms, perceiving animals as more representative of living beings.

The low levels of plant awareness in education are believed to improve through experience-based learning, such as laboratory investigations and outdoor learning activities (Stagg et al., 2024; Stroud et al., 2022). To enhance students' understanding of plants and increase their awareness, the Contextual Teaching and Learning (CTL) model emerges as a promising solution. Emphasizing active participation, CTL enables students to engage directly with the content, helping them connect academic concepts to real-life contexts. In the context of plant classification, the implementation of CTL includes seven essential components: constructing knowledge through constructivism, encouraging discovery through inquiry, fostering curiosity through questioning, creating a learning community, providing concrete examples through modelling, facilitating reflection to evaluate understanding, and employing authentic assessment to assess students' abilities (Hamid et al., 2024).

While numerous studies have highlighted low plant awareness and the dominance of lecture-based teaching in science education (Mindey, 2024; Zakirman et al., 2019), limited research has specifically investigated how the CTL model can enhance students' plant awareness. Most previous studies have only addressed students' differing perceptions of animals and plants without exploring effective teaching strategies to bridge this gap (Batke et al., 2020; Putriani et al., 2023). By investigating how the application of the CTL model enhances plant awareness and cognitive learning results in plant classification, this study aims to close this gap.

In addition to measuring cognitive understanding, this study also assesses students' visual perception of plants and their categorization of plants as living organisms, in line with the updated concept of plant awareness proposed by Pany et al. (2022). This concept includes four key components: visual perception, categorization of plants as living beings, knowledge, and attitudes toward plants. This study adopts this theoretical framework to investigate the effectiveness of CTL in enhancing plant awareness and students' understanding of plants.

2. Method

2.1. Research Design

With a quasi-experimental Nonequivalent (Pretest and Posttest) Control Group Design, this study uses a descriptive quantitative methodology. This approach was chosen because it enables the researcher to measure the changes that take place before and after the therapy while comparing the efficacy of the treatment on two groups that were not randomly selected (Creswell, 2023). The two groups involved in this design are the experimental group, which receives learning experiences through the implementation of the CTL model, and the control group, which follows conventional learning using the lecture method. As an initial step, both groups undergo a pre-test to assess their baseline abilities. After the treatment is administered, a post-test is conducted to examine the impact of the treatment on students' plant awareness and cognitive learning outcomes in the plant classification material.

Table 1. Research Design

Group	**Pre-test**	**Treatment (X)**	**Post-test**
Experimental	O_1	X	O_2
Control	O_1	-	O_2

(Creswell, 2023)

Note :

O_1 : Pre-test given to both the experimental and control groups

X : Treatment with the CTL model

O_2 : Post-test given to both the experimental and control groups

2.2. Population and Sample

The population in this study consists of seventh-grade students in the second semester of a public junior high school in Malang City, East Java, Indonesia. From this demographic, 60 pupils were chosen as a sample and split into two groups: Class VII A, which served as the control group, and Class VII B, which served as the experimental group. While the experimental group is taught using the CTL model, the control group's students are instructed using the traditional lecture-based method.

2.3. Variables and Research Hypotheses

The independent variable and the dependent variable are the two primary variables under investigation in this study. The dependent variables that are observed are students' levels of plant awareness and cognitive learning outcomes, while the independent variable is the CTL model.

The hypotheses proposed are as follows:

H_o1: Students in the experimental and control groups did not significantly differ in their pre-test and post-test scores on learning outcomes and plant awareness.

H_11: Students in the experimental and control groups' pre-test and post-test scores on learning outcomes and plant awareness levels differ significantly.

H_o2: The experimental and control groups' levels of visual plant awareness do not differ significantly.

H_12: The experimental and control groups' degrees of visual plant awareness differ significantly from one another.

2.4. Research Procedures

The implementation of this research consists of two main meetings and one follow-up stage. During the two main meetings, the CTL learning model is applied as the primary approach in the experimental group, while students in the control group receive conventional learning. This learning implementation aims to examine its impact on students' cognitive learning outcomes and plant awareness levels based on three indicators: (1) categorizing plants as living organisms, (2) knowledge about plants, and (3) visual perception of plants (Pany et al., 2022). The stages of the research activities can be seen in Table 2.

In the follow-up stage, students are given a visual plant perception test one month after the post-test, with the aim of assessing long-term retention of students' awareness of plants formed during the learning process. The selection of a one-month gap is based on the long-term memory theory in cognitive psychology, which supports this approach. This theory states that evaluation after a certain delay can provide a more accurate picture of how well information is retained and internalized into students' knowledge structures more permanently (Doolittle & Byrnes, 2024; Pashler et al., 2006; Rabbit, 1992).

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(a)

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(b)

Figure 1. Visual Perseption Test (a) Animal-focused Image (b) Plant-focused Image

The test consists of the question, “Describe what you see in the image?” Two images are displayed with different focus compositions. The first image shows an animal as the main object in focus, while the plant is less focused (Figure 1a). In contrast, the second image focuses on the plant as the main object, while the animal is less clear (Figure 1b). This approach refers to the study by Sanders, Nyberg, and Brkovic (2024),who used images with plants as the focus object, while the animal was less clear. The goal is to explore how students perceive the presence of both. Additionally, a similar approach was applied by Jose et al. (2019), but with the opposite visual composition, where the animal was the main focus, and the surrounding plants appeared less visible. By adapting both approaches, this test is designed to examine how students visually perceive the presence of plants compared to animals, which generally attract more visual attention.

Table 2. Research Implementation Stages

Session	Activity	CTL Components	Plant Awareness Indicators
Session 1	Pre-test (10 questions on categorizing plants as living organisms, 12 questions on plant knowledge)	-	• Categorizing plants as living organisms • Knowledge about plants
	Observation of objects in the surroundings to build initial concepts	Construktivisme	-
	Engaging with images and videos to examine the defining characteristics of living organisms	Modelling	-
	Formulating questions related to living and non-living things	Questioning	-
	Conducting a seed germination experiment to demonstrate that plants are living organisms	Inquiry, Learning Community	Categorizing plants as living organisms
	Observing seedling growth over a period of five days and recording the results in student worksheets	Inquiry	Categorizing plants as living organisms
Session 2	Identifying types of plants and analyzing the characteristics of roots, stems, and leaves	Inquiry	Knowledge about plants
	Classifying plants based on similarities in morphological characteristics	Learning Community	Knowledge about plants
	Presenting discussion outcomes and reflecting on the learning process	Learning Community, Reflection	-
	Post-test	Authentic Assessment	• Categorizing plants as living organisms • Knowledge about plants
Follow-up Stage	Conducting a visual perception test of plants (one month after the post-test)	-	Visual perception of plants

2.5. Research Instruments

The research instruments consist of cognitive learning outcome tests on plant classification material and a visual perception test on plants. The detailed indicators for each instrument are presented in Table 3.

Table 3. Research Instruments

No	Dependent Variable	Instruments	Type	Indicators
1.	Cognitive learning outcomes on plant classification material (categorizing plants as living organisms and knowledge about plants)	Pre-test Post-test	22 multiple-choice questions	• Remembering • Understanding • Applying • Analyzing • Evaluating
2.	Plant Awareness	Plant Visual Perception Test	Short-answer Test	Visual perception of plants

Prior to their implementation in the main study, the instructional instruments underwent expert validation through three evaluation tools: a learning instrument validation questionnaire, a content validity questionnaire, and a pre-test/post-test item validation checklist. This validation aimed to ensure not only the relevance of the instruments to the research objectives but also their feasibility for classroom implementation. The feasibility of the instruments was evaluated using percentage analysis, based on expert judgments applying both a 4-point Likert scale and the Guttman scale with binary "true" or "false" options (Widodo et al., 2023).

Following the feasibility validation, the instruments were further examined for validity and reliability using a sample of 30 seventh-grade students who had previously studied the topic of plant classification. Item validity was analyzed using the Pearson Product Moment correlation formula, where an item was considered valid if $r\ hitung > r\ tabel$ (Widodo et al., 2023). Out of the 30 test items, 22 were deemed valid and subsequently used in the main study. Reliability testing was conducted using Cronbach's Alpha, with an acceptable reliability threshold of $r\ \alpha > 0.70$ (Budiastuti & Bandur, 2018). The results showed that the 22 validated test items achieved a Cronbach's Alpha coefficient of $r\ \alpha =$ 0.904, indicating high internal consistency and confirming the reliability of the pre-test and post-test instruments for research use.

2.6. Data Analysis Techniques

The data analysis in this study was conducted using two software packages: IBM SPSS Statistics 25 and Microsoft Excel. IBM SPSS Statistics 25 was employed to analyze sample equivalence and students' cognitive learning outcomes, while Microsoft Excel was used to process and categorize the data related to plant awareness..

2.6.1. Sample Equivalence Analysis

Students' pre-test results were used in a sample equivalence analysis to verify the initial equivalence of the experimental and control groups. A homogeneity of variance test, conducted using Levene's Test for Equality of Variances, showed that the two groups had homogeneous variances (Levene's Statistic = 0.249, p = 0.620; $p > 0.05$). This result indicates that there was no significant difference between the pre-test scores of the two groups. Therefore, Class VII A and Class VII B were assigned as the control and experimental groups, respectively, as both demonstrated comparable initial characteristics suitable for comparative analysis in this study.

2.6.2. Analysis of Students' Cognitive Learning Outcomes

Several methods were employed to analyze the students' cognitive learning outcomes. The Shapiro-Wilk test, appropriate for sample sizes of fewer than 50 participants, was applied to assess the normality of the data distribution. The results showed that the pre-test data in the control group did not follow a normal distribution. Consequently, a non-parametric approach using the Wilcoxon test was adopted to examine the differences between the experimental and control groups. The significance value (p) obtained from SPSS was used in the analysis, with differences considered statistically significant if $p < 0.05$, and not significant if $p > 0.05$.

The effectiveness of the CTL model was also assessed using the N-Gain score, which was calculated by comparing the students' pre-test and post-test scores to the maximum possible score. Table 4 presents the criteria for interpreting the N-Gain index.

$$\boldsymbol{N - Gain = \frac{Post\ test\ Score - Pre\ test\ Score}{Ideal\ Score - Pre\ test\ Score}}$$

(Hake, 1999)

Table 4. Criteria for N-Gain Index Interpretation

N-Gain Value	Criteria
$0.70 \leq g \leq 1.00$	High
$0.30 \leq g < 0.70$	Medium
$0.00 < g < 0.30$	Low
$g = 0.00$	No improvement
$-1.00 \leq g < 0.00$	Decline

(Hake, 1999; Sukarelawan et al., 2024)

2.6.3. Analysis of Visual Perception of Plants (Plant Awareness)

The analysis of students' visual perception of plants adopted the procedure developed by Sanders, Nyberg, and Brkovic (2024). Each student's response was coded according to the presence of specific categories. If a student's answer included a particular category, it was marked as "present" (x), and if not, it was marked as "absent" (0). The coding process was conducted in two stages. In the first stage, students' answers were categorized based on their level of specificity. For instance, if a student mentioned specific examples such as "mango" or "rice," the response was classified under the category of naming plant species, in accordance with the categories shown in Table 5. In the second stage, these categories were grouped more broadly. For example, all mentions of plants or plant parts were classified as "Plant-Related Responses," whereas mentions of animals were categorized as "Animal-Related Responses".

Table 5. Student Response Categories for Visual Perception of Plants

Level	Category
0	The student did not mention any plant-related elements or only mentioned animals.
1	The student explicitly mentioned the word "plant."
2	The student referred to plants in general categories such as tree, grass, etc.
3	The student mentioned a specific plant species or a specific part of a plant.

(Sanders et al., 2024)

3. Results and Discussion

This study aimed to investigate the effect of the Contextual Teaching and Learning (CTL) approach on seventh-grade students' plant awareness and cognitive achievement in learning about plant classification. This research is based on the assumption that the contextual approach can strengthen the connection between scientific concepts and students' real-life experiences, as stated by Hamid et al. (2024), suggesting that this approach has the potential to enhance both conceptual understanding and awareness of plants.

3.1. Students' Cognitive Learning Outcomes

To evaluate the effectiveness of the instructional approach, statistical analysis was performed on the pre-test and post-test scores from both groups. Prior to further analysis, a normality test was performed. The results indicated that the pre-test data in the control group did not satisfy the assumption of normality ($p < 0.05$). In contrast, the post-test data for both groups did ($p > 0.05$). Therefore, the Wilcoxon test was applied as an appropriate non-parametric method to examine the differences in scores between the two groups.

Subsequently, the mean assessment scores for each group were analyzed. These data are presented in Table 6.

Table 6. Results of the Pre-test and Post-test

Group	**Mean (± SD)**		***p-value***
	Pre-test	**Post-test**	
Control	66.4 (± 12.9)	74.9 (± 9.4)	$p < 0.001$
Experimental	62.9 (± 13.2)	83.8 (± 9.3)	$p < 0.001$

The mean values in Table 6 indicate a gap in learning performance between the two groups. The group that received the treatment exhibited considerable improvement in performance compared to the control group. Specifically, the control group recorded a pre-test mean of 66.4 (± 12.9), which increased to 74.9 (± 9.4) in the post-test. In contrast, although participants who received the treatment began with a slightly lower pre-test mean of 62.9 (± 13.2), their post-test scores increased more significantly to 83.8 (± 9.3) following the implementation of the CTL model. This greater improvement in scores among learners exposed to the treatment indicates a more effective acquisition of knowledge resulting from the applied approach. In addition, the outcomes of the Wilcoxon test revealed a p-value of less than 0.001 for both cohorts, demonstrating a statistically significant difference between the initial and final assessments within each instructional group— both the one engaged with the CTL model and the one receiving conventional methods. Although both groups exhibited significant improvement, the magnitude of the gain differed. According to the N-Gain calculation, the group exposed to the treatment reached a score of 0.56, categorized as medium, while the control group obtained only 0.24, categorized as low.

The findings in this study indicate that the CTL model is more effective than conventional teaching in enhancing students' cognitive achievement on plant classification. This conclusion is reinforced by the notable rise in mean scores observed before and after the implementation of the model. Furthermore, the N-Gain analysis shows that the group receiving CTL instruction experienced a medium level of improvement, while the group receiving conventional instruction only showed low improvement. These findings offer empirical evidence supporting the claim that students' cognitive learning outcomes differ significantly depending on the instructional approach—specifically, between those who experienced the CTL strategy and those who received conventional methods. In other words, the CTL approach proves to be more effective in deepening students' comprehension of plant classification concepts.

Theoretically, these findings align with the constructivist concept proposed by Piaget (1972), which suggests that learning, when focused on active involvement through authentic experiences in real contexts, deepens conceptual understanding and increases student participation throughout the learning process (Erawati & Adnyana, 2024; Sumarna & Gunawan, 2022). The CTL model enables students to connect plant classification concepts with their real-life experiences, such as planting green beans and observing plants visually. This is consistent with research by Aningsih & Shalecha (2023) and Afni & Lufri (2019), which states that learning models designed as experience-based approaches facilitate active student participation in meaningful learning processes, promoting long-term retention and deepening conceptual understanding, particularly in the field of natural science. It also supports the view of Amirnudin & Saleh (2020) that experience-based learning activities can foster the construction of new knowledge through the integration of experience and reflection.

Additionally, the study's findings show that using the CTL model in plant classification instruction contributes to strengthening students' understanding of concepts that were previously abstract and difficult to grasp through conventional approaches. By directly engaging in observation and grouping plants based on morphological characteristics, students can more easily understand the basic principles of classification. This is in line with the study by Sandepogu & Somineni (2024), which states that observing morphological characteristics forms the basis of plant taxonomy, enabling students to effectively categorize plants. Rajamanickam et al. (2023) also emphasize that morphological characterization aids in understanding classification principles. This approach allows students to build a deeper understanding because they are not merely memorizing plant characteristics but also understanding the logical structure behind their classification.

3.2. Plant Awareness Indicators-Based Cognitive Learning Outcomes

The Plant Awareness analysis comprises three indicators: recognizing plants as living organisms, plant-related knowledge, and visual perception. The outcomes for the first two cognitive aspects are shown in Figures 2 and 3.

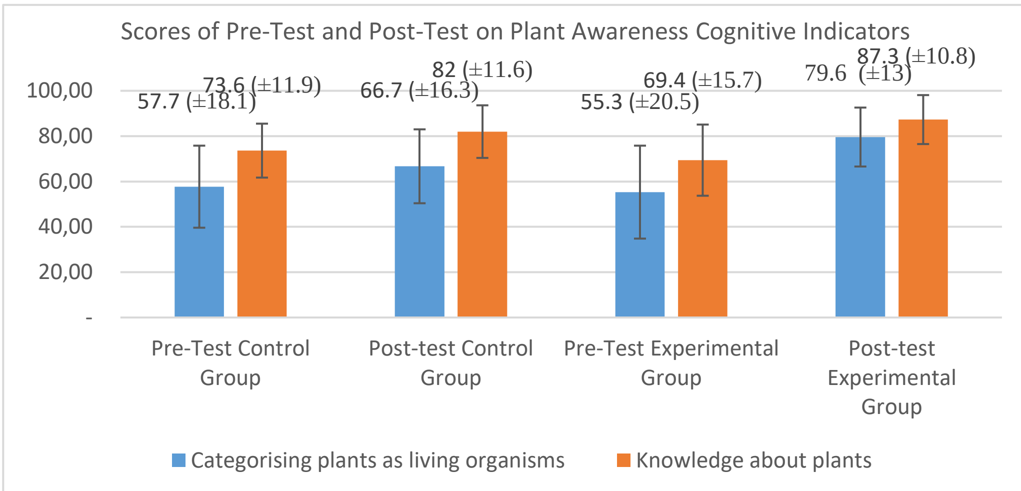

Figure 2. Graph of Mean Scores on the Plant Awareness Indicator Before and After the Treatment (error bars represent the standard deviation for each group, n = 30 for both the control and experimental groups)

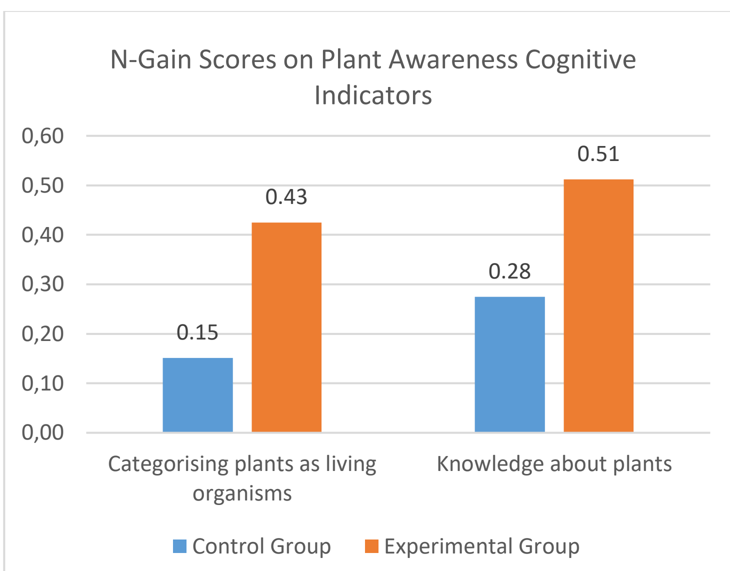

Figure 3. Graph Comparing N-Gain Scores for the Plant Awareness Indicator

For the indicator of categorizing plants as living organisms, the mean pre-test score for the experimental group was 55.3 (±20.5), which increased to 79.6 (±13) in the post-test. The control group's mean increased from 57.7 (±18.1) to 66.7 (±16.3) after the learning activity. The N-Gain analysis in Figure 3 shows that participants who received the treatment attained a score of 0.43, categorized as medium, while the control group scored 0.15, which is considered low. These results indicate that students' understanding of categorizing plants as living beings appeared to be more developed in the group that received CTL instruction, compared to the group that received conventional instruction. This improvement indicates that the CTL model provides students with the opportunity to connect theoretical concepts with real-world scientific phenomena, thus strengthening their understanding that plants are living organisms, not just background visuals or static objects. In line with the findings of Montero & Geducos (2022), the real-world context presented in the lessons helps students develop cognitive understanding of plants as living organisms that grow, develop, and respond to their environment. When students engage in activities like planting and observing, they begin to view plants not only as a visual background but as living organisms with important ecological roles (Pany et al., 2022; Ratnasari et al., 2024).

The second indicator, knowledge about plants, also demonstrates a similar improvement pattern. As shown in Figure 2, the treatment group's mean score increased from 69.4 (±15.7) before the treatment to 87.3 (±10.3) afterward. On the other hand, the control group increased from 73.6 (±11.9) to 82 (±11.6). The N-Gain analysis in Figure 3 shows that the experimental group scored 0.51, categorized as moderate, while the control group scored only 0.28, which is considered low. These results indicate that students in the treatment group showed higher post-test scores and achieved a medium level of N-Gain, whereas those in the control group remained within the low category. These findings are consistent with previous research by Montero & Geducos (2022), which showed that contextual learning is more effective in improving science content mastery compared to conventional methods, as it encourages exploration, observation, and reflection on experiences.

3.3. Visual Perception of Plants

The third indicator plant awareness, visual perception of plants, was analyzed using two images with different visual focuses: one focused on animal elements and the other on plants.

3.3.1. Students' Plant Visual Perception in Animal-Focused Images

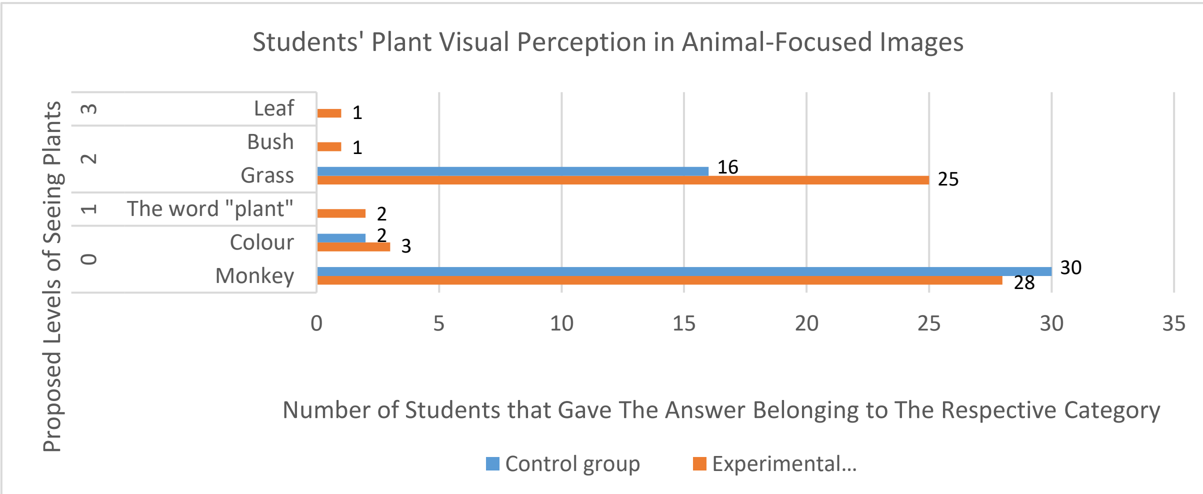

Figure 4. Number of studens giving responses in each category for the animal-focused image. Orange bars represent the experimental group dan blue bars represent the control group. Categories are grouped according to the proposed levels of seeing plants (0-3) in Table 5.

The distribution of students' responses across various levels of plant visual perception for Figure 1a is presented in Figure 4. In the image with a stronger focus on animals, nearly all students identified "monkey" as the primary element visible, about 93% of participants in the treatment group and all participants in the control group mentioned plant elements. However, a notable difference was observed in the mention of plant elements between the two groups.

Within the treatment group, 7% of students specifically identified "plant" at Level 1, whereas this was not observed among students in the control group. For Level 2, broad categories like "grass" were cited by 83% of students receiving the treatment, compared to 53% in the control group. Furthermore, "bush" was mentioned by 3% of the treatment group but was not noted by any students in the control group. References to particular plant parts (Level 3), such as "leaf," were also more frequent in the treatment group, with 3% mentioning it, while none did so in the control group.

In the animal-focused image, the majority of students in both groups focused on the main object, the monkey. However, those who received the CTL-based instruction continued to exhibit greater attentiveness to the presence of plant-related elements. This suggests that human visual attention tends to naturally focus more on animals than on plants, as explained by Balas & Momsen (2014) regarding plant blindness. Students who received the CTL model were able to develop a more holistic ecological mindset, where attention to plants remained present even when plants were not the main focus (Nyberg et al., 2021).

3.3.2. Students' Plant Visual Perception in Plant-Focused Image

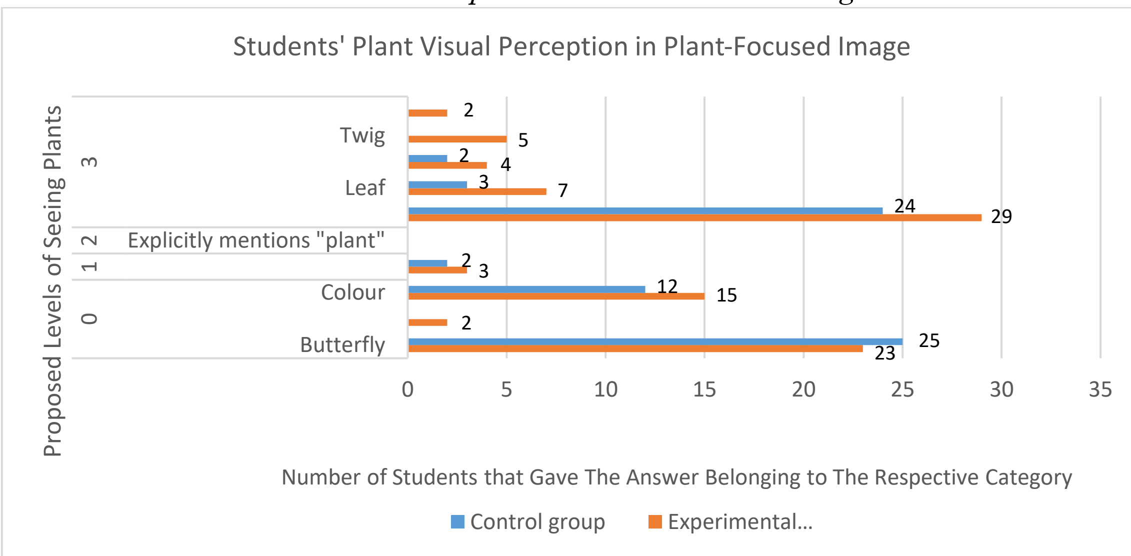

Figure 5. Number of students giving responses in each category for the plant-focused image.

The distribution of students' responses across various levels of plant visual perception for Figure 1b is displayed in Figure 5. Analysis of the students' answers revealed that in the plant-focused image, most students still noted animal elements, such as butterflies. (77% of students in the treatment group and 83% in the comparison group). Nonetheless, there were marked differences in how these elements were identified between the two groups.

Among students who received the treatment, 10% explicitly mentioned "plant" (Level 1), while only 7% of students in the comparison group did the same. General plant categories such as "grass," were not mentioned in student responses related to visual perception of Image 1b. On the other hand, more students in the treatment group referred to specific plant structures (Level 3) than their counterparts. For instance, “flower” was mentioned by 97% of students who received the treatment, as opposed to 80% of those in the comparison group. Similarly, "leaf" appeared in the responses of 23% of students in the treatment group, whereas only 10% in the comparison group referred to it. Other plant parts, including "stem," "twig," and "stalk", were also mentioned more —indicating that students in the experimental group had a stronger tendency to identify specific plant structures. Although the animal element (butterfly) was still mentioned by most students, the proportion of mentions of plant elements, particularly at Level 3, which details specific plant parts, was more dominant in the CTL group compared to the others. These findings suggest that highlighting plant elements in visual presentations enhances students' visual perception, a key aspect of plant awareness (Pany et al., 2022; Parsley, 2020). This result aligns with Stagg and Dillon (2022) findings that context-based education enhances student sensitivity to plant features in complex visual scenes.

Students who identified plant elements indicated that they began to position plants not merely as backgrounds but as crucial components of the environment, reflecting an increase in plant awareness. These findings also support Feldman's (2003) idea that objects observed not only form visual perception but also prompt students to process and categorize those objects in their minds (Sanders et al., 2024). This also reinforces the finding that plant awareness is not a binary condition but consists of various levels of perception and attention that can be developed through experiential learning (Pany et al., 2022; Sanders et al., 2024; Stagg et al., 2024).

Although this study shows the effectiveness of the CTL approach in enhancing plant awareness in both cognitive and visual perception realms, it should be noted that the indicators used for plant awareness were limited to three aspects. Affective and behavioral aspects, such as attitudes toward plant conservation and involvement in environmental protection actions, were not comprehensively analyzed. This limitation is based on the consideration that the material on plant classification and the learning objectives used in this study did not explicitly support the measurement of these aspects, both in terms of content and established learning outcomes. Therefore, future research is recommended to accommodate measurements that include attitude and ecological behavior aspects to offer a more complete insight into the effects of the CTL learning model on overall plant awareness

4. Conclusions

Based on the research findings, it can be inferred that applying the Contextual Teaching and Learning (CTL) model positively influences the enhancement of plant awareness and cognitive achievement among seventh-grade students studying plant classification. This effectiveness is demonstrated by the higher post-test results and moderate N-Gain scores shown by the group taught using the CTL approach compared to those taught with conventional methods. Moreover, students who received the CTL approach in learning showed improvement in their ability to categorize plants as living organisms and recognize plant parts visually. This success is closely related to students' active involvement in hands-on activities, such as planting and observing plants, which provide concrete experiences in understanding the concepts. Such activities help bridge theoretical knowledge with real-world contexts while fostering awareness of plants. Further research is recommended to integrate affective and behavioral aspects into plant awareness, such as attitudes toward conservation and engagement in environmental protection, to ensure a more comprehensive measurement of plant awareness across all dimensions.

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