Biocaster : Jurnal Kajian Biologi
E-ISSN 2808-277X; P-ISSN 2808-3598
Volume 6, Issue 3, July 2026; Page, 1726-1740
Email: biocasterjournal@gmail.com

THE EFFECT OF COCONUT WATER ON THE GROWTH OF *Aloe vera* PLANTS AS A SOURCE OF BIOLOGY LEARNING

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Submit: 27-05-2026; Revised: 14-06-2026; Accepted: 15-06-2026; Published: 27-07-2026

ABSTRACT: Contextual biology learning requires locally based learning resources that are easy to apply in research activities. One local resource is coconut water, which contains nutrients and natural growth hormones to support plant growth. This study aims to determine the effect of coconut water on the growth of *Aloe vera* plants and to identify the optimal concentrations of coconut water for different growth parameters, as a locally based biology learning resource. The method used was a completely randomized experimental design with five coconut water concentration treatments (20%, 40%, 60%, 80%, and 100%) and five replicates per treatment. The growth parameters observed included the number of leaves, leaf height, and root length over a four-week period. The data were analysed using ANOVA and Duncan's post hoc test at the 5% significance level. The results showed that coconut water significantly affected *Aloe vera* growth ($p < 0,05$). The 80% concentration produced the highest number of leaves (5,35 leaves), the 100% concentration produced the highest leaf height (11.50 cm), and the 60% concentration produced the greatest root length (3.95 cm). These findings indicate that different growth parameters responded optimally to different coconut water concentrations**.** These findings suggest that coconut water can serve as an affordable, locally available resource for biology education, enabling students to conduct experimental investigations into plant growth while developing skills in observation, measurement, data analysis, and scientific reasoning.

Keywords: *Aloe vera*, Biology Learning Resources, Coconut Water.

How to Cite: Magfiroh, S. L., & Cintamulya, I. (2026). The Effect of Coconut Water on the Growth of *Aloe vera* Plants as a Source of Biology Learning. *Biocaster : Jurnal Kajian Biologi, 6*(3), 1726-1740. https://doi.org/10.36312/biocaster.v6i3.1417

INTRODUCTION

Biology education plays a vital role in helping students understand living organisms and natural phenomena through scientific inquiry (Lestari et al., 2025). In line with 21st-century learning requirements, biology education is expected to employ contextual and inquiry-based approaches that encourage students to actively construct knowledge through observation, experimentation, and investigation (Umbunan et al., 2025). Such learning experiences enable students to connect biological concepts to real-life contexts while developing scientific literacy, critical thinking skills, problem-solving abilities, and scientific process skills (Parisu et al., 2025; Safnowandi & Efendi, 2025).

One strategy for implementing contextual biology education is to use local biological resources as learning materials. Using resources available in the students' immediate environment can provide authentic learning experiences and make

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biological concepts more meaningful and relevant (Wulandari & M, 2025). Additionally, local resources can serve as simple, readily accessible objects for scientific investigation, allowing students to observe biological phenomena directly in their daily lives (Ramadhani et al., 2025).

Aloe vera is a tropical plant with potential for development as a food crop in Indonesia, as well as for medicinal and industrial purposes (Susylowati & Rahmaniah, 2023). In addition, *Aloe vera* is widely cultivated, readily available, and exhibits observable growth responses, making it suitable as an object for biology learning investigations. *Aloe vera* is a perennial succulent plant that is drought-resistant (Wijaya & Masfufatun, 2022). Optimal *Aloe vera* growth requires attention to soil fertility and nutrient availability to improve plant production quality. One way to achieve this is to apply organic fertiliser derived from coconut water, which has high nutritional content to enhance *Aloe vera* growth.

Coconut water is rich in nutrients that support plant growth. One component of coconut water is nitrogen (Purwasita & Soeparjono, 2022). It also contains minerals and phytohormones such as cytokinin, auxin, and gibberellin, which support plant metabolism (Ariyanti et al., 2018). The hormone content of coconut water plays an important role in root growth and shoot formation (Yustisia et al., 2019). These characteristics make coconut water a potential natural growth enhancer for *Aloe vera* cultivation. Furthermore, the interaction between coconut water and Aloe vera growth represents an observable biological phenomenon that can be utilized in biology learning activities and scientific investigations.

However, the use of local biological resources in biology education remains suboptimal. Many biology learning activities and laboratory exercises still rely on pre-determined laboratory materials and learning objects, thereby limiting students' opportunities to explore the biological resources available in their local environment (Andarias et al., 2022; Nursidin et al., 2022). Consequently, students have fewer opportunities to conduct authentic scientific investigations based on local resources and to connect biological concepts with real-life experiences in their daily lives.

Learning resources are various materials used in learning activities to facilitate the delivery and understanding of material, including textbooks, print and electronic media, environmental resources, and so on, available in the learning environment to help optimise learning outcomes (Ikhsan et al., 2017). Learning in the independent curriculum requires teachers to think critically and creatively in the teaching process (Ledia et al., 2024). However, teachers have not yet optimised creative learning methods, so student engagement and motivation in learning remain low (Dewi & Astuti, 2022).

Therefore, teachers can invite students to learn biology by using the surrounding environment and observing the growth of *Aloe vera* when given coconut water. Using the environment as a learning aid and resource can improve the quality of the learning process (Rasiman et al., 2020). Learning with an environmental approach is a process in which students acquire knowledge and understanding through their own observations of objects in their surrounding environment (Sukawati, 2020).

Various studies show that the environment can serve as a source of biology learning through observation, interviews, field exploration, and technology and

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interactive media (Alifiyah et al., 2024; Andres et al., 2025; GH, 2024; Lamasai et al., 2017; Rahmawati, 2020). Other studies have reported the potential of coconut water as a natural plant growth regulator due to its phytohormone content and have demonstrated its positive effects on plant growth.

However, these studies generally focused either on environmental-based learning resources or on plant growth experiments separately. As a result, there is limited research integrating local biological resources, particularly *Aloe vera* and coconut water, into authentic biology research activities that can also serve as contextual learning resources. Furthermore, information regarding the most effective concentration of coconut water for *Aloe vera* growth remains limited.

To address these gaps, this study investigates the effects of different coconut water concentrations on *Aloe vera* growth and identifies the most effective concentration for several growth parameters. The findings are then utilized as a biology learning resource based on local potential. Therefore, the novelty of this study lies in integrating an experiment on the effects of coconut water on *Aloe vera* growth with the development of biology learning resources based on local potential, while also evaluating a wider range of coconut water concentrations to determine the most effective concentration for *Aloe vera* growth.

Thus, the research questions are as follows: 1) how does coconut water affect the growth of *Aloe vera* as a source of biology learning?; and 2) what are the optimal coconut water concentrations for different *Aloe vera* growth parameters?. The objectives of this study are to determine the effect of coconut water on the growth of *Aloe vera* as an alternative source of biology learning, and to identify the optimal coconut water concentrations for different *Aloe vera* growth parameters.

METHODS

This study was conducted in the greenhouse of PGRI Ronggolawe University using a completely randomised design (CRD). This study included 5 treatments with 5 replicates. The treatments were carried out at concentrations of 20%, 40%, 60%, 80%, and 100%. The number of replicates was determined using the replication calculation formula, namely the Federer formula, as specified by Indratama & Yenita (2019), as follows:

$$(t-1)\,(n-1) \geq 15$$

Description:
n = Number of repetitions; and
t = Number of treatments.

$$(t-1)\,(n-1) \geq 15$$
$$(5-1)\,(n-1) \geq 15$$
$$(4)\,(n-1) \geq 15$$
$$4n - 4 \geq 15$$
$$4n \geq 15 + 4$$
$$4n \geq 19$$
$$n \geq 19/4$$
$$n \geq 4{,}75$$
$$n \geq 5$$

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Based on the calculated number of repetitions, 5 were performed per treatment, yielding 25 experimental units. The treatments consisted of different concentrations of coconut water prepared using distilled water as a diluent, namely: P1 = 20% coconut water + 80% distilled water, P2 = 40% coconut water + 60% distilled water, P3 = 60% coconut water + 40% distilled water, P4 = 80% coconut water + 20% distilled water, and P5 = 100% coconut water. The experiment was designed to compare the relative effectiveness of different coconut water concentrations; therefore, a control treatment (0% coconut water) was not included.

Each experimental unit contained 2 *Aloe vera* seedlings, bringing the total number of *Aloe vera* plants used in this study to 50. Each polybag containing two *Aloe vera* seedlings was treated as a single experimental unit, and measurements from the two plants were averaged before statistical analysis. The following is the research design for the placement of polybags using a Completely Randomized Design (CRD).

1. P_3t_1	2. P_1t_1	3. P_5t_5	4. P_2t_3	5. P_4t_1
6. P_2t_2	7. P_4t_2	8. P_3t_2	9. P_1t_2	10. P_5t_3
11. P_1t_3	12. P_2t_1	13. P_5t_2	14. P_4t_3	15. P_3t_4
16. P_5t_4	17. P_2t_5	18. P_1t_4	19. P_3t_5	20. P_4t_4
21. P_4t_5	22. P_3t_3	23. P_5t_1	24. P_1t_5	25. P_2t_4

Figure 1. Research Design.

Description:
P1-5 = Treatment;
t1-5 = Repeat;
1-25 = Experiment number;
Orange = Treatment 2;
Blue = Treatment 1;
Pink = Treatment 4;
Green = Treatment 3; and
Grey = Treatment 5.

The population in this study comprised all *Aloe vera* plants available in plant shops, and the sample comprised 50 *Aloe vera* seedlings purchased from a nursery. The devices and materials used in this study are listed in Tables 1 and 2.

Table 1. Research Tools.

No.	Tool Name	Quantity	Specifications
1	Polybag	25	Size 25 x 25 cm
2	Watering Tool	1	Size 100 ml
3	Ruler	1	30 cm
4	Measuring Cup	1	100 ml
6	Camera	1	Android
7	Work Tools	1	-

Table 2. Research Materials.

No.	Material Name	Quantity	Specifications
1	*Aloe vera* Plants	50 seedlings	Height +- 10 cm, with 4 leaves
2	Coconut Water	24.000 ml	Mature coconut water
3	Aquades	16.000 ml	Aquades
4	Soil	12 kg	Red Mediterranean soil

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No.	Material Name	Quantity	Specifications
5	Compost	6 kg	Organic humus
6	Labels	25	Size 5x5 cm

This research procedure includes several steps, namely: 1) preparing the tools and materials used in the research; 2) making a growing medium with 1 polybag containing 2 *Aloe vera* seedlings, with a total of 25 polybags; 3) preparing coconut water solutions according to the treatment concentrations using distilled water as a diluent; 4) watering the *Aloe vera* plants four times a week on days 1, 3, 5, and 7 in the morning for four weeks; 5) applying 100 mL of the respective treatment solution to each experimental unit during every watering event; 6) maintaining all experimental units under similar greenhouse conditions with natural daylight exposure throughout the study; and 7) observing plant growth weekly for four weeks by measuring leaf number, leaf height, and root length; and finally documenting the growth of *Aloe vera* plants during the study. The observed parameters included leaf number, leaf height, and root length, which were measured and recorded weekly for four weeks. The data were analysed using ANOVA, and if the treatment effect was significant or highly significant Additional tests were performed using the Duncan Multiple Range Test (DMRT) with a significance level of 5%.

RESULTS AND DISCUSSION

The research data are presented in Tables 3–5, which contain the average numbers of leaves, leaf length, and root length for *Aloe vera* plants. The data were obtained from observations during weeks 1-4 to analyse the effect of coconut water on plant growth.

Table 3. Average Number of Leaves Affected by Coconut Water on *Aloe vera* Plants Weeks 1-4.

Coconut Water Concentration (%)	Week				Average
	1	2	3	4	
20 %	4	4.2	4.8	5.4	4.6
40 %	4	4.2	4.4	4.8	4.35
60 %	4	4.8	5	5.4	4.8
80 %	4	5	5.4	7	5.35
100 %	4	4.6	5.2	5.8	4.9
Average	4	4.56	4.96	5.68	4.8

Table 4. Average Leaf Height (cm) Results of the Effect of Coconut Water on *Aloe vera* Plants Weeks 1 to 4.

Coconut Water Concentration (%)	Week				Average
	1	2	3	4	
20 %	10.22	10.36	10.54	10.7	10.45
40 %	10.26	10.46	10.74	10.52	10.49
60 %	10.22	10.6	11.12	11.32	10.81
80 %	10.28	10.44	11.44	11.54	10.92
100 %	10.24	11.26	11.9	12.62	11.50
Average	10.24	10.62	11.14	11.34	10.83

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Table 5. Average Root Length (cm): Results of the Effect of Coconut Water on *Aloe vera* Plants from Week 1 to Week 4

Coconut Water Concentration (%)	Week				Average
	1	2	3	4	
20 %	0.2	0.2	0.3	0.9	0.4
40 %	1	1.2	1.5	2.2	1.47
60 %	2.9	3.4	4.4	5.1	3.95
80 %	1.5	1.9	2.6	3.1	2.27
100 %	1.5	2.14	2.24	3.26	2.28
Average	1.42	1.76	2.21	2.91	2.07

The results of data analysis on the influence of coconut water on the growth of *Aloe vera*, with observation parameters of number of leaves (Table 6), leaf height (Table 8), and root length (Table 10), are as follows.

Table 6. Results of ANOVA Analysis of the Number of Leaves Affected by Coconut Water on *Aloe vera* Plants in Weeks 1-4.

Number of Leaves	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	2.935	4	.734	9.623	<.001
Within Groups	1.525	20	.076		
Total	4.460	24			

The ANOVA test results show that this treatment has a significant effect on the number of leaves, with a p-value of 0.001 (p<0,05). This indicates a significant difference in the number of leaves between treatments, so that it can proceed to the DMRT test. DMRT test results in Table 7 are as follows.

Table 7. DMRT Test Results for *Aloe vera* Leaf Counts in Weeks 1-4.

Treatment	N	Subset for Alpha = 0.05		
		1	2	3
P2	5	4.3000		
P1	5	4.6500	4.6500	
P3	5		4.7500	
P5	5		4.9000	
P4	5			5.3500
Sig		.059	.190	1.000

The DMRT test results showed that P2 and P1 were not significantly different because they belonged to the same homogeneous subset. Treatments P1, P3, and P5 were also not significantly different because they fell within the same subset. Meanwhile, P4 formed a separate subset, indicating a significant difference from the other treatments.

Table 8. Results of ANOVA Analysis of *Aloe vera* Plant Height Watered with Coconut Water in Weeks 1-4.

Plant Height	Sum of Squares	Df	Mean Square	F	Sig
Between Groups	2.977	4	.744	99.220	<.001
Within Groups	.150	20	.008		
Total	3.127	24			

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The ANOVA results show that the treatment has a significant effect on leaf height, with a p-value of 0.001 ($p < 0.05$). This indicates a significant difference in the number of leaves between treatments, allowing us to proceed with the DMRT test. The DMRT test results are shown in Table 9.

Table 9. Results of DMRT Test on *Aloe vera* Leaf Height in Weeks 1-4.

Treatment	N	Subset for Alpha = 0.05			
		1	2	3	4
P1	5	10.4520			
P2	5		10.7420		
P3	5		10.8120	10.8120	
P4	5			10.9220	
P5	5				11.5020
Sig		1.000	.212	.056	1.000

The DMRT results showed that P1 produced the lowest average leaf height, whereas P5 produced the highest average leaf height. Treatments P2 and P3 were not significantly different because they belonged to the same homogeneous subset. Likewise, P3 and P4 were not significantly different because they shared an overlapping subset. Treatment P5 produced the highest mean leaf height. Although intermediate treatments showed overlapping DMRT groupings, the overall trend indicates that increasing coconut water concentration was associated with greater leaf elongation in *Aloe vera*.

Table 10. Results of ANOVA Analysis of *Aloe vera* Root Length Watered with Coconut Water in Weeks 1-4.

Root Length	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	33.860	4	8.465	300.452	<.001
Within Groups	.563	20	.028		
Total	34.423	24			

The ANOVA results show that the treatment has a significant effect on plant root length, with a p-value of 0.001 ($p<0.05$). This indicates differences in root length between the treatments, allowing it to be continued to the DMRT test. DMRT test results (Table 11).

Table 11. Results of DMRT Test on *Aloe vera* Root Length Weeks 1-4.

Treatment	N	Subset for Alpha = 0.05			
		1	2	3	4
P1	5	.3960			
P2	5		1.4780		
P4	5			2.2700	
P5	5			2.2820	
P3	5				3.9500
Sig.		1.000	1.000	.911	1.000

The DMRT test results showed that P1 had the lowest root length and formed a separate subset. Treatment P2 also formed its own subset. Treatments P4 and P5 were grouped in the same subset, indicating no significant difference between them.

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Meanwhile, P3 formed a separate subset with the highest root length, indicating significant differences from the other treatments.

Number of Leaves

Based on Table 3, the average number of *Aloe vera* leaves observed over four weeks shows differences in growth responses across treatments. In Table 6, the ANOVA results for the average number of *Aloe vera* leaves over 4 weeks show that treatment with coconut water has a significant effect on leaf number ($p<0,05$). Based on the results of the DMRT follow-up test (Table 7), there were significant differences between treatments. Treatment P4 (80% coconut water concentration produced the highest number of leaves and was significantly different from the other treatments. This result suggests that an 80% coconut water concentration provides an optimal balance of nutrients and growth-promoting substances required for leaf development. Coconut water contains natural plant growth regulators, particularly cytokinins, auxins, and gibberellins, which can stimulate cell division and leaf initiation. At this concentration, nutrient availability may be sufficient to support active growth without causing physiological stress, making it the most effective treatment for promoting leaf production in *Aloe vera*.

The increase in leaf number is associated with the cytokinin content in coconut water, which stimulates cell division and leaf tissue differentiation. Cytokinin increases shoot meristem activity, thereby accelerating leaf formation (Saepudin et al., 2020). An 80% concentration is the most suitable for plants because the available hormones are readily absorbed. Conversely, increasing the concentration to 100% no longer significantly increases the number of leaves. This indicates that plants have a limit to their ability to absorb dissolved substances. Excessively high concentrations can cause osmotic pressure, thereby inhibiting water and nutrient absorption by the roots. This is consistent with the findings of Simbolon et al. (2024), who reported that coconut water application affects mustard plant leaf growth at the appropriate concentration. Similar results have been reported by Prabawa et al. (2020), who found that 80% coconut water had the greatest effect on the germination of expired pagoda mustard. This indicates that coconut water contains effective growth regulators and nutrients when administered at the appropriate concentration.

Leaf Height

Based on Table 4, leaf height observations for *Aloe vera* over 4 weeks showed differences in growth response among treatments. In Table 8, the results of the ANOVA test on the average leaf height of *Aloe vera* during four weeks of observation showed that the coconut water treatment had a significant effect on plant leaf height ($p<0,05$). The DMRT results (Table 9) indicated that coconut water concentration significantly influenced *Aloe vera* leaf height, with the highest growth response observed in treatment P5. This finding suggests that higher coconut water concentrations may provide sufficient nutrients and natural growth regulators to support vegetative growth. The increase in *Aloe vera* leaf height can be influenced by the nutrient content and growth regulators in coconut water (Fauzi, 2021). Coconut water is known to contain potassium, which plays an important role in regulating cell turgor pressure, enzyme activation, and the transport of photosynthesis products. Potassium plays an important role in maintaining cell

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turgor pressure, enzyme activation, and assimilate transport, thereby supporting cell elongation and leaf growth (Fauzi, 2021; Ningsi et al., 2022). In addition, Coconut water contains natural growth hormones, namely cytokinin and auxin, which play roles in cell division and elongation. The presence of these growth hormones is thought to increase metabolic activity and plant tissue growth, which in turn leads to increased leaf height (Ariyanti et al., 2018). These conditions indicate that the availability of nutrients and growth hormones in coconut water can work synergistically to support plant vegetative growth.

Root Length

Based on Table 5, the average root length of *Aloe vera* over four weeks shows differences in growth response across treatments. Based on Table 10, the results of the ANOVA analysis of the average root length of *Aloe vera* over four weeks of observation show that the coconut water treatment has a significant effect on plant root length ($p<0,05$). Based on Table 11, there were differences in the root growth response of *Aloe vera* between treatments. Treatment P3 had the greatest effect on root length among the treatments. Treatments P4 and P5 did not differ significantly from each other, but both differed significantly from P1 and P2. Treatment P1 produced the lowest root growth, indicating that it was less effective at supporting root system development. This study indicates that 60% coconut water is the most effective concentration for stimulating root growth. Conversely, increasing the concentration above the optimum level tends to reduce root growth. This indicates that there is an optimal concentration limit, beyond which excessive coconut water can reduce root growth response.

Optimal root growth at a concentration of 60% is thought to be related to the auxin content in coconut water, which plays an important role in root formation and elongation. Auxin stimulates cell elongation and the formation of lateral root tissues, thereby promoting root development (Ariyanti et al., 2020). Coconut water is known to contain natural auxin, which can stimulate root initiation and growth (Nasution et al. 2024 & Nurmaulana et al. 2025). However, when the concentration of coconut water is increased to 80% (P4) and 100% (P5), root length tends to decrease. This may indicate a shift in resource allocation toward shoot development rather than root growth. Nevertheless, because biomass allocation was not directly measured in this study, this interpretation should be considered tentative and requires further investigation. These findings are consistent with those of Prabawa et al. (2020), who reported that a 30% coconut water concentration was the most effective treatment for promoting root and stem growth in candlenut plants.

Overall, *Aloe vera* growth showed a biphasic response to coconut water application at different concentrations. Low to moderate concentrations stimulated plant growth, whereas higher concentrations did not provide additional growth benefits. The highest number of leaves was obtained at the 80% concentration, leaf height increased optimally at 100%, and root length showed the best response at 60%. These results indicate that each growth parameter responds differently to the bioactive compounds present in coconut water. The observed differences among growth parameters indicate that the bioactive compounds present in coconut water influenced *Aloe vera* growth in different ways depending on the concentration applied (Kirani & Herawati, 2025; Santosa *et al.*, 2025).

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The variation in optimal concentrations suggests that shoot and root growth have different physiological requirements. The increase in leaf number and leaf height may be associated with cytokinin-induced cell division and auxin-mediated cell elongation, while enhanced root growth may result from auxin activity in root initiation and development. These findings demonstrate that coconut water can influence various aspects of *Aloe vera* growth, depending on the concentration applied, as reflected in the distinct optimal concentrations observed for leaf number, leaf height, and root length. The observed pattern supports the biphasic response theory, which states that a substance can stimulate growth at appropriate concentrations but may become less effective or inhibitory when the concentration exceeds the plant's physiological tolerance limit (Erofeeva, 2023). Similar responses have been reported in studies using coconut water as a natural growth promoter, where moderate concentrations enhanced vegetative growth more effectively than excessive concentrations (Kirani & Herawati, 2025). Therefore, coconut water can function as an effective natural growth stimulant for *Aloe vera* when applied at suitable concentrations.

From an educational perspective, this study can serve as a contextual resource for biology learning, particularly for topics related to plant growth, development, and plant hormones. Through direct observation of *Aloe vera* growth under different coconut water concentrations, students can connect theoretical concepts with real biological phenomena. The concept of plant hormones can be learned through resources available in the surrounding environment, enabling students to relate theoretical knowledge to observable biological processes (Kirani & Herawati, 2025; Ramadhani et al., 2025).

In addition, learning activities based on this research can support the development of scientific process skills. Students can participate in observation, measurement, data recording, and data analysis activities, allowing them to gain direct experience in scientific investigation. Such experiences help students understand how biological knowledge is generated through evidence-based inquiry (Azalia & Oktaviani, 2024; Sudirman et al., 2025).

Furthermore, research-based learning can improve students' biological literacy and critical thinking skills. Discussion and interpretation of experimental findings encourage students to explain biological phenomena scientifically and draw conclusions based on evidence. Learning that utilizes environmental resources has also been shown to enhance conceptual understanding because biological concepts are directly connected to everyday experiences (Ashlan & Firayani, 2025; Atikah & Haryanto, 2025; Triani et al., 2023; Yuhanna & Retno, 2025).

Practically, the findings indicate that coconut water has potential as an inexpensive, environmentally friendly, and readily available natural growth regulator for *Aloe vera* cultivation. Its utilization may reduce dependence on synthetic growth regulators while supporting sustainable plant cultivation practices. The use of locally available materials demonstrates how biological concepts can be applied in everyday life while promoting the use of local potential as an educational resource (Andarias et al., 2022; Wulandari & Djukri, 2021).

One limitation of this study is the absence of a control treatment (0% coconut water). The experimental design focused on evaluating the relative effects

of different coconut water concentrations on *Aloe vera* growth rather than comparing treated plants with untreated controls. Consequently, the findings demonstrate differences across coconut water concentrations but do not permit a direct assessment of the absolute growth-promoting effect of coconut water under normal growing conditions. Nevertheless, the study successfully identified concentration-dependent responses and the optimal concentrations for several growth parameters. Future studies should include a control treatment (0% coconut water) to provide a more comprehensive evaluation of coconut water's effectiveness as a natural plant growth regulator.

CONCLUSION

Based on the results of this study, coconut water significantly affected the growth of *Aloe vera* plants. The 80% coconut water concentration produced the highest number of leaves, the 100% concentration resulted in the greatest leaf height, and the 60% concentration generated the longest root length. These findings indicate that *Aloe vera* exhibits different optimum growth responses depending on the concentration of coconut water applied. The observed effects are likely associated with the nutrients and natural plant growth regulators present in coconut water, as reported in previous studies. In addition, this study demonstrates that *Aloe vera* and coconut water can be utilized as contextual biology learning resources, providing students with direct experience in observation, measurement, data analysis, and scientific inquiry. Therefore, integrating local biological resources into experimental activities can support meaningful learning, strengthen conceptual understanding, and enhance science process skills.

RECOMMENDATION

Future research is recommended to investigate longer growth periods and additional physiological parameters to understand better the mechanisms underlying plant responses to coconut water application. Furthermore, the learning resources developed could be made more interactive and innovative to enhance pupils' interest and understanding in biology lessons.

ACKNOWLEDGEMENTS

The author would like to thank everyone who assisted in conducting this research, enabling it to proceed smoothly and successfully.

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