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Enhancing Prospective English Teachers' Reading Skills with Eco-ELT: An Ecoliteracy-Based Learning Model Integrated with Metacognitive Skills

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ABSTRACT

Incorporating an ecoliteracy-based learning model within ELT also provides opportunities to promote ecological health through reading activities. By engaging with texts that explore environmental themes, learners can develop a nuanced understanding of ecological challenges and their broader societal implications. Therefore, this study aims to investigate the efficacy of the ecoliteracy-based learning model integrated with metacognitive skills in improving prospective English teachers' reading skills. This study employed a mixed method with an explanatory sequential design. 63 prospective English teachers are involved and share a similar level of language proficiency, ensuring uniformity in their academic background. The data are collected using reading tests, metacognitive tests, and interviews and the instruments are stated as valid and reliable instruments before used. Based on the data analysis, the findings showed that the ecoliteracy-based learning model integrated with metacognitive skills has a significant effect on learners' reading skills about environmental sustainability issues. Due to this, learners have positive responses to the implementation of ecoliteracy-based learning model integrated with metacognitive skills. This study underscores the transformative potential of ecoliteracy-based learning in enhancing language education. By integrating ecological principles with metacognitive skill development, the ecoliteracy-based learning model not only improves learners' reading comprehension and linguistic abilities but also fosters a deeper awareness of environmental issues.

Keywords: Ecoliteracy; Eco-ELT; Metacognitive Skills; Prospective English Teachers; Reading Comprehensions; Sustainability Education

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1. Introduction

Eco-ELT, which refers to the study and teaching of environmental sustainability issues in English language teaching and learning^[1], underscores the critical role of English language teaching (ELT) in addressing sustainability issues^[2,3]. This perspective posits that ELT holds a unique responsibility and potential to engage with and promote awareness of ecological challenges, fostering a more environmentally conscious mindset among learners. By integrating discussions of environmental sustainability into ELT, educators can align their teaching practices with broader global imperatives, such as the Sustainable Development Goals (SDGs)^[4]. One approach to achieving this is through genre-based pedagogy that focuses on ecoliteracy texts addressing topics like climate change, forest conservation, and water, sanitation, and hygiene (WASH) management issues. Prospective English teachers can explore diverse reading texts centered on these themes, enriching their understanding of ecological challenges while simultaneously developing their language skills.

An ecoliteracy-based learning model is a pedagogical framework specifically designed to cultivate an understanding of the interconnectedness between ecological systems and human behavior. It seeks to foster sustainability, environmental awareness, and holistic thinking among learners^[5]. This approach not only equips learners with knowledge about ecological principles but also encourages them to adopt environmentally responsible and sustainable practices^[6]. It is not done yet by English educators with combined eco-ELT and a lack of quasy-experimental evidence. By integrating ecological principles into ELT practices, the model promotes a mindset that values sustainability as a fundamental aspect of daily life and decision-making. Within the context of ELT, this model can be operationalized by exploring texts that discuss the interdependence of natural and human-made systems, gaining insights into topics such as resource conservation^[7], biodiversity, and waste reduction^[1]. These activities are not merely theoretical; they encourage learners to practice sustainable habits such as minimizing waste, conserving energy, and supporting biodiversity initiatives.

Incorporating an ecoliteracy-based learning model within ELT also provides opportunities to promote ecological health through reading activities. It is in line with Xiong^[8]

who informs that by engaging with texts that explore environmental themes, learners can develop a nuanced understanding of ecological challenges and their broader societal implications. For example, reading activities can be designed to encourage students to reflect on how climate change impacts global ecosystems or how deforestation threatens biodiversity. Such texts not only enhance linguistic competencies but also foster critical thinking and ethical reflection, encouraging students to consider their role in promoting sustainability^[9]. This dual focus on language development and ecological awareness ensures that prospective English teachers are well-prepared to address both academic and real-world challenges.

Reading skills are indispensable for prospective English teachers as they form the foundation for effective language instruction. Proficiency in reading enables teachers to understand main ideas, identify supporting details, and make inferences, which are critical for comprehending complex texts^[10]. These skills are particularly important in the context of ecoliteracy, where texts often present multifaceted ecological themes and arguments. By analyzing such texts, learners can develop the ability to think critically, evaluate bias, perspective, and the validity of sustainability-related arguments. This analytical approach enables learners to engage with texts on a deeper level, fostering an understanding of how ecological themes connect to broader social and environmental contexts^[11].

In an ecoliteracy learning context, prospective English teachers are not only trained to comprehend ecological themes but also to evaluate the arguments and evidence presented within texts. This ability to critically evaluate information is particularly valuable in a world where misinformation about ecological issues is prevalent^[12]. By fostering critical reading skills, the ecoliteracy-based learning model ensures that prospective English teachers can guide their future students in becoming informed and responsible global citizens. Integrating ecoliteracy into reading instruction for prospective English teachers involves fostering an awareness of environmental issues, sustainability, and interconnectedness within the context of language and literature^[13]. This approach enhances reading proficiency while simultaneously cultivating critical thinking, ethical reflection, and environmental responsibility^[14]. Moreover, this integration encourages students to consider how linguistic

choices shape perceptions of environmental issues, providing valuable insights into the role of language in promoting sustainability.

The success of reading skills and comprehension is significantly influenced by learners' ability to regulate their own thinking processes while reading^[15]. Metacognitive skills, which involve the awareness and regulation of one's cognitive processes, are therefore essential in this context. By integrating metacognitive skills into reading instruction, educators can enhance learners' ability to understand, analyze, and retain textual information^[16]. There is a lack of experimental evidence in metacognitive training in prospective teachers on reading subscales. Metacognition empowers learners to become active and self-regulated readers, capable of navigating complex texts with confidence. Research has shown that metacognitive awareness helps learners recognize their cognitive processes, enabling them to identify when a text is difficult and adjust their reading strategies accordingly^[15,17,18]. For instance, a learner might slow down their reading pace when encountering unfamiliar vocabulary or use contextual clues to infer the meaning of challenging passages.

Metacognitive skills also enable learners to actively control their cognitive processes by setting goals for reading, monitoring their understanding while reading, and reviewing key points after reading^[19]. These strategies are particularly valuable in the context of ecoliteracy, where texts often present complex and multifaceted information. Such strategies not only enhance comprehension but also foster a sense of autonomy and self-efficacy, empowering learners to take ownership of their learning. Due to this, by integrating metacognitive skills into reading instruction, educators can help them develop a deeper understanding of ecological themes and their broader implications^[20]. This reflective approach also promotes critical thinking, as learners are encouraged to evaluate the validity and reliability of the information they encounter. Moreover, metacognitive strategies can be tailored to individual learners' needs, ensuring that all students, regardless of their initial proficiency levels, can benefit from ecoliteracy-based instruction.

The integration of ecoliteracy and metacognitive skills into reading instruction for prospective English teachers represents a powerful approach to addressing both linguistic and ecological challenges. By fostering an awareness of

environmental issues and promoting critical thinking, ethical reflection, and self-regulated learning, this approach equips learners with the skills and knowledge needed to navigate an increasingly complex and interconnected world. The novelty of the study lies in the integration of ELT practices with global sustainability goals in reading activities and the ecoliteracy-based learning model offers a compelling framework for cultivating environmentally conscious and linguistically proficient teachers. Through thoughtful implementation and ongoing refinement, this model has the potential to transform ELT into a powerful tool for promoting ecological health and sustainability.

2. Materials and Methods

This study employed a mixed-method approach using an explanatory sequential design^[21]. In this approach, researchers first collect and analyze quantitative data, followed by a qualitative phase to strengthen and contextualize the quantitative findings. The study begins with quantitative data collection using an experimental design, aimed at determining the efficacy of the ecoliteracy-based learning model on learners' reading skills. This phase addresses the research question concerning the effect of the ecoliteracy-based learning model integrated with metacognitive skills. The quantitative data include learners' reading achievement scores, metacognitive scores, and results from t-test analyses. Following the quantitative phase, the qualitative data collection focuses on learners' responses, opinions, feelings, and perceptions regarding the implementation of the ecoliteracy-based learning model. This qualitative phase is designed to answer the second research question, which explores learners' responses to the ecoliteracy-based learning model. Together, the quantitative and qualitative phases provide a comprehensive understanding of the model's impact.

The research participants comprised 63 prospective English teachers enrolled in the English Language Education Study Program at Mandalika University of Education. This group included 21 males and 25 females, all of whom were in their fourth semester and currently taking reading comprehension courses. The participants were aged between 22 and 23 years and shared a similar level of language proficiency, ensuring uniformity in their academic background. Participants were selected based on specific criteria, including

their availability, willingness to participate, relevant characteristics, and expertise aligned with the study objectives. Ethical considerations were carefully upheld throughout the research process. Researchers obtained informed consent, ensuring that participants were fully aware of the study's purposes, procedures, potential risks, and anticipated benefits. Confidentiality was strictly maintained, with researchers safeguarding participants' personal information and ensuring their data was used solely for the purposes of the study, promoting trust and ethical integrity.

The study collected both quantitative and qualitative data to ensure a comprehensive analysis. Quantitative data were gathered using reading tests and metacognitive tests. The instruments were validated for their content validity, construct validity and reliability, ensuring they met the necessary academic standards. Reading tests were administered to learners enrolled in reading comprehension courses during pre-test and post-test sessions. In the experimental class, learners were taught using the ecoliteracy-based learning model, while the control class was instructed using an alternative, selected learning model. Metacognitive tests were distributed to both groups after the final treatment to evaluate the learners' levels of metacognitive skills. These tests provided insights into how the ecoliteracy-based approach influenced their cognitive awareness. On the other hand, qualitative data were collected through structured interviews. Researchers used interview guidelines and questions to explore participants' responses and perceptions of the ecoliteracy-based learning model integrated with metacognitive skills.

The data in this study were analyzed using both quantitative and qualitative methods to provide a comprehensive understanding of the findings. Quantitative data analysis was conducted through statistical techniques, including both descriptive and inferential statistics. Descriptive statistical analysis was employed to summarize and describe learners' reading and metacognitive scores, providing an overview of their performance. Inferential statistical analysis, specifically t-tests and ANOVA, was utilized to examine differences and relationships between variables^[22,23]. The t-test was used to determine whether there were significant differences in the outcomes between the experimental group, taught using the ecoliteracy-based learning model integrated with metacognitive skills, and the control group, which followed the selected

learning model. ANOVA analysis was conducted to explore the interaction effects between the ecoliteracy-based learning model and metacognitive skills, particularly in their combined influence on learners' reading skills. A critical assumption for performing these statistical analyses was ensuring a normal distribution of the data, as this is a prerequisite for their validity. The hypothesis of the study was tested against a significance level of 0.05, with the hypothesis being accepted if the significance value exceeded the p-value. This rigorous approach ensured that the findings were statistically reliable and provided clear insights into the efficacy of the learning models under investigation.

3. Results

3.1. Prospective English Teachers' Reading and Metacognitive Achievement

The implementation of the ecoliteracy-based learning model is designed to improve learners' reading skills in the English language education study program. In enhancing learners' reading skills, metacognitive skills have a potential impact on influencing reading skills. Reading skills in this study refer to comprehension skills, critical thinking and analysis, inferencing and interpretation, and vocabulary and conceptual knowledge. **Table 1** presents the learners' reading skills after treatment using the ecoliteracy-based learning model.

Table 1 presents the data of learners' reading achievement from experimental and control classes, which are different both in the pretest and post-test. Prospective English teachers' reading mean scores in pretest have the same level before subjecting to any learning activities, with 70.53 in the experimental class and 70.70 in the control class. Meanwhile, in the post-test, learners who are treated using the ecoliteracy-based learning model have greater reading achievement (82.25) than those who are treated using the elected learning model (80.48). While both groups showed improvement, the experimental group demonstrated a greater increase in mean scores, suggesting that the ecoliteracy-based learning model had a more pronounced effect on enhancing reading skills. Additionally, the relatively stable standard deviation in both groups indicates that the interventions were effective across diverse learners within each group.

Descriptive Statistics						
Reading Classes	N	Minimum	Maximum	Sum	Mean	Std. Deviation
Experimental (Pretest)	32	56.00	80.00	2257.00	70.5313	4.45757
Experimental (Posttest)	32	75.00	90.00	2632.00	82.2500	4.86594
Control class (Pretest)	31	56.00	78.00	2192.00	70.7097	4.19677
Control Class (Posttest)	31	65.00	90.00	2495.00	80.4839	6.23362

one's cognitive processes while engaging with texts. These skills enable readers to think critically about how they comprehend, interpret, and respond to written material. **Table 2** presents the learners' metacognitive skills in reading.

Descriptive Statistics					
	N	Minimum	Maximum	Mean	Std. Deviation
Metacognitive skills in the experimental class	32	65.00	90.00	80.3125	5.73297
Metacognitive skills in the control class	31	70.00	90.00	79.7097	6.03983

the ecoliteracy-based learning model may have contributed positively to fostering metacognitive awareness. The similar ranges and standard deviations in both classes reflect a comparable distribution of metacognitive abilities, although the experimental approach may have offered marginal benefits in enhancing learners' skills. This highlights the potential of integrating ecoliteracy with metacognitive strategies in promoting self-regulated learning.

The efficacy of ecoliteracy-based learning model integrated with metacognitive skills was proven by using t-test and ANOVA analysis. The following **Table 3** presents the result of t-test analysis which shows the ecoliteracy-based learning model integrated with metacognitive skills has a positive effect on learners' reading skills for English language education study program.

		Independent Samples Test						
Reading Achievement		t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
							Lower	Upper
Reading Posttest Score	Equal variances assumed	2.825	61	0.006	4.386	1.553	1.281	7.491
Reading Posttest Score	Equal variances not assumed	2.813	56.290	0.007	4.386	1.559	1.263	7.509

Table 3 shows that the Sig. (2-tailed) values from the independent samples test indicate the significance of the difference in reading posttest scores between the experimental and control groups. When equal variances are assumed, the Sig. (2-tailed) value is 0.006, which is well below the conventional significance threshold of 0.05. Similarly, when equal variances are not assumed, the Sig. (2-tailed) value is 0.007, also below the threshold. These results confirm that the difference in reading posttest scores between the groups is statistically significant. This indicates that the experimen-

tal group, which experienced the ecoliteracy-based learning model, outperformed the control group by an average of 4.386 points, and this improvement is unlikely due to chance. The consistent significance across both variance assumptions reinforces the robustness of these results, highlighting the effectiveness of the ecoliteracy-based learning approach in improving learners' reading skills. In addition, there is a strong interaction between the ecoliteracy-based learning model and the metacognitive level in improving learners' reading skills. **Table 4** presents the ANOVA analysis.

Table 4. Result of ANOVA Analysis.

ANOVA					
Reading Skills	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	1272.620	2	636.310	37.490	0.000
Within Groups	1018.364	60	16.973		

The ANOVA table indicates a statistically significant difference in reading skills among the groups analyzed. The Sum of Squares Between Groups is 1272.620, with a Mean Square of 636.310 and an F-value of 37.490, which is highly significant with a Sig. Value of 0.000. This p-value is far below the standard significance threshold of 0.05, indicating that the differences in reading skills among the groups are unlikely to have occurred by chance. The Sum of Squares Within Groups reflects the variability in reading skills within the groups. The high F-value suggests that the variability between groups is much greater than the variability within groups, emphasizing a strong effect of the treatments or conditions applied to the different groups. These findings suggest that the intervention, such as the ecoliteracy-based learning model, likely had a significant impact on improving reading skills compared to other approaches. The results validate the effectiveness of the instructional methods used in differentiating group performance. Further post hoc analysis may be necessary to identify specific group differences.

3.3. Prospective English Teachers' Responses

The implementation of the ecoliteracy-based learning model integrated with metacognitive skills is effective in improving learners' reading skills in English language study program. The teaching steps of the learning model consisted of organizing reading texts, outlining the texts, interpreting

the texts, reflecting the texts, and concluding the texts. The aspects of teaching steps are formulated in some questions as the basis of interview activities. **Table 5** presents the learners' responses to the implementation of the ecoliteracy-based learning model integrated with metacognitive skills.

The responses from prospective English teachers in **Table 5** highlight the transformative impact of a structured approach to reading ecological texts. By organizing texts, they enhance comprehension skills, recognizing main ideas, supporting details, and implicit messages that reveal the interconnectedness of ecological systems with real-world scenarios. The outlining phase allows them to focus on key points, fostering critical thinking and enabling a clearer understanding of text structure and purpose. Interpreting texts takes their engagement further, as they connect the content with personal experiences and broader environmental issues, making learning both relevant and meaningful. Reflecting on the texts encourages deeper self-awareness, with participants recognizing the consequences of daily habits on global environmental problems and feeling empowered to adopt more responsible behaviors. Finally, concluding activities help consolidate their understanding, emphasizing the personal and community relevance of sustainable practices. Together, these teaching steps effectively promote critical, reflective, and practical engagement with ecoliteracy, equipping future educators with the tools to foster environmental awareness in their own classrooms. The text continues here.

Table 5. Prospective English Teachers' Responses on the Ecoliteracy-based Learning Model.

Aspects of Teaching Steps	Prospective English Teachers' Responses
Organizing the text	S1: ...I can develop my comprehension skills through understanding main ideas, supporting details, and implicit messages in texts related to environment topics...organizing texts in the first make me recognize how ecological systems are interconnected to real-world scenarios... S2: I can identify information in texts such as climate change, biodiversity, and conservation through arranging the texts being read...
Outlining the text	S3: ...on identifying main ideas and supporting details.. creating an outline helps me focus on the main ideas instead of getting lost in all the details. It makes understanding the text much easier... S4: ...when I identify the main points and supporting details, I feel like I have a clearer picture of the text's structure and purpose... S5: ...outlining a text forces me to think critically about what the author is trying to say and how the details connect to the main argument.... It's like breaking the text into smaller parts, which makes it easier to analyze and understand the connections between ideas...
Interpreting the text	S10: ...when I interpret the text, I feel like I'm not just reading words but really understanding what they mean and why they matter... It's exciting to connect what I know with what I'm reading, especially when it's about real-world environmental issues... S11: ... I realized that some of the environmental problems in the text relate to things I've seen in my own community, and that made it more personal and meaningful... Interpreting the text allows me to use what I already know and apply it in a new way, which makes learning feel more relevant...
Reflecting the text	S12: ...reading about these issues made me think about how my daily habits, like wasting water, actually contribute to larger problems... I never realized how my small actions could have a bigger impact on the environment until I connected it with what I read...
Concluding the text	S13: ...I never thought about how things like conserving water or recycling directly impact my community, but now it makes sense... This stage made me think about my own habits and how I can change them to be more environmentally responsible...

4. Discussion

This study unveiled two essential findings concerning the efficacy of the ecoliteracy-based learning model integrated with metacognitive skills to enhance prospective English teachers' reading skills and their responses to the ecoliteracy-based learning model. The eco-ELT (ecoliteracy-based English Language Teaching) framework not only enhances reading skills but also cultivates awareness of environmental issues among learners. These outcomes align with the findings of Noto et al. [24], who observed that learners' comprehension skills of texts could be significantly developed through activities centered on environmental topics. Such topics encourage learners to identify main ideas, supporting details, and implicit information within texts, making them more adept at textual analysis. Furthermore, reading within an ecoliteracy-based context involves evaluating arguments and assessing the credibility of information presented in ecological texts, which is a crucial aspect of fostering critical thinking skills [25].

The findings of the study indicate the role of eco-ELT in stimulating learners' analytical and evaluative skills by encouraging them to delve into the perspectives and intentions of authors. This approach not only broadens their understanding of texts but also deepens their appreciation of

cultural dimensions related to sustainability issues [1,20,26]. Beyond improving linguistic abilities, the eco-ELT framework integrates the understanding of natural systems and the promotion of sustainable thinking, providing learners with a more holistic approach to education.

Empirical evidence highlights that the eco-ELT learning process helps learners evolve into global citizens who are acutely aware of the impact of human activities on the environment. By engaging with sustainability issues, learners not only enhance their critical thinking skills but also improve their capacity for analytical language use [27,28]. By giving them the opportunity to outline and interpret environmental topics, learners can reflect on their roles within the natural world. This process promotes a sense of responsibility for sustainability while simultaneously developing persuasive language skills. These findings reinforce the notion that ecoliteracy-based learning provides a comprehensive framework for language education, combining linguistic growth with the cultivation of sustainable thinking. By aligning language learning with ecological awareness, learners acquire the ability to communicate effectively and foster a deeper connection to the natural world [29].

One notable finding revealed that by integrating ecoliteracy into reading instruction, learners felt more capable of connecting language instruction to both global and local chal-

allenges. They were not only learning linguistic features but also gaining insights into pressing environmental issues. This dual approach aligns with Noto et al.^[24], who highlight that ecoliteracy-based learning contexts can significantly enhance learners' vocabulary acquisition. This is particularly evident as learners are exposed to terminologies related to the environment, sustainability, and climate change. According to Saiful and Yuniarti^[30], this vocabulary acquisition has the potential to be applied in diverse reading and writing activities, further reinforcing learners' linguistic and analytical abilities. Consequently, the implementation of the ecoliteracy-based learning model inspires students to become critical and informed readers who care about sustainability^[11]. In practical terms, learners are encouraged to engage in research and present their findings on sustainability topics, which helps them develop a multifaceted understanding of both language and ecological issues.

The findings indicate that ecoliteracy-based learning effectively integrates the principles of ecological literacy into education, fostering an understanding of natural systems and their interdependencies. For language learners, this approach offers a dual opportunity: enhancing language skills while cultivating sustainable thinking^[13,30]. From a linguistic perspective, learners can improve their reading comprehension, inferencing, interpretation, and vocabulary development. By focusing on ecological content, learners are able to analyze texts more critically and with a greater appreciation for the interplay between language and environmental contexts^[24,27].

Responses from learners regarding the implementation of the ecoliteracy-based learning model demonstrated a variety of opinions and feelings related to different teaching steps. Each teaching step, with its unique focus, offered distinct benefits to learners. For instance, in the process of organizing texts, learners found it helpful to identify main ideas, supporting details, and critical information. Learners who have high level of metacognitive skills have greater reading skills than those who have low metacognitive skills^[17,19]. The metacognitive skills affected learners' comprehension of environmental texts. Additionally, they gained a deeper understanding of how ecological systems are interconnected with real-world scenarios. These findings align with the work of Goga et al.^[31], who observed that ecoliteracy-based learning enables learners to identify, challenge, and evolve their views on natural systems and contemporary environmental

issues within their own societies, both locally and globally.

The findings also reveal that learners appreciated the opportunity to learn English through diverse materials that extended beyond traditional educational texts to include topics such as climate change, waste management, and forest conservation. This aligns with Saiful and Yunianti^[30], who conducted a study on pre-service English teachers' perspectives on current ELT practices. Saiful's findings indicate that language learners are increasingly willing to shift ELT practices towards a greater focus on sustainability, recognizing their roles as future leaders in achieving sustainable development goals^[14]. The integration of ecoliteracy-based learning materials proved to be particularly impactful in enriching learners' experiences. Through engaging with environmental topics, learners not only developed their reading and comprehension skills but also cultivated a sense of purpose and responsibility towards global sustainability challenges^[32,33]. These materials encouraged learners to think critically about the information presented and to assess its relevance and reliability. This process, in turn, enhanced their ability to articulate their thoughts in both written and spoken forms, thereby strengthening their overall language proficiency.

Moreover, ecoliteracy-based learning models encourage learners to adopt a more reflective and analytical approach to reading. These findings align with Saiful^[1], by analyzing the perspectives and intentions of authors, learners become more adept at understanding complex texts, including those that explore cultural dimensions of sustainability. For instance, learners might examine how different cultures approach environmental conservation or address the challenges of climate change. This level of analysis not only improves their comprehension skills but also fosters an appreciation for diverse perspectives and solutions to global issues^[34].

The ecoliteracy-based learning model's emphasis on sustainability also provides learners with a sense of empowerment. As they engage with topics such as renewable energy, biodiversity, and environmental ethics, they develop a deeper understanding of their roles in promoting sustainability. This understanding is reinforced through activities that require learners to research, discuss, and present their findings on various ecological topics. By doing so, learners are encouraged to become active participants in conversations about sustainability, using their language skills to advocate for

meaningful change^[7]. In addition to fostering critical thinking and analytical skills, ecoliteracy-based learning promotes collaborative learning. Group discussions and projects centered on environmental themes enable learners to share their insights and learn from one another^[26,35]. This collaborative approach not only enhances their language skills but also builds a sense of community and shared responsibility for addressing environmental challenges. Learners are exposed to diverse viewpoints, which broadens their understanding of ecological issues and encourages them to think creatively about potential solutions.

Furthermore, the ecoliteracy-based learning model supports the development of metacognitive skills. The findings are in line with Chen^[36] who informed that learners become more aware of how they approach reading and comprehension tasks. This self-awareness helps them to identify areas for improvement and to develop more effective strategies for understanding complex texts^[18]. For example, learners might use graphic organizers to map out the main ideas and supporting details of a text or employ questioning techniques to deepen their understanding of an author's arguments.

The findings of this study underscore the significant benefits of integrating ecoliteracy into language education. By combining linguistic development with ecological awareness, the ecoliteracy-based learning model provides learners with a well-rounded educational experience. It not only enhances their reading and comprehension skills but also equips them with the knowledge and skills needed to address the complex challenges of sustainability^[37]. As learners become more proficient in analyzing and interpreting ecological texts, they are better prepared to contribute to global conversations about environmental conservation and sustainable development.

The ecoliteracy-based learning also represents a transformative approach to language education. By aligning language instruction with ecological principles, it fosters a deeper connection between learners and the natural world. This approach not only enhances linguistic skills but also cultivates critical thinking, metacognition, and sustainable thinking. As learners engage with environmental topics, they develop the ability to communicate effectively about complex issues, making them more informed and responsible global citizens. The findings of this study highlight the potential of ecoliteracy-based learning to inspire a new generation

of language learners who are equipped to tackle the challenges of the 21st century with both linguistic competence and ecological consciousness.

5. Conclusions

This study underscores the transformative potential of ecoliteracy-based learning in enhancing language education. By integrating ecological principles with metacognitive skill development, the ecoliteracy-based learning model not only improves learners' reading comprehension and linguistic abilities but also fosters a deeper awareness of environmental issues. The findings demonstrate that engaging learners with sustainability topics enriches their critical thinking and analytical skills, allowing them to evaluate complex ecological arguments and the perspectives of authors. This dual focus on language and ecological literacy equips learners to connect language learning with pressing global and local challenges, empowering them to communicate effectively about sustainability and fostering their roles as informed global citizens.

Moreover, the ecoliteracy-based learning approach provides learners with a holistic educational experience that combines linguistic growth with sustainable thinking. It enhances vocabulary acquisition related to ecological topics, encourages reflective and collaborative learning, and instills a sense of responsibility for addressing environmental challenges. By aligning language instruction with sustainability, educators can inspire learners to critically engage with ecological issues and contribute meaningfully to global conversations on sustainability. These findings highlight the importance of embedding ecoliteracy into educational frameworks to prepare future leaders who are equipped to tackle the interconnected challenges of the 21st century.

The implications of this study are significant for educators, curriculum designers, and policymakers. For educators, it emphasizes the importance of incorporating ecoliteracy into language instruction to create a more engaging, meaningful, and socially relevant learning experience. By doing so, lecturers can foster critical thinking, global awareness, and language proficiency simultaneously. Curriculum designers can use these findings to develop instructional materials that integrate sustainability topics, promoting both linguistic development and ecological responsibility. Policymakers are

encouraged to support initiatives that prioritize ecoliteracy-based education, aligning curricula with sustainable development goals. Furthermore, this study invites future research to explore the long-term impact of ecoliteracy-based learning on students' linguistic skills, environmental attitudes, and their ability to influence positive change in their communities and beyond.

Author Contributions

Conceptualization, H.H. and D.S.; methodology, H.H.; software, I.M.P.U.; validation, H.H., D.S. and I.M.P.U.; formal analysis, H.H. and I.M.P.U.; investigation, D.S.; resources, H.H.; data curation, H.H. and D.S.; writing—original draft preparation, H.H.; writing—review and editing, H.H. and D.S.; visualization, I.M.P.U.; supervision, D.S.; project administration, H.H. and I.M.P.U.; funding acquisition, H.H., D.S., and I.M.P.U. All authors have read and agreed to the published version of the manuscript.

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Institutional Review Board Statement

The study was conducted in accordance with the Declaration of Helsinki, and approved by the Institutional Review Board.

Informed Consent Statement

Participation in this study is entirely voluntary. By agreeing to take part, the participants acknowledge that they have been informed about the purpose, procedures, potential risks, and benefits of the study. Participants understand that their identity are kept confidential and that all information they provide are used solely for research purposes. They have the right to withdraw from the study at any time without

any penalty or loss of benefits to which they are otherwise entitled. By continuing, they give their informed consent to participate in this research under the conditions described.

Data Availability Statement

The data utilized in this study cannot be made publicly available due to strict adherence to privacy concerns and ethical obligations that safeguard participant confidentiality. This ensures compliance with ethical research standards and data protection regulations. However, researchers or interested parties who require access to the dataset for validation or further analysis may request it. Such requests will be considered on a case-by-case basis and must be deemed reasonable. Importantly, approval from the appropriate institutional ethics review board is mandatory before any data can be shared, to ensure that the proposed use aligns with ethical guidelines and participant consent terms.

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While preparing this manuscript, the authors utilized ChatGPT as a language tool to assist in proofreading, refining grammar, and enhancing the clarity of English expressions.

Conflicts of Interest

The authors confirm that they have no known conflicts of interest related to this publication.

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