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Benefits of Adopting Wild Pedagogies in University Education

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Abstract: Several studies have demonstrated the positive impact of wild pedagogies on the well-being and learning of primary learners. However, wild pedagogies in higher education remain relatively obscure. This study assesses whether wild pedagogies affect the wellness of university students and analyzes the outcomes of the natural learning experiences in a higher education setting. As such, we use the roBERTa model to evaluate the sentiment score and thematic content to analyze 167 reflective essays on conducted natural learning experiences by undergraduate engineering students from a large Canadian public university. Our findings indicate that wild pedagogies benefit the wellness of university students and provide positive learning experiences. Moreover, positive natural learning experiences motivate students to develop environmental consciousness and sentimental connections with nature.

Keywords: forest bathing; wild pedagogy; sentiment analysis; university students; student wellness; AI models

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1. Introduction

Our common future depends on a deeper and more mutual relationship between humans and nonhumans in every aspect, especially education. Learning in nature can be traced back to ancient times when humans were deeply connected to the land [1]. In Canada, Indigenous peoples have practiced land-based education since time immemorial, evident in their language and culture, which is intimately tied to nature [2,3]. Today, formal, Westernized education is steeped in colonialism, where students are told about the world without experiencing it for themselves. This pedagogical approach can lead to the disconnect between learning and nature.

One only needs to read the news to see how this educational approach is failing people and our planet. As environmental educator David Orr states, "It's not education that will save us but education of a certain kind" [4]. Research suggests a more engaging pedagogical approach involves bringing students into nature to learn [5]. Over the past few decades, the relationship between education and nature, especially amongst young children, has received recognition across North America and Europe. As a result, nature-based learning programs are becoming more popular as a form of supplementary education. A recent study found that between 2018 and 2019, Canada had over 165 outdoor and nature-based learning programs, engaging between 40,000 and 65,000 children [6].

Different terms describe nature-based learning, including nature pedagogy, land-based pedagogy, and wild pedagogy. Nature pedagogy acknowledges nature's rights and encourages a deep relationship with nature to adopt a sustainable education [7]. Land-based pedagogy helps students break free from colonial education constructs by engaging land as teacher and renewing students' sense of stewardship towards the land [8]. Wild pedagogy is an open-ended approach to education where students engage with the natural world to foster an increased connection with nature to enhance discovery and innovation [9,10]. Due to its history of use for university students, wild pedagogy will be used moving forward.

Concepts around wild pedagogy began to crystalize around 2012 through a group at Lakehead University in Ontario, Canada [11]. While the term "wild" can be easily misconstrued, it is used in this pedological context in a purposeful way to denote reclamation, reimagination, and reintroduction [11].

> "Wild pedagogy involves challenging dominant cultural notions of control—of each other, nature, education and learning. It rests on the premise that an important part of education can involve intentional activities that provide a fertile field for personal and purposeful experiences without controlling the outcomes . . . A big part of this restoration of the teacher's role in society is to allow teachers the freedom to generate creative spaces for students—and themselves—as learners were personal knowing is honoured". [12]

Wild pedagogy provides an element of freedom of will, associated with "wild", that is an important part of the teaching. It recognizes that the learners themselves are a part of the subject matter, and they themselves become part of the learning process. The environment also becomes an active member in the teaching and learning.

University students are one group that may benefit significantly from wild pedagogies due to nature's widely cited healing benefits [13–15]. Academic institutions are beginning to acknowledge the importance of green spaces on university campuses as an important health resource for students and an opportunity to deepen their relationship with nature [16]. These nature-based approaches are being implemented at an unprecedented time, with university students facing high risk of undergoing mental health issues, due to academia's high-stress environment caused by academic pressure, changes in living environment, feelings of isolation, and financial stress [17,18]. A 2019 study by the Ontario University and College Health Association found that 52% of Canadian postsecondary students reported feeling depressed to a point where it affected their ability to function [19]. This metric has increased from 38% in 2013. Similarly, students experiencing overwhelming anxiety was 69% in 2019, up from 56% in 2013 [19]. Adopting wild pedagogies in universities is an opportunity to address mental health issues amongst students whilst also providing learning benefits. Multiple studies have investigated nature education's mental, physical, and emotional benefits for early childhood and elementary school learners [5,7]. Wild pedagogies are gaining support at the university level but are still relatively rare. One professor implementing these alternative pedagogies and writing about them is Dr. Spiegelaar. Spiegelaar recently found that a sustainability pedagogy approach that encouraged university students to connect with a sit spot every week and write reflections based on the experience and class readings supported student coping, comprehension, and sustainability mindsets during the COVID pandemic lockdown [20]. Additional research to support these findings may help to shift university pedagogies towards embodied experiences that facilitate healing and learning [20]. Evidence also suggests a need for more mixed-methods studies on student learning outcomes in higher education [21–23].

This paper explores the experiences of wild pedagogies for university students and assesses whether wild pedagogies facilitate students' well-being and learning. Throughout this paper, the effects of wild pedagogies on students are explored by considering a case study involving undergraduate students engaging in a forest bathing assignment designed to foster a sense of how trees and forests have helped develop civilizations over the centuries. After describing the study, this paper quantitatively and qualitatively analyzes a sample of student reflections from the forest bathing assignment to understand the effect of wild pedagogies on students' well-being and learning.

2. Materials and Methods

2.1. Case Study

The sample for this study includes students enrolled in an undergraduate engineering course at the University of Toronto. The course focuses on how trees and forests have helped develop civilizations through their use for shelter, heat, entertainment, sport, furnishings, communication, food, and medicines. One of the class topics was forest bathing and how

it is widely used in Japan to improve mental well-being. Forest bathing (shinrin-yoku) was coined in 1982 to describe an ancient Japanese practice that involves using all five senses to engage with nature [13]. To help students understand the potential spiritual and physical ways that forests have co-created cultures, they were encouraged to try the ancient Japanese practice and reflect on their experience.

2.2. Reflections

Before forest bathing, the students were introduced to the practice through course readings. They were also given a handout with forest bathing instructions. After completing the assignment, they were asked to reflect on the experience in a journal reflection with prompts asking how they felt before and after forest bathing, what they experienced, and their opinion on the legitimacy of the assignment. Reflective journaling is a form of experiential learning that encourages introspection, active learning, and personal growth [24]. According to educational theorist David A. Kolb, experiential learning is essential for obtaining meaningful and lasting educational outcomes [24]. For the students, reflecting on their experience by writing about it provided them an opportunity to reaffirm their opinions.

The reflections of 167 undergraduate students were analyzed using quantitative and qualitative methods. Three reflections were omitted from the analysis, as they did not answer how the student felt before versus after the forest bathing experience. To our knowledge, this is the first mixed-methods study to analyze the effect of wild pedagogies on university students. It is also the first study that uses sentiment score analysis to quantitatively analyze student reflections from a forest bathing assignment to better understand the mental well-being and educational impacts on students.

2.3. Sentiment Score Analysis

The reflections were analyzed quantitatively using machine learning to understand the sentiment of student reflections. Sentiment analysis is a natural language processing technique that labels text data as positive, negative, or neutral. Sentimental analysis is often used to analyze social media, online reviews, and news articles [25]. However, the text on social media is structured differently than student reflections. For this analysis, each reflection was manually separated into individual sentences using Python. The individual sentences were inputted into a pretrained sentiment analysis model from the Hugging Face Hub, which has over 215 sentiment analysis models publicly available online.

Four sentiment analysis models were considered when determining the most accurate model for this research. The RoBERTa model which was employed in the analysis is a transformer-based language model. It uses self-attention to process input sequences and generates contextualized representations of words in a sentence [26]. The four models were:

1. cardiffnlp/twitter-roberta-base-sentiment [27];
2. finiteautomata/bertweet-base-sentiment-analysis [28];
3. cardiffnlp/twitter-xlm-roberta-base-sentiment [29];
4. cardiffnlp/twitter-roberta-base-sentiment-latest [30].

To select the optimum model, ten hand-picked reflections were used. The individual reflections were first reviewed by the authors and described in terms of the sentiment of the reflection, interpreting for students' feelings/observations before forest bathing, during forest bathing, and after forest bathing (Figure 1).

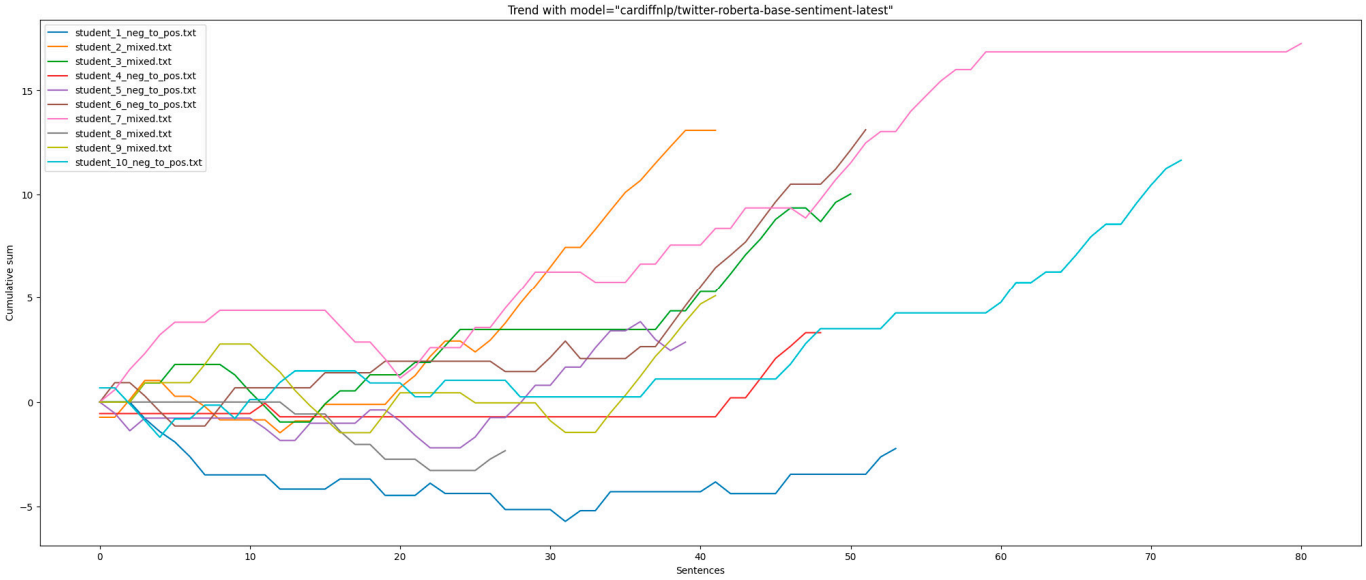

Figure 1. Ten individual reflections analyzed by authors and model outputs.

For the model evaluation, the following was carried out for each of the selected reflections:

1. Reflections were converted to text files.
2. Text files were separated into individual sentences.
3. Sentences were run through the sentiment analysis model.
4. A value was generated for each sentence, which included the probability that the sentence has a positive, neutral, or negative sentiment (Figure 2).
5. Using the sentences highest sentiment probability, sentences with a negative sentiment were assigned a negative sign label, neutral sentiments were assigned a zero label, and positive sentiments were assigned a positive sign label.
6. The sentiment score of each sentence was graphed in sequence (Figure 3).

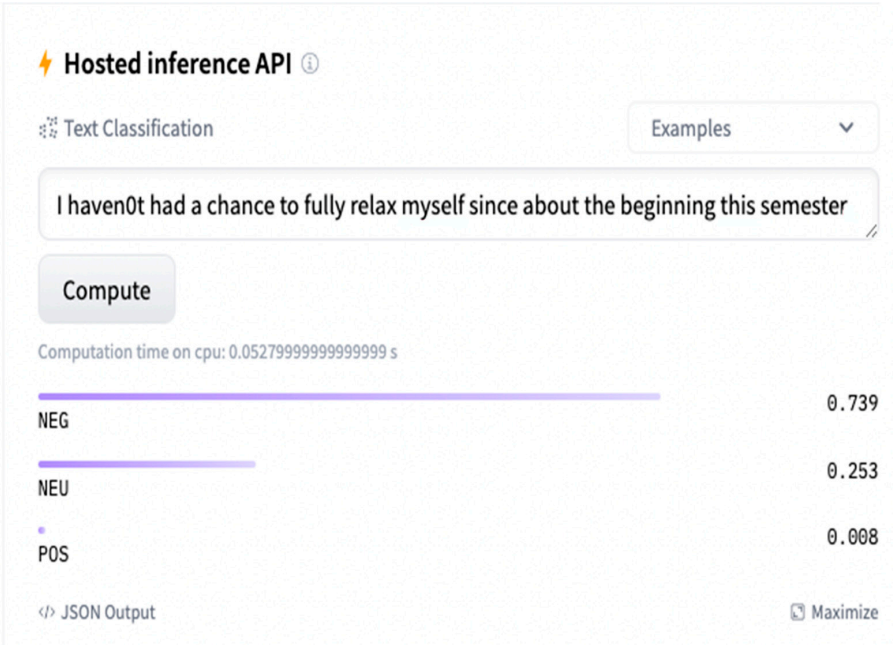

Figure 2. Example of the output from the "Hugging Face" model for one sentence.

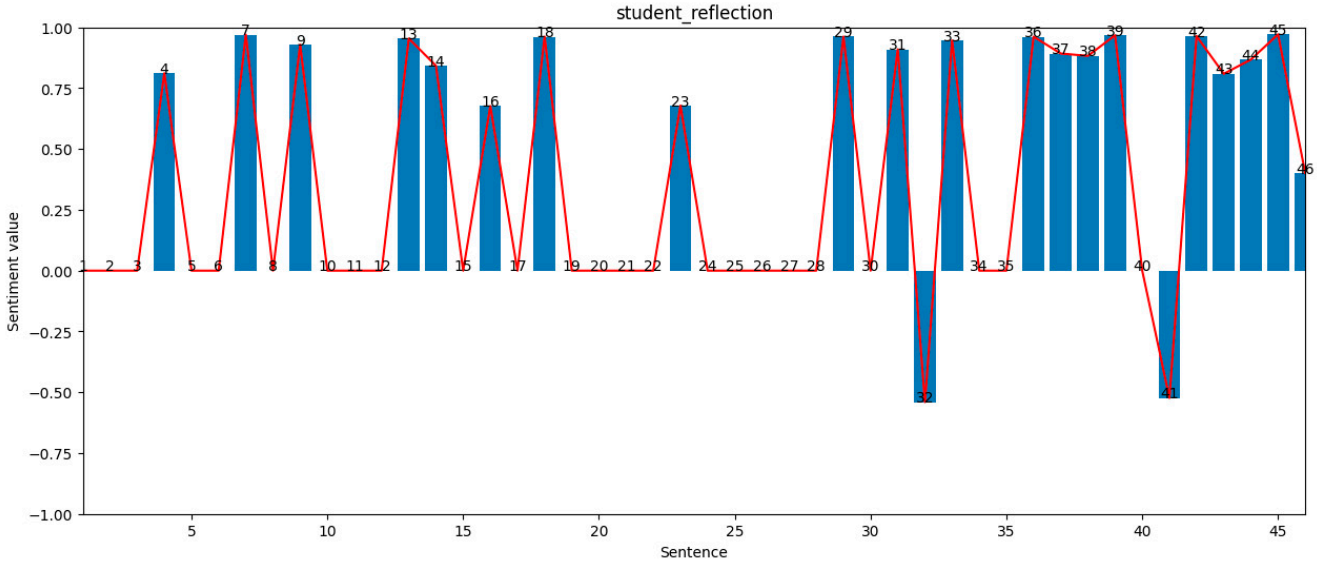

Figure 3. Chart of sentiment values (per sentence) for one individual student reflection.

The sentiment score charts resulting from each model were then evaluated against each other and against the authors' perceptions. Our findings indicated that the most suitable model for this work was the roBERTa model, trained on 58 million tweets and tweaked specifically for sentiment analysis. The roBERTa model is available on the Hugging Face website [31].

To compare the sentiment analysis score of all the students' reflections, each sentence was labeled with a timestamp of "before", "during", or "after". The labeling process was essential to understand whether the students enjoyed and benefited from the assignment. The process for labeling each sentence with a timestamp can be found in Table 1. The mean score for each timestamp (before, during, or after) was calculated and graphed for each reflection (Figure 4).

Table 1. A description of the sentence-labeling criteria used for the sentiment analysis.

Forest Bathing Timestamp	Criteria
Before	Participant's mental status and observations before entering the forest.
During	Participant's mental status and observation during their forest bathing experience.
After	Participant's mental status and observation after leaving the forest.
N/A	Sentences that are not direct experiences, observations, or reflections of the participant.

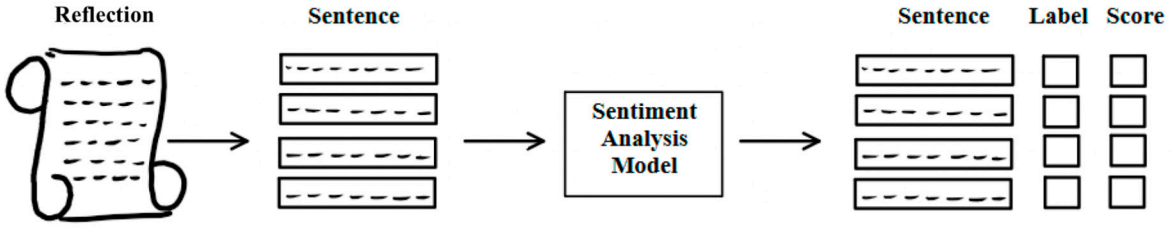

Figure 4. The process undertaken using Python to run a sentiment analysis.

2.4. Thematic Content Analysis

The reflections were also treated using qualitative thematic content analysis to identify and code concepts and themes relevant to the effects of wild pedagogies on student well-being and learning. The qualitative research methods used in this inquiry share features of phenomenological, holistic, and integral research approaches [32]. Identifying emerging themes within the student reflections can provide a detailed and full description of the studied experience [32]. The themes identified through thematic content analysis include restored resilience, creative thinking, and ecological consciousness (Table 2). Quotations from student reflections are included to demonstrate their experiences and illustrate themes. Names are omitted from personal reflections to maintain anonymity.

Table 2. A description of the sentence-labeling criteria used for the thematic content analysis.

Thematic Content	Criteria
Restored resilience	The participant mentions that interaction with nature has reduced stress, restored attention, or increased energy levels.
Creative thinking	The participant displays creative thinking by making connections between themselves and nature, noticing and observing patterns, and asking and answering questions.
Ecological consciousness	The participant uses emotional and figurative language to describe nature, showing their strong engagement with the environment.

3. Results and Discussion

3.1. Student Wellness and Learning Outcomes

3.1.1. Sentiment Score Analysis

Embodied Knowing

The students were more likely to write positive sentences when talking about their experience after the forest bathing session than before. Figure 5 displays the results of the text analysis, where the rating of each sentence (1.00 positive, 0.00 neutral, −1.00 negative) is found on the y-axis and the location of where each sentence occurs in their reflection (before, during, after forest bathing) is found on the x-axis.

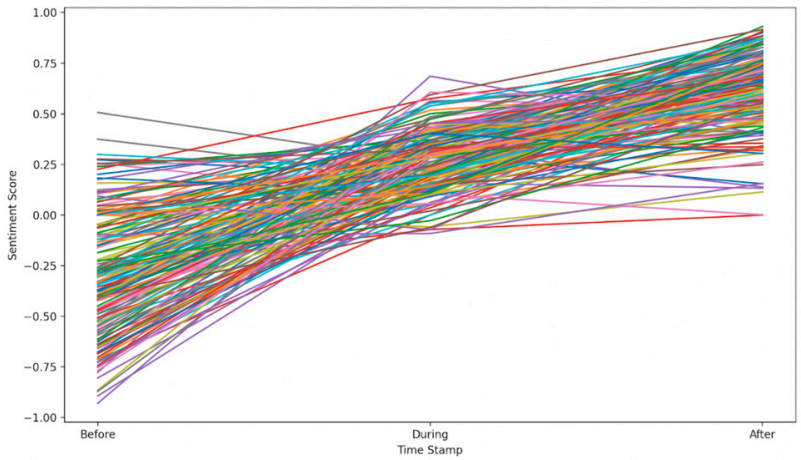

Figure 5. The trend of sentiment scores from before, during, and after forest bathing for each of the student participants. The before sentences generally have a lower sentiment rating than the during and after sentences.

The combined score of each reflection's before sentences minus the combined score of the after sentences is plotted in Figure 6. The plot is normally distributed, showing the differences among the students' forest bathing experiences. The graph indicates that some students felt more negative at the beginning of the forest bathing assignment, and others

felt more positive. However, despite their initial feelings, all students wrote more positively when reflecting on how they felt after the forest bathing experience.

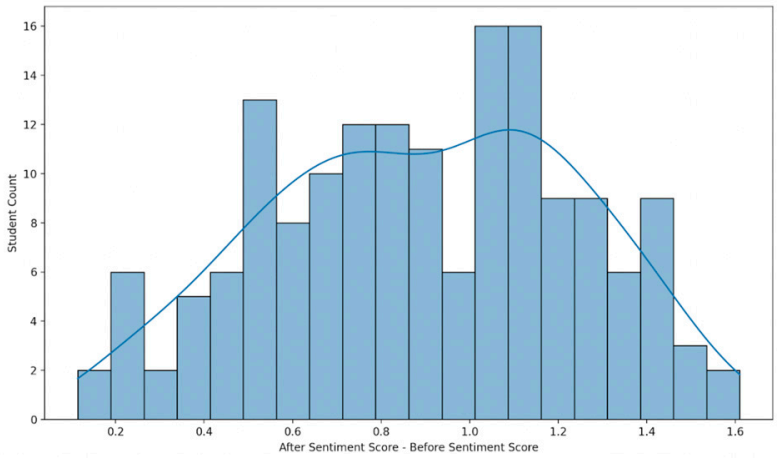

Figure 6. The difference between the score of each reflection "after" and "before".

The students' positive experience from this assignment aligns with ecopsychology findings that spending time in nature has many positive psychological effects, such as increased happiness and self-perceived well-being [33]. In addition to the finding that the students enjoyed the assignment, this assignment also strengthened their inquiry skills by encouraging them to test the hypothesis that forest bathing has positive physical, psychological, and emotional health benefits for themselves.

Experiencing and reflecting on this assignment allowed students to understand how the forest bathing assignment made them feel. Many students described their experience using terms such as "less stressed", "happier", and "convinced of the benefits". Additionally, many students wrote about agreeing with or believing in the research after doing it themselves. For instance, one student shared, "I believe forest bathing does have positive physical and mental health benefits as I personally felt the various benefits, such as high concentration, decreased stress and a strong immune system".

The quantitative and qualitative analyses indicate that the students were more likely to write positive sentences when writing about how they felt after forest bathing than before the event. Engaging the students by encouraging them to test this in nature allowed them to experience embodied ways of knowing. Embodied knowing shows up in the students' reflections on learning about the world and themselves. The students experienced firsthand how to test a hypothesis, form an opinion, and question research. According to David Orr, these are essential skills for students to learn [4]. Education can and must be interactive, as knowledge is embodied when students are encouraged to learn by observing, thinking, and questioning the world around them.

3.1.2. Thematic Content Analysis

Restored Resilience

Along with having an enjoyable experience and displaying embodied knowing, the students alluded to the restorative effects of learning in nature, with over 96% of students mentioning the positive effects of the assignment on their well-being. Restored resilience was expressed as students feeling "relaxed", "refreshed", "calm", "present", "energetic", "at ease", "less anxious", "ready to study again", "clear", "focused", and "free". One of the students wrote, "Somewhere along the line, my worries had melted away, replaced by the sweet smell of pine sap, the songs of the birds, the story of the forest". The student's experience of nature reducing their worries is not surprising given the vast amount of literature on nature immersion lowering self-reported and physiological stress levels [34,35].

Reducing stress is especially important for students because chronic stress can negatively affect memory and cognition, impacting academic performance [36,37]. University environments can be competitive and high stress; for some students, it is their first time living independently. Implementing wild pedagogies into the curriculum can help students learn in an environment that "melts" or "washes away" their worries, allowing them to focus on the lessons being taught.

Besides fewer worries, some students also felt energized to study afterward, "After forest bathing, I felt more relaxed, calm, clear headed, and confident than ever before, as if I recharged to full energy and could ace all projects, assignments, and exams". Similarly, another student writes, "I have come to the understanding that even if I have a million things on my plate, a walk on campus under the trees will more often than not give me and energy and clarity boost in completing my tasks at hand". The field of environmental psychology supports the theory that being in nature can increase concentration levels and allow individuals to synthesize information more effectively [5,38].

One explanation for this phenomenon is Attention Restoration Theory (ART) proposed by Kaplan and Kaplan [39]. ART suggests that being in nature allows the brain to restore itself to a calm state [39]. Research also indicates that natural environments are associated with soft fascination [40]. For instance, one study found that walking in nature is associated with decreased amygdala activation compared to walking in an urban environment [41]. A study of 100 participants randomly assigned to one of three activities—a guided walk outdoors, a mindfulness walk outdoors, and a walk indoors—found that those who walked outdoors mindfully experienced greater positive effects on their mood than those who walked indoors [42]. These studies suggest that humans require moments of downtime and being in nature allows our minds to replenish and restore.

Two main findings related to this theme came out of this assignment. Firstly, the students were mentally restored and re-energized to return to their studies. Secondly, through the reflections, the students displayed intrapersonal intelligence. Intrapersonal intelligence involves a deep awareness of one's emotional state and feelings [43]. Both are important for navigating everyday university experiences such as stress and anxiety. Overall, wild pedagogies may improve student academic performance by reducing stress, giving way to clearer thinking, boosting students' energy levels, and helping them understand their feelings, all of which help restore their resilience.

Creative Thinking

Over half (53%) of the students displayed creative thinking when reflecting on this assignment. Some students specifically acknowledged feelings of "enhanced creativity". These observations align with other findings that individuals perceive themselves as more creative after they spend time in nature [44]. For most students, creative thinking was expressed in their observations, especially of animal behavior. For example, some students suggested that hearing bird songs in the fall indicates that they have yet to migrate. Other students observed different bird songs and wondered what the birds were communicating about. Curiosity is an important trait for creative thinking and is often the basis of developing new solutions to problems [45,46].

Many students completed this assignment in autumn, when the leaves changed from green to shades of red, orange, and yellow. As a result, many questioned why and how this process happened. Multiple studies suggest that curiosity gives way to creative thinking based on a desire to know and understand [47,48]. Similarly, another student was curious about a smell in the forest, stating, "I may not know what creates the smell but it makes me want to explore the forest more". A study by Plambech and Konijnendijk van den Bosch evaluated 17 Danish professionals' creativity levels and relationship with nature and discovered that spending time in nature can nourish creativity by promoting curiosity, new ideas, flexibility, and the synthesis of information [38].

In addition to curiosity, some students observed and found meaning in nature's cycles. One of the students writes, "I couldn't tell what kind of seed they were, but it

reminded me of the life cycle of everything around me. The leaves fall and decay to create a fertilized bed for a new life, helping the seed to grow. Even the decay of life had its beauty and meaning". These observations about the relationships between elements indicate an expanded awareness of the unity of things, a necessary skill for solving problems [4,11]. Another student illustrated creative thinking when reflecting on the challenges that nature must endure to survive, "I could not help thinking that trees are like people, no matter how harsh is the environment, they always overcome challenges, conquer fears and strive to grow up. I believe that is the meaning of life". Similarly to the previous passage, this student shows awareness of the interconnections between people and nature. Witnessing these recurring patterns in nature and comparing them to their own experiences can drive a desire to understand nature and themselves better.

From feeling more creative and curious to experiencing an enhanced awareness of their relationships with nature, the students, directly and indirectly, allude to heightened creativity. Observing animal communication, questioning how leaves change color, finding beauty in death, and philosophizing about the similarities between trees and people are all acts of creative thinking. Not only did the students experience creative thinking but underlying this was the discovery or rediscovery of nature and how dynamic, intricate, unified, and sensitive it is. Wild pedagogies give students the freedom to notice and wonder about the world around them, which can often lead to creative thinking.

Ecological Consciousness

The final theme demonstrated by 93% of students was ecological consciousness arising from feeling connected to the natural world. In their reflections, students commonly used terms such as "home", "connected", "safe", "grateful", and "comfortable" to describe how they felt during the assignment. Ecological consciousness involves an awareness of the interconnections between humans and nature and recognizes the importance of living in harmony with the natural world [49].

From this assignment, many students showed a sense of ecological consciousness through feeling empathy, kinship, and awe toward nature. For example, one student wrote, "I gently touched it as if it has feelings". Expanding our awareness towards nature to acknowledge that a tree has feelings indicates an increased sense of empathy. Research suggests that increased empathy, gratitude, and awe caused by connection with other beings can lead to the emergence of ecological consciousness [49,50].

Similarly, another student writes, "The forest gives me a feeling of kindly old grandpa. He does not speak very often, but instead, he loves to hear from you with big smiling, and watch you just like his favourite grandson". Comparing the forest to family members indicates a relationship with the land and feelings of communion with nature. This deep connection leads to a sense of belonging in nature and thinking about more than just the self, which is critical for repairing our relationship with place. For example, a study on the nature connectedness of Singaporean students demonstrated that high nature connectedness is associated with more innovative and holistic thinkers [51].

Many students also wrote about feeling part of something larger than themselves. For example, one student writes, "I sensed the wind was touching my skin, I sensed the sunshine warming my cheek, I sensed that I was part of the environment, and I was growing in the nature, together with the trees around me". This student writes about feeling in sync with nature and belonging to it, which is often associated with being more caring toward nature [13]. This is especially important because our health and the future of our species depend on our connection with nature.

The theme of ecological consciousness was evident throughout the students' reflections in various ways. When students learn in and from nature, they develop a deeper relationship with the more-than-human world. The students discovered that they are a part of nature, growing alongside and with all other beings. Feeling connected to nature is often the predecessor for pro-environmental behavior because our worldviews inform our values, and our actions and behaviors follow our worldview [52,53]. Enhanced ecological

consciousness, a feeling widely cited by the students, demonstrates the importance of connecting students with nature through wild pedagogies.

4. Conclusions

The present study investigates how a wild pedagogy assignment affects university students' well-being and whether the students experienced any learning outcomes. Evidence from this study suggests that the students enjoyed the assignment and experienced various mental well-being and learning benefits. However, we must consider that the outcomes were analyzed from a student assignment, which may have been influenced by professor expectations. It is also difficult in a time-limited study to evaluate deeper evidence of learning over time. Finally, it is necessary to remember that this research focuses on students from one university within a Western society. Future research analyzing the effects of wild pedagogies across all disciplines at various universities worldwide is necessary.

Despite these limitations, the results from this study further validate that learning in nature positively benefits students' wellness and learning. Learning in nature can encourage students to develop or restore embodied knowledge, resilience, creative thinking, and ecological consciousness. At the same time, wild pedagogies can benefit nature by encouraging connection to the land and pro-environmental behavior amongst students. Implementing wild pedagogies into more courses and across curriculums can allow students to learn from the more-than-human world, develop critical life skills, and find a sense of belonging and community. These are essential considerations for addressing the mental health and ecological crises that humanity is experiencing.

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