Assessing Schoolyard Biodiversity in Peterborough

Includes:

Final Report

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Table of Contents

Introduction

This community-based research project focuses on schoolyard biodiversity in elementary and intermediate schools located in Peterborough, Ontario. All research was conducted between January 2025 and March 2025.

Biodiversity loss is a significant issue, threatening an increasing number of ecosystems globally. Biodiversity is defined by the World Health Organization as "the variability among living organisms from all sources" (WHO, 2025). The following research is focused on designing green spaces in schools to increase nature connectedness. Nature connectedness refers to the relationship between an individual and the natural world (Pritchard et al., 2020). The purpose of the study is to highlight the importance of biodiversity and encourage student engagement in both creating and maintaining greener schoolyards. The project goal is to determine how to develop a framework that works to measure, maintain, and engage students on schoolyard biodiversity. To achieve this, we observed the current state of biodiversity before creating our recommendations. Additionally, the project will provide resources to support the frameworks used in the curriculum. The creation of a successful framework will assess current biodiversity in schoolyards and increase it while providing recommendations on biodiversity maintenance. Furthermore, it will link with the Ontario curriculum and be adapted across other school boards to reduce barriers in outdoor learning.

The creation of a framework is important to improve the opportunities for nature-based education within schools. Some schools already successfully follow such a framework. In Peterborough this can be seen in 'Rowan Tree Children School' which has been inspired by the Forest School Model. The school follows the Ontario Curriculum whilst also incorporating tending to the garden and tree nursery (Rowan Tree School, 2019). However most schools

currently encourage little engagement with nature. Children need to have a relationship with nature to encourage positive engagement with the environment and to support their mental well-being (Rosa et al., 2018). The project aims to address the following research questions:

1. *How can we develop a framework for measuring schoolyard biodiversity?*

This question relates directly to our project goal. It aims to highlight the need for introducing a framework into schools based on the current assessment of biodiversity in schoolyards.

2. *How can we create an interest in a biodiversity framework for students and teachers?*

This question researches and emphasises the importance of ensuring the created framework is engaging for both teachers and students. For the study to be introduced to the curriculum successfully, encouraging positive engagement between schools and nature is critical.

3. *How can schools sustain a culture of connection to nature and environmental stewardship among students?*

This will address ways to maintain engagement with the framework. By discovering methods to make interactions with nature accessible and enjoyable, a meaningful relationship can be created.

By addressing these research questions, the outcome of this report is to introduce a potential framework that provides effective recommendations to implement and explain the benefits of increasing biodiversity in schoolyards, as well as long-term methods to maintain them.

Methods

The research included field visits to three schools located in Peterborough, to observe green space in schoolyards, referencing literature, and creating a framework for schoolyard biodiversity. Field visits were carried out at two elementary schools and one intermediate school. Each school was visited by members of the research team, however, the only data able to be gathered was pictures and an estimated level of biodiversity percent coverage based on present trees, sand/asphalt in playground equipment, and field type (i.e. football field) due to the winter season. To find strategies for improving biodiversity in the schoolyards, the research group conducted a literature review and compiled the most feasible practices to increase green spaces for students and educators. The team also had monthly meetings with members of the school board to get their opinions on possible next steps that were proposed. The research team focused on practical and stimulating solutions that could be easily implemented on school property. These strategies were developed into a set of recommendations that can be given to the Kawartha Pine Ridge District School Board, one of the local school board of Peterborough. Based on the biodiversity assessments and stakeholder input, the research team developed tailored recommendations for schools around the Peterborough area, which can be later seen in the recommendations section. This research follows ethical guidelines for community-based research, and school visits were conducted outside school operating hours.

Results

The outcomes of our field observations confirmed the lack of visible biodiversity in Peterborough schoolyards, and our research review found that there were limited opportunities to bring ecological knowledge into schools and for students to reap the benefits of nature-based learning. It was hypothesised that very little biodiversity would be observed, and after visiting

the three schools, it was confirmed true. School 1 and School 2 had similar results, as both institutions had limited observed plant cover, it is estimated to be 5% and <5% respectively, of the total yard. This estimate excludes the large monoculture fields as they contribute little to the overall diversity of the yard. While large fields of grass may host a diverse population of insects and microorganisms, they significantly lack plant diversity. The institutions both had very few trees, and mostly had coniferous species. The major features of the schoolyards included a flat grass football field, large asphalt basketball court, and a baseball diamond. Although they take up the largest sections of the yard, these features are not significant contributors to biodiversity.

The final school included in the field assessment, School 3, was the smallest of the three schoolyards. Small clumps of trees along the edges of the yard were observed. Although it was the smallest yard included in the field assessments, the highest tree diversity was found at School 3, including species of maple, ash, birch, and pine. Diameter at Breast Height (DBH) was also assessed in this yard due to the increased concentration of trees. The average DBH of the trees was 83 centimetres, meaning that the trees are well-established. Despite the increased tree diversity, little plant diversity was observed. *Figure 1* depicts the average schoolyard composition in Peterborough, based on the observations made at the three schools. It is common for schools to have trees only around the outside of the yard to make room for sports fields, playgrounds, and multi-use asphalt spaces. With this however, it is important to note the seasonal impact on biodiversity in these schoolyards as it was conducted in the winter. Small plant diversity and seasonal plant diversity was not observed due to snow cover. Estimations for plant diversity were made in places where it could not be observed.

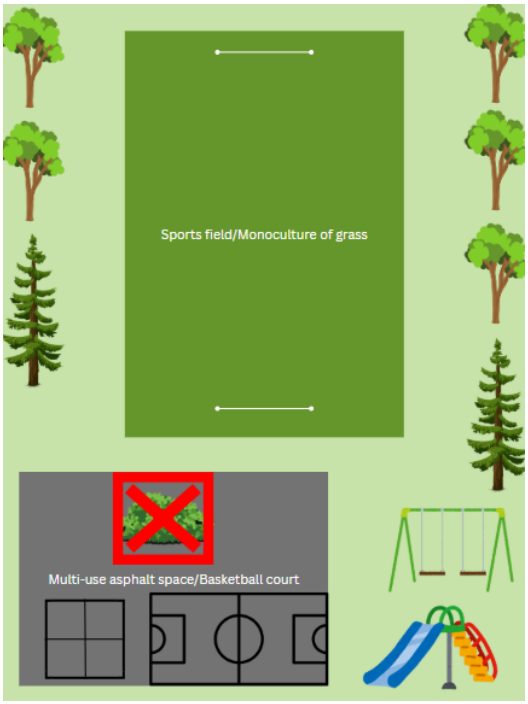

Figure 1. Average Peterborough schoolyard layout, based on field observations.

It is clear that when planning a schoolyard, green spaces and overall biodiversity are not considered by the land-use planner. This study discovered that it should be considered in schoolyard planning due to its benefits on how students perceive the environment. The consideration of biodiversity and nature-based learning in schools is an opportunity for the inclusion of traditional knowledge sources to be integrated into learning (Kölmel, 2023).

Promoting land-based learning and biodiversity enhancements in Peterborough schoolyards can include Indigenous practices and ways of thinking, which will open doors for further Indigenous learnings. This can be done through a deeper and more detailed education of native plants' significance and the importance of specific species to specific cultures. Understanding different worldviews and sides of history contributes to the development of a student's personal worldviews (da Silva et al., 2023). Biodiversity and the knowledge that comes with embracing it can be a gateway to students pursuing Indigenous knowledge further. This

increases the representation of these cultures and viewpoints in schools and offers the opportunity to freshen up the material in courses like English and science (Yazidi & Rijal, 2024). Incorporating traditional ecological knowledge allows for reconciliation.

Access to green spaces for students to enjoy should be prioritized just as much as an asphalt playground. Nature-based learning and frequent engagement with nature lead to improved mental health in students while also boosting their performance in school (Kuo et al., 2019). This is effective because it is a new way to learn for many students, and change ensures that students remain engaged with the content. Not all students have the opportunity to explore topics like biodiversity outside of school, and this could be rectified with access to green spaces during school activities. Students in public schools come together in these schoolyards, regardless of socioeconomic class or status, making these yards important spaces for equal opportunities. Having a consistent environmental baseline regardless of socioeconomic class and culture is important for creating the next generation of environmentalists (Askerland et al., 2022). Creating green spaces to address the lack of biodiversity in the schoolyard can look different based on the site. Natural areas and gardens are among the most common types of spaces used to enhance student learning, health, and overall climate resilience. Students in North Carolina were surveyed in a similar study and found to have increased positive feelings when nature-based activities were assigned (Zhang et al., 2022). From this, it can be hypothesised that public school students across suburban North America have similar sentiments. In a study by Lindemann-Matthies & Köhler, a group of students were surveyed on what they prefer in their schoolyard. In the context of aesthetics, students preferred options that included gardens and a more natural look instead of trimmed sports fields and asphalt, indicating that there is an interest

from students in implementing green spaces in schoolyards (Lindemann-Matthies & Köhler, 2019).

Discussion

Limitations and Suggestions for Future Research

This study encountered some limitations, the primary being the time of year. This study was researched during the winter semester, therefore, schoolyard visits in Peterborough were not as fruitful due to the snow cover and overall reduced vegetation and wildlife. Future studies expanding on this project should consider researching more schoolyards during the spring or summer semesters, so native species can be identified and given an appropriate basal coverage, potentially using a 10x10 plot. For future studies seeking a deeper assessment with a longer timeline, alpha, beta, and gamma biodiversity indices could help quantify species on a spatial scale for each schoolyard (Heydari et al., 2020). While some wildlife can be seen in the winter as there are fewer places to hide, other wildlife that would typically hibernate during the winter or migratory species would be best observed during the spring. Furthermore, trees and their canopy coverage could be more easily observed during this season, as well as the types of species blooming. Overall, an assessment during the spring or summer months, or even autumn, would allow for a more thorough assessment of biodiversity in schoolyards to be developed, as the limited activity of ecosystems of peak winter can hinder a comprehensive assessment. Finally, this study proposes a potential framework that could work for educators providing recommendations and justification based on an extensive literature review – but these suggestions are not implemented in the timeline of this project. Future studies with additional resources could implement this framework or a modified version to determine if the suggested integration of biodiversity education in classrooms is feasible. Gathering direct input from

students and educators would be invaluable, however, ethics approval is a lengthy process that goes beyond the scope of this project.

Promotion of Biodiversity in Intermediate and Elementary Schools

Assessing the current state of biodiversity in schoolyards is vital to raise public and municipal awareness to formulate a solution to the accelerating impacts of climate change while nurturing youth on the importance of ecological balance and conservation. Early education regarding biodiversity would instill values of environmental stewardship and allow green maintenance to occur sustainably and safely, preserving human, animal, and plant life for today and the future (Dominata, 2023). Furthermore, the roles of educators to foster connection to nature have proven to have significant benefits to students and communities, which is expanded on more later in this report. In a study by Zhang et al. (2022) the authors found that teacher involvement on how students interact with the environment help untangle the abstract ideas of community-ecological relationships, such as a) the benefits of supporting wildlife b) the value of clean air for children, and c) the positive emotional and behavioural outcomes of maintaining and enjoying the natural world. This relationship is essential to create, and with the current state of biodiversity in Peterborough schoolyards, this relationship is strained.

In a study by Dominata (2023), the author researched the need for green schools and curriculums to ensure environmental sustainability in Indonesia. The study asked informants on the idea of integrating environmental-specific subjects in the school curriculum. The results showed that the majority of participants agree with the implementation of a green curriculum, however, it is essential to integrate it into existing subjects to reduce additional costs. Furthermore, some informants highlighted the need to make environmental education mainstream to change people's behaviour, as creating it as a separate, special subject will only

allow students to practice it for certain hours a day and not habitually (Dominata, 2023). With these considerations and the need to establish a connection to nature, we developed a potential framework for educators to get a comprehensive understanding of how educators can implement biodiversity and environmental stewardship in their classrooms on an everyday basis and how it can connect with Ontario's curriculum.

Potential Framework

Recommendations

The framework proposes the following recommendations to be implemented by educators. The introduction of a science unit in the curriculum that focuses on local biodiversity will increase knowledge and engagement with nature. The unit should educate on the importance of biodiversity and discuss the threats to local ecosystems. It is also advised that there is a focus on incorporating traditional ecological knowledge. This can be done by ensuring native plants, such as White Sage, Sugar Maple Trees, and Bunchberry, are present in the ecosystem and allowing Anishinaabeg people, the Indigenous peoples of Peterborough, to guest lecture and provide guidance regarding local ecosystems (GreenUP, 2024). Creating an information board depicting native species in the schoolyard could help younger audiences point out potential biodiversity that may be present in the ecosystem. This will encourage students to explore the environment around them. Additionally, involving students in the planting process provides experiential learning opportunities for green skills and species identification.

The creation of a biodiversity club for every school will encourage further opportunities for students to engage with the environment. Students in the club would complete biodiversity surveys, monitoring the progress of the new species in the ecosystem. If required, students will be encouraged to participate in schoolyard greening projects (Smith, 2019). In particular,

students could focus on the prevention of invasive species, such as the aggressive emerald ash borer in Peterborough, to ensure that biodiversity is thriving. This may be more ideal for students in intermediate schools, as it requires a deeper understanding and responsibility from students. Additionally, student collaboration on installing a continuous compost and recycling program in each school that uses the organic wastes is a way to allow students to learn about organic fertilizers and habitat building, encourage growth for pollinators, and allow for sensory engagement (UNESCO, 2017). Implementing some of these recommendations will ensure that biodiversity is discussed and addressed in Peterborough schoolyards.

Connection to Kawartha Pine Ridge District School Board Curriculums

The integration of schoolyard biodiversity projects into the curriculum of Kawartha Pine Ridge District School Board (KPRDSB) elementary schools, the school board of Peterborough, offers an invaluable opportunity to engage students with both local ecosystems and broader environmental issues. The goal of this curriculum is to engage students in environmental learning by providing hands-on learning experiences and a deep connection with nature, emphasizing the importance of biodiversity and the local environment. Peterborough has lots of green space both on and off school properties, allowing for an extensive environmental curriculum that can be very useful for the future of environmental protection. Teaching kids the importance of the environment from an early age allows their passion for the outdoors to grow, which is essential for the future of environmental protection in Canada. By studying local species in their schoolyards, students learn about the delicate balance of ecosystems and each species's critical role in maintaining environmental health.

The current KPRDSB curriculum emphasizes outdoor education but not as much environmental protection as it could (Kawartha Pine Ridge District School Board, 2023). We

aim to improve that aspect of the Ontario curriculum by adding elements such as traditional ecological knowledge and environmental protection units to improve this part of the curriculum. For instance, teaching students about the significance of planting native plants not only honours Indigenous traditions but also reinforces the importance of restoring native species to the local environment. This approach encourages students to learn from the wisdom of Indigenous cultures and understand how these practices have sustained local ecosystems for generations (Sumarwati, 2021). Environmental protection lessons can be included in the biodiversity part of the curriculum, which will teach students about the environment and why it is important to protect it. Another positive approach Peterborough has is engagement with nature that extends beyond classroom activities. Many Peterborough schools have embraced the creation of nature clubs, where students can become actively involved in planting, tending, and learning about local species (Zhang et al., 2019). These clubs serve as another option for students to get involved in protecting and conserving local ecosystems. Additionally, nature trails within schoolyards and local green spaces provide opportunities for students to observe and document species in their natural habitats (O'Brien et al., 2010). Projects like this are a powerful tool for enhancing environmental education in Peterborough's elementary schools and will contribute to building a more informed and ecologically aware generation.

Benefits

Biodiversity holds a variety of benefits across many disciplines. This includes various aspects of environmental health, including increased productivity and ecosystem services. Aside from environmental health, biodiversity also offers educational benefits, including promoting environmental stewardship and helping students learn more about the natural world. Additionally, it holds significant mental health benefits through the reduction of stress and

improvement of cognitive function (Sandifer et al., 2015; Marselle et al., 2019). These diverse benefits show the importance of increasing biodiversity for both well-being and the planet.

Ecosystem Services

Biodiversity holds many environmental benefits; as biodiversity increases, ecosystem productivity also increases as they are complementary factors (Duffy, 2008). In addition, the increase in productivity throughout the ecosystem also results in more efficient use of resources as the organisms found within the ecosystem as the interactions are complementary. Biodiversity in ecosystems also promotes species richness and resilience (Duffy, 2008). Due to this increase in richness and resilience, increasing biodiversity can cause the ecosystem and the environment around it to thrive. This is because the schoolyard's increased biodiversity can cause the surrounding ecosystem's species to be more protected and have a stronger chance of surviving potential diseases or invasive species that could threaten the species. It can also be seen that biodiversity can affect nutrient supply and cycling (Duffy, 2008). This is beneficial to the environment because with more species present, it allows the ecosystem to maintain its health.

Educational benefits

Increased biodiversity within Peterborough schoolyards would also be beneficial to the quality of education within schools. This is due to an increase in real-world examples and experiential learning possibilities that could be incorporated into the curriculum. In addition, previous studies have concluded that students who were exposed to biodiversity education programs were more attentive in the future (Lindemann-Matthies, 2010). This was determined because students were more attentive to species biodiversity in settings outside of school after being exposed to the programs, demonstrating the success and importance (Lindemann-Matthies, 2010). This demonstrates that students retain the biodiversity information when placed in a

hands-on experience to help them learn about biodiversity, indicating the potential for success within this project.

Mental health benefits

With an increase in biodiversity being implemented in schoolyards across Peterborough, a benefit to mental health within the school may be seen. Studies have shown that there is a link between mental health and nature (Keniger et al., 2013). With an increase in exposure to nature within the schoolyards, an increase in mental health could also be possible due to the positive correlation. The health benefits due to an increase in biodiversity could include an increase in cognitive function, social interaction, and improved resilience (Sandifer et al., 2015; Marselle et al., 2019). This would be an excellent improvement to have at schools as the brain is still developing in the earlier stages of life. The aspect of increasing biodiversity within these schoolyards, potentially increasing cognitive function, would be a great asset to the schools as well as the students themselves. It would allow for a deeper learning, in addition to improving social interaction, which is increasingly important due to the significant amount of technology children are being introduced to at young ages.

Conclusion

The community-based research project based on schoolyard biodiversity located in Peterborough, Ontario, highlights the current lack of biodiversity in local schoolyards and the significant opportunities available for improvement. School yards in the area are predominantly covered with grass, paved areas, and coniferous trees, with minimal plant diversity and ecological engagement. Our research showed the need for a shift in how schoolyards are designed to better support biodiversity and meaningful nature-based learning for students.

This study has outlined some key areas for future development, including the addition of Indigenous ecological knowledge, promotion of biodiversity through hands-on learning, and development of learning frameworks for teachers. The proposed frameworks for teachers included the importance of local biodiversity, ecological knowledge, and a need to establish sustainable environmental practices such as biodiversity clubs, green spaces, and composting programs.

This research has also shown the numerous benefits of increasing biodiversity in schoolyards. Students can benefit in various ways that contribute to a more hands-on learning environment that will aid in the overall development of students. This study faced limitations due to the time of year and the inability to fully access biodiversity during winter months, thus, the finding would serve as a solid foundation for future research and action.

In summary, improvement of biodiversity in Peterborough's schoolyards is not only essential for the environment but also would serve significant benefit for students and our future generations. Implementing the recommendations of this project would foster a stronger connection between students and the natural world. This project will benefit students and the greater Peterborough community for generations to come.

Additional Resources

These resources are supplementary to the recommendations presented in the framework and can assist in providing further insight into how educators can support students in nature connectedness and promote environmental stewardship in schoolyards.

1. Teaching Tools About Biodiversity - WWF
2. Biodiversity Learning Kit Volume 1 - UNESCO

3. Biodiversity Learning Kit Volume 2 - UNESCO

4. Pathways to Stewardship and Kinship - Kawartha Pine Ridge District School Board

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