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Collage as a Reflective Tool: Teachers' Perspectives on Forests and Urban Environments

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Abstract

The study aims at professional development directed towards finding new pathways in education for and in sustainable development. In this study, we consider how primary teachers from two schools in Gothenburg, Sweden, experience the forest and the urban area as potential learning environments. This study focuses on teachers' perceptions (understanding) and experiences (emotional) of two places, the urban area, and the forest. To make visible teachers' relationships with the urban area and the forest, we use collage inquiry as a research method to stimulate teachers' reflection, conversation and writing about the forest and urban area. Primary teachers from three schools in Sweden participated in the study and made collages The collage inquiry brought out their emotions, perspectives, and curiosity about the forest and the urban area described in three themes*; temporarily situated*, *place dependent* and *emotionally connected*. Knowledge of teachers' perceptions and experiences ensures opportunities to deepen the ability to teach technology beyond the classroom. To bridge between biology and technology and compare ecological and technological systems constitutes a possible basis for continued work and development of teaching for sustainable development.

Keywords

Ecological literacy, technological literacy, collage inquiry, practice-based research.

Introduction

Teachers' perceptions and experiences of how technological systems and ecological systems are structured, and function have significance for how they tackle sustainability issues in the classroom. The study presented in this paper is part of a collaborative practice-based research project (Svensson, Sanders, & Thorén Williams, 2022) aiming at finding new paths in education for sustainable development through school subjects, technology, and biology. In the project, biomimicry forms a bridge between knowledge of the ecological systems in the forest and how these systems can be imitated in human-made technological systems in an urban environment for increased sustainability. The urbanisation of society indicates that the distance between people living in urban environments and nature is increasing. Reflection is viewed as one of the powerful ways for teachers to develop their knowledge (Dillon, 2011) and a sense of being able to handle teaching subject content in relation to sustainability issues in the classroom. In this study, we explore an art-based method to stimulate reflection. The method, which is inspired by Butler-Kisber's (2010) chapter in Qualitative Inquiry: Thematic, narrative and arts-based perspectives and is called 'Collage inquiry'. The purpose is on the one hand to the mapping of teachers' perceptions and experiences of nature and urban environments, and on the other hand, to evaluate the potential of the collage inquiry as a tool for stimulating reflection and making different perspectives visible.

The teachers' perceptions and experiences of the forest and the urban area, lay the ground for their bridging of the two environments to address sustainability issues on a system level in the classroom. In this paper, we make a distinction between perceiving and experiencing something. Perceiving connects to how we think and what we understand while experiencing relates to emotions and senses. Concerning our purposes, these research questions are identified:

- What perceptions and experiences of the urban area and the forest appear in the collage inquiry?
- In what ways does the collage inquiry make visible teachers' relationships with the urban area and the forest?

Background

Practice-based research is of relevance for education and pedagogy, aiming at schools' development and conducted by researchers and teachers in collaboration (Nilholm, 2020). Persson (2020) highlights the importance of being careful as researchers, in practical research projects to be able to switch between the necessary closeness and familiarity that one needs to have about the practice one is studying, and at the same time to have a scientific and professional distance. It is therefore important to see practical research as a development of knowledge where one presupposes the other. The current study takes its point of departure in a practice-based research project where primary school teachers together with science centre educators and a research group, learn about how we relate to the forest and the urban area personally and professionally in different ways.

The small forests near the schools are places where primary school teachers regularly go with their students to play and learn about animals and plants. The nearby urban areas are, in contrast to the forest, areas which are not related in the same way (Szczepanski, 2013). Urban areas are human-constructed worlds with various artefacts and technological systems that have the purpose of meeting human needs. In this project, both the urban area and the forest are essential places, for bridging between technology and biology teaching, where the forest ecosystem(s) with its organisms can inspire and challenge teachers' and their students' thinking about how to design sustainable technological systems.

Students' understanding of technology's importance to and impact on people, society and the environment is emphasised in the Swedish National Curriculum (Skolverket, 2022). According to this curriculum, technology education should develop the students' technological awareness and ability to relate technological solutions and their use of technology to issues related to sustainable development. By making technological solutions visible and comprehensible in teaching, students are given the conditions to orient themselves and act in a technology-intensive world. In recent years, several researchers (Ingerman & Collier-Reed, 2011; Svensson, 2011) have referred to this type of knowledge or generic skills as technological literacy. Technology is about developing and designing new artefacts and systems to change and improve our surroundings. There is a downside to the human drive to constantly develop and change artefacts and systems if consideration is not given to the global and environmental impact of this development. According to McCormick (2006) and Keirl (2006) technology literacy is also about enabling students to reflect on their technological lives, to develop critical awareness about how to live in a technological world, and to learn to discern the benefits and

disadvantages of technology. Therefore, it is of great importance to include sustainability perspectives in design work to find new sustainable ways to develop technological solutions (Pavlova, 2013). In this regard, we find Ingerman and Collier-Reeds (2010) model of technological literacy useful where two interrelated perspectives are fundamental elements of the concept of literacy, the potential for technological literacy and the enactment of technological literacy. The potential is made up of knowledge about a particular situation, personal engagement with a situation, and social engagement with the world. Enactment requires a particular set of skills in action, which together help to shape the situation: recognising needs, articulating problems, contributing to the technological process, and analysing consequences.

As societies progress and become more technologically advanced, there is a noticeable decline in the general population's understanding of ecological systems and their importance to human survival and well-being. This knowledge gap not only hinders effective policy-making and personal decision-making but also exacerbates the disconnect between humans and the natural world. The pursuit of ecological literacy, as explored in the works of Lisberg Jensen (2016), McBride et al. (2013), and Magntorn (2015), highlights a critical educational endeavour necessary for fostering an environmentally aware society. Lisberg Jensens (2016) discusses the diminishing ecological literacy in modern societies, identifying a growing disconnect from nature due to more abstract and less experiential educational approaches. This ecological illiteracy, Lisberg Jensen (2016) argues, obscures our ability to effectively engage with and respond to environmental challenges. According to McBride et al. (2013), ecological literacy is described as the understanding of ecological systems through scientific inquiry and systems thinking. It pertains to the comprehension of the relationships and functions within ecosystems, stressing the biological and scientific aspects of environmental interactions. Magntorn (2015), focuses on the concept of "reading nature," an ability to recognize organisms within their ecosystems, understanding their roles and interactions with other organisms and the environment. This ability to identify parts and their function within a system is an essential component of ecological literacy. All three sources advocate for a transformative educational framework that goes beyond traditional learning to include direct experience and interaction with the natural world, aiming to cultivate a deep-seated ecological consciousness among individuals.

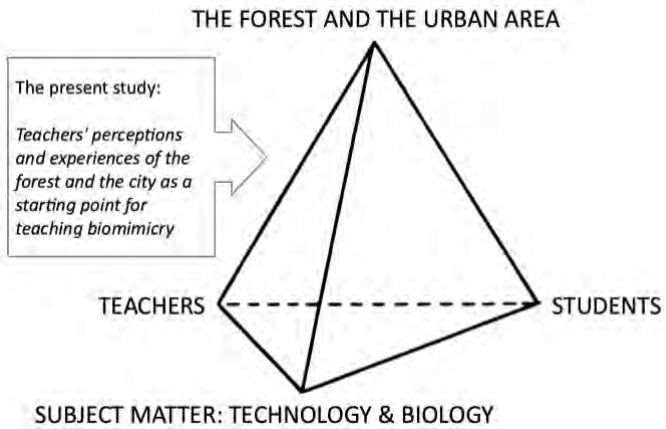
In this research project, the overall purpose is to explore teachers' perceptions and experiences of technological systems in the urban area and ecological systems in the forest, to prepare them for teaching about sustainability issues. We want them to focus on the two situations/contexts, which are different but similar in terms of the systems perspective and the need for systems thinking to understand the situations. We see systems thinking as an aspect of technological and ecological literacy. Using the technological literacy model (Ingerman & Collier-Reed, 2010) allows us to describe the potential of both ecological and technological literacy and to find traces of knowledge, and personal and social engagement with systems in the forest and the urban area.

The didactic tetrahedron

To contextualize the present article within the broader scope of the practice-based research project, it is pertinent to employ the didactic tetrahedron model, initially proposed by Rezat and Sträßer (2012) and subsequently adapted by Nyman (2017) and further by Thorén Williams

(2021). This model provides a comprehensive framework for understanding the interrelationships between the teacher, students and the subject matter engaged within a didactic situation and the interrelationships within the research project. Brousseau and Balacheff (1997) conceptualize didactical situations as instructional contexts that facilitate student engagement with the subject matter, a concept further illustrated by the didactic triangle framework (Rezat & Sträßer, 2012). In these situations, the actions of the teacher cannot be comprehensively understood without a concurrent understanding of the student's actions and the structured knowledge of the subject matter. This interrelation forms an indivisible system characterized by the didactical triangle, which includes the teacher, student, and subject matter. The dynamics within this triangle are perceived holistically, wherein each component influences and is influenced by the others. Rezat and Sträßer (2012) extend this model by introducing a fourth vertex, representing the environment's material resources, thereby acknowledging their role and impact within the didactical situation. This addition enhances the model's capacity to account for external influences such as a physical environment on the teaching-learning process (Thorén Williams, 2021)

Within this framework, the present article is elucidated and aligned with the 'Teachers – The forest and the urban area relationship, as depicted in Figure 1. This model thereby serves both as a structural foundation for the overarching research project and as a guiding didactic framework for each constituent study.



Figure, 1. The figure illustrates how each of the four studies relates to the areas of the didactic tetrahedron (Author, 2021), adapted by Nyman (2017) and initially developed by (Rezat & Sträßer, 2012).

Method

Art-based research methods are highlighted as valuable for their ability to unlock novel insights and foster more equitable researcher-participant relationships. However, art-based methods which consist of a palette of techniques, encompassing creativity, visualisations, and performative approaches, have only been marginally incorporated in science education research (Hoppe & Holmegaard, 2022). In their literature review, Hoppe and Holmegaard (2022) discern four central themes that underscore the unique advantages of art-based methods, 1) non-verbal language; facilitating a broader range of expression, allowing participants to convey meanings that might be difficult to articulate verbally, 2) power and positions; altering traditional power dynamics in research settings, offering participants a more

active role in the knowledge creation process, 3) knowledge through artefacts; where artefacts act as mediators in the research process, helping access deep-seated memories and meanings, thus enriching the understanding of the participant's world, and 4) time for reflections; providing a slower, more reflective pace of interaction, which is crucial for deeper engagement with the research topic. One example of using collage inquiry as an art-based method in science education is Awan (2007). In her study, young people aged 13 to 14 were invited to create identity collages using media materials. The collages, along with accompanying reflective commentaries, formed a valuable dataset for the study. Similar to Awan's (2007) study, data in the form of collages together with teachers' discussions and descriptive texts constitute valuable data in this paper. However, in this study, teachers are asked to reflect on their relationships to phenomena in the world, both personally and professionally.

Butler-Kisber (2010) explores the use of collage, specifically employing found images from popular magazines, as a tool for reflection, elicitation, and conceptualization. Elicitation involves drawing out a variety of perceptions, interpretations, and possibilities. We agree with Butler-Kisber & Poldma (2010) that the visual approach such as "making a collage is not daunting because everyone, whether a novice or veteran, can cut and paste and ultimately gets a sense of satisfaction with the product" (p. 5). Collage inquiry is a user-friendly art method that leverages basic skills like cutting and sticking, familiar from early childhood (Butler-Kisber, 2010). The collage inquiry is thus chosen with regard to the teachers' and researchers' familiarity with creating collages. Furthermore, collage inquiry sets out a specific 'angle of arrival' (Allsop & Dillon, 2018) to engage the participants to reflect upon the forest and the urban areas. Making the collage involves selection, wanting to choose a specific kind of representation and the option to add words and symbols. In creating the collages, the teachers' relations to the urban area and the forest emerge (Butler-Kisber, 2010). In addition to mapping teachers' perceptions and experiences of the forest and urban area, making a collage can afford affective elements such as emotions and attitudes. The collage inquiry used in the current study takes inspiration from Butler-Kisber's (2010) "Collage Inquiry". Although collage inquiry can unlock novel insights, Hoppe and Holmegaard (2022) emphasize the need for sensitivity towards the participants' backgrounds and capabilities in art-based methods. Researchers must be cautious of potential power imbalances and ensure an inclusive, respectful approach to participant engagement. therefore, the researchers also participated in collage creation together with the participating teachers.

In the collage inquiry, fragments from materials such as magazines, and coloured paper of various kinds of yarn and fabric were used to visualise perceptions and experiences of forests and urban areas. The cut-outs that we take from magazines and other materials and put together in a collage provide a tool that allows for expressing and communicating phenomena in a more diversified way. The collage inquiry works here as a tool to stimulate reflection (Hoppe & Holmegaard, 2022) and broaden perspectives and conversations about the forest and the urban area. The collages constitute visual documents within the practice-based research project of which this study is a part (Butler-Kisber, 2010).

Participants

The two schools participating in this study reached out to researchers in teacher education to collaborate around teachers' professional development concerning sustainability. This interest initiated a practice-based research project. Seven teachers from the three primary schools in

Gothenburg (see Table 1), and three researchers participated in the collage inquiry workshops. All three primary schools (students of ages 6-12) were diverse schools with teachers and students with Swedish as an additional language.

Table 1. A demographic overview of participating teachers (assigned pseudonyms).

Schools	Participating teachers	Demographic characteristics
A	John and Veronica	Upper primary school teachers (students ages 10-12). Teach Mathematics, technology and science.
B	Anna and Cecilia	Lower primary teachers (students ages 6-9). Class teachers with eligibility to teach Swedish, mathematics, English, social studies, history, religion, geography as well as natural science and technology.
C	Salma and Eva	Lower primary teachers (students ages 6-9). Class teachers with eligibility to teach Swedish, mathematics, English, social studies, history, religion, geography as well as natural science and technology.
	Annefrid	Preschool/preschool class teacher, has training in Children's communication and language; Children's Mathematical Learning; Play, learning, development and care; Collaboration with guardians, preschool class, after-school centre and school; Aesthetic learning processes; Nature, environment and technology

The data consists of the collection of photos of the teachers' collages, teachers' descriptions of collages, teachers' interpretations of each other's collages on post-it notes and transcriptions of video- and audio recordings of the collage workshops. The transcribed data is from the part of the workshop when all the collages have been completed and after everyone in the group has taken part in the others' collages and with a few words or sentences (on three separate post-it notes for each collage apart from their own) wrote down his interpretation of the collage.

The Approach to the Collage Inquiry Workshop

The group of teachers were divided into two workshops, three teachers in the first one and four teachers in the second workshop. We as researchers participated in both workshops. Each workshop occasion took about two and a half hours. Before we started making collages, the researchers prompted these questions: What are your perceptions of the urban area and the forest? What are your experiences of the forest and the urban area? In addition, everyone was instructed to use the materials (magazines, paper, fabric, and yarn) that were presented to make a collage that represents one's perceptions and experiences of these environments.

The work with the collage took about 45 min up to an hour for everyone. Then about 20 minutes were devoted to writing a paragraph about one's collage and giving it a title. After a 15-minute break for refreshments, we all looked at each other's work and, on each collage, everyone had to write down their short interpretations of the collages on three separate post-it notes for each collage apart from one's own. These interpretations could be sentences or words. The Post-it notes were then attached to the back of the collages.

After this step, we all gathered around a large table to present the collages to each other. The presentation followed a given order, where everyone in turn read out the title of their collage and then their descriptive paragraph. Not everyone had time to write a paragraph during the workshop but submitted one later. The participant who presented his or her collage then had to turn the collage with the back facing up and read aloud what was written on the post-it notes attached. An important part of this step was affording the collage owner to comment and reflect on the other participants' interpretations and perspectives. After everyone presented their collages, a discussion followed about the different interpretations and perspectives of forests and urban areas.

Analysis

The transcriptions of video, recordings and collage descriptions were analysed through thematic analysis (Braun & Clarke, 2006). In this process, the three researchers' collages, descriptions and presentations were excluded from the data material. Pictures of the collage together with the teachers' written descriptions and the transcribed presentations and discussions were read and reread by all three researchers to code and find themes across data that described what perceptions and experiences of the two places, the urban area, and the forest, were in the foreground of teachers' reflections in all three sources. The thematic analysis largely followed the process described in Riger and Sigurvinsdottir (2016) with some exceptions. For example, this study carried out a more theory-driven analysis (Braun & Clark, 2006), which meant that the three senior researchers had the research questions in mind during the analytical process. This study's data material consisted of transcriptions of the teachers' presentations of their collages, subsequent discussions and the teachers' descriptive texts. It was therefore important to ensure that coding and themes were valid across the entire data material. The teachers' collage descriptive texts were critical in the analysis as they constituted teachers' more detailed descriptions of perceptions and experiences of the forest and the urban area. Thus, the texts could confirm or contest the researchers' interpretations of the transcriptions. The emerging themes were evaluated through discussion between the three authors and with research colleagues at the PATT40 Liverpool 2023 conference (Thorén Williams, Svensson & Sanders, 2023) to describe the special nature of the themes. To deepen the understanding of the three themes, the model of technological literacy (Ingerman & Collier-Reed, 2010) was used to describe the potential of ecological and technological literacy as knowledge, personal and social engagement.

Results

The collage inquiry as a method makes visible not only teachers' perceptions and experiences but also their professional identity and personal/private identity concerning the urban area and the forest. The collage inquiry brought out emotions, perspectives, and curiosity, which are powerful tools in teaching and engaging students. Three themes, temporarily situated, place dependent and emotionally connected emerged in the analysis which describes the character of the teachers' reflections that came into their foreground about their perceptions of the forest and the urban area and their experiences of these places.

Temporarily Situated

In this theme, the teachers are reflecting on the places by looking into the future and/or looking back on history, focusing on humans living close to nature and then moving into cities, becoming more separated from nature. The problems that we see in the urban area today need

to be solved sustainably in the future. John presents his collage and points at the picture (Figure 2) of a child.

Figure, 2. John's collage

> *It is a child who symbolizes the future and who looks up with the hope that it will be even better and more sustainable in the future... at the same time there is a man in fur who reminds us of the old days when the cities were dirty and smelled bad because they lacked knowledge about sustainable living, hygiene and how to build, choose materials and plan....all people and residents have their primary needs, instincts, but all problems need to be solved... in the cities.*

Veronica describes her experiences and understanding of the two environments:

> *Once upon a time people thought it was great fun to live in cities and this is [points to an image in the collage] the image from the nomads' what is it called, tents that they left in a pile and then they move to the city and very quickly you discover that you need - we have always had the forest in our homes. An example is the Christmas tree, which we go to the forest to get when we celebrate Christmas and so on and so forth...*

The teachers have chosen pictures that represent the future in the urban areas, spaceship and modern buildings, and the forest as a Christmas tree or a green area between buildings and the past with pictures of tents and forests. This reflects their feelings and understanding of a change in society as well in nature. We also interpret this as an understanding of the effects that technological development can have on nature and society over time, both in making life easier for humans and causing problems regarding sustainability.

Place Dependent

The teachers describe their relations to the forest and the urban area by highlighting things to see and do. There are also traces of limitations of the places. In the forest, you can play as a child but in the urban area, you are not allowed to move around as you want to. The two places invite to and afford certain activities and can thus be seen as complementary and integrated.

Figure, 3. Anna's collage.

> ***Anna**: When I think of the city, I think of people. Lots of people gathered in one place. Everyone needs somewhere to live, employment, to get to different places by car, bus, tram, etc.[...] In the forest, there is calm, peace, nature, soothing scents, moisture after the rain, the sun shining through the trees, a cup of hot chocolate. Good clothes and shoes. Child playing, climbing, running, exploring. Mushrooms, berries, ghost walk, animals, insects. Light, darkness.*
>
> ***Cecilia**: My experience of the forest is the silence and at the same time the life of the forest. I also often experience the forest/nature within the city, such as in gardens, farms, forest groves in the city. It shows humans' need and desire to be close to nature, even in the middle of the city [...] my understanding of the city is that it should be accessible, efficient, convenient for people who live there. Water, heating, communication, payment system, sewage, infrastructure (bridges, roads) everything must work. My experience of the city is instead about religion, culture, art, education, and other values found in the city. (The kind that I don't get access to in the forest).*

The teachers' experiences of the forest are depicted in pictures that show when and why "I visit the forest": picking berries and fruit, resting, and exercising, cycling, jogging, and walking the dog. The experience of the forest is the silence and at the same time the life of the forest. They also often experience the forest/nature within the city, such as in gardens, farms, and forest groves in the city. This indicates that people need and want to be close to nature, even in the middle of the city. Their perception of the city is more about religion, culture, art, education, and other values found in the city. Something they don't have access to in the forest.

The teachers' perception of the forest is instead about the ecosystems that prevail there, hierarchies in the forest, and how tough the forest is for those who live there. It is about the survival of the fittest, but also the adaptability of the forest and the animals. Perceptions of the forest are also how we humans affect the forest through logging, fossil fuels, cultivation, etc. Their perception of the city is that it should be accessible, efficient, and comfortable for the people who live there, water, heat, communication, payment system sewage, infrastructure (bridges, roads) and everything should work. There is a personal engagement in both the

technologically intensive urban area and the non-technological forest which we interpret as a sign of potential technological and ecological literacy.

Emotionally Connected

The theme describes teachers' emotional connections to the forest and the urban area. Their feelings about the urban area have a more negative character, i.e., stress, high noise level, and disorder, but there are also traces of friendship and belonging. The forest, on the other hand, brings out emotions such as calm, silence and order, and light but here too there are negative feelings such as darkness, fear, and uncertainty.

> ***Eva**: I listen to the forest outwardly, both for sounds that fill me with well-being and also for sounds that can warn me of danger. In the forest there is peace and quiet but also anxiety. Some of my biggest fears live in the woods – spiders, moose, and wild boar. In the city, I listen inwardly, do what I want to do, spend time with friends and family, go to the gym and exercise [...] But there is also anxiety in the city, anxiety about having an accident - maybe getting hit by a car -, anxiety about running into people who want you badly.*

Figure, 4. Eva's collage

Our interpretation of this is that the images that the teachers choose when they make their collages bring out emotions that might otherwise be difficult to access. The pictures act as mediators in the process, helping access memories and meanings and in that way enriching the understanding of how the teachers experience the forest and the urban area.

Discussion

With the collage inquiry, different interpretations and perspectives were made visible (Butler-Kisber, 2010). The collage inquiry stimulated reflections and discussions about personal as well as professional relationships with the forests and urban areas. Coming together as teachers and researchers, reflecting, and sharing ideas through the making of collages, contributed to self-awareness and a sense of community. The commitment and creativity that arose allowed reflections, without the teachers exchanging any words during the collage work. Finding images, cutting, composing, and pasting images required concentration. The desire to find a

particular image, symbol or word was a purposeful endeavour. It was noticeable how the making of the collage slowed down the pace of interaction, allowing one to reflect on one's relationships with the forests and urban areas. The making of collages also brought out emotions in ways that we did not expect. The three themes; *temporarily situated*, *place dependent* and *emotionally connected* indicate that collage inquiry encompasses several dimensions, including teachers' relationships to history, situation and identity. Awareness of these dimensions is critical to teach complex issues of sustainability in technology and biology.

The making of collages enabled a wider spectrum of expressive possibilities, permitting teachers and researchers to communicate meanings that could be challenging to express through verbal articulation alone (Hoppe and Holmegaard, 2015). During each and everyone's presentation of the finalized collages, it became evident that these compositions served as a significant facilitative medium for narrating perceptions and experiences. The writing of paragraphs and the assignment of titles to the collages were activities that most of the teachers undertook after the collage creation. It exemplifies how the collages functioned as mediators in the writing process, facilitating the elicitation of deeply entrenched memories and meanings, thereby enhancing the comprehension of the participating teachers' perceptions and experiences (Hoppe and Holmegaard, 2015). However, writing came easier to some of the participants than to others, which further enhanced the power of the collage inquiry for stimulating reflection and discussion in the teacher-researcher group. The active role of the teachers is an important prerequisite in the practice-based project as a whole.

Different aspects of the teachers' personal relationship to the two environments, the urban area and the forest, and their understanding of the relationship between the two emerged during the collage inquiry, but also aspects related to the society were discernible. This indicates a system thinking approach, seeing parts and connecting them, which are essential for understanding sustainability issues, and thus part of technological and ecological literacy. Similar to what is described by Ingerman and Collier-Reed's (2010) in their model of a potential for literacy, personal and social engagement are two dimensions that in this study are salient. Traces of the knowledge dimension were present, however, emotional connections to the environments constitute a first step towards technological and ecological literacy.

Knowledge of teachers' perceptions and experiences ensures opportunities to deepen the ability to teach beyond the classroom and to reflect on that teaching. From a teaching and learning perspective, this relates to one of the surfaces of the didactic tetrahedron (Thorén Williams, 2021): the teacher – the forest and the urban areas - the subject matter (the technological and ecological systems). The teachers' relationships to the two environments, visualised through collage inquiry raise teachers' awareness about the technological and natural world. Using a system thinking in discerning the benefits and disadvantages of the two worlds is critical in sustainability education to find new ways to develop technological solutions. In the continued work of teaching for sustainability, we believe biomimicry has the potential to support this development and bridging between biological systems and technological systems.

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