

Teachers' perceptions and impressions of the forest and the city as a starting point for teaching biomimicry

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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 the ways in which primary teachers from two schools in Gothenburg, Sweden, experience the forest and the urban environment as potential learning environments. The teachers' descriptions are the basis for introducing biomimicry as a way to strengthen teaching in, and about, sustainable development. Biomimicry has the potential to bridge knowledge of forest ecological systems and how these can be imitated in human-made technological systems in the urban environment. The research questions that this study focuses on are what experiences and understanding of the two places, the urban area, and the forest, are in the foreground of teachers' reflections? In what ways does the collage method make visible teachers' relationships with the urban environment and the forest? The collage method was used to stimulate teachers' reflection, conversation and writing about forest and urban environment. Data were collected when groups of 3-4 teachers in each group, first illustrated their experiences and understandings of the environments individually and secondly described their collage as a written text and in conversation with the group. Emergent findings indicate that the collage method brought out teachers' emotions, perspectives, and curiosity about the forest and the urban environment, which are powerful tools in teaching and engaging students.

Key Words: biology education, technology education, collage inquiry, practice-based research

1. INTRODUCTION

The study presented in this paper is part of a collaborative practice-based research project aiming at finding new paths in education for sustainable development through school subjects, technology, and biology. Biomimicry forms a bridge between knowledge of the ecological systems in the forest and how these systems can be imitated in the human-made technical systems in an urban environment for increased sustainability (Svensson, Sander & Williams 2022). The urbanisation of society indicates that the distance between people living in urban environments and nature is increasing. Teachers' experiences and understanding of how technical systems in

the urban environment and ecological systems are structured and function have significance for how they view the world and by extension how questions about sustainability issues can be tackled in the classroom.

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 (2018) chapter in *Qualitative inquiry: Thematic, narrative and arts-based perspectives* and is called 'Collage inquiry'. The purpose is on the one hand to mapping of teachers' experiences and understanding of nature and urban environments, and on the other, to evaluate the potential of the collage method as a tool for stimulating reflection and making different perspectives visible.

The teachers' experiences and understanding of the forest and the technologically urbanised environment, lay the ground for their bridging of the two environments to address sustainability issues on a system level in the classroom, which is the overall aim of the practice-based research project that this study is part of. In this paper, we make a distinction between experiencing something and understanding something. Experiencing relates to what we can perceive with our senses, while understanding connects to how we think and what we know about something. In relation to our purposes, these research questions are identified:

- What experiences and understanding of the two places, the urban area, and the forest, are in the foreground of teachers' reflections?
- In what ways does the collage method make visible teachers' relationships with the urban environment and the forest?

2. BACKGROUND

Practice-based research is research where educational and pedagogical research of relevance to the school's development is focused on and problematized 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.

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 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 technical solutions (Pavlova, 2013). Biomimicry is an interdisciplinary discipline that examines how we humans can imitate nature's solutions to develop a sustainable design of, for example, artefacts/objects, processes, or technical systems (Benyus, 1997; Lenau, Orrù & Linkola, 2018). Imitating nature is a common design approach used by industrial companies and design education (Coccia, 2017; Han et al., 2019; Shanta & Wells, 2020). However, in primary schools, biomimicry is a relatively new approach to strengthen teaching in, and about, sustainable development. By combining technology and biology subjects, a bridge between knowledge of technological systems in urban environments and ecological systems in the forests enables new pathways for sustainability education. 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

2.1. Why map teachers' experiences and understanding of the forest and the urban area?

The purpose of gaining more knowledge of the teachers' and our own experiences and understanding of the small forest and the urban areas, is to learn about how we relate to these places personally and professionally in different ways. In doing so, we aim to deepen the capacity to teach beyond the classroom and reflect upon such teaching. The knowledge we gain (as a collective in the project) forms a foundation for the project, which we can build on in the further work of the project.

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 environments are, in contrast to the forest, areas which are not related to in the same way (Szczepanski, 2013). Urban environments are human-constructed worlds with various artefacts and technological systems that have the purpose of meeting human needs. In this project, both the urban environment and the forest are essential places, for building, through biomimicry, the bridge 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 technical systems.

3. METHOD

The collage method is inspired by Butler-Kisber's (2018) "Collage Inquiry", which can be viewed as an art-based research method. 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 these places emerge (Butler-Kisber, 2018). In addition to mapping teachers' experiences and understanding of the forest and urbanised environments, making a collage can afford affective elements such as emotions and attitudes. With the collage method, fragments from materials such as magazines,

and coloured paper of various kinds of yarn and fabric were used to visualise experiences and understanding of forests and urban environments. 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 method works here as a tool to stimulate reflection and broaden perspectives and conversations about the forest and the urban environment. The collages constitute visual documents within the practice-based research project of which this study is a part (Butler-Kisber, 2018).

3.1. Participants

The two schools participating in this study reached out to researchers at the teacher education to collaborate around teachers' professional development concerning sustainability. This interest initiated a practice-based research project. Eight teachers from the two primary schools in Gothenburg, and three researchers participated in the collage inquiry workshops. Four of the teachers were teaching students of ages 7-9 and the other four, students of ages 10-12. Both primary schools (students of ages 6-12) were diverse schools with teachers and students with Swedish as an additional language.

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.

3.2. The approach to the collage inquiry workshop

The group of teachers were divided into two workshops, 3 teachers in the first one and 4 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 experiences of the city and the forest? What are your understandings of the forest and the urban environment?* 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 environments.

3.3. Analysis

The transcriptions of video and audio recordings were analysed through thematic analysis (Braun & Clarke, 2006). Pictures of the collage together with the teachers' written descriptions and the transcribed presentations were read and reread by all three researchers to find themes that describe what experiences and understanding of the two places, the urban area, and the forest, are in the foreground of teachers' reflections in all three sources. The emerging themes were evaluated and through discussion between the authors to describe the special nature of the themes. The analysis is a work in progress and may develop with additional themes.

4. EMERGENT FINDINGS

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

4.1. 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 environment today need to be solved sustainably in the future. New technological solutions will help us in the urban environment, indicating technology positivism. John presents his collage and points at the picture of a child.

Figure 3.
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 reads her paragraph describing her experiences and understandings 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] this is 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 at home. An example is the Christmas tree then, which we go to the forest to get when we celebrate Christmas and so on and so forth.

4.2. Place dependent

The teachers describe their relations to the forest and the urban environment 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 environment, 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 2.
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, the soothing scents, the 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).

4.3. *Emotionally connected*

The theme describes teachers' emotional connections to the forest and the urban environment. Their feelings about the urban environment 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, 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 but 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 3.
Eva's collage.



5. DISCUSSION

The collage method stimulated reflections and discussions about personal as well as professional relationships with the forest and urban environment. In addition, the making of collages brought out emotions in ways that we did not expect. Coming together as teachers and researchers, reflecting, and sharing ideas through the making of collages, contributed to self-awareness and a sense of community. With the collage method, different interpretations and perspectives were made visible (Butler-Kisber, 2018). A further contribution of the study is the deepened knowledge of the teachers and our own personal and professional relationships with the places - a map that can form the basis for continued work and development of teaching for sustainable development using biomimicry as a bridge between biology and technology.

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