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SENSING NATURE: EXPERIENCE DESIGN FOR LEARNING THE INTERPLAY BETWEEN MATERIALS AND EMOTIONS

While the importance to human and planetary well-being of meaningful contact with nature has been well documented, less attention has been paid to creating educational activities that correlate emotional well-being with nature. This study is transdisciplinary research-in-practice, focusing on three main matters: human-nature connection, materials (from nature), and emotions (from humans). This project i) co-designs digital-physical learning experiences – from enquiry into sources to construction of 3D prototypes – to explore relationships between emotions and materials, ii) explores tangible and intangible tools such as meditation and natural inks, iii) investigates the effects of sensorial experiences with nature on children’s behaviour from a social and environmentally-sustainable perspective. The aim is to create meaningful learning experiences to enhance children’s understanding of themselves and of the natural world. The approach is mixed-method; the primary methods are Participatory Action Research and co-design, including workshops with educators (n=35) and children (n=80; aged 12-13), and co-creation sessions with field experts (n=11) in Psychology, Design, Education, Cognition, and Materials in Finland. The outcomes are the design and evaluation of a toolkit including i) the ab-step process and ii) guidelines for educators to implement “Emotional Nature” learning experience to explore the origins of emotions and materials. This study contributes to Finnish and global discussions in environmental education related to emotions and nature, and UNESCO’s Sustainable Development Goal 4: ‘Quality education’. It is the first stage of a broader ongoing research project called Sensing Nature.

Keywords: human-nature connection, education, well-being, sustainability, biomaterials.
INTRODUCTION

Meaningful connection with nature provides several benefits for humans’ physical and mental well-being, as well as for planetary health (Mayer, Frantz, Bruehlman-Senecal & Dolliver, 2009; Moss, 2012; Yuen & Jenkins, 2019). Nevertheless, in recent decades, opportunities for children to engage with nature during school have diminished (Moss, 2012).

Lack of engagement with natural processes has negative effects on children’s inner (emotional and mental) and outer (physical) states (Mayer, Frantz, Bruehlman-Senecal & Dolliver, 2009; Moss, 2012). This study addresses both states through the topics of emotions and materials (see Figure 1). The overall aim is to contribute to education for sustainability (UNESCO, n.d.) through cultivating a more balanced relationship between humans and nature.

The Sensing Nature project comprises four stages, including this first, “Emotional Nature”, using the framework of experience design for learning (Leinonen, 2010). Experience design is a field that acknowledges connections between various disciplines, considering different tangible and intangible aspects of the desired experience and giving meaning to the created links within a systematic approach to a solution (Leinonen, 2010; McLellan, 2000; Shedroff, 2001).

The key fields within Sensing Nature research are: sustainability, human-nature connection, education, design, materials (nature), emotions (humans), senses, cognition, and psychology (see Figure 2). The experience design for learning presented here is centred around the opportunity in Environmental Education for activities that interrelate emotions and nature (Jeronen & Jeronen 2012, emphasising the importance suchlike learning experiences for individuals’ emotional growth and connection with nature). It also builds off Dweck’s Growth Mindset learning principle (2012), which states that anyone at any age can learn and develop their capacities further. Therefore, the focus is on how to design learning experiences and facilitate those experiences for all. This paper presents the Sensing Nature’s first stage, Emotional Nature, which focuses on creating educational activities that interrelate emotions and nature for children ages 12 and 13 in urban areas of Finland.

This research explores in practice the original sources of materials and emotions. It formulates possible outcomes by bringing together various digital and physical tools that allow children to build tangible and intangible relationships between emotions and materials and to be more in touch with nature. In the first stage, I explore physical tools like metaphors, meditation, and materials, including natural inks from berries (Rueda Mejía, 2019).

Grounded in transdisciplinary research, this study includes several theory-based links among the topics of humanity, nature, emotions, and materials to convey the complexity of the design opportunity (see Figure 3). For instance, it considers the relevance of emotions in taking sustainable actions, as well as how emotions are regulated when we have the chance to sense nature through materials in the classroom (Rueda Mejia, 2019). Other such links are the process of nature becoming material (both natural and man-made), and the key use of materials for making sense of emotions and within cognitive processes (Malafouris, 2013; Rueda Mejía, 2019). Here, I present nature as the common-sense perception constructed to differentiate human from the other beings. While the project research examined other emerging concepts such as new materialism as well, these do not apply in the Sensing Nature context.
Relevance of Emotions

Nature has notable impact on emotions. Meaningful time in green spaces increases capacity for calm and resiliency (Mayer, Frantz, Bruehlman-Senecal, & Dolliver, 2009; Moss 2012, Yuen, H. & Jenkins, G., 2019). Further, emotions are a critical causal factor in the sustainability challenges we face today; studies describe how most sustainability issues are rooted in human action, mainly driven by our emotions and mental models (Goodman, 2002; Senge, 2006). For instance, when feeling sad, people shop and accumulate things to make themselves feel better. In the education context, Boler’s study discusses the challenges of dealing with emotions in school settings (Boler, 1999).

The strength of children’s meaningful contact with nature is central to the relationship between their outer and inner dimensions – their “hidden, affective world” – as noted by Moss (2012). Connecting with the hidden world – emotions through nature, can also curb and redirect children’s tendency to consume and acquire new goods. Incorporating these theories, my hypothesis is that connection with nature as the original source of natural and man-made materials may increase the incidence of humans taking emotionally resilient and environmentally sustainable actions (see Figure 4).

Relevance of Materials

Malafouris’s study (2013) focuses on the relevance of material things to our learning process and proposes how materials and things become extensions of the human mind, at the same time playing a significant role in our understanding of emotions in individual and social dimensions. In practice-based projects prior to Sensing Nature, I had the opportunity to engage in self-exploration with biomaterials, especially wood-based materials, at CHEMARTS Summer School, Aalto University (Kääriäinen, Niinimäki & Lindberg, 2017). There, I was captivated when I made the connection through my hands between different bio-based materials and nature (Rueda Mejía, 2019). For instance, while working with berries to extract their colours, I grasped the connection between inks and nature. Furthermore, I was able to observe, how experimenting with biomaterials also engendered positive emotions like joy in my classmates and me.

The Emotional Nature stage of the Sensing Nature project is organized into four cycles of mixed methods like co-design practices (Jégou & Manzini, 2008), and the Participatory Action Research approach (Kelly, 2005). The result of the research is a designed, evaluated toolkit for educators and children, composed of the 4h-step process and a learning experience for exploring the origin of emotions and materials. Each element helps participants explore the interplay between emotions and materials, as well as enhances children’s personal connection with nature for their individual well-being and engagement in sustainable behaviours.

DEVELOPMENT & FINDINGS

To provide a wider picture of the phenomenon of human-nature connections through emotions and materials, the research combines qualitative and quantitative approaches. The main methods are Participatory Action Research (PAR), questionnaires, self-explorations, intuition, and co-design methods such as workshops and co-creation sessions with experts.

The PAR method provides the general framework in engaging stakeholders during the different stages of this study, to take action and create knowledge (Kelly, 2005). It is an iterative process developed in cycles. For this stage, I organised four cycles based on the same general objective and co-design methods, each cycle with its own specific objective: i) define key stakeholders and tools, ii) validate the relevance of the experience in the Finnish educational context, iii) improve the experience with field experts, iv) test the final prototype of the learning experience and toolkit with educators, children, and field experts.

The first cycle involved designing an initial prototype of the learning experience based on an intuitive process originated in previous self-explorations, theoretical knowledge, associations, and feelings (Raami, 2015). In particular, I applied intuition for selecting the tangible and intangible tools, and organised them into four main steps to provide coherence and a sensible order for participants.
Afterwards, I implemented various co-design practices. I conducted 11 interviews with field experts, built on three open-ended questions resulting in co-creation dialogues (Rueda Mejía, 2019). Some of the areas of expertise discussed were pedagogy, psychology, cognitive neuroscience, design, craft, and material sciences. These interviews were crucial for understanding the practice context and giving the research a viable trajectory.

Alongside these interviews, I employed workshops to co-design and prototype the learning experience. I undertook six workshops (5-7 participants each) with children (n=5), educators (n=22), and design experts (n=7). Participants answered questionnaires at the workshops’ start and finish, using a 5-point Likert scale to track the progress of the designed experience.

After the workshops, participants were invited to dialogue openly about their perspectives on the selected content, tools, and steps of the learning experience in order to create meaning, uncover feelings, obtain insights and recognise patterns (Phillips, 2011; Mattelmäki, 2006). The data from the workshops, questionnaires, and dialogues were carefully analysed and discussed to draw conclusions. The key findings of the first stage of Sensing Nature are divided into the project’s two main practice objectives: i) co-design for enhancing human-nature connection; and ii) making sense of the interconnections between materials and emotions.

**Co-designing Bridges for Human-Nature Connection**

For this study, the co-design practice is crucial to contemplating multiple perspectives, providing viability to the research project, and joining the various theoretical and practical elements of the research in a coherent manner. Specifically, co-design acts as a bridge to connect people, research fields, and knowledge, as well as enhance the links between humans’ inner and outer natural worlds. One co-design example is the 4h-step process constructed through intuitive exercises and dialogues with co-creators, allowing the scientific and artistic strains of the research to merge. The 4h-step become a link between human and nature throughout: The Head step - understanding the theory; Heart step - moving to heartfelt conversation; Hands step - exploring biomaterials and possible nature sensations; and Hum step - reflecting on what participants felt and thought.

Another example is the evolution of the initial perception of the human-nature relationship as linear (see Figure 5). From the dialogues with educators and experts, another conceptualisation of the human-nature relationship arose: an enclosing sphere (see Figure 6).

In the Finnish educational context, co-design also serves to bring existing governmental guidelines and the latest academic knowledge into everyday learning activities in schools.

Specifically, it can support educators in designing learning materials and activities that incorporate others’ knowledge, as well as students’ insights and learning desires. Thus, co-design makes lessons more engaging and inclusive to the needs of each generation and to all character types in a classroom.

**Experiencing Materials Through Emotions**

Sensing and feeling materials with our hands eases the process of our understanding and connecting with their natural sources. At the beginning of the Emotional Nature Learning Experience, participants are invited to sense a bottle of plastic and a piece of wood. While touching the materials, they are also guided to remember and trace the origins of plastic and wood (see Figure 7). Plastic typically comes from fossils of prehistoric plants and animals, and wood comes from trees. While participants are touching the materials, they also feel emotionally touched (Rueda Mejía, 2019). In this way, emotions become the link between the touched material and information provided about the original sources of the materials (Malafouris, 2013; Rueda Mejía, 2019). This experience thus nurtures participants’ cognitive processes relating nature and materials.
Experiencing Emotions Through Materials

During the workshops, participants reveal how the materials, and in particular biomaterials, become a bridge between the body and mind. This created bridge supports their own process of recalling, sharing, and materialising emotional memories (Rueda Mejía, 2019). Through the activity, participants sense different materials with their hands, while sharing a previous emotional experiences (See Figures 8 and 9). Afterward, with a short guided meditation, they imagine a creature. Subsequently, they build a physical model of their emotional creature with organic materials such as paper pulp and berry inks. In this case, materials become the element that makes emotions palpable. In addition, this exercise allows participants to notice how the same emotion can be perceived in different ways, through the opportunity to visualise and listen to how other people experience it.

In implementing these workshops, I was able to observe some of the difficulties and misconceptions that exist in educational settings and that were highlighted in Boler’s study Emotions in Education (1999). For instance, the majority of educators who participated in the dialogues suggested that children are not open to sharing their emotions with others. However, during the workshops, the child participants were eager to share their emotions and listen to others’ emotional experiences.

RESULTS

The first stage of the Sensing Nature research the main results were: the Toolkit with its various materials, the 4h-step process, and the validated “Emotional Nature” Learning Experience.

Toolkit: Designed mainly for educators, the toolkit is the concrete starting point for stimulating the curiosity of educators and children alike, inviting them to take the first step into the interconnections between emotions and materials and its impact in sustainability. Some of the elements of the toolkit includes are recipe cards for using organic materials, “values cards” to create the desired atmosphere, an educators’ folder with materials and guidelines, a spoon, a fork, and a box with small containers to prepare natural inks from berries (See Figures 10 and 11).

The 4h-step process: This system is a crucial tool for educators that emerged from combining the theoretical and practical parts of the research. The steps are: i) Head – a short introduction to the learning experiences and theories of emotions and materials. ii) Heart – participants hold heartfelt conversations around the topic of emotional memories in nature, evoked by touching a plastic bottle and a piece of wood. iii) Hands – Craft activities begin with a short meditation for imagining an emotional creature based on the shared emotional memories. Participants give shape to their emotional creature with plants and wood-based materials. iv)
Hum – A final individual and group reflection on each participants’ emotional and material experiences is held for closure and to enhance their relationship with nature and their learnings around the topics of materials and emotions (See Figure 12).

The “Emotional Nature” Learning Experience: (See Figure 13). This experience was designed with the aim of creating a safe, temporary space in schools to meet and raise educators and children’s interest in exploring the topics of emotions and materials, through the combination of various tools. During the last prototype and before the validation of the learning experience, seven participants evaluated the experience from 0 (not relevant) to 10 (highly relevant). The average rating was more than 9. Thereafter, the finished prototype of the “Emotional Nature” Learning Experience design was validated in the Aalto University Junior Lab with 75 children and 6 educators from multiple fields of the Espoo International School in Finland. Some of the collaborators in the various stages of the research project commented:

“I see myself more deeply and have connected my biological body with nature.”

“I could also use this experience with my kids to understand their feelings and thoughts.”

“When I was touching wood and paper pulp I got many memories of nature.”

“This project opens a Pandora’s box; my colleague in the Department of Chemistry has been implementing more practice-based courses for teenagers at Aalto.”

“I find it gratifying that environmental education and education for sustainable development are studied and developed from this new perspective.”

Though the learning experience is designed to encourage exploration of both the topics – emotions and materials, some educators still expressed difficulties in bringing the topic of emotions to classrooms. Nevertheless, this first stage of research has not only stimulated curiosity in schoolteachers and children around both topics and their interplay, it has also inspired field experts to design their own courses for different audiences, mainly around the phenomenon of materials.

CONCLUSION

This research is the first prototype of more to come in Finland and in other locations around the globe. It has posed a unique challenge to my way of thinking and approaching design, triggering a move from certain frameworks and specific methodologies towards a multidimensional perspective that links knowledge from several fields and research methods. These new methods are based on careful and critical reading of the environment and on existing theories, as well as deep listening to co-creators, and connection to intuition.

I am particularly interested in further exploring the many tangible and intangible relationships between emotions and materials in order to connect us with nature and ourselves. My overarching aim is to achieve high-quality education (UNESCO, n.d.) and more balanced human-nature relationships. My main methods are co-design of learning environments and exploration of digital and physical tools as means to this end. The first stage was focused on exploring physical tools. The next stages will explore digital tools such as 3D printing.

As I mentioned in the introduction, a key feature of this research is its transdisciplinary perspective, which also makes it is difficult to place within a specific field. Rather, the research yields various findings and results as it develops. It is like being and learning in nature: the learnings and outcomes are many, and vary with each one of us.

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**PROTOTYPE OF A SELF-SUFFICIENT BIOFABRICATION PROTOCOL FOR REMOTE TERRITORIES**

The exploration of materiality is of fundamental importance for the processes of architecture and design. Due to the rapid development of digital manufacturing, prototyping processes today allow the manufacture of customized systems accessible to all audiences. However, not all parts of the planet have access to these technologies and standardized materials to which today’s industrial machinery and standards require them. Therefore, creating bio-manufacturing practices, where locally self-sufficiency using local materials is essential to create circular models. This fact underlines the importance of experimental materials research that connects the exploration of territories of all kinds of environments, with self-understanding and responsible use of technologies in sensitive territories, thus allowing the development of self-sufficient emerging manufacturers in extreme territories.

This work highlights the essential points in the approach to bio & eco-manufacturing by investigating the use of materials in one of the areas with the last cardinal points of the planet, Puerto Williams, Chile. The planning procedure is developed for a correct approach to the territory, as also the development of first samples of bio-composites and potential materials to work in this area. As a result of experience, this paper discusses both the technological aspects of bio-manufacturing and the social and ecological considerations involved. It also integrates cooperation within an interdisciplinary group of networked Laboratories interested in disseminating and contribute to the bio-fabrication design movement in Chile.

**Keywords:** Biofabrication, biomaterials, self-sufficiency, remote territories, open source

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