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Pre-school teaching for creative processes in education for sustainable development – invisible animal traces, purple hands, and an elk container

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ABSTRACT

Living in the anthropocene requires addressing several challenges. New forms of teaching where experiences of problem solving, creativity and innovation strategies are needed and considered important. This Swedish study contributes with knowledge on pre-school children's creativity processes when working on an authentic, child-initiated sustainability problem about consumption. Teachers' careful listening was important when forming the teaching context for the sustainability problem. A pragmatic perspective on learning and meaning-making is used to identify the significant features of the different phases in the creativity processes. The empirical results show: the importance of affording a creative context with uncoded material for children to transact with; previous experiences have a prominent role when imagining and reaching beyond the ordinary; the importance of teachers' positive aesthetic judgments for sustaining the creative process. In alignment with the idea of learning as participation, the children broadened the consumption topic to contribute with creative outcomes for animals' welfare.

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Introduction

The 'wicked' issues within the sustainability area have escalated in the era of anthropocene and will continue to trouble future generations globally and locally (Weber and Khademan 2008). Bruno Latour (2018) excavates this new, changed situation where problems loom large by describing earth as an unpredictable 'terrestrial attractor', a forceful milieu now responding by 'acting back' upon human actions. This new geological era requires creative and novel approaches and strategies in education. This is something Greene (1995) had previously elaborated on by stating that flexibility and adjustments to new, unfamiliar circumstances are relevant and urgent to address in education when dealing with complex environmental related issues. Being able to develop new habits, procedures, and strategies to purposefully handle changeability and care for others and places is indeed an educational challenge. We believe that this challenge is important to address already in Early Childhood Education (ECE). Several scholars in educational research have put forward the need for creativity (Cheng 2019; Daskolia, Dimos, and Kampylis 2012; Sandri 2013). Among educators working with children, the term creativity is often used as problem solving that involves the construction of new meaning (Cheng 2019).

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There is a need to further explore and scrutinise how to teach, and what educational affordances are considered vital, when the purpose is to contribute with new forms of teaching for sustainable development in ECE.

Recently, in a Swedish context, recommendations for including problem-solving in teaching for sustainable development have been introduced by Van Poeck and Östman (2019). They stress the teacher's responsibility in designing spaces where students' different perspectives, facts, knowledge, and values are recognised as resources when dealing with wicked problems (Weber and Khademian 2008). Others have put forward other teaching recommendations. Bob Jickling (2009) asserts that education has a responsibility to support students to come up with brave ideas with potential when working with sustainability issues. Furthermore, he stresses that robust educational systems often tend to marginalise in-between spaces where novelty and change can grow, implying that open spaces are important to arrange if the purpose is to nurse students' explorative and creative learning (cf. Rhodes 1961). To educate for improvisation is indeed challenging, as education contexts seldom are rich enough in terms of triggers and starters. Another concern addresses teacher's professionalism in practicing tentativeness and fine-tuned listening towards students' suggestions, even if they at first might seem romantic, naïve, or impossible (Jickling 2009). In fact, if those provisional ideas posed by students are refined and further elaborated on in learning loops, something new and unique might occur.

Another aspect to consider when dealing with sustainability issues is how education can support the growth of care and concerns for more than humans, as well as cultivating children's engagement with natural environments (Häggström and Schmidt 2020; Jickling and Blenkinsop 2020). Being sensitive towards others and 'learning with' species and materials in indoor and outdoor spaces has recently been empirically shown in work by Weldemariam (2020), on how preschool children deepen their learning with bees, elaborated as 'becoming-with-bees'. In his research, a question is posed that we wish to empirically contribute to in this study: 'Are we fostering creativity, or are we unintentionally stopping it while sticking to certain conventional ways of knowing and being?' (405). Furthermore, according to Olsson (2009), children have an exceptional desire for 'creative thought' (131), continuously installing themselves in the scoop of potentiality, exploring 'what if' and hence, they imagine and invent both problems and solutions. Roy (2005) notices that children's explorations often are diverse and multidimensional; there seems to be no sharp dividing line between the real and the virtual, sense and nonsense, or fact and fiction when children create meaning (Olsson 2013). An inference from this is that the teachers' responsibility in treating these explorative events of children as having merit, something new might be in creation. Accordingly, education for creativity puts emphasis on teachers' roles in terms of encouraging border crossing movements – anchored in the educational idea of 'learning as participation' (Lawy and Biesta 2006; Van Poeck and Vandenabeele 2012).

The particular interest in this study is to explore children's meaning-making processes on a project focussing on consumption and how children broaden the topic to include animals' welfare. We pay specific attention to how children's suggestions and concerns emerge in the creative process as well as targeting the creative outcomes invented. Accordingly, the purpose of this study is to contribute with knowledge on what characterises preschool teaching for sustainable development, with specific interest in creativity processes where children, teachers, the materials in use as well as the contextual features are simultaneously involved.

Background

This study is performed in a Swedish context where, according to the national curriculum, education should be 'undertaken in democratic forms and lay the foundation for a growing interest and responsibility among children for active participation in civic life and for sustainable development' (National Agency for Education, 2019, 5). Drawing on children's democratic rights,

Hägglund and Pramling Samuelsson (2009) remind us that the young generation ought to have more influence and impact on sustainability matters. Children are the ones who will invent and live the narratives of tomorrow, and 'the mission of ECE in the anthropocene should therefore be to allow and enable children to imagine and practice a good, safe, and sustainable future' (Wolff, Skarstein and Skarstein 2020, 15).

Creativity and imagination-research in education for sustainable development

Cultivating creativity conceptualised as processes of imagination with an outcome that is regarded as novel, original, and of value, has been described in education for sustainable development by Sandri (2013) and addressed by Sterling (2009) as well. The core argument conveys that human have an extraordinary ability to envision and re-envision different alternatives and solutions when encountering multi-layered problems. Sandri (2013) introduced an example of a young child who comes up with an idea in response to a sustainability-related problem, a skilful machine that rescues vulnerable baby penguins is imagined. In a study by Cheng (2011), students characterised their creative learning as a form of playful and active learning, encouraging them to think more broadly and develop their confidence, curiosity, initiative, and motivation. Creativity has also received attention in a pragmatic, empirical study on pre-school children's imagination in the field of science and sustainability education (Caiman and Lundegård 2018). The result revealed that when children, supported by the teacher, lived through imaginative processes, problem-solving on how to rescue animals from a traffic road progressed. In the flow of imagination, a wagon for lazy baby frogs, a tunnel, and finally a trampoline was invented and sketched out as potential solutions to the problem of animals dying due to human impacts.

More recently, Sundberg, Areljung, and Ottander (2019) have carried out an extensive study, building on observations in 14 pre-schools. The empirical investigations of pre-school teachers and children's joint explorations resulted in several didactic examples where teaching gave opportunities for education for sustainability. By starting from children's interests and allowing teaching intertwined with dimensions of children's lives, such as emotions, play, and physical experiences, for example, agency and empowerment could grow and expand. Also, children's play and exploration supported the development of caring, empathy, and concern for organisms. Furthermore, play and fantasy were significant dimensions in children's creative problem-solving processes. In view of these few research contributions, imagination and creativity seem to have a key role when the teaching interest is in children's creation of new knowledge as well as developing engagements for various animals. However, as stated by Sandri (2013), few empirical and theoretical contributions on the topic are carried out. In this paper, we join this debate on the importance of supporting children's concerns, and furthermore empirically strive to contribute with teaching for sustainable development with a special interest in creativity processes, as living today requires new procedures and strategies to handle uncertainty and risk. We build on Sandri's call and examine the role of imagination and creativity when preschool children explore leftover biological materials: fruit no one uses.

Multidimensional meaning-making requires fine-tuned teaching

Multidimensional meaning-making is used to describe teaching that acknowledges the multifaceted ways in which young children engage in learning; intertwining dimensions such as emotions, play, physical experiences, and aesthetic modes of expressions (Siry 2014; Siry and Brendel 2016). Such teaching has the potential to empower children and support their abilities for developing agency (Siry 2014; Caiman and Lundegård 2015). Specifically, teaching for sustainable development requires tentativeness to students' questions and concerns relevant to

their lives. Adding to this is the teaching challenge recurrently addressed; young children's meaning-making often reaches beyond merely oral language (Dahlberg and Moss 2005; Olsson 2013). Accordingly, different modes of communication, such as aesthetic and art representations, gestures, and bodily actions, are all vital to take into consideration in teaching, as well as in research, to understand what is going on in children's diverse explorations. Practicing 'radical listening' to the multidimensional ways of children's meaning-making is considered necessary to avoid marginalising children's voices and interests (Siry and Brendel 2016). Hedefalk, Almqvist, and Lundqvist (2015) also discuss this child-teacher relationship, acknowledging the professional expertise of the pre-school teacher explicitly. Their empirical study showed how the teacher cautiously, with tentativeness to children's interests, managed to guide the young learners towards certain directions without falling into a dominant, normative 'supervised teaching' (32) at the expense of children's concerns. Similarly, Hedefalk et al. (2021) exposed preschool teacher students discussion when planning education for sustainable development. On one hand, the educational purposes were underlined as the teacher's responsibility where certain content to be learned by children is regarded as vital. On the other hand, they stressed that children ought to be empowered to influence both the process and the content. Consequently, planning for teaching in early childhood education reveals a challenging balancing act, a careful selection of predefined content to be learned as well as teaching for 'content as created' (Hedefalk et al. 2021, 41). Both dimensions were considered important for development of interest and active participation for sustainable development among children.

Theoretical framework – a pragmatic perspective on meaning-making

This section presents the theory of the pragmatic perspective vital for studying children's meaning-making and creative processes. How this is operationalised into an analytical framework is described in the methodology section.

An experience – how to handle a problem

Drawing on Dewey ([1934] 1980), aesthetic experiences are significant for holistic learning and meaning-making. Hence, aesthetic experiences are expressed through positive and negative aesthetic judgments in daily life (Jakobson and Wickman 2008; Wickman 2006). A vital experience comprises emotional, intellectual, and practical dimensions interwoven, and equally imperative, enclosed by aesthetics (Dewey [1934] 1980). Based on this view on learning, Dewey maintains that when humans live through aesthetic experiences, anticipation is involved in reaching for what is yet to come. Hence, in situated meaning-making and learning processes, people continuously establish relationships to come to a closure (Dewey [1934] 1980). Hence, an experience is characterised as a dynamic rhythm in terms of a beginning, development, and closure. Accordingly, when humans create meaning, continuity and change are involved, present in the rhythm of growth (Dewey [1934] 1980). In the principle of continuity, previous experiences are reconstructed and transformed, having consequences for the actual situation and future ones. In close relation to the principle of continuity, Dewey develops the empirical method, a naturalistic description of how humans recurrently face context-dependent problems. Those problematic situations need to be handled in order to cope with the new situation. Human actions are needed to restore equilibrium (Dewey [1925] 1958). If those actions bridge the problematic situation, learning and meaning-making is said to occur, and we can continue our activities and affairs. Such experimentalism is often socially transacted with others (humans, things, forces, the environment, and so forth), but sometimes it is solely an individual affair (Dewey and Bentley [1949] 1991). Meaning-making and learning are context-dependent, contingent, as well as habitual. Habits of actions are sometimes sufficient but sometimes new forms

of actions are needed to cope with complex problems piling up. Furthermore, Dewey ([1899] 1990) discusses the importance of enlarging students' degree of freedom, supporting them in formulating and inventing their own purposes shaped by their desires and anticipations. This should not be confused with teachers' responsibilities to oversee the ultimate purpose (Dewey [1925] 1958). Based on Dewey's notion of the vitality of freedom in education, the student's purposes ought to be aligned with the overall purpose.

To imagine, a vital part in creativity processes

Notions of creativity have not received particular interest in Dewey's pragmatic writings, but the role of imagination in human conduct has been elaborated in the work *Art as experience* ([1934] 1980). Dewey explains that the process of imagination is about the 'dissolution of old objects' transformed into something new (Dewey [1925] 1958, 220). Accordingly, imagination is the forceful ability to combine and reconfigure different experiences and 'ideas that can possibly reconstruct the situation' (Garrison 1997, 96). It is worth pointing out that Dewey avoids treating imagination as a mysterious intrinsic ability hidden inside the human mind. Rather, imagination is considered a part of daily practice and life, described as a process, a movement toward possibilities; visions of what is yet to come.

Likewise, in Dewey's principle of continuity, imagination has a significant role dealing with the 'conscious adjustment of the new and the old' (Dewey [1934] 1980, 272), which in turn is intelligible by living through an aesthetic experience. When the process of imagination comes into play in the sequence of trials, we manage to intertwine the actual and the possible, and consequently, reach beyond habitual ways of acting, associated with learning something new (Garrison 1997). Furthermore, in the process of cultivating children's ethical growth, imagination is the prerequisite for ethically embracing the 'other' (human or non-human). The ability to enter someone else's position is, however, a challenging exploration as we can never experience the world from another human or non-human perspective. Hence, we can imagine what it would be like to be that other person or 'non-human'. To stress this, actualisations and transformations of previous experiences (the actual) blended with imagining (the possible) increase our possibilities to cultivate sympathetic understanding and empathy with the other (Dewey [1932] 1996).

To summarise, living in the anthropocene implies that humans (with special regards to future generations) will face various environmental challenges elaborated and described as 'wicked' problems. Situated in education, there is a call for cultivating and supporting processes of creativity, based on the conviction that imagining is an important resource when coping and handling sustainability issues (cf. Sandri 2013; Wolff, Skarstein, and Skarstein 2020). To imagine can be described as a process where familiar objects are rearranged and blended in a dynamic flux where something new emerges, and consequently, the human experience is deepened and broadened. It is appropriate to point out that fiction and facts, sense and nonsense, are all resources of equal importance in the process of imagination. In this study, we examine children's situated meaning-making and how they, supported by the teachers, imaginatively and creatively 'hands-on' wrestle with a sustainability-related problem they anticipate and are in charge of.

Methodological considerations and analytical framework

Qualitative research contributions are powerful when the specific interest is in explanations of educational processes and phenomena, in this particular situation, explanatory accounts in regard to creativity processes. This requires skills in fine tuning the context, not reducing it to external sets of variables, and hence recognising the participants' meaning-making. In light of this, awareness of the social dimension, meanings and values are put forward as having 'explanatory significance' (Maxwell 2004, 7). By following Maxwell's (2004) argumentation, we attend

to the contextual features of the sustainability-aesthetic discourse, scrutinising the relationships established in preschool activities in and outdoors, including the various recycled materials in use.

Creativity processes operationalised – a practical epistemological analysis

We adopt a qualitative analysis method, Practical Epistemology Analysis (PEA), as the method is applicable when analysing situated meaning-making and learning processes. PEA is a well-established analytical method (Kelly, McDonald, and Wickman 2012) rooted in pragmatic theory and the later works of Wittgenstein's philosophy; an epistemology taking the social dimension and the specific situations into consideration (Wickman and Östman 2002). The PEA-method is suitable when the aim is in creating specific knowledge on what characterises the different phases in the on-going meaning-making processes. PEA consists of four operational concepts: encounter, stand fast, relation, and gap (Wickman and Östman 2002). In social practices, encounters with people and the surrounding world continuously occur. Matters, humans, animals, tools, and materials, paintings, and sketches and so forth transact in the stream of life. A predefined purpose or a growth of purpose guides the participants' situated actions and have consequences for the meaning-making process in which learning occurs in the encounter (Dewey [1938] 1997). When the conversation proceeds without the participants posing questions or hesitating, the communication is analytically described as standing fast, i.e. nothing is questioned in the dialogue. However, what is standing fast might change during the process as gaps appear. A gap is visible when the interlocutors show hesitation and the conversation halts. During the process, the participants continuously construe relations to what is standing fast, and the ongoing meaning-making develops and expands. When relations are construed, gaps are said to be filled and meaning-making occurs. However, sometimes the interlocutors do not succeed in filling gaps, which then are said to be lingering, and the activity might go astray or come to a halt.

Creativity processes – from a design and innovation stance

To carry out a more profound analysis on pre-school children's creative processes and outcome, we draw on creativity and design-theory (Rhodes 1961). Accordingly, we make use of a particular creativity model where contextual aspects and the teacher's qualified participation in the different phases in the creativity process are established (Xu and Izadpanahi 2016). Originally, the model was invented for architectural co-design with students. The model consists of four dimensions needing to be considered when the purpose is to support creativity flow, both with regards to the process and the outcome (Figure 1). The four dimensions consist of the creative context – which includes the importance of setting the problem and arranging for collaborative work with material resources, preferably uncoded, i.e. not predefined but materials that can serve many purposes. The dimension of creative designer positions the child as someone with extraordinary talents worth nursing in education. The creative process includes applying dynamic teaching strategies, for example drawing, sign-making, digital narratives, role play and drama, and so forth. The teachers' participation is characterised by encouraging what the children express, uttered as positive judgements. If necessary, the teacher supports the children with facts, knowledge, and other resources but not in the initial phase of the creative process. Creative outcome is the product or final suggestion. As follows, a joint reflection phase in the end of the process focuses on two dimensions, usefulness and creativeness when highlighting the outcome formulated as two teaching questions: a) Is the idea/product somehow useful now or in the potential future when refined? and b) Is the idea/product creative in terms of news-value based on the children's experiences and knowledge? Both these aspects are necessary to apply at the end of the process. In this case, the creative context is provided with 'uncoded materials', and the shared problem is in how to sustainably handle apples left on the ground. The children

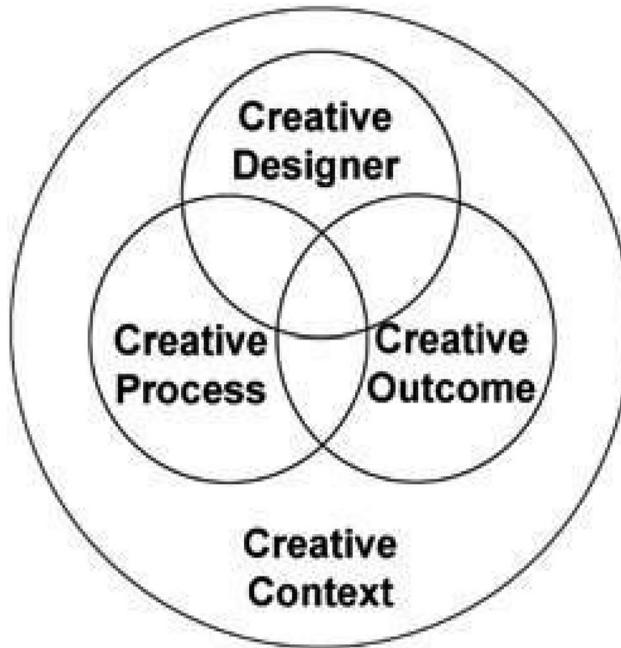


Figure 1. The model of dimensions important for stimulating creativity (Xu and Izadpanahi 2016).

are positioned as the creative designers and their ideas of solutions of the sustainable problem drove the teaching activities forward.

A pragmatic model of analysing creativity

In this study, we analyse the units corresponding to the overall purpose, i.e. what characterises preschool teaching for sustainable development with specific interest in creativity processes. To expose and analyse the different phases in children's meaning-making and the teacher's role, we adopt the analytical methods PEA (encounter, stand fast, relation and gap). First, we examine the children's actions, that is the situated meaning-making and learning process (Wickman and Östman 2002). In the next step, we use the component of the creativity model (Figure 1) to be able to target the features of creativity, regarding the creative context, creative designer, creative process and creative outcome (Xu and Izadpanahi 2016).

Procedure

This study is part of a four-year long project of didactical modelling of pre-school teaching for sustainable development, in which two researchers and five preschool teachers collaborate with a shared epistemic interest (Olin et al. 2021). Based on each partner's specific knowledge and experience, empirical studies of the preschool practice, and theoretical underpinning, didactical model(s) will be developed through several cycles, i.e. didactic modelling. The collaboration so far consists of two phases, and in each part a specific area of sustainability teaching was addressed. In the first phase, the focus was on identifying and forming authentic, and children-initiated, sustainability problems to continue to work with. In phase two, the focus was to stimulate creativity that purposefully tackle the sustainability problem. The data collection for this study concerns phase two (Table 1). The educational situations are developed in collaboration; with the preschool teachers taking the major responsibility of shaping the activities.

Table 1. Presentation of collaborative activities, and an overview of the data collection.

Phase 2 March–June 2020	Activities
Two meetings Collaboration in planning	Teaching for creativity in relation to sustainable consumption.
Implementation of teaching: One teacher (Greta) Five children	Four teaching activities performed in a mixed age group of children. Transcribed video sequences: Three hours and 55 min
Reflective meeting Researchers and preschool teachers	Reflections and discussion on the teaching performed, experiences and how teaching could develop. Audio recording of discussions.

Participants, teaching practice and data collection

The preschool chosen for this project is in a middle-sized town in Sweden. Two preschool teachers were responsible for the teaching activities in two groups of children. The consumption project started with pre-school teachers being attentive to one of the children that became aware of apples in a nearby garden in their local community. The child was a little bit troubled by the fact that the apples were still hanging on the tree, wondering why the adults did not pick them. The child's authentic problem concerning apples being wasted was the starting point for the sustainable development project, a problem that the other children at the pre-school, jointly with their teachers, explored further throughout the project. The teaching activities were video recorded (Table 1). Those video sequences correlating with the overall purpose of the study were transcribed and analysed (in total 3 h and 55 min).

Ethics/ethical considerations

The study complies with Swedish research ethics. Participation was voluntary, and we made sure to inform the children before each video recording. Their parents signed an agreement for the children to participate in the project. Participation was of course voluntary for the teachers too, and they signed agreements. All the participants have been given fabricated names.

Analysis and results

The educational affordance prepared is an aesthetic activity, a means for children to invent solutions to the child's authentic sustainability related problem with leftover apples no one uses. A small group of children (five individuals) took part but even though they are together in the group, they mostly do not cooperate verbally. The analysis and results of the meaning-making is presented as three phases in accordance with the rhythm of the teaching course of action; termed the beginning phase, the development phase, and finally, the closing phase.

Vignette 1. The beginning phase – apples, ladders, and baskets

In the following vignette, we zoom-in on the early teaching phase supervised by the teacher Ronja. Initially, the teacher poses the question based on the children's concern: 'What can you do about it, with all the apples in the trees that no one cares for?'. In doing so, she creates a venue for children to create meaning and solutions to the child's authentic 'apple problem' and to come up with ideas and solutions. The purpose of the first activity is to create posters on the topic, and the children design the posters by drawing, mainly executed by individual work. Drawing tools, water colours, and different papers are arranged, and hence, the context is imbued with art signals.

Setting the sustainable problem

The teacher Ronja and the children Rami, Robert, Rebecka and Rahin participate. The activity has just started, and they recapitulate what to do with the apples in the wooden crown. The task was to create signs for the community, to inform of sustainable ways of handling the apples.

In this encounter where the meaning-making takes place, the teacher instructs the children what they are going to do. They discuss what they did the last time and continue to discuss

		Yes, you talked about making signs [to the apples in the trees]. What would the sign show?
1.	Teacher Ronja	
2.	Robert	Ladder, use a ladder! [points to the drawing, Figure 2]
3.	Teacher Ronja	OK, and what else? Use a ladder ...
4.	Robert	... to pick the apples [points to the ladder, Figure 2]
5.	Teacher Ronja	Yes! So we got the apples down, huh? What did we say earlier? Should you buy bananas from Ecuador or pick your apples from the tree?
6.	Robert	The tree
7.	Teacher Ronja	Yes, one should pick the apples from the tree, right? Why is that?
8.	Robert	Because ... because ... it takes a long time to go to Ecuador.
9.	Teacher Ronja	Yes, it takes a long time to go to Ecuador. Then it's better to pick the apples

the sustainable problem of the left-over apples. This determines and reminds the children of their earlier solutions to the sustainable problem. As no one interrupts or shows hesitation, we can consider that this action is standing fast for the children. The teacher proceeds by posing a question, a gap concerning 'What should the sign say?' (line 1). In line 2 Robert construes a relation to the drawing ([Figure 2](#)) and utters, 'Ladder, use a ladder!' and the gap is bridged. The teacher says 'Yes, and what else?' expanding the previous gap inviting the children to be more specific regarding the sign. Another relation between the blue ladder in the drawing ([Figure 2](#)), and the act of picking apples is construed, and the idea of the sign-making is settled (line 4). The teacher continues by asking where you should get your apples; from 'Ecuador' or from the tree (in the local setting). Without hesitation Robert utters 'the tree'. As follows, the teacher poses the question 'why is that' and Robert shows uncertainty repeating 'Because...because' (line 8). A relation is constructed between 'why' and 'long time' to travel to Ecuador and the



Figure 2. Robert's poster is finished with a clarifying text. "Pick apples with a ladder so you can reach".

teacher confirms the child's explanation – the gap is bridged. Due to the teacher's participation in turn 5–9, the local sustainability problem is extended into a potential global problem – consuming fruits from abroad. Through the presented dialogue the sustainability problem and the course of action are outlined and settled. The blue ladder serves as a solution to the authentic apple-problem.

The creative process is staged with an aesthetic activity and the child's ideas serve as a motor in the teaching activity. The solution, a useful outcome, of the sustainable problem is based on Robert's previous experiences. However, the process does not result in something new or imaginative at this stage in the process, but the creative designer (Robert) is in charge of the event.

Familiar experiences – apples, ladders, and baskets

Three more posters are sketched out by three other children, exposing how various experiences are reconstructed and transformed into suggestions to the apple problem. Apples, ladders, trees, as well as baskets have a prominent role when creating solutions visible in the children's drawings (Figures 3–5). In Figure 5, one of the children's own addresses is written, a clarification where to find the apples. The drawn illustrations executed by the creative designers are concrete and attainable where familiar resources are combined, resulting in well-known, useful habits on how to take care of fruits and nature resources that are valuable. However, the experiences are not yet rearranged or combined into new outcomes, imaginations, or visions of what is yet to come. Creativeness is not yet shown.

Extending the problem: brown apples for animals

In parallel, another child, Rima draws a significant detail in her sketch, and as a consequence the field of exploration is broadened. Based on the drawing (Figure 6), Rima orally makes a distinction; 'the rotten, brown apples are for animals and the fresh apples are for humans'.

In Figure 6, the drawn illustration, executed by the creative designer (Rima), exposes lines of red and brown apples (Figure 6). Earlier experiences (of apples, a ladder, and the tree) are combined resulting in well-known, useful habits connected to self-catering of fruits, but



Figure 3. A ladder and 8 baskets with green apples



Figure 6. Rima colouring the ladder and several brown apples are depicted.

affordances of the uncoded material (fabrics, paper, colours) are supplied for the children to work with. Departing from the child's idea of giving the rotten brown apples to animals, the teacher aims for qualifying and advancing the explorative work by posing a question: 'How will the animals know how to find them [the apples]'. Different ideas are suggested by the children 'they can peek', 'they can look' or 'they can sniff'. As follows, another teaching question is raised 'can you make a sign for animals how to find the apples?' and further clarified 'but how do you make a sign for animals?'. The discussion continues and the children propose that the animals can read the text on a poster informing them where to find the apples. However, one of the children questions the animal's ability to read and the teacher reminded them that they previously talked about sniffing animals. Hence, the activity's purpose is now outlined by the teacher: 'Today you will make signs for the animals, bring out all of your imagination of how to do it'.

A 'two-senses sign'

Two children bodily and jointly fabricate an installation that seems to activate the elks' senses: seeing and smelling signs guiding the elks toward the apple recourse even if the animals cannot read (Figure 7). The result unfolds; a creative outcome, a 'two-senses-sign' that is potentially useful for elks comes into existence. A first novel prototype has been developed due to the teacher's initial question and the creative context. Noticeable, the dialogue is a bodily affair, no oral communication is going on.



Figure 7. A particular sign for elks.

Container in transformation – purple hands and a mini-door

Another child, Rebecka, explores the teacher's question on how to deal with the brown apples by sketching a solution on how to feed rabbits. The context contains different colours and papers, and the teacher observes how the drawing has taken shape and poses a question:

17.	Teacher Ronja	If s you [animals] cannot use the ladder ...are there any other ways to get in [into the container]?
18.	Rebecka	Maybe a mini door? A mini door ... Yes, that will work. If an apple starts to roll away – there's a button to open the door - and, and then maybe [inaudible] and then a hand comes out. The child begins to draw a purple hand near the bottom of the container.
19.	Rebecka:	Woops ... it became two purple hands ... well, that's OK ... If one isn't the real one – then there is an extra!
20.	Teacher Ronja	That's good.

In this encounter where the meaning-making takes place, Rebecka and the teacher are gathered around the sketch taking form. The teacher poses a question, expanding the field of inquiry '...are there any other ways to get in?' inviting the child to create more entries to the container for hungry animals. As follows, Rebecka construes a myriad of relations between previous experiences of a mini-door, apples, a button, a door, and a hand (line 18) to the posed question in line 17, and the gap is bridged in the process of imagination. In turn 19, Rebecka explains what is happening in the act of drawing by uttering 'Woops it became two purple hands'. Once again, imagination is involved visible in the utterance: 'If 'one [hand] isn't the real one then there is an extra' (line 19, [Figure 8](#)). The teacher participates in the peripheral, confirming Rebecka's improvisation with a positive, aesthetic judgement in line 20, 'that's good'.

Previous experiences are re-actualised, blended, and transformed into a new combination; the container is in change. When drawing and talking in the creative context, a skilful machine-container emerges, noticeable both in the creative process and in the creative outcome. The specialised hands set the container into motion and the whole sketched construction is transformed into a working machine capturing apples as well as serving as a storage. The solution operates in the domain of creativeness and usefulness, with potential in the future. In the flow of imagination, fiction and facts, the real and unreal, are all vital parts when something new is in creation.

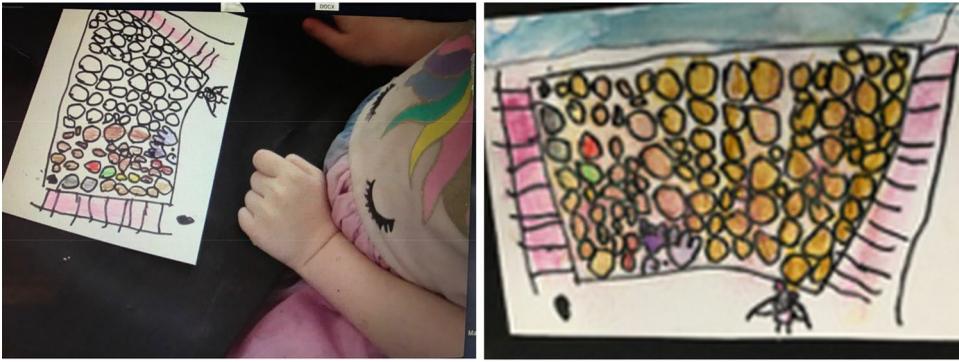


Figure 8. A container with apples, a rabbit, two pink ladders and two purple hands.

Container in transformation – different traces for different animals

Another child, Ruth, takes another course of action through the act of drawing as a response to another teacher-raised question: ‘How to guide the animals to the apple resource’. The teacher participates by listening and observing Ruth’s aesthetic work in progress. It is Ruth who opens the dialogue:

In this encounter, Ruth construes relations in line 21 and 23 between previous experiences of transparent container, small animals, adults, large container, large footprints, small footprints, and invisibility and the posed question on how to guide the animals. In the flow of imagination, the gap exposed is bridged. By creating different distinctive traces due to animals’ different

21.	Ruth	This is a transparent container for small animals. The big container is for grown-ups.
22.	Teacher Ronja	Mm
23.	Ruth	It is a lot of footprints in the picture ... the animal sees the footprints and then, they can find the way to the apples! The big footprints are for big animals. ... The small ... are invisible for the small ... for a small ... for a rabbit.
24.	Teacher Ronja	So good, really great.

sizes, invisibility, and transparency fertilise the problem-solving, and the meaning-making proceeds (Figure 9). Noticeably, handling the problem with animals’ lack of reading skills is also implicitly addressed (introduction vignette 2). Once again, the teacher participates in the peripheral and utters in the final turn, with a positive, aesthetic judgement: ‘so good, really great’, and the short process is fulfilled.

Unfolding the creative process, experiences of apples, visible and invisible footprints, small and big animals, a rabbit and a transparent container are re-actualised, blended, and transformed into something new. A creative outcome potentially useful is imagined, specified both for big and small animals.

Vignette 3. The final phase – framing the ideas outdoors

The purpose of the final activity is to support the children in realising the different creative solutions in a surrounding where animals might appear. The new outdoor environment serves as the creative context. To finally arrange the invented containers in the surrounded milieu requires bodily hands-on, tinkering work.



Figure 9. Containers for small and big animals surrounded by footprints.

Innovation put into practice

In the outdoor environment elaborated as the creative context, Rebecka refined her sketched out idea (Figure 10) by using different recycled materials. No oral communication is occurring. A particular detail, the two purple hands, are designed in spiral-wire and the container is constructed in cardboard. To finish the whole installation requires extensive tinkering and bodily work (Figure 10). Finally, the whole 'container installation' (the creative outcome) with all the details is fixed – the imagined mobile innovation is put into real practice (usefulness). Notably, three brown apples have rolled out, also arranged by the creative designer, Rebecca (Figure 10). Maybe they will be captured by the mobile purple hands creatively invented in vignette 2b?

Innovation put into practice

Ruth and Raya, working in silence, tinker with the resources designing the outdoor arrangement jointly. Visible and invisible traces are placed in a row (line 23), aiding the animals that cannot read toward the transparent bucket containing brown apples. A carrot is also put into the storage. Reaching for the closure, some cinnamon is dashed over the traces serving as smelling traces for animals; the container installation is put into use.

Stressing it, nothing significant came into existence in the final teaching phase in terms of blended combinations. The outcome though was executed and fulfilled in the outdoors, which



Figure 10. Photos of the work with the container and the placement of the container in the outdoors with rotten, brown apples.

is important if the purpose is to take children's concerns and suggestions seriously when contributing to solve sustainable consumption problem. The care for the animal's welfare finally gained real impact (usefulness) in the nearby surroundings.

The designs were fulfilled outdoors by the creative designers. Although the outcomes are useful and creative in terms of functioning containers, no significant combinations of resources are imagined when installing them in the outdoor context. However, the children being in charge of their authentic problem, developed agency and reached for real impact (usefulness) for the animal's welfare.

Summary

In the initial teaching phase, habitual ways of acting were actualised when children worked with the sustainability problems with the apples in the tree. Their drawings might be dismissed as mainly being ritual and repetitive acting (a well-known composition). On the contrary, children drawing on those familiar experiences showed to be vital preconditions to advance and participate creatively in the development phase where imagination fertilised the process, reaching beyond the ordinary. By transacting with the uncoded materials in and outdoors, as well as having teaching support characterised as making positive aesthetic judgements, the children blended the resources that resulted in new combinations; containers reaching different animals by communicating with non-reading animals. However, the reflection phase pin-pointing usefulness and creativeness was not elaborated on in the teacher- children dialogue.

Discussion

This study contributes knowledge on characteristics of pre-school teaching for creativity processes in relation to sustainability issues, something requested by many scholars (e.g. Cheng 2019; Sandri 2013; Caiman and Lundegård 2018; Sterling 2009, Weldemariam 2020). We explore the teaching of a sustainability issue, initially planned to focus on consumption, where the learning content expanded along the course of action when the children's interest broadened towards utilisation of apple resources for the animals. Similarly to Wolff, Skarstein, and Skarstein (2020), the children in this sustainable development project managed to create new narratives visible in their local surroundings. In the project, both recycling and 'upcycling' transformations emerged, something requested by Östman and Öhman (2019) when working with consumption; a true challenge of today.

The pre-school children explored sustainable consumption connected to the welfare of and concern for animals; an authentic problem owned by the children throughout the process. A finding that resonates with discussions of learning with others than humans (Jickling and Blenkinsop 2020), and is in line with the idea of 'learning as participation' put forward by Van Poeck and Vandenabeele (2012). In the early teaching phase, familiar experiences of ladders, apples, and baskets turned out to be important resources when the children sketched out posters for the public in the local society on how to take care of the left-over fruits still hanging in the trees.

Regarding the creative process specifically identified in the development phase, the teaching contexts were filled with an abundance of uncoded materials able to be blended into new combinations fertilised by imagination in the act of drawing and talking (Garrison 1997). New potential visionary outcomes were invented (Xu and Izadpanahi 2016). Hence, the children installed themselves in the zone of potentiality, as, for example in turn 19, 'woops it became two purple hands' showed that fiction and facts, sense and nonsense were blurred in the act of imagination (Olsson 2009, 2013; Caiman and Lundegård 2018; Sundberg, Areljung, and Ottander 2019). As a result, different constructions of animal feeding storage as well as an imagined working 'container-machine' emerged (Figure 9); an example of an adjustment of the 'new and the old' (Dewey [1934] 1980, 272). Furthermore, the presented possibility of becoming

'creative-with the leftover fruits and the container constructions,' imply the necessity of teaching where experimenting and exploring is treasured when aiming for the not yet known (cf. Weldemariam 2020). Put differently, when reaching for novelty and change, it is valuable that pre-school teaching supports the children to take part in forming the 'created learning content' (Hedefalk et al. 2021, 44).

In early childhood education several aspects such as embracing bodily actions, being tentative to different forms of sign-making, as well as oral communication is important to take into consideration to understand children's diverse ways of learning (Dahlberg and Moss 2005; Siry and Brendel 2016). Moreover, listening to, and supporting the young learner's anticipations and suggestions is a way to promote active citizenship in line with the idea of democracy as a form of life (Dewey 1916). Returning to the result of this study, the teacher's participation was characterised as confirming utterances in terms of positive aesthetic judgements. This made it possible for children to transact with the environment without being interrupted by the teacher. The opposite, when teachers interfere too much, have been shown to often prevent creative flows (Xu and Izadpanahi 2016). Furthermore, the closing teaching phases, that took place in and outdoors, served as open spaces suitable for the children to execute and close their mission. The containers gained impact in the forest glade, and both creativeness and usefulness were fulfilled. However, the nature materialities imbued in the forest were not creatively transacted on. As a consequence, the full potential of the creative process was not taken further outdoors. Furthermore, a joint reflection was missing during the final teaching phase, considered important in the creativity model by Xu and Izadpanahi (2016). On the other hand, the degree of seriousness and children's agency increased as well as the place-based meaning-making in terms of usefulness of the outcomes (Figure 11). The question posed by Weldemariam (2020, 405); if conventional ways of knowing and being are privileged at the expense of creativity, gain its empirical answer in this study. Our results analytically show that familiar experiences and habits, here, using ladders and baskets, are a prerequisite for nursing the creativity flow. Thus, giving time for conventional ways of acting in a creative context, can ignite creative processes. Put it differently, composition (the problem, previous experiences, well-known resources) and improvisation (blending resources into novel combinations) are significant when reaching for the extraordinary. In light of this result, the course of action can be regarded as fruitful acts of challenging habitual ways of acting (Jickling 2009). This study strengthens the message that education has an important role in supporting students to imagine and create new ideas, even if they seem naïve or impossible (Jickling 2009). As pointed out, we do not have all the answers and solutions yet (or ever will?) regarding sustainability problems. When the purpose is designing teaching for sustainable development in preschool with a particular interest in situated, creativity processes, the overall instrument, an aesthetic experience (Dewey [1934] 1980) is in focus. Accordingly, framed and shaped in the children's meaning-making process, five intertwined dimensions constituting a synthesis simultaneously serve as teaching explanatory claims (Maxwell



Figure 11. Pictures of the construction, foot-prints (hands), and the arrangement outside.

2004): Children's authentic problems - previous experiences as valuable resources - creative contexts and materials - imagination as fertiliser - teacher's positive aesthetic judgements.

Disclosure statement

No potential conflict of interest was reported by the authors.

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