

From Oil to Soil. Learning for Sustainability and Transitions within the School Garden: a project of cultural and social re-learning.

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ABSTRACT

Profound socio-environmental changes taking place at a planetary scale are threatening food security (Godfray et al., 2011), with food production located at a critical nexus between land-use, reduced availability of fossil fuels and the urgent need to reduce emissions (Harvey & Pilgrim, 2011). While debates on food security and energy transitions proliferate in the scientific literature, policy discussions continue to focus on technical solutions, "without seriously engaging with the content and social practices of education for sustainable transitions" (Bangay & Blum, 2010, p. 335). In this context, school gardens are receiving renovated attention. Drawing on current drivers in Scottish policy seeking to tackle economic disadvantage and 'close the attainment gap', this project developed as a partnership between a teacher education institution, a non-governmental organisation, a city council planning and infrastructure department, and three primary schools in three regeneration areas of a city. Data were collected through a semi-ethnographic approach incorporating qualitative data obtained through observation schedules; visual data and interviews with teachers and pupils over the course of the project. By adopting a socio-material approach to the analysis, findings articulate the significant changes in both discourses and practices of learning associated with school gardening. Beyond the use of gardens as a context for delivering curricular outcomes and/or acquiring practical skills, tending to the gardens and growing food showed to contribute to the formulation of a learning aesthetics which foregrounds the centrality of the body in learning; acknowledges the living state of materials and positions children's actions as a way of being and becoming in the world.

Keywords: *relational-materiality, food gardens, intra-action, embodied cognition*

INTRODUCTION

Profound socio-environmental changes taking place at a planetary scale are threatening food security (Godfray et al., 2011). As noted by the Food and Agricultural Organisation, "climate change, increased demand for food, rising food prices, higher fuel input costs and loss of agricultural skills and human resources" (FAO, 2010, p7) are key issues which are calling for multi-levelled actions across multiple sectors. In the UK, estimates since 2014 suggest that around 10% to 15% of people aged 15 or over were moderately to severely food insecure (The Scottish Government, 2012), with evidence linking poor physical health with social, economic and educational inequalities (Pirrie & Hockings, 2012; Public Health England, 2014). More recently, food insecurity has also been linked to, obesity and sedentary lifestyles (Kaur et al., 2015; Smith, 2016; Nettle, 2016).

Equitable access to quality nutrition is central to children's well-being, with pertinence to several of the United Nations Sustainable Development Goals (e.g. Goal 2: Zero Hunger through increased access to healthy food; Goal 3: Good Health and Well-being and Goal 4: Quality Education). Enabling communities to develop necessary skills and knowledge about nutrition and food growing can thus be a powerful means

for addressing inclusive urbanisation (Goal 11), as well as responsible consumption and production (Goal 12), for a more prosperous and sustainable society (Bangay & Bloom, 2010).

School gardens, we suggest, offer such an opportunity. While there are many initiatives in schools which have focussed on food education and healthy eating, the emphasis on 'quick fixes' and regulatory approaches has made it impermeable to everyday practices and curriculum, often missing the link between better nutrition for individuals and the global sustainability of food systems. We argue that food growing in school gardens may drive forward a different perspective on pedagogy, and one which can speak directly to the current scenario of socio-economic transitions. In this view, schools are put forward as 'spaces for growth' in the vital sense of *grounding* our human lives more closely to the soil, upon which we physically, socially and ecologically depend. Drawing upon the 'corporeal turn' in social theory (Iverson, 2012), in combination with studies from philosophy of cognition and outdoor learning (Affifi, 2017; Gray and Colucci-Gray, 2018), this paper will extend theoretical and empirical understandings of food growing in school gardens as a pedagogical practice, offering a tangible and timely contribution to current discourses of sustainable transitions.

SCHOOL GARDENS

Recent years have seen a growth of initiatives seeking to promote food growing in communities as a means to tackle poverty and malnutrition and teach people about the origins and qualities of food (The Guardian, 2017). The revival of community gardening has been associated with 'sustainable transitions', as a form of collective engagement to reduce carbon emissions and increase equality. In this context, gardening has been associated with a renovated emphasis on addressing real-life concerns and taking collective actions, also in education. As stated by Green & Duhn (2015):

"...the international renewal and redefining of food and agricultural literacy in schools through gardening is now identified as one of the key influences for increasing children's food consciousness and for rejuvenating children's relationship with fresh food (p.61)

Children and young people's participation in school gardens has been associated with nutritional awareness, increase in vegetable uptake and general appreciation of diverse, healthy foods (Gibbs et al., 2013; Nury, Sarti, Dijkstra, Seidell, & Dedding, 2017). More recently, studies have focussed on well-being through learning outdoors (Dyg & Wistoft, 2018) along with improved motivation to study science subjects (Passy, Morris, & Reed, 2010), with benefits most readily traced in groups which do not normally enjoy classroom activities (Ohly et al., 2016; Bucher, 2017). Food growing relate to a myriad of themes; from intercultural education (Cutter-Mackenzie, 2009) to ethics, with studies pointing to food growing as a driver for community cohesion and intergenerational equity (Dutta & Chandrasekaran, 2017).

Such renovated interest in food growing in school gardens resonates with current trends in the field of science education. Contributions from critical theorists and post-colonial studies, have emphasised the need for a science and technological education which responds to community needs (Bencze & Alsop, 2014). In addition, contributions from environmental education and childhood studies have evidenced significant links between childhood nature experiences and the ability to position oneself in reciprocal relationship to the wider world (Waite, Goodenough, Norris, & Puttick, 2016; Gray & Sosu, 2018). Hence, such wealth of international studies is suggestive of a growing awareness of the role that communities - including schools - should play in responding to global socio-environmental changes and measuring progress towards International targets and goals (Zalasiewicz, Williams, Steffen, & Crutzen, 2010). Yet, as reported by Ralston (2011), there are more fundamental questions to consider, which pertain to the purposes of education, and thus the wider social and political role of food gardens within the everyday practices of learning and teaching in school.

Notably, the community studies scholar Mary B. Pudup (2008), pointed to a 're-occurring' of interest in food growing throughout American history, that she associated with social change at the urban/rural intersection, variations in the subsistence economy of families and changing understandings of plant-human relationships. Thus, food gardening is critically located at the nexus between nature and culture and can be viewed as a means to better understand "*the relationships between the kinds of spaces we occupy on a daily basis, and the wild spaces that environmental ethics most want us to protect*" (King, 2010, p.4). Such observations move attention away from evaluations targeting the positive effects of gardening on children's health or in the absorption of carbon dioxide, thus reducing gardening to a

compensatory/remedial action for wider social problems. Rather, in line with Ralston (2011), we seek to enable greater understanding of gardening as a 'relational' assemblage of humans and non-humans, a space of unfolding *capabilities* that are cognitive, physical, social and discursive, bringing forth both new realities and ways of being, and new forms of knowledge. Central to this shift is a renovated and radical appraisal of the body and materiality in pedagogical practice, to expose and re-orient the workings of power and agency in the socio-ecological space.

THE 'CORPOREAL' TURN IN EDUCATION

From a curriculum perspective, food growing in school gardens can be defined as interdisciplinary learning, bringing disciplines to bear upon, for example, the science of biological growth, the physics of energy and materials, the cultural practices of selecting and sharing seeds. All these elements also pertain to other, cross-cutting areas of education, such as outdoor learning, place responsive pedagogies (Mannion, Fenwick, & Uynch, 2013), and citizenship education, which have featured in school curricula internationally for many years. Yet there has been ongoing discussion about how they might be brought together as a unified pedagogy, to elicit greater dialogue between science education, environmental education and sustainability education (Colucci-Gray et al., 2006; Mannion, 2019). Arguably, a tension exists in modernist educational reforms, between curricular expectations largely emphasising the delivery of content - whereby 'learning gardens' (Dilafruz, 2015) like other 'innovative' interventions are used as a means to specified ends; and action-based implementations, focusing instead on current relevant problems and practical experiences.

Such tension has been widely reported in the field of sustainability education, since the seminal work of Stephen Sterling (2001) based on the concept of *nesting systems*. In this view, education is a system of knowledge, values and practices which can be understood as part of a hierarchy of cultural systems, where the bigger context "shapes, limits and gives meaning to the smaller parts" (Sterling, 2001, p. 31). Using this insight, educational change will always be framed within larger, social and material practices associated with resource use and community structures. For example, in current times, the oil-fuelled economic expansion of Western societies of the past 100 years has given rise to a discourse of commodification and consumption of both knowledge and resources, human and non-human. As captured by Ivan Illich:

"[...] that learning and the growth of cognitive capacity require a process of consumption of services presented in an industrial, planned, professional form; that learning is a thing rather than an activity. A thing that can be amassed and measured, the possession of which is a measure of the productivity of the individual within the society. That is, of his social value. (Illich, 1975, quoted by Gajardo, 1993: 715)

Commodified ideas of knowledge are well rooted into representationalist views of knowledge, dating back to the enlightenment period, resting on the assumption that the world can be described, manipulated and measured by a human agency entirely external to it. Hence, in a similar fashion, knowledge can be accumulated and transferred to the minds of the young - as if through a vertical line descending towards the empty minds of those deemed to be the least 'knowledgeable'. Drawing on Bernstein's concept of 'code' (1974), Ivinson (2012) describes pedagogies as powerful devices for overturning the structures which presume that a divide exists between those who 'know' and those who 'do not know', a power relationship which is reflected in many areas of society, across genders and socio-economic classes. Emblematic of such divide is the privileged place given to the abstract codes of formal education - seeking to represent the world within the restricted language of academic communities - and verbal, experiential codes associated with common, practical, everyday experiences. Children do not have access to the 'experts' who produce texts and codes; and children from poorer backgrounds even less so, for the production of formal language relates to who has '*control of what can be thought and taught in society*' (Ivinson, 2012, p. 491).

Taking this analysis further, theoretical insights developed in different fields - from phenomenology of cognition, enactivism to new materialist philosophies - have emerged in rejection of representational ideas

of the mind, by advancing a view on knowledge and learning grounded in active engagement in the world¹. Early phenomenological accounts of cognition (Merleau-Ponty, 1968) point to the centrality of the 'corporeal and perceptual' experience in 'making sense' of our being and becoming in the world. As suggested by Dahlin, Østergaard, & Hugo (2009):

"the ontological primacy of the perceptual lifeworld must replace that of abstract scientific models; the epistemological primacy of attentive practice must replace that of conceptual cognition; and the pedagogical primacy of cultivating competencies must replace that of imparting ready-made knowledge." (Dahlin et al., 2009, p.185)

This view asserts the primacy of the *sensorium* as a prime locus of cognition, and bodily movement as central to the development of identity and the self, reflecting well-known biological principles such as autopoiesis (Maturana & Varela, 1987) and the constitutive co-ingredience (Anderson, 2004) of organisms and environments. Such understandings have important ontological repercussions, for all organisms are viewed as nexuses of ongoing relationships and transformations of energy and materials, asserting the centrality of the body in knowing and in learning. As explained by Affii (2017), the ability to perceive the world -by making cognitive distinctions and responses - "are wrapped up together" as the organism coordinates its ongoing relationship with its internal and external environment. This understanding of learning as 'embodied' breaks down the boundaries between biology - as largely concerned with material processes, and education, as concerned with symbolic and computational understanding. Most importantly, it recognises that learning is not the unique prerogative of human beings, but it is viewed as part of a complex and dynamic, socio-material endeavour, a heterogeneous 'assemblage', whereby each part has the expressive capacity to affect and be affected by each other (Mannion, 2019). In the context of this study, the exploration of the learning processes occurring in the gardens will thus require a detailed examination of relational phenomena, and the ways in which the '*somatic and the semiotic*' become central to questions of power and socio-ecological justice (Evans, Davies and Rich, 2010).

Fundamentally, adopting such relational focus means sharing in the sensorial and embodied experience of the children as part of the relational assemblage, generating what Uatham (2003) describes as a kind of 'intuitive knowledge. that is - profoundly practical' (*ibid*, p. 2001). This research stance is opposed to researchers (or teachers) acting as a bystander, seeking to describe what is being said against a set of preconceived outcomes, foregrounding instead the relational knowledge that emerges at the interface between subject and object; human and non-human. Such perspective however may not be easily accommodated within formal schooling, concerned with the transfer of knowledge and curriculum, beyond local experiences. A second level of analysis is thus required to understand the place of food growing in school gardens as part of a the more radical shift in education towards an ecological view. To this purpose, we draw upon the insights of feminist, new materialism and the work of Karen Barad to keep widening our gaze, linguistically and discursively from a position which focuses on children (and nature more generally) as 'external' to the reality of schooling to "*matters of practices/ doings/actions*" (Barad, 2003, p. 802). In this view, language is not subsumed to thought; instead it arises from the movement of a thinking and feeling body. Such body is both sustained by and becoming with the material context, as the apparatus which perceives *with*, act *with* and *think with* the materiality of gardens. Such relationship between body and materials is one of reciprocity and as Barad continues: "*the relationship between the material and the discursive is one of mutual entailment*" (Barad, 2007, p. 152).

Such recognition will also entail that the agency of the children's bodies in the garden is not confined to specific meanings for single individuals; rather, it is a *public act*, for the performance of the body in space-time relations is part of a "*phenomena in ongoing materialization*" (p.151): a reality that comes into being and one that comes *to matter* for all those involved, in an entanglement of material bodies, seeking to transcend original, distinctions between nature and culture, children and adults, inside or outside. Within this framework, our attention was specifically focussed on exploring the material 'doings' of children and

¹As reported by Mannion {2019}, and echoed also by Affii {2017}, relational ontologies have characterised a number of different theoretical approaches which have been developed at different times, by different theorists, in different contexts. It is not our intention here to offer a synthesis or a detailed account of the different positions. Instead, our focus is on drawing upon the notion of 'relationality' to explore children's learning as active engagement in the world.

gardens, and '*what comes to be valued*' as learning in the educational setting. Such focus was captured by two research questions guiding the study:

1. How are ecological relationships 'enacted' - through practical, sensorial and cognitive processes - in the garden space?
2. In what ways do school gardens come to matter in the educational space of the school?

THE SCOTTISH CONTEXT

As reported by other contributors to this issue (see Christie et al. 2019), with the acceptance of the 31 recommendations of the 'One Planet School Report', the Scottish Government expressed a commitment to Uearning for Sustainability, as a framework bringing together health and well-being, outdoor learning and global citizenship as central, cross-cutting themes in the Scottish curriculum. Alongside Uearning for Sustainability, Scottish education features a national framework for inclusion, promoting equity and social justice as a statement of intents to permeate the entire educational provision (Pantie & Florian, 2015). Critical analyses of Scottish educational policy however have pointed to tenacious inconsistencies between the aims espoused at the macro-level and teachers' practices on the ground (Menter, 2018), which are seen as reflective of discursive gaps in the globalised discourse, between what is promoted and what is being valued - *what matters*. So, while a clear focus on children's well-being is visible in Scottish education policy, persistent issues of inequality of inputs and misrecognition of children's social experiences remain, with authors calling for new sets of guidewires for bridging pedagogy with authentic participation in learning (McCluskey, 2017)

Within the current policy context, this paper reports on an experience of food growing in three primary schools located in areas of high deprivation in the city of Aberdeen, in the North-East of Scotland. Originally a fishing and trading port, with approximately 200,000 inhabitants to date, Aberdeen built a burgeoning economy upon the oil and gas extraction industry of the North Sea gaining the title of 'Oil capital of Europe'. In recent years, the city has seen the departure of the richer, international population leaving behind redundant infrastructures and rising unemployment, the city's history being an emblematic case of the social and environmental challenges associated with energy transitions. It is in this context of shifting value perceptions about economic development and its social impacts, that the garden project developed. The study is presented here as a 'case' defined by the geographical location and three schools which did not display particular attitudes towards gardening, apart from the desire to find ways to engage pupils and meet their needs. The study is thus presented here as an 'illustrative case' with the aim of contributing to the wider debate around questions of learning and action at times of transition.

RATIONALE FOR THE PROJECT

The project developed as a partnership between a teacher education institution, a non-governmental organisation, a city council planning and infrastructure department, which provided financial support and access to the council services (waste and recycling; parks and green spaces), and five teachers from three selected primary schools. The research team involved in the project consisted of two academic staff and two PhD students, plus the chairman of a voluntary organisation which had an involvement in supporting initiatives of food growing across the city. As a key condition of funding offered by the City Council, the schools were to be chosen from three different parts of the city, with each area being overall in the 2nd Decile of the Scottish Index of Multiple Deprivation, all in the 1st Decile for Education and Crime and one in the first decile for health, with the other two in the 2nd decile. All three schools were located amongst the most deprived areas in Scotland as measured in the Scottish Index of multiple Deprivation (Scottish Government, 2016). Preliminary enquiries were sent to the Headteachers in schools in each of the three identified areas to scope the level of interest. Following site visits and discussion with headteachers in a number of schools, the three pilot schools were selected based on geographical location and ease of accessibility for the team, willingness of the staff to be involved, and space available in the school grounds. 5 classes of 8-9 years old children in total took part in the project. The project lasted for most of the school year, from November 2017 to July 2018. Over the course of the year, the team met and communicated regularly with the teachers and visited the schools on a regular basis to offer practical help in the garden - for two of the schools, planters were built from scratch - and developing educational materials for classroom use.

An illustrative case

A semi-ethnographic approach was adopted for the collection and analysis of the data. As a whole team, we all engaged in regular observations in class and outside, amounting to around 20 hours of researcher engagement per class. Observations were recorded through field-note taking, short-video-clips and photographic documentation of the activities, on a fortnightly basis over the course of the school year. In order to capture the unfolding experience of the children through their sensory involvement, visual data was gathered along with detailed notes to capture the context and physical environment within which the activities took place, varying from classroom setting to school grounds in a variety of temperatures and weathers, rain or shine. The team interacted regularly with the children and teachers and towards the end of the school year, focus groups with children were undertaken along with "in the garden" interviews with teachers (Anderson, 2004). The interviews were transcribed and analysed. Ethical permission was granted by the University of Aberdeen and consent was sought for the use of pictures and quotation from all children and the teachers.

Our analysis was informed by approaches described in new materialist ontologies where human agency is de-privileged and the focus is rather placed upon how "assemblages of the animate and inanimate together produce the world" (Fox & Alldred, 2015, p.399). We thus shift from ideas where agency is tied to human action, and social inquiry is predicated on humans and their bodies to, instead, one which examines how "relational networks or assemblages of animate and inanimate affect and are affected" (ibid). The argument in new materialism is, essentially, that if people, places and materials are entangled and continuously becoming, we need an approach that is different from those that look only at the human subject as the centre, we need a relational approach that focuses on the agential capacity of non-human matter (Mannion, 2019). In this study such a focus allows us, as it did with Green and Duhn (2015, p60), to "*focus on the agential capacity of non-human forces as a way of producing different knowledge about children's garden experiences.*" Hence, we are at pains to clarify that this work is presented as a descriptive case, with the purpose of exploring children's sensorial learning occurring in the gardens, and the reality that came into being, as opposed to tracking or demonstrating the effectiveness of an intervention on given targets. In this vein, we draw upon the contribution of case-study analysis as described in the field of public relations (Stacks, 2013), to enable ourselves and others to view a situation from a different point of view. By drawing on the theoretical insights of new materialist approaches we aim to explore data according to a relational perspective, one which does not isolate children, but sees them as 'becoming' in a relational context. A naturalistic approach guided the selection of the data to provide examples which follows closely the timeline of the project through the growing season. In what follows, an enactivist account of the findings will be presented to describe the changing nature of relationships among teachers, children and the materiality of the garden space.

Cartesian triad

Drawing on observational data, the early phases of project planning involved a series of visits to the school grounds. All three schools selected for the pilot project were characterised by large areas of concrete, used partly for staff parking and for children's outdoor games. Two of the schools featured areas covered entirely with grass, regularly punctuated by foil wrappers; while one of the schools presented a large garden, which had been formerly created by the charitable portfolio of a local oil company. The garden was still exhibiting a small pond and pots with a large variety of aromatic herbs, but now in complete misuse.

In the initial stages, reflections involved the nature of the school-community links; in all three schools, acts of vandalism to the building and playground equipment (purchased with the recent award of Government funding through the pupils' equity fund) were a regular occurrence. The community around the school comprised largely white, Scottish people with some Polish groups, with only one of the schools having hosted a potato growing event with a local community group in the past. At the start of the project, the school grounds and the school buildings appeared as distinct units, offering classical examples of the Cartesian epistemology and its triadic structure including formal language (e.g. the curriculum transferred indoors), knowers and things (Barad, 2003). The grounds were largely an inert space for children to exert their physical agency - *to let off steam* - or to perform the 'Daily Mile' (part of the recent government's

policy on health and well-being; Chesham et al., 2018). From a knowledge point of view, an inherent distinction was evidently set between subject and object, knower and what is to be known.

Further to the initial visit, the team focussed on the garden design phase, in collaboration with teachers and pupils. In this phase, observational and interview data, along with selected photographs, are used to illustrate the development of embodied awareness and the intra-active exchanges taking place in the garden.

Developing embodied awareness

After the initial observations of the school grounds, children were informed about the garden project by their teachers. When we visited the classrooms to talk to the children directly, they all welcome the idea with smiles, questions and a sense of expectation, as this was a new activity for them. However, with the garden spaces not being in place yet, and the one, existing garden requiring some substantial maintenance before it was fit for use, some preparatory activities were required, including designing of the garden and planning for planting, in which children were directly involved. Then, once the raised beds and planters were in place, the larger, raised beds were used for potatoes, while the smaller beds were divided into what are known as "square foot gardens". In this way, every child in the class had responsibility for their own square foot garden, and the plants that were grown in that space. While this was essentially a pragmatic strategy, designed to ensure that all children were fully involved and to increase the range of produce, the individual allocation turned out to have significance in the development of the children's affective engagement with the garden.

So, the prime objective of the educational work was to foreground children's sensorial awareness, as a mode of knowing in everyday experiences. At first, teachers raised concerns about children's behaviour: in all three classes a significant amount of time was spent by the teachers to manage the children to 'sit and listen' and to 'get in line' in the classroom space. There were doubts that the children were going to behave themselves while outside, especially with the absence of a garden that was 'yet to be put in place'. So, in the first instance, we focussed on getting children to familiarise themselves with some key biological processes, such as life in the soil, composting and germination. For example, as part of the activity on composting the children engaged in a role play activity, in which each child participating took on the role of a vegetable extracting nutrients from the soil:

"Their fingers served as roots which they used to pick the bottle tops, as nutrients from the soil. Cabbage dipped his fingers in the soil and picked some bottle tops". (R3, notes)

Each child (playing either a vegetable, the sun or the weather) took it in turn to play their actions, such as taking nutrients from the soil, as noted:

"When potato dipped her hand in the soil and could find only one bottle top she exclaimed, oh no, the nutrients are all finished". (R3 notes)

Role-playing was used to engage children in a performance that challenged the initial and existing separation between humans and non-humans. The experiential activity initiated some discussion about what was in the soil, what is a nutrient' for whom, and where they come from, as well as the necessity of 'putting nutrients back' into the soil by using compost. Role-play in a science education context is relatively common, and it is often used to 'represent' or 'model' dynamic processes. However, in this context the act of performing was used to draw children's sensorial attention to soil and legitimise it discursively in the classroom as a "go-to" place for nutrition and sustenance, in a way the child may not normally experience in an urbanised context. Directing attention was the prime objective, as opposed to the more common representation of a food-web to memorise abstract processes or the names of particular organisms. Besides, the embodied performance using everyday objects of consumption, such as fizzy drinks bottles and caps, drew attention to what Barad (2007) termed as 'intra-actions', to refer to the mutual co-production of the children's internal and external environments. In this case, the soil emerges as relational space, a phenomena understood in its *becoming*, not as a thing that can be described by exclusively intrinsic characteristics, and that exists as separate from the children.

Sensorial intra-actions

As we might anticipate the sensorial aspects of gardening were central to the experiences of the children. All five main senses were engaged, sight, sound, taste, touch and smell in a variety of ways.

"I loved it like a very...like our very first taster when we got the lettuce, and the red lettuce, and the radishes and all that, I loved that" (Focus group, 1T)

The physicality of touching and working the soil, handling the tools and feeling the growth of the plants was an important part of the experience for the children. Figure 1 offers just three examples of the hands of the children, capable and flexible in their movements, as they reach for and tend to the plants. The highly sensitive palm is stretched to feel a response; in such doing however, the response is immediate, it is the feeling itself, which generates other embodied responses. In this sense, we are not seeing the dexterous hands of the children as implementing pre-ordained gardening training instructions from the mind; instead, it is 'touch' which emerges as the primary, relational force of the human and non-human assemblage. When asked if and why they liked to work in the garden, one child stated:

"Because you get to interact with loads of plants, and touch the seeds, and you get choices, you don't have to just one thing, you get to choose what you want to do" (Focus group, 1W)

While another child in the same class, when asked about what they had learned said:

"[we learned]...like how to plant them carefully, and not just go, oh yeah, like, there's a hole and just shove it in. You do it nice and gentle." (Focus group, 1W)

Children and plant come together *"for an intense moment in time where individual learning is superseded by the coming together of forces and forms"* (Green & Duhn, 2015, p.66). Such a scene was replicated in many instances with the use of tools, the construction of the trellis for the pea plants, the weeding and watering, all moments where material engagements involved the plant as much if not more than the individual child's actions.



FIGURE 1: INTRA-ACTIVITY BETWEEN CHILDREN AND THE PLANTS

Using the words of Barad (2003), through the "intra-action" we could see the children and the garden in a process of "becoming" together and asserting new forms of causalities and agency in the educational space.

Affective relationships

Throughout the experience of the gardens the children showed affective modalities which had been rarely seen inside the classroom. As the months went on, children became increasingly concerned about the well-being of the plants and expressed the need/desire for 'going outside'. The 'garden project' had been timetabled for 1 hour a week for each class; yet, as the temperature rose, the plants were calling to be watered more frequently, and the weeds grew more vigorously too. The teachers had to respond to the situation by attending to the urgency of the children's requests, as observed by one of the teachers:

"It's been good like watching them just take ownership for something as well and they're very protective about it, and they're constantly reminding me, you know, it's Monday, we need to go out, we need to water our garden." (Teacher, School 2)

The children called for a strategy to water the plants more effectively as none of the schools had a pump and hose; recycled milk bottles were made into 'watering cans'. Children were divided in groups, each one taking care for their own planter. While many children loved the physicality of movement, we also noted that some children spent time observing, contemplating, gently touching and communicating with their plants, for extended periods of time: different ways of developing affective relationships. While standing in the gardens with the children, one member of the team caught sight of the girl in the picture (Figure 2), who appeared to be particularly drawn to the leaves of her lettuce plant. Crouching on her knees, she entered into an almost contemplative state of equanimity. If she is communicating with the plant, that moment also appeared as if the lettuce reciprocated that communication. Empathy and a sense of care are visible; yet such ideas are not given as instructional 'inputs' feeding through the head, as if the body was external to it. Rather, the body was immersed in the material space, where knowledge is co-produced with values.



FIGURE 2: AFFECTIVE RELATIONSHIPS

Response-ability

Within the relational space of the gardens, new discourses started to emerge. Children expressed growing attachment to gardening, a practice that they wished to replicate and continue elsewhere:

"I'm going to replant these at my home";

In the words of Barad (2007), an 'agential cut' has occurred. The plant is isolated from the new assemblage of children and growing processes yet retaining its association with the school experience. As we saw it at the beginning, a line of separation between classroom and the outside and children and schools was culturally and physically demarcated. Similarly, 'agential cuts' were also exposed while being in the garden, as the children were 'paying attention' to other species, learning about them and feeling their somatic states of being and living (Figure 3).



FIGURE 3: HOLDING THE FROG

The holding of a frog is just enough to keep it safe and show it to others; in so doing, the child was also exerting public agency, isolating from the new assemblage something that 'came to matter' to all of us standing there with the children. According to Greenhough & Roe (2010) drawing on Haraway's notion of companion species (Haraway, 1997), this attention to the 'performance of bodies' and 'when bodies meet' marks a sharp departure from more conventional bioethics discourses and practices. The child holding the frog is not 'speaking for the frog' but he is involved in an act of somatic sharing which "*demands more than representation, it demands active co-presencing*" (p. 44). During the focus groups with the children at the end of the project, one of the comments made did indeed relate to the frogs:

"Because like it's good for nature and frogs, 'cause I think a lot of frogs have gone, and that can keep them like living, but like the dry ones, well they do go into water sometimes, maybe, but they...the ones that like being in water, it's good for them 'cause like they know...so like they don't die". (Focus group, 2T).

It is from the somatic stance that Haraway (1997) developed the concept of 'response-ability', a recognition that one's/our way of being is dependent on the lives and well-being of others. From this perspective, we see that children recognised the wide-ranging, material implications for themselves and others in the school:

I think we did the garden to help the dinner ladies inside the school, and to also make food for the children... It's healthy, and nice and that." (Focus group, 2T)

"...if we have a garden and it just makes a huge...more possibilities" (Focus group, 1T)

These examples provide an insight into the way in which materiality plays a role in pedagogical practice in a way which is not normally recognised in classroom teaching. In conventional cognitive learning theories, the child sits apart from the object, and the learning is primarily an anthropocentric and logocentric phenomenon (Uenz Taguchi, 2011). While the child is located 'at the centre', language as 'words' is deemed to be the primary conduit for learning. Reflecting on Barad's concept of "intra-activity", the materiality of gardening acts in a very different way from what is traditionally conceived of in more familiar socio-constructivist perspectives. Here, the garden is 'becoming with' the children, and the process of learning is shared amongst all the materials intra-acted with. This is very similar to Dewey's idea of *transaction*, which is compared with intra-action by Hammarstrom, (2010): "*In a transactional perspective there is no basic differentiation of subject and object, no knower to confront what is known... a thing is not something static, but always in action.*" (Hammarstrom, 2010, p.4). It is in this sense that we started to see the transcending of the Cartesian divide in the educational space: from a situation which identifies children as the agents of tomorrow, to a process of response-ability unfolding today in the garden space.

Reconfiguring the material-discursive

So, to paraphrase Barad (2007), matter 'comes to matter' for the children; yet in a way which was not obviously evident to the teachers. The inside/outside boundary, and the idea that going outside is a way to retract from the work of learning, was still prevalent in the teachers' discourse:

"For some...they just enjoy it because it's being outside rather than actually, you know getting involved". (Teacher, School 2)

Conversely, the children expressed a different idea of learning, by recognising the importance of 'feeling well' while gardening and while being at school:

"it lets you plant your own things and just you get to express yourself"; (Focus group 2T)

"to just get everything off your mind and just do gardening"; (Focus group 2T)

It was also interesting to observe how the regulative discourse of the curriculum - defining what children 'need to know and be able to do' - both clashed and coalesced with the children's instructional discourse. While teachers expressly recognised formal connection between the garden experience and formal instruction:

"The project links in with eating and nutrition, the designing was maths and science, learning about germination, it all linked in with our science curriculum" (Teacher, School 1)

- the children articulated the relationship they had with the plants they tended, drawing out their sensory experience of coming close to something new, which affected them directly:

"The radish was lovely" (Focus group, 1B)

"I did not like the salad" (R3, notes)

and the tangible and material causal effects which affect and make life possible:

"My lettuce died" (Focus group, 1B)

"...my flowers broke!"(Focus group, 2W)

"Someone stepped on C's cucumbers." (Focus group, 1W)

"I think my carrots aren't going to grow." ((Focus group, 1W)

Through the children's own noticing of life events, the relational garden space offers a genuine point of conjunction and coalescence of 'action', 'speech' and 'language', in which "culture and biology are multiply interpolated to form assemblages that unfold in time" (Ivinson, 2016, p.503). It is in this sense that the gardens respond to social inequities, inclusion and inequalities: by allowing for multiple literacies to grow and unfold: *"the garden is fun. It's a fun thing to do as well, doing like writing or something"*. (Focus group, 1B)

Teacher Learning

As the project developed, considerable learning took place on the part of the teachers. While some of the teachers indicated an interest in gardening, this tended to be quite occasional and low level:

"No, it's something I'd like to be interested in, but I don't have one, so I've never really gardened." (Teacher 1a, School 1)

"No, because I live in a flat, so, we don't have a garden. Not really, I like getting, like, a nice bunch of flowers, but that's about it." (Teacher, School 2)

Only one of the teachers out of five had some prior experience, although it was outside her teaching remit:

"...In my last school I worked with the gardener, I worked with her and I learned a lot from her but I wouldn't say I'm a gardener. But I do... I actually do enjoy it, yeah." (Teacher 2, School 3)

Initially, all teachers lacked the confidence to involve the whole class, opting to staying in the classroom while the research team took smaller groups of children outside. However, as the project developed, they took the opportunity to lead on classroom-based activities (e.g. germination of seeds; role-playing of a restaurant with real tasting sessions). Towards the end of term, teachers and children together were actively involved in harvesting, with the children showing talking about how their plants had grown, and how to water them without breaking the tender stems:

"So I really was starting from scratch learning everything new ... I will learn everything from scratch myself, which is great because I was learning with the kids as well". (Teacher, School 2)

We deemed this to be a notable observation, showing the materiality of the gardens coming to bear upon the discourse of the curriculum, balancing the emphasis on outcomes with the power and agency of articulating *what matters* in the educational space.

CONCLUSIONS

This paper sought to describe the role of school gardens within the context of sustainability transitions. Findings from the study point to embodied cognition as a powerful framework for bringing together knowledge, with values and actions. Children's affective engagements with the materiality of the gardens significantly disrupted the inside/outside divide. Our observations pointed to a renovated perception of the outside, not as an empty space, where no learning can take place; the 'outside' as a space of exclusion, for those who are not sufficiently able, either intellectually or physically, or not compliant enough to sit in the classroom. By acknowledging and stimulating material intra-actions, the outside becomes current, problematic and pregnant with possibilities. Findings pointed to children's feelings of well-being and motivation for action, confirming much of existing literature on the benefits of gardening (e.g. Waite et al., 2016).

However, beyond the single, reported effects, the study offered a reading of children's gardening actions as powerful tools for re-inscribing the status of the children as learners who are 'response-able'. Findings showed that raising children's sensorial attention - as opposed to exerting regulatory control over their bodies - enabled children to become engaged and make sense of their experiences as valuable and meaningful to them. As described by Ivinson (2016), reporting on a study of youth living in ex-mining communities in Wales, the perception of a disciplined, quieter body may be at odds with the local culture, which values movement and a moving body. In a similar fashion here, we observed the children's display of physical ability, and the desire to be seen as powerful - holding the watering can, removing large areas of weeds and leaves. And yet, they also shared "ownership" of their section of the planter with others; they were response-able for both their plants' growth and for their own: "*I got my mental health better*" (Focus Group 1T). This is particularly important for children living in areas of multiple deprivation - that are otherwise disenfranchised, displaced, disadvantaged. It is in this sense then, that we respond to our first question about how ecological relationships are enacted in the garden space: children's attention was not simply focussed on concepts, outcomes or produce, but it pertained to their sense of being responsible and attentive to their own actions, and those of others. From these considerations we can start to see how learning for sustainability can be brought in line with policy ambitions for educational inclusion and participation (McCluskey, 2017): not by exceeding and adding new content or additional provision, but by drawing upon pedagogies engaging the body in new forms of signification (Gray and Colucci-Gray, 2018). Importantly, we noticed how such processes involved teachers in responding to necessities that were shared amongst the children, they were learning *with* the children and adapting the curriculum accordingly. In this sense, we also respond to question 2, how the garden came to matter. We see the materiality of the garden space at the core of an emerging discourse which can help position teachers not only as 'competent agents' - but as response-able - whose ability to nurture children's capabilities can have significant influence on students' experience of school.

This study was limited to 5 classes from a local area in Scotland. It is however illustrative of wider socio-cultural discourses in education, and points to a new way of looking at learning beyond the individual child; beyond differentiation, as a means to support children towards a defined standard (Pantic & Florian, 2015). In this paper we sought to show how children can bring forth the world they wish *to become* with. There are important implications for teacher professional learning and the knowledge base of teacher education. Gardening can and should be seen as part of a broader set of pedagogies of embodied learning, not simply as a strategy for teaching abstract concepts, or a compensatory measure for the non-academic child. Drawing on Greenhough and Roe (2010), response-ability is a commitment to the well-being and sustainability of oneself and others; and it should permeate and guide all people, in all professions. There are also important implications for academic researchers and teacher educators: this project involved commitment to being in the gardens and with the children, transcending perceived or given knowledge and identities.

We wish to conclude with an observation: in all three schools children showed preoccupation about their gardens being vandalised. And in none of the schools this happened. The children's public performance pushed back the idea that those particular schools 'were given' something they lacked, or

that should have had in order to be put on a par with other, better schools. We are possibly coming closer here to the Goethean' idea of a science of quality whereby: *"the most important business of education becomes the schooling of faculties, not the mastery of information"*. (Zajonc, 1987)

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