Children's Creative Engagement in Hybrid Nature Crafting

Materiality - Meaning - Connection

Abstract

Forging children's nature connections involves affective, sensory, and imaginative engagements, underscoring the value of place-based, tactile, and creative interactions. While craft and making offer potential synergies, many digital approaches for children remain limited to designed artefacts that foster contact in, as opposed to *with*, nature. Inspired by art-based approaches, this study introduces Hybrid Nature Crafts (HNC) a craft approach that integrates diverse materialities, such as leaves and light, to foster children's connections with nature. To examine how HNC supports these connections, we conducted two workshop series in distinct physical settings with 15 children, documenting their creative processes throughout. This pictorial highlights how craft enables children to notice nature, perform place-making, and construct meanings of and with nature. Findings advance understanding of hybrid approaches and offer practical insights for designing workshops that nurture children's ecological identities through creative making.

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1.0 introduction

In the Anthropocene, the imperative to reframe human relationships with nature has never been more urgent. As interaction designers continue to explore how digital initiatives might foster such reconnections, it becomes vital to consider children, whose lives are deeply entangled with the realities of climate change now and in the future. Our work focuses on children's hybrid crafts as a

Author Keywords
Craft, making, paper circuits, nature connection, children

CSS Concepts
Human-centered computing-Interaction design-Interaction design process and methods

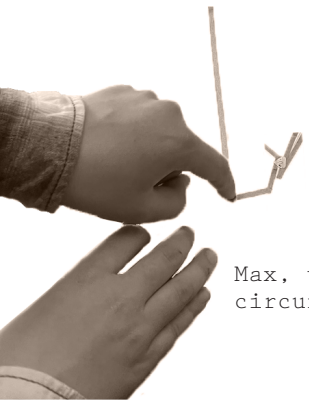
DIS '26 June 13--17, 2026,Singapore, Singapore

ACM ISBN 979-8-4007-2563-0/2026/06
https://doi.org/10.1145/3800645.3812794

means of supporting and reimagining child–nature connections—i.e. children's subjective relationship with the natural world [27].

Within child–computer interaction (CCI), child-nature connections have been considered through the prism of nature engagement technologies that currently constitute a key strand of CCI's environmental sustainability research [35]. To date, these efforts have largely clustered into four categories: instructional technologies that support science-based learning; exploratory technologies that digitally trigger play and contact in nature; contributory technologies that enable species monitoring; and, more recently, imaginative technologies that invite children into nature storytelling [2] [36]. Across these clusters, much of the research has relied on audio-visual modalities designed to encourage children to be in nature, often privileging cognitive learning outcomes [36].

In contrast to this orientation, other work identifies various pathways through which human–nature connection can be fostered: contact (sensory engagement), beauty (attention to nature's aesthetics), meaning (using nature or symbolism to convey concepts), emotion (affective responses to nature), and compassion (extending care toward nature) [25]. Together, these pathways foreground the importance of felt, bodily experience in nature. Environmental education scholars, such as Bonnet, argue that such embodied engagement holds significant educational value [5][6]. Recent calls within interaction design more broadly, and CCI specifically, echo this perspective by advocating for multisensorial forms of meaning making [11][34][36] in a move away from purely scientific ways of knowing plants [19]. However, despite its growing recognition, the potential for digital technologies to support children's direct tactile, multisensory and affective contact with nature remains underexplored.



Max, testing circuit design

To address this gap, our research draws inspiration from art-based approaches orchestrated and designed to foster child-nature connection. Art-based approaches combine nature exploration in place with creative practices. In doing so, they emphasise children's movement, materiality and ultimately move beyond language, opening the potential for inclusivity across different age ranges. Mostly situated in nature spaces, with some performed in formal/informal settings (e.g. museums or schools), art-based workshops have used drawing, film, performance and songwriting to spark children's creative expressions [1][3][4] [18][29][38][39]. A systematic review synthesising the findings of prior art-based workshops with children has shown these approaches to foster children's subjective feelings of nature connection [28].

Results drawn from this research bolster an understanding of how art-based approaches forge the nature pathways. Children's embodied exploration through their local natural environments as part of their art engagements sparks their agency, sense of freedom and place making [4][18][39]. When navigating their environments, it has been also shown that children use their senses to notice the aesthetics of nature e.g. textures, light, plant movement [1][11][38], with one study re-counting the gradual development of this sensibility [38]. Children's artistic outputs expressing their feelings and representations of nature increase over the course of their participation, indicating their active and evolving meaning making [38]. Crucially, art-based approaches can support a shift from children's psychological nature connection toward a relational lens whereby children begin to consider themselves as part of nature, i.e., enabling them to reflect on how they relate to the more-than-human world [20]. While empirical research shows that this shift can happen when arts invite direct performance with multispecies (e.g. children playing music and birds signing prompting musical co-creation [1], children role playing native animals [4]), other research shows that nature relations can develop even in representational art practices (e.g. drawings) which one study reported led children to value non-human life, create analogies between the life of plant and humans, and advocate for nature regeneration [38].

The present work combines art-based approaches for child-nature connection with hybrid craft. By hybrid craft we refer to crafts that combine electronics with a range of other materials [8], and in our work we draw materials and techniques from nature crafts. In the context of children, hybrid crafts have been typically entangled with the STEAM agenda in schools and inclusive computing (e.g. [23]). In contrast to this direction, we align with [9], and position hybrid craft as a creative and expressive process that may involve children in nature connection pathways, whereby electronics are one of many materialities. Although the art-based approaches we examined have not engaged with a craft lens, the breadth of craft techniques and materials, alongside its alignment with abstract and materially grounded intuition, invites us to consider how craft might support children in forming new connections with nature. We refer to this emerging direction as "hybrid nature crafts."

We thus ask, *how does craft involving hybrid materialities foster human-nature connection pathways?* This question is explored in the context of hybrid nature craft workshops with children situated in their everyday nature spaces.

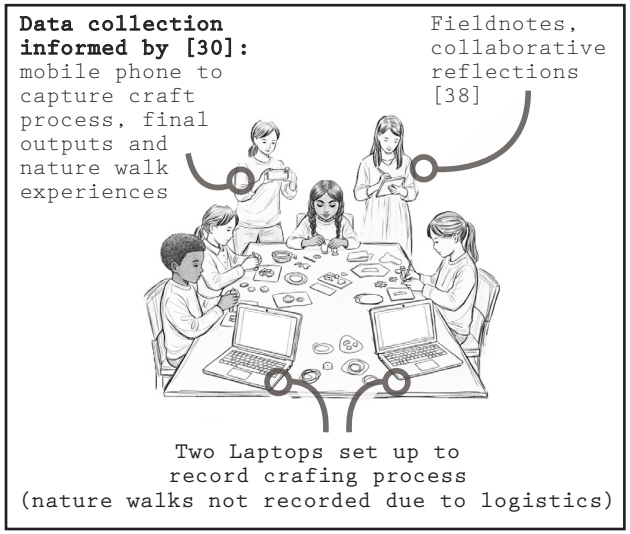
Aria, braiding using a spool of thread

2.0 workshops

The pictorial chronicles two series of workshops during which children created their own hybrid nature crafts. Supported by a Year 5 teacher, the first workshop took place in Spring 2024 in the grounds of a primary school in Oxfordshire, UK. Following parental and child consent, seven children (three boys, four girls) from the same class participated, aged 9-10. The second workshop took place in Spring 2025 in a community spiritual and garden centre in the same area as the school. Advertised to families through a local museum and a climate emergency centre, eight children (two boys, six girls) living in the wider geographical area gave informed consent and participated, aged 9-12. Children were signed up by their parents due to a range of reasons e.g. child-minding, processing difficult emotions, special education needs, nature or technology interests.

Previous work has shown that children's noticing and creativity develops over an extended period of time [11][39] which we reflected in both sets of workshops through the inclusion of multiple sessions over days/weeks.

Seven hybrid nature crafts were introduced across both. The crafts were previously designed and piloted by three of the authors (AV, AG, MX; all nature crafters), supported by a PhD student who led on the circuit prototyping and advice from an education provider of paper circuits. The following page summarises the crafts, the techniques children learned, and their appearance in the two workshop settings. Craft types were sequenced to deepen the techniques used e.g. progressing from single layer nature prints to multiplayer prints, or transitioning from pre-designed circuit templates to original circuit designs. Two adult facilitators, fluent with the crafts and the techniques, supported the children during the workshops. Previous work on nature engagement technologies has shown adults to lead children outdoors, facilitate technology use, and support pedagogical experiences [36]. In both school and community workshops, the facilitators guided children's noticing during nature walkthroughs in accessible and local places which were intertwined with craft work in a dedicated indoor space. When crafting, children used nature materials they foraged in the walkthroughs. Facilitators modelled the craft techniques through live demonstrations supported by craft storyboards and craft examples (see supplementary material), whilst encouraging children's exploration. Finally, the facilitators discussed and supported children's responsible material selection and use. This included teaching them to forage (e.g. avoiding taking from smaller patches, collecting only necessary materials) and to handle digital materials (e.g. cut to size, recycle waste). Moreover, rechargeable batteries were used in the paper circuits. Further methods contextualization appears in the findings.



Analysis: Inductive thematic analysis following [7] was carried out by the first author using the fieldnotes alongside the associated photos as the primary data source. Following the fieldnotes, the same author engaged in focused viewings of the videos to follow up on specific examples. While coding, attention was given to the effects of craft types and workshop settings on the emergent themes. Moreover, specific codes were generated by looking at both linguistic data and visual data. As five themes were refined, new visuals were also designed. The visuals show children's body in space as they engaged with their material surroundings and their handiwork. Charting the movement of the hand, we used sketching to interpret the tempo of children's movement across crafting. The initial codes, themes, and interpretive analysis were discussed amongst the authors in iterative reflective coding [7]. Our themes are:

- *Different ways of noticing* communicates how the craft intension sharpened multisensory noticing.

- *Place-making through blended, real & imagined spaces* documents how connections with familiar spaces were made, and blending craft/nature spaces.

- *Material agency sparks nature aesthetics* reflects sudden craft moments with an unexpected outcome.

- *Multiplicity of nature expressions* captures how children used crafts to recreate plants/landscapes, express meanings and reflect on crafting.

- *Material & creative identities* considers the practice of layering as a way to slow down and for children to cultivate their creative identity.

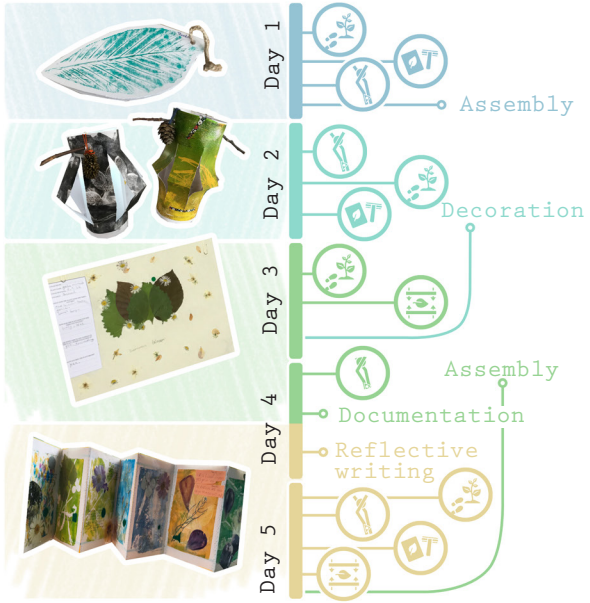
All images presented were taken in the workshops. Photo editing was used to isolate elements and combine them in collaging. Google Labs AI 'whisk' was used to create authentic illustrations of photos. As part of our visual choices, we have strived for a balanced representation of the 15 children's voices.

3.0

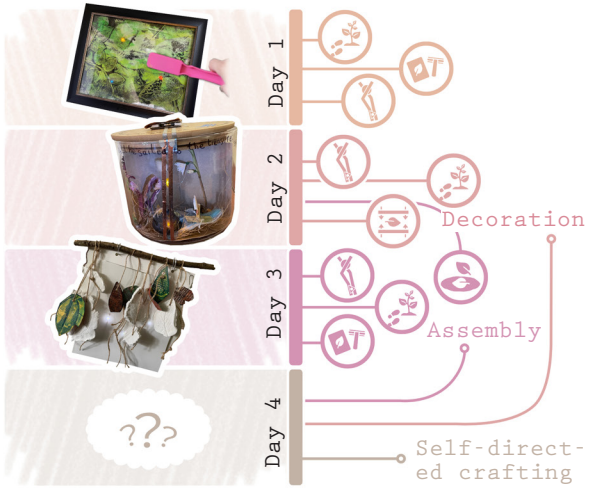
hybrid nature crafts

Tree of light consists of folded leaf prints. Using a circuit template, children assemble a simple one-light circuit couched inside the fold. The printed lit leaves are mounted with string on branches, forming a luminous tree. **Leafy lantern** children use a circuit template to create a three-light strip, then print leaves and petals on A4 paper and cut it into a lantern. A transparent sheet inside diffuses the light, the circuit is clipped in place, and two holes hold a stick across the lantern. **Botanical circuits** children document a focal plant on an herbarium label while foraging its leaves. They press and dry the leaves and create a collage. Three spots to light up are marked, and a reed switch is added for interactivity, activated with a magnet. After testing, the circuit is secured beneath the collage with its label. **Nature artist book** children apply a range of techniques to collaboratively create a multi-page interactive accordion book with a pressure switch, using light, texture, and written messages to communicate themes of gratitude, curiosity, and environmental awareness. **Illuminated nature print** children create a two-layer print with leaves/petals, design a three-light circuit on a frame. They mark light spots, add a reed switch for interactivity, and test the circuit. Frame and circuit are assembled, making the print interactive via a magnet. **Terrarium stories** children explore and select natural materials such as dried plants, feathers, and bark, considering how they interact with light and shadow. They layer these items in a glass jar, adding a light circuit along the glass walls that is activated when twisting the lid. **Dangling lights** children explore conductive thread and prototyping LEDs to make a light circuit. Attaching this to a robust stick, they layer on top paper-clay objects, gel prints, and dried nature materials on strings to make hanging wall art.

School workshops(2h/day)



Community workshops(6h/day)



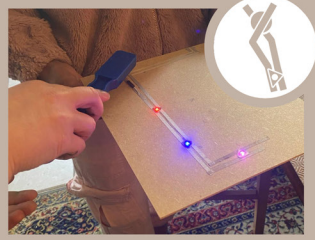
techniques

Nature walkthrough|A guided outdoor exploration, drawing children's attention to nature, e.g., shapes, textures, smells, seasonal changes.

Gel printing|Roll paint onto a gel plate, press natural textures like leaves, then lift the patterned surface onto paper for unique, layered prints.

Pressing & drying| Carefully collect nature materials, then dry or press between paper and heavy weight to preserve details. Dried materials curated in a "library of plants".

Clay impressions|Roll paper clay flat, press flowers or leaves for texture, cut shapes, pierce holes, then thread string through to create hanging ornaments.



Circuitry|Create circuits by arranging conductive tape or thread, connecting LED and watch battery, ensuring a closed loop for power and light.

different ways of noticing

Aligned with [34] who invite designers to consider specific nature places, we introduce the locations explored in the nature walkthroughs, prior to the craft work. In the community workshop there was a walk by the river, a visit to a public nature space and visits to the community centre's own garden. In the school setting there was a visit to a school garden with mature trees including flower beds and an orchard enveloped by a range of shrubs.

tasty textures

All the children approached the nature walkthroughs embedded in the workshops through a craft lens. They foraged plants that introduced interesting shapes (e.g. "heart"), textures (e.g. "hairy") and tactile feelings (e.g. "fluffy touch", "sticky") they could later use in their focal craft. To do this, children engaged in a multi-sensorial exploration assessing the visual and tactile qualities of the plants they explored (e.g. peeling a stem), whilst often smelling or even tasting them. In a few instances, plants were raised against the natural light to determine their transparency in anticipation of their inclusion in circuits. Thus, the intention to craft, evoked through our introduction of worked out craft examples, introduced a new perspective through which to notice and experience nature. Moreover, guided by our facilitation, many of the children exercised care when picking nature materials. This included taking plants that retained their form, yet were coming to the end of their cycle, being frugal when picking and foraging dried plants that had less value to other living organisms.

glistening lines

As visualised in the next page, several pathways guided this craft-oriented noticing and acted as constraints to children's exploration. First, children used **Thing-based discovery.** By exploring Things, such as a log encased with plant life by the river, they discovered and assessed new plant matter. Second, guided by their own sensory preferences (e.g. colour, smell) they identified focal plants and engaged in the **intense study** of these plants, both within a single workshop and across several workshops. Third, they attended to their body to perform **intentional noticing**; akin to moving a photo camera, children regulated their gaze (e.g. looking up/down) and body posture (e.g. kneeling, stretching upwards) to ensure they had engaged with the breadth of nature around them. Importantly, intentional noticing broadened children's lens on their environment, whilst Thing-based discovery and intense study narrowed their focus.

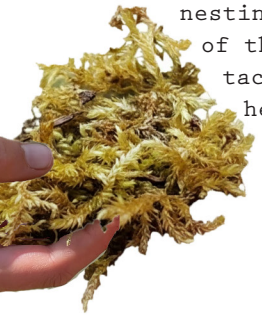
Alongside these three pathways and aligning with a broader and generative craft lens, a few children embarked on the nature walkthrough with specific aims previously triggered by the craft examples and materials introduced in the workshop space. Following children's intrigue of dried Magnolia leaves in the 'library of plants', one boy, Max, collected Magnolia leaves in pursuit of the same technique. Another child, Sumita, drew inspiration from a black and white bird feather found in the same library that generated an aesthetic framing for her future craft around the theme of 'winter vibes' expressing a winter atmosphere. Thus, in entering the nature walkthrough with prior craft ideas, children undertook targeted **aesthetic inquiry** looking for plants that expressed literal or symbolic qualities.

Despite these shared findings, there were differences across the two settings of the workshop. The community workshop invited the full gamut of these pathways whereas children in the school workshop engaged in these pathways to a lesser extent. Moreover, within the community workshop, there were points of friction as children explored a broader set of public natural environments; one child, Max, identified and handled pieces of discarded carpet by the river sparking his spontaneous reflection on whether this material was part of nature.

Intertwined with their craft-orientated nature explorations, children engaged in a broader multisensory and embodied interaction with nature appreciating nature in its own right. This included leaning over to smell a buttercup for its predicted aroma, or appreciating the light reflecting from thin strands of moss held in one's hands. Nature and play were also prevalent as children in both workshops rolled down a small hill, chased each other in emergent play, and attempted to climb on a big old tree. Moreover, children's attention to the non-human world extended to insects. This was expressed through their attempts to name them, spontaneously explain their food reliance on plants, but also often voicing their fears toward specific insects (e.g. spiders, bees).

smelly shapes

Max inspects a log nesting by the side of the river. After tactile exploration, he discovers and collects a textured blob of moss for his craft.



Thing-based discovery
aesthetic inquiry

Hai has been noticing plants, directing her gaze low to the ground and at eye level. She suddenly exclaims “I forgot to look up!” looking up and reaching for leaves on a tree.

St Ethelwolds, Abingdon

intentional noticing
intense study

Inspired by a contrasting feather she identified in the library of plants, Sumita approaches the walkthrough through the lens of ‘winter vibes’. She searches for materials that express this atmosphere and mood. She collects a cone and a dried winter flower, whilst reflecting aloud whether they fit the intentioned aesthetic.

Abbey Gardens, Abingdon

River ock, Abingdon

During the first nature walkthrough, Matilda is drawn to garlic mustard, a native plant that is also edible, often used in salads. Unfamiliar with this plant, she smells it and comments about its pleasant fragrance.

Matilda impulsively tastes the leaf finding it “disgusting”!

Over the course of the five workshops, Matilda collects leaves from the same plant twice, and persistently uses it as a focal piece within her craft.

Europa School Grounds, Culham

place-making through blended, real and imagined spaces

Hybrid nature crafts engaged two types of spaces – the physical craft workshop and the nature space. Children's nature noticing and foraging outdoors, as detailed in 4.1, catalysed subsequent craft in the designated workshop room. In the school workshop, the library was chosen due to its available tabletop workspace and the presence of a sink for cleaning paint residue, whereas for the community workshop we booked a sizeable room featuring a long table and an adjacent kitchen. Place-making is both political and cultural [32]. In line with the cultural dimension, we observed children's shifting practices in their everyday nature spaces, interacting with their outdoor spaces through the intention to craft (4.1).

Children also performed placemaking by *mentally connecting* hybrid nature crafting to the past, creating associations with nature spaces, social memories and practices. Most of the children related the plants they encountered in the walkthroughs, and the workshop's library of plants, to those they experienced in their own gardens and local areas. In selecting to interact with these plants in their craft, they connected distal physical spaces through their imagination and thus meanings from one space crossed over to the other.

"These dried flowers are snow drops!" (Hai)

"A pct of my favourite nature spot" (Marival)

One of the crafts, the ***nature artist's book***, made these imaginative connections tangible. Within the book, children had been invited to bring their own visual media to express their feelings about the craft process. One girl, Marival, incorporated a photograph of her favourite local nature place in her page, whereas another, Henriette, introduced a photograph of her sister standing by a donkey to express her love for animals and her appreciation of a meaningful moment with family.

"I often get sticky weed stuck on my clothes when cycling to Oxford with my family" (Ivy)

"I can finally touch this leaf. We have the same tree in our garden but it is too tall to reach!" (Toby)

"We have tried out printing with leaves in class" (Davi and Bobby)

Within the school context, safeguarding concerns with regards to children's unsupervised access in the gardens led us to decline their requests to access the outdoors midway in the craft process.

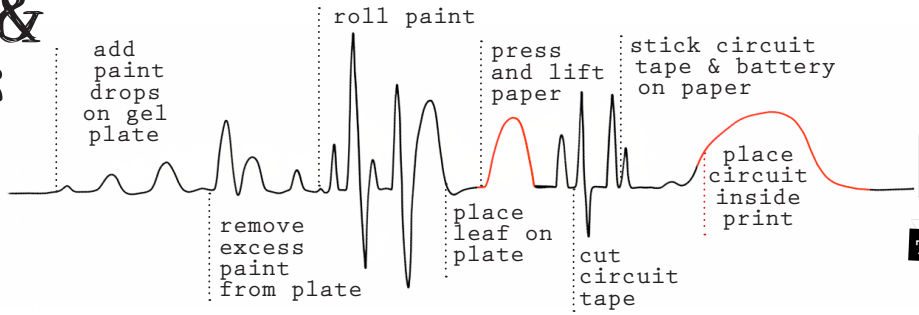
'Workshop' and 'garden' were treated as separate spaces during the first few days of the community workshop. This separation was orchestrated through sequencing the nature walkthrough before the craft could begin. However, by the third day of the workshop, as children worked on their craft pieces, they retreated to the community centre's garden to look for new ideas. For example, Yasira searched for pebbles in the garden to fill in her earthy terrarium. Therefore, a *blending of spaces occurred where craft ideas took form through a connected exploration of garden and craft.*

material agency & nature aesthetics

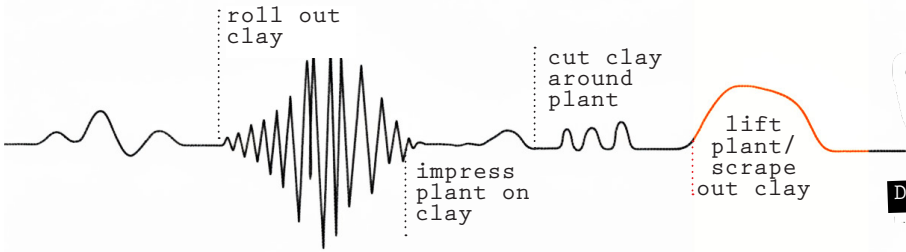
In the workshops, each focal craft was deconstructed into parts inducting children to a technique that progressed their craft (e.g. designing a working circuit).

When children encountered unfamiliar techniques, the agency of the materials initially prevailed. This was because they often failed to produce the visual or functional effects the they intended. Supported by the facilitators in individual and collective reflections, children observed and experimented with the properties of the materials whilst evaluating their effects under different conditions, transitioning from material encounters to performance [15]. Child and material agency developed dynamically as many children began regulating their actions and bodies to the material effects they observed. For instance, they began to roll the paint with less pressure to avoid drying or ensured circuit corners touched so the current could flow.

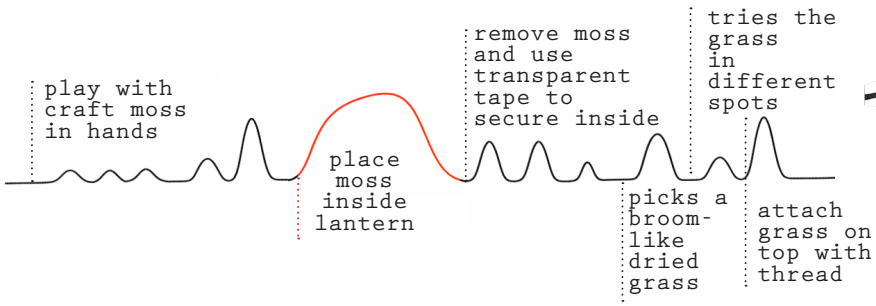
As children engaged their bodies in crafting over time, new material assemblages emerged. Some assemblages highlighted nature aesthetics which departed from children's original intentions and expectations. Amplified by moments of anticipation and revelation (e.g. lifting a print), many children attended to these nature aesthetics with surprise and joy. Such moments (annotated with red lines) thus created possibilities for *ephemeral nature connections* as children appreciated nature's beauty from within their craft. Ephemerality was also expressed through the *unpredictable nature of the aesthetics* as sometimes children attempted to reproduce the same effect in vein.



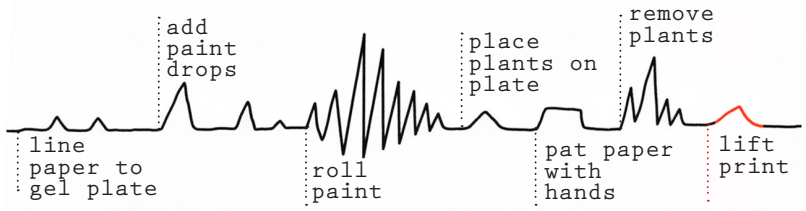
Ivy observes green paint lifted from a past print accenting a leaf texture. She notices the veins of a leaf print highlighted by the light circuit.



Aria reacts to the traces of yellow pollen impressed in the material of her clay flower.



Davi notices how light diffuses through a mesh of craft moss couched in his lantern.



Toby attends to the soft and yet bold print created with lilac and other leaves.

multiplicity of nature expressions

Nature representations: Children composed materials into recognisable plant shapes in the ***botanical circuits*** (e.g. clustered leaves arranged in a forest, leaves composed in a flower) or landscapes in ***terrarium stories*** (e.g. desert, rainforest). Several children, who expressed other creative meanings in their crafts, still incorporated elements of nature representations in their pieces, e.g., selecting a blue LED to indicate water in a pirate story depicted in the ***terrarium stories***, or using a broom-like grass to embody a feather on the 'hat' of the ***leafy lantern.***

Botanical circuits

Working in a group, Davi and Bobby intuitively find and mix fresh and decayed leaves in a flower-shaped composition, later placed above a light circuit. Diasies are sprinkled around it, which are in season during the workshop.

Nature artist book

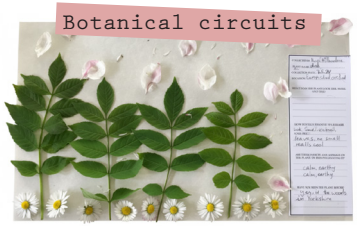
Ivy creates a multi-layer page of nature elements expressing her joy in exploring the variety of plants around her intertwined with skills learning and team work.

Reflection: This emerged in the ***nature artist book*** where children explicitly reflected on the craft process leading most of them to articulate the nature (e.g. attending to diverse local plants) and crafting experiences (e.g. troubleshooting circuits, being outdoors) they most valued during the workshops.

Terrarium stories

Aneesha uses a painted piece of log, previously used to produce a print texture. This inspires her to create a rainforest piece. Rocks, craft moss, dried plants are composed in the jar. Writing on the glass "rainforest chaos vibes' indicates the focus of her creative nature representation. Green and blue lights accent the tropical imagery.

Botanical circuits

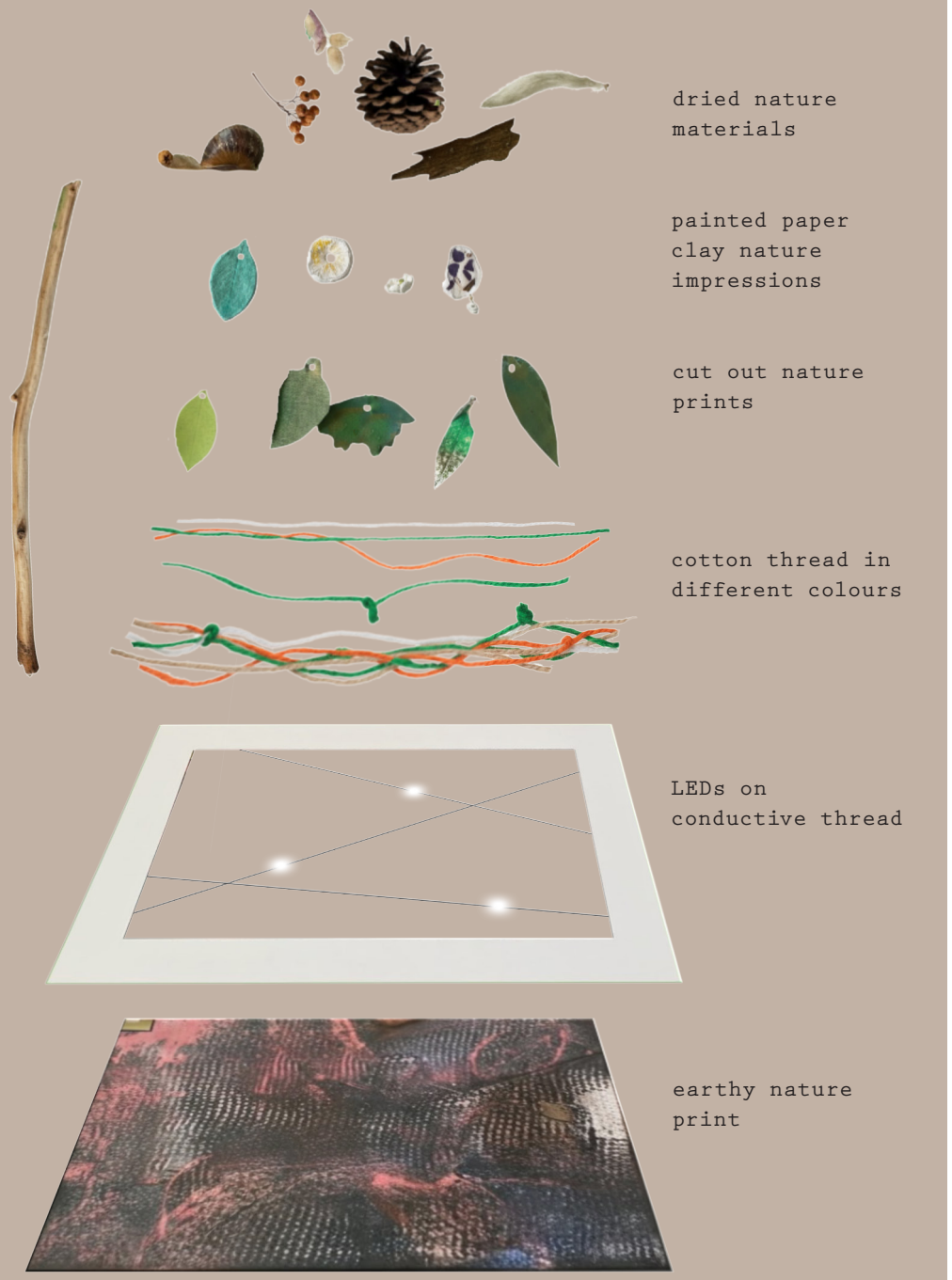


Toby and Henriette arrange clusters of leaves in a line forming a forest. Diasies indicate the earth and apple bloosom petals express rain.

Meaning making: Two of the older girls engaged in symbolic meaning making using craft materials to express abstract concepts. Sumita explored notions of seasonality and feelings related to seasonal changes in her ***terrarium stories***, whilst Yasira contested assumptions about nature as being always pristine and lush in her ***dangling lights*** piece. Though these themes were pursued by the older children, it is noteworthy that a craft constructed by two 9-year-old boys, Davi and Bobby, combined fresh and decayed leaves suggesting an intuitive appreciation of seasonal changes.

Dangling lights

Yasira's wall piece combines brown and green colours arranged throughout, which she reports using to express seasonality and the idea that nature is not always pristine.



materials & creative identities

All hybrid nature crafts – both simpler and more complex – offered the opportunity to elaborate and embellish the craft. The practice of "layering" craft aesthetics became a means for children to discover and express their creative artistic identity. This manifested most prominently in crafts whose design relied on layering, such as the ***nature artist's book***, ***terrarium stories***, and ***dangling lights***.

Nonetheless, in addition to "layering up", other crafts such as the ***leafy lantern*** provided the possibility for "layering around" whereby children could attach materials inside and around their craft. Alongside the layering possibilities invited by the craft type, the practice of layering organically emerged during the making process as children produced half-baked outputs, or in Hei's words "glitched", which they intended to use as layers in a future craft.

Whilst some children such as Hei enthousiastically immersed themselves in the practice layering, others such as Ivy, Aria, Sumita or Aneesha took their time to meticulously work on each layer prolonging the craft work. Nonetheless, even though most children used layering to experiment and discover their craft identities in different degrees, others did not engage in this practice. To this end, three out of the 15 children approached their crafts instrumentally striving to complete all the steps quickly.

Hei's ***dangling lights*** piece combined six layers of materials. Hei implemented nature printing using mute colours she had previously worked with to produce a ghostly pattern. She experimented with overlapping circuit lines, carved, cut and painted handmade clay and paper ornaments, and selected a range of diverse nature materials from the library of plants to attach on the stick. Appreciative of the rich mixed media she had used, Hei justified her bold choice for a colourful background and explained that the piece reflected a consistent "treasure island" craft identity she had adopted over the workshops.

5.0 discussion

This exploratory research on Hybrid Nature Crafts (HNC) aimed to ground children's creativity in familiar, local nature spaces. We contribute to HCI by proposing a craft-based approach to children's nature connections, analysing its distinctive qualities, considering spatial and temporal factors, and offering craft-informed insights that advance nature engagement technologies [40]. Before presenting our contributions, we acknowledge that our findings were generated with a small group of children. Nonetheless, participating children's diverse profiles and motivations, also strengthen the transferability of our findings.

How hybrid nature crafting triggers children's nature connection

As we detailed earlier, art-based approaches with children have shown how the arts can stimulate multisensory exploration of nature spaces, aligning with concerns within HCI [34]. Echoing past work, in this research, children used their bodies to navigate nature environments freely, attended to finer botanical details, and became more aware of other living organisms (e.g. [1][11][18][38]). Our study, also, goes beyond corroborating past research to evidence the particular ways in which *craft materiality* engaged the children.

During the nature walkthroughs, children's craft intentions and their prior exposure to the focal craft's *material qualities sparked a form of purposeful noticing and exploration*. Children anticipated the materials' crafting potentials which invited tactile engagement as they collected new nature materials. Therefore, craft introduced a filter through which children perceived nature, suggesting that craft materials can accent different forms of noticing.

Whilst crafting, *material assemblages unexpectedly accentuated nature aesthetics,* eliciting positive affect. These moments foregrounded the importance of "revealing," as previously suggested by [11] in relation to cyanotypes' unexpected behaviour. Moreover, as children's understanding of material agency grew, it became clear to them that craft outputs were not always reproducible and were especially valued. It could be argued that children had control over the craft process, yet these material assemblages offered a persistent reminder of the contrary, metaphorically aligning with nature's often unknown, self-arising character [5].

The *material qualities of natural elements shaped how children constructed meaning throughout their creative processes.* For some children, materials shaped representational forms, while for others they became a continuous source of symbolic interpretation. Considering the pathway of "meaning", children explored their artistic identities through HNC while creating meanings associated with nature, a finding in alignment with [9] who reported on youths' cultural expression when designing nature-inspired interactive murals. Craft offered a diverse space of possibilities allowing children to construct their own pathways.

These findings indicate that HNC and their facilitation enabled the contact, beauty, meaning, and emotion pathway. Our study also shows that compassion was expressed when children responsibly collected materials from local places; thus, care for nature manifested as a material concern, which we aim to deepen in future work.

The impact of space and time on nature pathways

Art-based approaches with children have most commonly been situated in schools, museums, and youth centres [28]. Prior research suggests that the nature pathways discussed above require time to develop [39], reflected in the extended durations of past studies. To date, however, there has been little comparative reflection across settings. Our study offers a distinct opportunity to inform this gap.

In the school setting, HNC sessions were delivered over five weeks, totalling ten hours, whereas in the community centre the sessions were more immersive, unfolding over four full days. Moreover, in the school adult supervision rules kept children from freely exploring the school grounds. These conditions limited children's sense of freedom and their ability to transcend spatial boundaries. Consequently, compared to the school context, children in the community workshops employed a wider range of strategies to explore their surrounding nature spaces, creating more opportunities to develop their noticing. They also took advantage of the setting to interweave craft sessions with craft-led visits to the adjacent garden to collect materials.

Unlike other settings where families self-select into niche educational initiatives, schools are uniquely positioned to reach diverse cohorts [16]. While this underscores the importance of reflecting on the school setting forming part of this research, art-based approaches with an explicit nature focus, including STEAM-oriented initiatives, remain uncommon in schools [39]. Nonetheless, as education policies increasingly advocate nature-based education, e.g. [10], our work contributes to future initiatives through four ways of enhancing children's noticing within school grounds (Thing based discovery, intentional noticing, intense study, and aesthetic inquiry). Additionally, our findings highlight the importance of longer-term education programmes and the need for continuous movement between nature and indoor craft spaces.

HNC and nature engagement technologies

When designing nature engagement technologies

in situ, the intention to foster nature connection and relations with the more-than-human world can sit uneasily with the immersive qualities introduced by digital technologies [13][17][40]. In response to this tension, prior work has argued that such technologies should remain unobtrusive [17]. In this pictorial, we extend this position with our findings. We argue that *digital materialities need not only be unobtrusive but can instead form part of integrated, hybrid compositions*. The diverse yet harmonious configurations created by children exemplify how technology and nature can intersect without technology becoming dominant.

Moreover, even though technology can act as a tool to "capture" nature and help children form an affective relation with ecologies (e.g. [33]), our work extends beyond this utilitarian view. It is here that the holistic craft approach we adopted, foregrounding nature spaces and embedding electronics within an art-based process, shifted engagement away from a utilitarian positioning of technology toward one that supported aesthetic enhancement, meaning making, and creative expression. Contrasting with the concept of technological nature (i.e., "technologies that in various ways mediate, augment or simulate the natural world") [24] (p.1), we propose that HNC *positions technology as part of* the more-than-human world *[14], and opens up new ways of thinking about and exploring its role in nature connections*.

In summary, by approaching technology as one expressive material among many, and introducing it in a holistic process, concerns about its potentially disruptive or distracting role did not surface. Such reflections speak to STEAM in schools which has tended to deprioritise the role of arts compared to computing [21] contributing to such dichotomies and strengthening the importance to integrate "*more maker technology into arts subjects–particularly those subjects with epistemological roots in hand/mind forms of knowledge*" [16].

Our study also speaks to a further theme of concern within interaction design, the defamiliarisation of existing understandings of nature. Past research has developed digital artefacts that visibilise non-humans, sparking surprise, curiosity and relation e.g., reveal plant responses [19], calls to native animals for active listening and communication [17]. Elsewhere, the craft of knitting acted as a resource of inspiration for making sense of trees, whereby knit patterns were designed after deep noticing, creative explorations of tree textures that generated new knit patterns [31]. We join the conversation with these latter, creative approaches and introduce them to CCI.

Future directions

In future work, we recognise the opportunities of HNC to reflectively explore more-than-human relations in addition to the child-nature connections our approach supported. Similar to [31] we envision activities that attune children to noticing patterns in non-human lives as a source of inquiry and inspiration in their HNC. In taking this line, our study highlights the importance of ensuring that children develop prior familiarity with the materials, and their agencies, through experimentation with variations in technique. Moreover, we speculate that the forms of material agency observed in our study could be further expanded from working with nature materials to crafting with and attuning to more-than-human processes more broadly, such as temperature, rain, air, or light. We draw inspiration from [22] and their work with bees, describing how they adapted their methods to bees' temporal living rhythms. In our own practice of outdoor nature printing, we closely attend to weather conditions, avoiding warmth and wind, which accelerate paint drying and shape the print. We ask whether such forms of crafting might strengthen children's meanings of nature as "self-arising" [5], thereby fostering their relationality.

We finish by responding to the call for transparency on what nature settings and lived experiences are represented in HCI research [34]. In working with children who lived in a nature-rich environment, it is not a surprise that craft experiences evoked spontaneous disclosures of past nature contact. These histories became part of children's ongoing engagement, affect, and meaning making. Contrasting with this, other work with disadvantaged groups of children or children disenfranchised from nature shows that art-based approaches increase their noticing and relationality with the non-human [4][38]. These contrasting lived experiences underscore the importance of understanding children prior to art-based approaches informing responsive facilitation adapted to children's socio-cultural experiences, an issue also raised in the context of STEAM [37]. Nonetheless, as [26] alerts us, the pristine nature settings in which prior research often takes place in are not part of all children's lives, a reflection triggered in our workshop when one of the children attempted to make sense of a piece of carpet disposed of by the river. We thus ask how art-based approaches, such as HNC, might engage children who live within environmental degradation? Moreover, at a time when children's eco-anxiety is heightened, we join [12] to probe whether art-based approaches can scaffold children's imaginative thinking from the present toward envisioning hopeful futures.

While offering empirical insights into hybrid nature crafts, the pictorial serves as a creative output exhibiting fifteen children's work.

Acknowledgements

We are grateful to the fifteen children who took part in this research, and to Europa UK School, One Planet Abingdon, and the Abingdon County Museum for their support. We also thank Dr Ibrahim Alsaggaf for supporting the craft prototype pilots, and Dr Jie Qi and the Chibitronics team for their enthusiasm, ideas and general support. Sijia Xiong is gratefully acknowledged for her participation and support during the school workshop. This work was partially funded by a Research England's Higher Education Innovation Fund.

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