

Entangled Musicianship: Rethinking Music Education and Digital Musical Interactions through Posthumanist Theory

Abstract

This paper develops entangled musicianship as a theoretical and conceptual orientation that rethinks inclusion at the intersection of music education, digital musical instrument (DMI) design and Human-Computer Interaction (HCI). Drawing on findings from an AHRC funded network, it interrogates how disconnections between pedagogy, technology, access are sustained by humanist and cognitivist paradigms. Through a posthuman and diffractive methodology, the paper foregrounds relationality, and intra-action as central to both musical learning and digital design. Entangled musicianship emerges as a provocation toward more ethical and responsive approaches to inclusion, offering a significant contribution to interdisciplinary discourse across music education, DMI and HCI.

Keywords

Posthuman, Digital Musical Instruments, Inclusion, Human-Computer Interaction, Learning

Acknowledgments.

With thanks to OHMI and Rachel Wolffsohn our partners in the project. Further thanks to all the participants in the AHRC Music and Disability Research Network : Jennifer MacRitchie, Holly Radford-Jones, Amble Skuse, Matthew Wright, Emma Brown, Brian Condon, Jessica Pitt, Cobi Ashkenazi, Maria Witek, Landon Morrison, Matt Davison, Lu Shannon, Simon Holland, Nicholas Canny, Lia Mice, David Baker, Christina Karpodini, Franziska Schroeder, Alex Lucas, Tychonas Michailidis, Tim Yates, Sophie Gray, James Risdon, Barry Farrimond, Sarah Whitfield, Bridget Whyte, Peter Worrell, Ian Burton, Lisa McCloskey, Jacob Harrison, Sara Dasent, Julie Sellars, Jason Dasent, Emma Nenadic, Adie Dickinson, Ruud Van der Wel, Jennie Henley, Martin Fautley, and Deborah Amend. . This research is supported by AHRC under grant AH/W010429/1 ("Music and Disability: Deconstructing the barriers to full participation").

Introduction: Rethinking Music, Learning and Design.

In an increasingly digitised and technologically mediated music education system (Bayley, 2018; Ruthmann & Mantie, 2017; Asplund, 2022), questions around how we learn, make, and interact with music demand renewed scrutiny. Traditional models of music education, particularly those framed around the learning of a traditional acoustic musical instrument, have long privileged the cognitive over the corporeal, often framing learning as a sequential, skill-based process rooted in psychological developmentalism and formalist musical structures (Reimer, 2003; Swanwick, 1999; McPherson & Welch, 2012). These frameworks typically valorise individual achievement, notational literacy, and stylistic conformity, frequently at the expense of affective, social, and embodied modes of musical engagement (Green, 2008; Philpott & Spruce, 2012; Burnard & Dragovic, 2015; Kinsella et al., 2024).

Compounding this issue is the current political climate for music education in England, which increasingly privileges traditional approaches centred around staff notation, Western classical repertoire, and theory-based assessment models (DfE, 2021; Spruce, 2022; Wright, 2010; Fautley, 2017). Similar trends are observable internationally: in Australia, Canada, and the United States, policy frameworks often reinforce Eurocentric musical canons through prescriptive curricula and standardised assessments (Ballantyne & Harrison, 2015; Schmidt, 2017; NAFME, 2014; Abramo, 2016). These marginalise diverse musical expressions, particularly those emerging from participatory, improvisatory, or technologically mediated traditions. Despite the growing relevance of digital and participatory music-making cultures among young people (Kallio et al., 2021; Tobias, 2013), educational institutions have been slow to adapt, often relegating these practices to the periphery.

Parallel epistemological tensions are also found in the field of Human-Computer Interaction (HCI), and specifically in digital musical instrument (DMI) design. Traditional approaches in HCI have tended to emphasise usability, optimisation, and cognitive ergonomics, and those factors have been imported into DMI research (Wanderley and Orio, 2002; O'Modhrain, 2011). However, HCI researchers and DMI designers alike have long been aware that usability metrics and technical factors are not the whole story (Redström, 2006; Jordà, 2004), and there is increasing recognition that instruments and interfaces should not assume normative bodies and universal tasks (Homewood et al., 2021, Rodger et al., 2020). Notions of expressivity and control are appropriate for some but not all musical contexts and are often nebulously defined when proposed as properties of particular instruments and interfaces

(Gurevich and Treviño, 2007). An emerging alternative approach situates instrument design as a relational and affective practice (Hayes and Marquez-Borbon, 2020; Norman et al., 2025) which Morrison and McPherson (2024) articulate within the emerging paradigm of ‘Entanglement HCI’ (Frauenberger 2019). However, Morrison and McPherson caution that the field remains at a liminal stage and question how posthumanist insights might be translated into actionable methods for inclusive, co-creative design.

This paper asks: what if educators and designers reimaged musical learning not as the transmission of discrete knowledge or skills, but as an emergent, situated process shaped through embodied, affective, and more-than-human engagements with sound, tools, environments, and others? What if design was not a question of optimisation, but a question of co-performance, care, and accountability?

Drawing on the work of Karen Barad (2007) and Donna Haraway (1988, 2016), this paper engages with posthuman concepts of entanglement. Barad’s agential realism conceptualises phenomena not as fixed or stable, but as dynamic material-discursive entanglements that emerge through intra-action where boundaries, meanings, and identities are enacted rather than pre-given. Haraway’s (1988) notion of situated knowledges challenges claims to objective, universal truth, advocating instead for accountability, partial perspective, and epistemological plurality. In her later work *Staying with the Trouble* (2016), Haraway urges scholars and practitioners to resist resolution and remain with complexity, to attend to friction, uncertainty, and the ongoingness of world-making. These frameworks provide a theoretical grounding for reimagining musical learning and interaction beyond human-centred, hierarchical paradigms. In this paper, we draw together insights from music education, HCI and DMI design to propose *entangled musicianship* as a perspective that foregrounds these intra-active relationships between people, technologies, bodies, sounds, and social-material conditions in music education and digital musical interaction.

Music, Disability, and Fragmented Fields.

This paper emerges from ‘Music and Disability: Deconstructing the Barriers to Full Participation’, an AHRC-funded research network that brought together a transdisciplinary group of stakeholders working across music education, digital instrument design, music technology, disability studies, psychology, policy, and lived experience. The network was convened in response to persistent and systemic inequalities that limit disabled people’s

participation in musical life. These inequalities span access to music education, the design and availability of accessible instruments, and broader cultural, pedagogical, and policy discourses that continue to privilege normative models of musical ability and engagement.

Rather than treating these domains as discrete problems requiring isolated solutions, the network sought to explore how their intersection might generate new approaches to inclusion.

Over an eighteen-month period, the project hosted four interconnected events, each designed to interrogate specific dimensions of accessible music-making across education, technology, and design. The first event convened stakeholders from music education including teachers, researchers, and cultural organisations for a series of roundtables, presentations, and facilitated discussions. These sessions critically examined dominant pedagogical practices and policy frameworks, surfacing limitations in current inclusion strategies. The second event focused on digital musical instrument (DMI) design and Human-Computer Interaction (HCI), challenging dominant techno-solutionist narratives. Through provocations and collaborative dialogue, participants explored how accessible technologies are often developed without sustained engagement with the pedagogical and cultural contexts they aim to serve.

The third event adopted a sustainathon model, a reconfiguration of the traditional hackathon format towards documenting and replicating existing designs to address a culture of ephemeral technical objects (Morreale & McPherson, 2017; Zayas-Garin et al., 2021). Hosted in collaboration with Drake Music and drawing on their instrument library, this session brought together instrument designers, disabled musicians, and educators to revisit and iterate on previously developed adapted instruments, emphasising care, longevity, and shared authorship. The fourth and final event brought together a panel to explore the intersections of inclusion, quality, and pedagogy, synthesising learning from the series while advancing critical debate on aspiration, value, and systemic transformation in music education.

Whilst the network spanned a wide range of themes, this paper focuses on two central and interrelated facets of the discussions that emerged: music education, particularly within the English context; and human-computer interaction (HCI) and digital musical instrument (DMI) design. These two fields, though both deeply implicated in questions of access, have historically operated in parallel rather than in collaboration. By examining the tensions, synergies, and disconnections between them, we aim to better understand the structural conditions that shape, and limit, disabled musicians' opportunities, and to propose more integrated approaches for inclusive practice.

Ethical approval for the network was granted by Birmingham City University, covering the documentation of the events through fieldnotes and the collection of anonymised quotations from consenting participants. The focus of this documentation was on surfacing key ideas, themes, and questions that emerged during the events, rather than conducting individual case studies or interviews. Participants were informed of the purpose of the documentation, and consent was obtained for the inclusion of direct quotations and shared insights within research outputs. The work is documented in a series of collaboratively authored provocation documents (Kinsella et al., 2024, 2025a, 2025b). This paper draws on these situated dialogues not as data points, but as affective and epistemic moments that informed the development of entangled musicianship. We propose this as a theoretical orientation that challenges discipline-specific solutions and instead foregrounds inclusive, embodied, and materially responsive modes of participation and design.

This paper will begin with a brief overview of the music education landscape in England, situating current policies and practices within wider debates about inclusion, access, and representation. Following this, we turn to the research domains of HCI and DMI design, tracing how technical and design innovations have responded to, and at times overlooked, the complex educational and cultural contexts in which musical engagement takes place.

Music Education in England

In England, music education is delivered through a complex ecology comprising curriculum music in schools, specialist instrumental and vocal tuition (often provided by peripatetic teachers), alongside a multitude of community and third-sector organisations offering short- and long-term music-making opportunities. Henley (2011) characterised this landscape as ‘fragmented’ and ‘patchy’, prompting a call to ensure that *all* pupils receive a high-quality music education (DfE & DCMS, 2011, p.7). This led to the first National Plan for Music Education (NPME) in 2011, which Music Education Hubs as a mechanism to coordinate provision and create a more coherent, partnership-based model across schools and external organisations. The NPME asserted that “the best model for Music Education includes a combination of classroom teaching, instrumental and vocal tuition and input from professional musicians” (DfE & DCMS, 2011, p.13).

While the first NPME made progress in addressing some challenges of access and provision, its implementation revealed significant inconsistencies. As Spruce (2013) argued, the plan often privileged narrow, formalised notions of musical knowledge rooted in Western classical traditions, approaches that marginalised informal learning, embodied practice, and learner agency. This poses particular challenges for inclusive music education, where pedagogies must be flexible, relational, and attuned to diverse modes of communication and expression, including those used by disabled young people.

Recent policy developments have continued this trend. The Model Music Curriculum (DfE, 2021), produced as non-statutory guidance, further reasserts a traditionalist view of musical progression, favouring notation-based, genre-specific approaches. Critics (Henley & Barton 2022, Spruce 2022, Young 2023, MacGregor, et al 2025) have noted its lack of attention to inclusive pedagogies, learner-led creativity, or adaptive strategies that support access for disabled learners. The second iteration of the National Plan for Music Education (*NPME2*, DfE & DCMS, 2022) continues to emphasise “access for all” but does so within a rhetoric of excellence and progression that remains largely underpinned by ableist assumptions about what constitutes musical achievement. Despite references to inclusion, little guidance is offered on how to meaningfully embed inclusive practices or challenge systemic barriers that continue to marginalise disabled young people.

Consequently, music education in England remains shaped by competing policy logics where on one hand, the aspiration to broaden access and participation and on the other, a prescriptive and hierarchical vision of musical learning that can inadvertently exclude those whose ways of engaging with music fall outside normative frameworks. For disabled learners in particular, whose creativity may be multimodal, embodied or non-verbal, the ongoing lack of flexibility in policy and practice continues to restrict meaningful participation and recognition (Ainscow et al 2006).

Accessible Design

Within the field of Human-Computer Interaction (HCI), accessible and inclusive design has emerged as a critical force in reimagining musical participation. The development of Digital Musical Instruments (DMIs) has opened up new expressive possibilities for those historically excluded from conventional music-making due to physical, sensory, or cognitive barriers. Often employing alternative interfaces, gestural input, or multisensory feedback, DMIs are

uniquely positioned to respond to the embodied, affective, and relational dimensions of musical engagement (Frid & Turchet, 2021; Nijs & Leman, 2016).

Innovative instruments such as The Kellycaster (Ockelford, 2020) and research programs like Inclusive Interactions (Frid, 2019) exemplify how user-centred and co-creative approaches can challenge normative assumptions of ability, virtuosity, and musical value. Research in this area demonstrates that adaptive instruments can enable high levels of expressivity, personalisation, and collaborative creativity (McPherson & Kim, 2019; McDonald et al., 2021). Disabled musicians across diverse contexts are increasingly using such technologies not only to perform, but to compose, improvise, and co-create in both professional and community settings (Gurevich & Stapleton, 2008), and while awareness is growing of the importance of disabled-led approaches to design research (Skuse and Knotts, 2020).

This relational ethos is further explored in the work of Drake Music Northern Ireland, whose partnerships with Queen's University Belfast through the 'Performance without Barriers' initiative has developed immersive, accessible instruments such as VR performance environments and eye-gaze-controlled music systems. These initiatives challenge not only what counts as an instrument, but how collaboration, access, and authorship are constituted in musical practice. As ethnographic research has shown (Samuels, 2019; Lucas, 2023), the success of adaptive DMIs often hinges less on their technical sophistication than on the ecological systems in which they are embedded, tutors, communities, institutional support, and shared pedagogical values. Similarly, Schroeder and Lucas (2021) demonstrate how the sustainability of accessible instruments is shaped by long-term relational practices, not just technical efficacy. Their work on distributed participatory design highlights the fragility of these innovations when detached from robust infrastructures of care and collaboration.

However, despite these advancements, the impact of accessible instrument design often remains constrained. A persistent disconnect between technological innovation and educational practice continues to limit the full integration of DMIs into mainstream music provision. Evaluation frameworks within HCI frequently prioritise technical novelty and usability (Barbosa et al., 2019; Bongers, 2000), with less attention given to the pedagogical relationships and sustained engagement required for meaningful musical learning.

This fragmentation was a central concern that surfaced throughout the AHRC network. Although the network was based in England, participants recognised that these issues reflect international patterns of exclusion. In various national systems around the world, dominant

curricula and assessment frameworks continue to privilege Western classical notation, solo performance, and cognitive mastery (Ballantyne & Harrison, 2015; Schmidt, 2017, Wright & Davies 2010).

In response, this paper will position entangled musicianship as both a conceptual intervention and a practical provocation. It calls for the reconfiguration of educational and technological systems not as parallel domains but as co-constitutive ecologies, where access is not retro-fitted but designed in from the outset. This shift foregrounds a posthuman, ecological perspective that values difference as foundational rather than exceptional, and that treats inclusion not as a compliance issue but as a site of pedagogical, creative, and ethical innovation. To fully explore the implications of this reorientation, the following section develops the theoretical foundations of posthumanism that underpin this work.

The Posthuman Turn in Music Education and Technology

Posthumanist theory has catalysed a significant rethinking of how we conceptualise learning, interaction, and subjectivity across domains. Rather than maintaining a centralised humanist epistemology, posthumanism foregrounds relationality, embodiment, and entanglement, inviting us to consider how bodies, technologies, environments, and discourses intra-act in co-constitutive ways (Barad, 2007; Haraway, 1988, 2016; Kinsella, Fautley & Whittaker, 2024).

In music education, this shift destabilises cognitive developmentalism and individualist notions of musicality that have long structured pedagogical practice. As Kinsella et al. (2024) argue, posthumanist frameworks “disrupt the notion of human centrality and our relationship within the world,” recognising musical knowing as distributed across assemblages of the human and more-than-human through instruments, gesture, space, sound, and affect (Bennett, 2010).

Posthuman concepts such as diffraction (Haraway, 2016), intra-action (Barad, 2007), and agentic assemblage (Bennett, 2010) challenge linear and representational models of learning. These notions enable us to reposition the classroom as what Barad (2007) refers to as a spacetime-mattering (Barad, 2007): not a static backdrop but a dynamic, multisensory ecology where knowledge emerges through relational encounter. This perspective problematises

dominant assessment regimes in music education, which tend to privilege fixed outcomes, and progression along normative developmental stages (Philpott & Spruce, 2012; Ball, 2003).

Within performative educational cultures, standardisation and auditability have intensified, shaping a system in which creativity is often subordinated to quantifiable attainment. A posthumanist stance invites educators to shift from assessment as measurement to assessment as attunement, recognising relational, affective, and emergent forms of musical meaning-making. Clark (2022) and others have called for pedagogies that “linger in the moment,” honouring the improvisatory, embodied, and situated aspects of music learning that defy simple codification.

The posthumanist shift is mirrored in recent research in DMI design. The field long ago expanded its horizons beyond purely engineering-driven questions around digital sound synthesis and rigidly codified notions of expressivity. Practice-based artistic research incorporating improvisation and creative exploration is well-established (Green, 2014; Gurevich, 2016; Stapleton and Davis, 2021), and such outlooks can even guide technical development processes which upon close inspection are rarely as goal-directed as they might seem (Pelinski et al., 2025). The key contribution of posthumanist thinking is not so much the complex relationships between instrument, player and other well-defined stakeholders (Jordà, 2004; O'Modhrain, 2011) but the contestability of the boundaries between any of these entities in the first place (Reed et al., 2024b). Where the player ends and the instrument begins was already very much up for debate in terms of physicality (Alperson, 2008) and cognition (Nijs et al., 2017). Posthumanist accounts also challenge the distinction philosophically, rejecting not only the Cartesian mind-body dualism but also the seemingly obvious distinction between humans and technical objects. Recent work has explored whether musical instruments might be better considered as evolving processes rather than well-defined objects (Waters, 2021); who or what determines the “locus of meaning” in the relationship between a player and a digital instrument (Reed et al., 2024a); and where agency might be located in human-technical systems (Stapleton and Davis, 2021; Tahiroglu, 2024; Butt et al., 2025). Such critiques reframe the digital instrument not as a neutral interface but as an active participant in musical becoming, a sociomaterial assemblage where histories, gestures, algorithms, bodies, and affordances intra-act (Barad, 2007; Haraway, 1991; Bennett, 2010). Morrison and McPherson’s (2024) perspective on “entanglement HCI” examines the potential for design practices that embrace friction, multiplicity, and relationality over universality and optimisation. Drawing on Haraway’s (2016) imperative to “stay with the

trouble”, DMI design becomes a site of co-creation, ambiguity, and care which is open to the complexities of bodies, contexts, and musicking practices. Rather than asking what an instrument allows a user to do, posthumanist design inquires into what forms of life, expression, and relation are made possible, or foreclosed, by particular configurations of sound, code, material, and interface.

This approach has concrete implications. It enables us to design and teach in ways that are not merely accommodating of difference but fundamentally reshaped by it, foregrounding an ethics of care and of pedagogical humility.

Entangled Encounters

The AHRC-funded Music and Disability network created a series of cross-sector events which were not only spaces for sharing practice but also for surfacing epistemological tensions, institutional gaps, and emergent methodologies. In what follows, we present key insights that emerged across these events, organised around six interwoven themes: (1) challenging techno-solutionism, (2) design as pedagogical and ethical work, (3) the fragility of inclusive technologies, (4) music education as access work, (5) the need for systemic professional development, and (6) ethical collaboration.

1. Challenging Techno-Solutionism

Across the network events, participants consistently challenged techno-solutionist logics such as the belief that innovation alone can “fix” access barriers through new tools or interfaces. Rather than treating technology as a neutral solution, they emphasised that inclusive design must begin with a shift in values: from designing *for* disabled musicians to designing *with* them and to disabled-led approaches. This involves a move away from the deficit model that positions disabled users as problems to be solved, toward a relational, situated, and ongoing process of co-creation grounded in trust, care, and lived expertise.

“It can be exhausting as a disabled musician. Not only do you have to be good at what you do, you have a lot of practical things to consider. It takes time and is emotionally draining.”

This statement shared during one of the events, powerfully captured the often invisible and ongoing affective labour involved in navigating musical and physical environments that remain structurally inaccessible. It spoke not only to the logistical and material barriers musicians face, but to the cumulative emotional toll of being constantly required to justify one's presence, adapt to unsupportive infrastructures, or educate others about access needs. Network participants argued that access must not be treated as a matter of individual resilience or workaround. Instead, it must be designed in from the outset as a structuring principle that shapes technologies, pedagogies, spaces, and relationships. Co-design, in this light, is not simply a method, it is an ethical and political commitment to building with, not despite, difference.

2. Design as Pedagogical and Ethical Work

Participants reimagined design not as a purely technical or aesthetic endeavour, but as fundamentally pedagogical and ethical work. Instruments were frequently described not as isolated artefacts or interfaces, but assemblages co-constituted by the relationships, values, knowledges, and infrastructures that surround them. These assemblages include not only the material instrument but also the assumptions embedded in its design, the forms of documentation that accompany it, the emotional labour required to navigate its use, and the networks of support that determine whether participation is truly possible.

“It’s not about adapting to a tool, it’s about the tool adapting to how I move and think.”

This participant comment reflects a powerful reframing of agency, shifting emphasis from individual adaptation to collective responsiveness. Rather than requiring the musician to conform to the instrument’s logics, participants called for instruments that are capable of attuning to diverse embodied ways of knowing, sensing, and creating. Design, in this view, becomes a dialogic process (Wright and McCarthy, 2018; Zayas and McPherson, 2022), one that listens, learns, and evolves in relation to the people and contexts it engages.

Crucially, support materials and care infrastructures often peripheral in mainstream design discourse were identified as central to sustaining meaningful access (Lucas et al., 2025). In this framing, design is situated as a long-term relational and educational practice, with shared

responsibility across designers, educators, and communities to maintain engagement and foster equitable participation over time.

3. The Fragility of Inclusive Technologies

A recurring theme was the precarity and temporality of many inclusive technologies. Whilst **bespoke** design was widely celebrated for its responsiveness to individual needs and contexts, it was also critiqued for its vulnerability to short-term funding cycles, staff turnover, and the loss of expertise. One participant commented:

“Bespokeness is a double-edged sword... The longevity of adapted instruments often depends on the availability of the maker or on limited academic funding cycles.”

This tension was felt most acutely in the context of adapted instruments, where sustainability is often jeopardised by rapid technological change and a lack of infrastructure for maintenance and repair. Participants highlighted the way hardware components become obsolete, spare parts become unavailable, and knowledge is seldom transferred from one maker to another, leading to instruments that are no longer usable even when they remain theoretically 'accessible'. This technological fragility underscores a wider structural problem: access is often tied to individual champions or project-based interventions, rather than embedded in sustainable, systemic practices.

In response, participants called for open-source design practices, community stewardship, and long-term investment in inclusive innovation, emphasising that the future of adaptive instruments depends not only on their ingenuity, but on the ecosystems of care, documentation, and collective expertise that sustain them beyond the lifespan of individual projects.

4. Music Education as Access Work

Music education was reframed by participants as a site of access work, not merely a context for inclusion, but a structure that often reproduces exclusion through its pedagogical, institutional, and symbolic dimensions. Participants identified multiple, intersecting barriers:

- Physical – inaccessible venues and equipment

- Curricular – rigid progression routes that fail to accommodate diverse learners
- Attitudinal – deficit-based assumptions about disabled students’ abilities
- Symbolic – the ongoing absence of disabled role models within music education and leadership

These reflections revealed how early disengagement is not about a lack of interest or talent, but often a result of structural inflexibility and inaccessibility. One participant noted:

“I did a concert recently and it said it was step free, but backstage it wasn’t. I’m always thinking and planning accessibility. Venues may be accessible to the audience, not performers.”

And another:

“Music education and formal routes are quite rigid. If you can’t access one bit, you’re put off the whole thing.”

This powerful insight underscores the invisible labour often carried by disabled musicians, who must navigate and compensate for systems, locations, venues, transport and institutional practices that assume able-bodied norms. Participants called for a transformation in how musical achievement is defined, moving away from narrow hierarchies rooted in Western classical tradition, notation literacy, and solo performance. Rather than seeing inclusion and excellence as mutually exclusive – a dichotomy often reinforced in educational discourse (Henley & Baron 2022, Kinsella et al 2024), the network surfaced a growing consensus that inclusive practices can and must be rigorous, high quality, creative, and aspirational.

There was also particular concern that even progressive inclusion efforts risk reproducing normative values if they fail to question the deeper assumptions about what music education is for, and who it is designed to serve. As one participant explained:

“I think there are two elements to accessibility in music that need to change – attitudes and physical access. There aren’t many disabled classical musicians. When you think about Paralympians you can name a few, but you can’t name many disabled classical musicians.”

The lack of visible disabled role models was a recurring theme. As another participant shared:

“When I first became disabled, I was looking for people that look like me on Google and I couldn’t find much. Things are changing but we still have a long way to go to change people’s attitudes.”

This was furthered by another participant who argued:

“We need to extend beyond the instrument to encompass the cultural and institutional structures that shape who is seen and heard as a musician.”

This insight points toward the need to reconfigure not only pedagogies, but also the broader conditions of visibility, value, and participation within music education and society more widely. It suggests that inclusion must be embedded across all levels, from curriculum design and assessment frameworks to funding priorities, professional development, and cultural narratives of musicality, not merely implemented at the level of access to tools or spaces.

5. The Professional Gap: Inclusion as Shared Responsibility

In parallel to point number 4, participants voiced concern about the lack of training and systemic support for educators. Inclusive music teaching was often positioned as the domain of specialists, leading to fragmentation and inconsistent practice. There was a strong call to reposition inclusive pedagogy as a shared professional responsibility, embedded across teacher education, continuing professional development, and leadership frameworks. This provision should not be reserved solely for specialist SEND teachers but recognised as a core pedagogical need across the profession. It must be at the fore of both initial teacher education and ongoing professional development as one participant noted:

“I didn’t get any training on specialist provision with pupils with complex needs, inclusive ensembles, or engaging with pupils with specific needs, or even an exploration into lived experience.”

This includes training on the social and medical models of disability, alongside more subject-specific approaches that address how inclusive practice can be meaningfully embedded within music education. The absence of joined up thinking between music education and disability discourses perpetuate gaps in provision and limited innovation. This fragmentation was seen to affect not only learners but also educators who may feel underprepared or isolated in attempting to implement inclusive strategies.

6. Ethical Collaboration and the Labour of Participation

Finally, ethical collaboration emerged as a central concern. Participants stressed that working across difference must be grounded in principles of consent, credit, and co-agency, especially when disabled individuals are invited into research or design processes (Ymous et al., 2020; Skuse and Knotts, 2020).

“Always ask potential collaborators how they want to be involved and how they want to be compensated or credited.”

This insistence on non-extractive practice aligns with a broader reconceptualisation of inclusion, not as compliance, but as a shared, evolving, and ethically charged commitment. Participants advocated for diffractive methodologies (Barad, 2007; Haraway, 2016) that attend to complexity rather than reduce it; that embrace contradiction and multiplicity; and that see access not as resolved, but as an ongoing negotiation within entangled ecologies of people, tools, environments, and histories.

“It’s important to understand more about me and what shapes me as a musician, the places I practise, the wider things I enjoy that shape me as a musician.”

The AHRC network events made visible the urgent need for sustained cross-sector collaboration. Participants emphasised that real inclusion requires more than adaptive hardware or well-meaning policy; it demands shared, ongoing, and materially grounded practices that resist fragmentation. The challenge now is not just to design better tools, but to design with communities, curricula, and cultures in mind. Entangled musicianship offers a framework through which such futures might be imagined and enacted.

Entangled Musicianship: Reconfiguring Systems, Bodies, and Knowing

The findings illuminated the complex web of disconnections that persist between inclusive education, digital musical instrument (DMI) design, and broader music education systems, disconnections that are underpinned by entrenched humanist paradigms, instrumentalist assumptions, and siloed disciplinary practices. These tensions do not resolve into neat solutions. Instead, when read diffractively, they reveal the need for a fundamental reorientation: not simply new tools or adaptations, but a reconfiguration of the conceptual, pedagogical, and material conditions under which musical learning and access take shape.

Entangled musicianship is offered here as one such reorientation. Grounded in posthuman theory and animated through cross-sector dialogues in the AHRC network, this outlook resists linear, outcomes-based models of education and design. Instead, it calls for an ecological, relational approach that positions music-making as co-constituted through human and more-than-human intra-actions including bodies, tools, environments, gestures, and histories.

This reimagining entails a series of interrelated shifts:

- Musical knowledge is seen as emergent from movement, relation, and sensory engagement. It is not reducible to symbolic literacy or cognitive mastery.
- Accessibility is embedded through co-design and lived expertise, not retrofitted onto existing norms.
- Pedagogy becomes a dynamic practice rooted in attunement, improvisation, and affect, not the transmission of fixed skills.
- Technology is not a neutral tool, but an active co-performer entangled in the production of meaning and musical identity.

These shifts are both conceptual and deeply practical. They imply structural transformations such as the rethinking of assessment frameworks and public examinations to recognise DMI-based expression, investing in sustainable inclusive design infrastructures, and embedding inclusive pedagogies in teacher training and curriculum policy. Crucially, they demand new alliances across education, technology, disability, arts, and policy, alliances grounded in ethical relationality, shared responsibility, and openness to more-than-human epistemologies.

But this framework also invites a deeper ontological shift, a re-(e)valuation of corporeality as central to musical learning. Posthumanist and new materialist thinkers challenge the ideal of the autonomous, rational subject and instead position the body as a site of becoming - shaped through rhythms, intensities, and affective resonance with both human and nonhuman actants (Spiel, 2021; Homewood et al. 2021; Sanches et al., 2022). In both music education and DMI design, normative assumptions about dexterity, perception, and endurance have historically marginalised many disabled musicians and learners. Entangled musicianship insists that we begin not with deficit, but with difference and recognise corporeal variation as a source of creative potential.

This rethinking of embodiment transforms pedagogical and design imaginaries. It reframes assessment as attunement, invites curricula that value sensory exploration and improvisation, and calls for instruments that adapt to and evolve with the bodies that play them. As scholars like Asplund (2022) and Ingold & Bates (2021) remind us, musicking is never a solitary act; it is always a relational, co-performed negotiation across bodies, technologies, materials, and cultural histories.

Crucially, this corporeal orientation also unsettles long-dominant learning theories that continue to shape educational systems internationally. Frameworks grounded in cognitivism and symbolic representation, such as those of Piaget (1950), Bloom (1956), and Bruner (1960) remain foundational in curriculum design, assessment structures, and teacher education. These models tend to prioritise internal mental processes, linear developmental stages, and individual cognitive mastery, often at the expense of sensory, embodied, and relational forms of knowing. Their enduring prominence reflects a broader tendency within education to locate learning within the mind, rather than across dynamic human and nonhuman assemblages.

Posthumanist perspectives offer a necessary rupture. Learning is no longer conceived as the transmission of content to a bounded individual, but as an emergent, situated phenomenon enacted through intra-action (Barad, 2007) between bodies, tools, sounds, spaces, and histories. Corporeality, then, is not a barrier to be managed, but the very condition of creative and educational possibility.

In drawing together theory, practice, and empirical insights from across the AHRC network, this paper contributes a timely intervention into both music education and digital musical interaction. It challenges dominant paradigms rooted in cognitive individualism, symbolic assessment, and technocratic design, offering instead a situated, ecological, and ethically responsive framework. Entangled musicianship is not a prescriptive model, but a generative agenda: one that invites us to stay with complexity, attend to difference, and reimagine what, and who music education and digital design are for.

Diffraction Methodologies: Reading Across Fields, Practices, and Differences

Methodologically the AHRC network also revealed that knowledge did not emerge from isolated disciplines or predetermined categories of expertise, but from the interference

patterns generated when perspectives, experiences, and domains were brought into relation with each other. To engage seriously with posthumanist theory in education, music, and design is therefore to reckon with the methodological implications of entanglement, materiality, and more-than-human agency, implications made visible through the network's unfolding encounters.

This paper does not simply apply theory to data; it works with theory to reimagine what knowledge is, how it emerges, and how we remain accountable to its complexity. The concept of diffraction, drawn from Barad (2007) and further developed by Haraway (1992, 2016), offers a powerful methodological orientation. Rather than resolving difference, diffraction attends to how differences make a difference, surfacing productive tensions, collisions, and overlaps that can reconfigure understanding.

The events themselves enacted a diffractive research process. Participants from music education, HCI/DMI, disability studies, and policy did not simply exchange perspectives; their dialogues generated new shared critiques and relational insights. Frictions, such as the precarity of bespoke design, the absence of inclusive curricula, or the extractive nature of some collaborative models did not need to be, nor could be resolved in the events, but were taken seriously as sites of learning and responsibility.

In the network, diffractive methodology was activated through:

- Reading across music education and DMI/HCI brings to the surface interferences rather than parallels;
- Engaging theoretical provocations not as external lenses but as intra-active participants in meaning-making;
- Treating the AHRC network events not as data collection exercises, but as situated, affective spaces of thinking-feeling-knowing.

This methodological stance is not neutral. As Barad reminds us, intra-action entails ethical responsibility. In this light, we foreground the partiality of our account and position knowledge production as a relational and accountable practice.

Within music education, HCI and DMI research, adopting a diffractive methodology shifts the focus from predefined outcomes and stable frameworks toward practices that remain open to complexity, affect, and embodiment. These commitments underpin the framework of

entangled musicianship proposed here, not as a generalisable model, but as a situated, relational practice of research, design, and pedagogy.

Word Count: 6003

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