

# The Problem of DMI Adoption and Longevity: Envisioning a NIME Performance Pedagogy

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## ABSTRACT

This paper addresses the prevailing longevity problem of digital musical instruments (DMIs) in NIME research and design by proposing a holistic system design approach. Despite recent efforts to examine the main contributing factors of DMI falling into obsolescence, such attempts to remedy this issue largely place focus on the artifacts establishing themselves, their design processes and technologies. However, few existing studies have attempted to proactively build a community around technological platforms for DMIs, whilst bearing in mind the social dynamics and activities necessary for a budding community. We observe that such attempts while important in their undertaking, are limited in their scope. In this paper we will discuss that achieving some sort of longevity must be addressed beyond the device itself and must tackle broader ecosystemic factors. We hypothesize, that a longevous DMI design must not only take into account a target community but it may also require a non-traditional pedagogical system that sustains artistic practice.

## Author Keywords

NIME, pedagogy, communities of practice, ecosystem

## CCS Concepts

•Applied computing → Sound and music computing; Performing arts; •Human-centered computing → HCI theory, concepts and models;

## 1. INTRODUCTION

Within NIME practice and discourse two issues drive an important part of research agendas: instrumental longevity and virtuosity. Common assumptions assert that any instrument/interface that achieves some sort of longevity will necessarily provide the required conditions to achieve instrumental virtuosity [2, 28, 27]. While both are extremely complex issues, in this paper we will focus on the former as it presents broader implications for musical practice within NIME and related fields.

Adoption and longevity of novel musical devices are longstanding problems, despite the ever increasing number of instruments, interfaces, and technological platforms for music

produced every year [20], whether in academic or commercial domains. Most cases are limited to bespoke systems for individual use or as research probes [28], resulting in DMIs from past conferences whose longevity is only maintained either anecdotally or as paper citations [28].

Beyond NIME, these problems have also been addressed in the public sphere, citing that very few DMIs have ever sold at least one unit [28] and seemingly implying that not many will reach the public eye [25]. Certainly these are not easy issues to tackle due to the multiple factors that come into play within the broader ecology in which particular DMIs are developed and deployed [27]. Comparing DMIs to traditional music instruments may not be the best approach either due to the extensive histories and musical practices behind a particular acoustic instrument, such as well defined repertoires and pedagogies developed over decades, if not centuries. This is a matter not only of instrument design, but of established musical practices. We cannot directly compare in this respect a violin to the Hands [39] or even further, compare a violin to an augmented violin in this way [30].

Because we identify longevity as a complex issue, we first need to discuss how our view of technology in this domain leads us to overlook significant and emergent relationships that are developed from and in response to a DMI in a particular context. As Marquez-Borbon and Stapleton discuss in their accompanying commentary [24], the causes of a lack of established performance practices in NIME can be partially attributed to the constant pursuit of novelty and a lack on engagement with distinct communities: “*We suspect the primary cause is a lack of connection to sustained and emerging real world performance practices, and a lack of engagement with academic and professional communities that sustain these practices. The “N” in NIME itself is perhaps partially to blame, in that it resists the long-term development of performance pedagogies, repertoire and critical discourse necessary for the legitimisation of a performance community within the wider NIME community.*”

This paper aims to shed light on some of those relationships, arguing in favor of the development of performance practice through the enactment of non-traditional musical pedagogies and communities of practice.

## 1.1 Technological Determinism in the Context of Music Technology

The predominant discourse within NIME prizes technological advances by means of functional and implementation issues [12]. It could be argued that technological determinism tacitly permeates NIME research objectives. Certainly, as [19], and [15] explain, technological advances symbolize



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progress and modernity, while simultaneously reducing the user to a mere component of a system. Following development in the field of Human-Computer Interaction (HCI), there is an increasing emphasis on rationality and control where interactive systems are abstracted in order to determine its operators and products [16, 37].

This view is evident in the historical developments of computer music and new musical interface design where early research concerns focused on the technological developments of the time, as well as on the implementation of music theory, artificial intelligence, and cognitive science in computer systems [33]. Bryan-Kinns [5] observes that these initial concerns obscured the examination of other issues such as interaction, group/social activity, or alternative practices that depart from the traditional composer-performer-audience model. In this manner, the musical system took precedence over the user as a research concern. As Richard [36] explains, such developments attempt to mirror scientific and technological progress. Similarly, in contexts where music technologies are employed, the technological aspect is placed above musical activity along with its socio-cultural and historical factors [43]. (Figure 1) shows the different changes in research paradigm shifts within NIME.

## 1.2 Setting up the Problem

Regarding the longevity of DMIs, i.e. whether the interactive music systems are being used in artistic performance situations for prolonged periods of time and beyond their research purpose, we might be tempted to ask “why are some DMIs more successful than others?” The question, we believe, should be reframed. Rather than focusing on the particularities of design such as heuristics or evaluation methods [28], we should be searching at both the community and ecosystem level.

We further observe that focus still lies on assessing aspects of NIME communities which are centered on successful community formation and sustainability by means of crowdfunding, platform establishment, and appealing technological capacities [28] building. However, being NIME a “community-of-communities” [24], we must consider whether any of these communities are indeed establishing a relationship between DMIs and potential performers outside the academic context of NIME. Therefore, the question remains on the development of a performance.

## 2. PREVIOUS RESEARCH

In this section we will present examples of current research investigating how design and community building foster the longevity for a particular technological platform. We continue our discussion by presenting how learning is done within the context of computer music and NIME.

### 2.1 DMI Design and Longevity

Recently, Morreale and McPherson [28], presented the outcomes of a survey investigating the factors that influence the success and failures of DMIs in order to formulate a design framework addressing instrumental longevity. Results from this study show the diversity of motivations for design, as well as the limited target users for any given DMI (mostly for the designers themselves). Also of importance are the limited contexts and opportunities for performances exhibited by the survey. As shown, very few DMIs are (frequently) performed in public and are mostly limited to one user (again, the designer). These results are particularly striking given the global aim of the community. While the work of the authors above does not further inquiry into the

reasons for these results, we consider such trends to be significant hurdles to the broad uptake of DMIs at larger scales and with wider user-bases.

### 2.2 Community Building: Case studies

The existing communities within NIME play a fundamental role for the creation, establishment, and prolonged usage of DMIs. As reported by Morreale et al., [29] the successful uptake of the Bela Platform consisted of a series of stages in which Bela evolved from being a custom hardware board for the D-Box (a hackable DMI, [45]) into a platform and toolkit used by a growing DMI designers and enthusiast community. This was achieved by gradually supporting established software used by other communities within NIME, such as Pure Data and SuperCollider, and eventually launching a crowdfunding campaign with successful results [29]. Although it is in fact remarkable to approach community sustainability by means of empowering and merging with other like-minded communities, as well as establishing connections with their members, it is still arguable whether the preservation of such platforms may prolong the usage of potential DMIs that might embed them in actual performance practices.

In a similar manner, Patchblocks [18], was developed with community interactions in mind, such as their creative processes and the share and adaptation of ideas. As analyzed in [24], such social factors are integrated in the design of Patchblocks leading to the collaborative development of the interfaces’ technology. In this case, the social aspects of music performance practices are a primary consideration to the artefacts design, which purposefully integrates communal activities of knowledge development, as well as a collaborative music-making.

From these two cases we can observe how taking a community element into consideration can serve different purposes, such as increasing awareness and spike public interest to support community formation or to inform the design of artifacts that support collaborative interactions. Nonetheless, a common factor between both cases seems to be the presence of communal learning processes happening in both collocated and distributed spaces, such as workshops and online forums, respectively, in which novices and experts concur as supporters and facilitators. However, a broader performance-pedagogy ecosystem seems to be missing from the scope of research and practice of communities within NIME.

### 2.3 Learning (with) DMIs

Throughout the years NIME has developed a curriculum encompassing diverse design, implementation, and evaluation practices for DMI development [22]. Here we will limit our discussion to learning for musical performance.

The rationalization and operationalization of DMI design practices and philosophies introduced the concept of ‘learnability’ as an additional element to be considered and evaluated [42]. However, this concept, defined as the “time needed to learn how to control a performance with a given controller” (ibid), reduces the complex process of learning to a mere function of time. Learnability in this manner follows the notion of expertise within the conservatory tradition where invested time in practice is the principal factor in learning. That is, amassed practice time directly correlates to the achievement of expert performance [8].

In addition, within NIME it is recognized that develop-

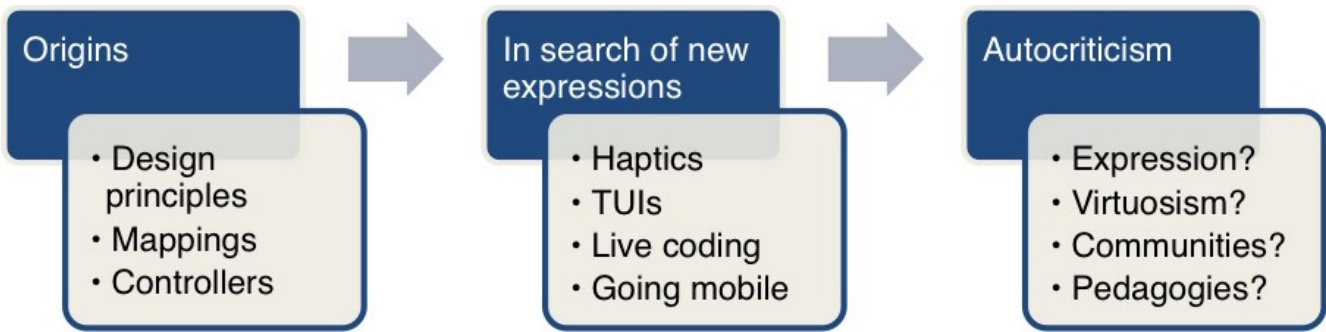


Figure 1: Paradigm shifts within NIME

ing performance practices is particularly difficult due to the quickly evolving nature of technology and its obsolescence which make establishing performance practices, including repertoire, challenging [30]. The nature of DMI designs, their simplicity or complexity, may inhibit investing in necessary practice and learning [5], which is further complicated by the lack of formal structures for learning how to play DMIs [41]. To this end, performance pedagogy is reduced to transmitting formalized knowledge [1, 35] and/or simply knowing the system’s functionality [3, 23].

Whether the concept of learnability is directly related to Western musical pedagogy is not entirely obvious; however, what is important is to note how these cultural and intellectual movements further inform some of the pedagogies employed in this context. In this manner, the conservatory music tradition becomes the dominant pedagogy by de facto and without critique simply by being immersed within that culture [38].

The few observed attempts to establish learning methods and pedagogies within NIME exhibit such inheritances. The studies presented here identify the problem of longevity and address it through a learning perspective. For example, Fels and Hinton [9], and Oore [31] provide descriptions of the learning experience of glove-based gestural controllers. The former study emphasizes the quantitative changes in performance along with the amassed practice time of 100 hours. The latter study, while also shows an investment of 100 practice hours, describes the learning as a complex process from the perspective of the performer given the self-directed nature of the task. Butler [6] and Zybyszynski [46] developed what they deemed etudes and methods for DMIs. These materials are analogous to those existent for acoustic musical instruments. These cases are important because they attempt to establish specific practice criteria for fostering prolonged engagement with DMIs.

### 3. ADDRESSING LONGEVITY THROUGH EDUCATIONAL ECOSYSTEM DESIGN

Perhaps the most significant challenge for developing a performance practice for DMIs is time. This concern is product of comparing the evolution of acoustic music instruments and DMIs [32]. We consider time alone to be insufficient for providing longevity or persistence of a given DMI because, as an abstract measure, it does not provide the necessary conditions by which different tasks and aims are achieved. Meaning that there is no guarantee of success simply because we let enough time pass.

However, taking into account the numerous factors that can be accounted for in the design of a DMI, along with the

multiple stakeholders and contexts of use, can prove overwhelming if not impossible [27]. One possible path forward would involve a consideration of the ecology in which the DMI is situated [32]. The design strategy should therefore go beyond the artefact and into ecosystem design, particularly the educational ecology.

The educational ecosystem’s purpose is to develop performance practices that contain repertoire, pedagogical strategies, and ultimately, following a Community of Practice (CoP) model [21]), and different stakeholders ranging from novices to experts that engage in mutual activities of learning. However, Lave and Wenger’s definition of a CoP does not entirely fit within the NIME Community of Interest (CoI), which appears to have neglected how certain aspects of musical CoPs, such as informal learning environments, have proved to be beneficial for improving certain performance practices, such as improvisation and composition skills [11].

One relevant example attempting to prompt the development of performance practices is the Magnetic Resonator Piano [26]. This study not only organizes a community surrounding the device, but fosters the development of repertoire between composers and performers. In effect, this example can be considered as an instance where a learning ecosystem is being designed and enacted. However, this particular approach to creating a musical community is limited to the accounts of the composer as the sole agent generating materials to the community to perform. Developing musical practice does not solely rest upon composers to expanding an instruments’ repertoire. Using a CoP approach to learning grants all members the opportunity to participate in the co-creation of practice. As seen in alternative musical practices, such as improvisation, multiple stakeholders take part in the creative activity. In this light, different musical practices must be considered in order to maintain activity and relevance [14].

#### 3.1 Pedagogical Design and Performance Practices: Non-traditional Pedagogies

As previously mentioned, the cultural context, along with its normative musical practices, inform both DMI design and their performances. By extension, this context further informs pedagogies which by their deep rooted nature prove challenging to move away from [4, 38]. To some extent, Western pedagogy may be regarded as having an “information-processing” approach, i.e. reducing the teaching and learning dynamic to a mere transmission of knowledge. In this sense, knowledge acquisition is abstracted to a point in which the learning experience is decontextualized from its social aspect. Following this trend, the Western music conservatory tradition is hierarchically structured

and prescriptive, as its pedagogical methods demand experts to dictate how are musical knowledge and performance practices transmitted and evaluated.

By contrast, alternate pedagogies embrace the embodied, social, and situated aspects of learning. Recently, efforts have been made to propose pedagogies that counter the dominant philosophy of music education. Two related proposals are the ecological [4] and enactive music pedagogies [38]. Both pedagogies promote the idea that teachers and learners mutually constitute the learning environment (physical and social) by engaging in an “open-ended, communal, and dialogical process of mutual specification whereby knowledge and understandings emerge from the relational and co-operative (musical) pedagogical ecology they co-enact” [38].

Teachers, more than being authorities imposing facts, rules, and techniques, are regarded as facilitators organizing learning and revealing possibilities to the student. Similarly, the student engages in this relationship by bringing their own ideas, perspectives, and practices. Because of the nature of cooperation developed here, the group may develop and enact their own goals, as well as coordinate themselves through dynamic adaptive processes. The social is not limited to collaborative and community learning, but it suggests the different ways of engaging with the world and how these emergent relationships give meaning to our actions and thoughts [21, 38].

## 4. DISCUSSION

Instrumental longevity is widely recognized as an impediment for achieving virtuosity [28, 44]; however, its solution is not entirely evident despite recognizing its source in the design of the DMI itself [27, 40]. This poses a problem, on one hand, given the difficulty in identifying and implementing in the design the traits that are significant in the development of expertise. On the other, as previously discussed, it becomes necessary to develop and foster a community which may present a larger likelihood for a DMI to be widely adapted and therefore show some signs of longevity in use.

However, the communal aspect further demands an additional element of organization that promotes performance practice. Oore, Butler, and Zybyszynski provide example cases for the transfer and implementation of the Western music conservatory approach to DMIs. These show the process and outcomes of this process. While important in their efforts, nonetheless they suffer from the decontextualization and artificially imposed learning materials borrowed from this particular music tradition. It must be recognized that developing any kind of performance practice demands a significant time investment. As exemplified by the community building and organizing activities surrounding the Magnetic Resonator Piano [26], composition and acquiring performer expertise for a new musical instrument takes time. While the point being made here is not to say these approaches have failed, rather it is to recognize their limitations within the context of NIME.

Learning to play a DMI may not demand following a prescriptive or fixed learning agenda, such as that proposed by the conservatory tradition, but may take advantage of embodied learning processes [7] organized by ecological or enactive pedagogies that orient the performer in the learning task. Additionally, these pedagogies take into account the

informal and imitative learning strategies, common outside of academic settings [11], that are important in learner’s experience. By taking an open-ended and co-created learning environment it is possible to create a community that allows for the inclusion of multiple artistic practices that may often be overlooked. This would include co-operative music making or co-practice where musicians informally meet with the goal of communicating and exploring musical spaces, musical coherence, and the roles of materials and instruments within that context of practice [12].

Similarly, free improvisation, following Borgo, provides a disciplined way to explore the musical possibilities and spaces afforded by DMIs. Contrasting improvisation with a composition perspective [26], we can foresee faster turnaround times given the diversity of activities and roles the agents can take in the creative process. In this manner, time may be effectively reduced because composers and performers are folded into a single agent, while communal activities prompt a range of methods for musical production. However, we must not fall into the trap of taking improvisation for granted and regard it as “a substitute for work” [10].

### 4.1 Examples

We have identified the ecological and improvisation oriented approach to learning in different research studies. These examples highlight the importance of improvisation as an explorative, creative, and collaborative practice serving as foundation for further composition and performance activities.

For example, in [17], we can observe a remarkable educational ecology where teachers, researchers and musicians engaged in the tutelage of the students through a series of workshops during a large-scale music education program. Throughout the program the students captured and manipulated sounds by using a series of tools such as recorders, microphones, maker kits (e.g. Makey-Makey) and software (e.g. Max patches developed by the researchers). With these sounds the students created scores for each other and performed experimental and improvisatory music with them by using a series of electronic and acoustic instruments they had made themselves with the kits and other classroom materials.

In this case we can observe how an enactive pedagogical approach, where performance practices such as improvisation and collaborative composition were carried out by different stakeholders ranging from novices to experts by using some of the standard DMI design and sound synthesis practices of the NIME community. Such activities engaged them in mutual activities of learning, having positive results for students and teachers. Such informal learning environments have proved to be beneficial for improving certain performance practices, such as improvisation and composition skills [11] and are key aspects of musical Communities of Practice [21].

A similar ecology is observed in the Digital Orchestra Project [34], where researchers from three disciplines: performance, composition and music technology developed a series of DMIs and two idiomatic [Vasquez] compositions for them. In particular, the authors circumvented the lack of a performance tradition for these instruments (i.e. established techniques and repertoire) by engaging in a series of improvisation sessions with the DMIs, where their performance capabilities were explored and mapped out, resulting in the development of a notational system that accommodated the particular techniques of the instrument. Having

specific notation for each DMI allowed the composers and performers to characterize a body of idiomatic techniques for them to practice and write repertoire with. Additionally, the authors recognize the importance of having documentation of the interface available as materials for further development of repertoire by practitioners.

The Magnetic Resonator Piano [26] demonstrates an attempt to establish an ecology of performance through communal practice. This study not only organizes a community surrounding the device, but fosters the development of repertoire between composers and performers. In effect, this example can be considered as an instance where a learning ecosystem is being designed and enacted. However, this particular approach to creating a musical community is limited. This is due to the account of the composer being the sole agent generating materials for the community to perform.

In contrast, creative agency within an ecological-enactive approach is granted to all stakeholders and not only to composers. Musical materials, such as repertoire or musical notation, is cooperatively developed through a diverse range of activities, whether design, composition, and improvisation (see [13]). Using a CoP approach to learning grants all members the opportunity to participate in the co-creation of practice. Additionally, different musical practices, such as improvisation, contribute to maintaining the activity and relevance of a given musical system [14].

## 5. FINAL REMARKS

NIME's main pedagogy already demonstrates enactive and ecological characteristics. However, this pedagogy is mainly directed towards the design and creation of DMIs [22], and not towards developing musical performance with these systems. Our proposal, instead, is oriented towards the design of musical pedagogies for musical performance as an approach to establish the prolonged use of a DMI.

NIME as a broad community provides a good opportunity for implementing novel pedagogical strategies that foster values already embraced by its practitioners: imagination, creativity, exploration, and innovation. To this end, as discussed by Borgo and Van der Schyff, we can further address through novel educational strategies issues of inclusion, participation, and diversity, as well as challenge institutional priorities that favor productivity, efficiency, and competition over critique, reflection, and cooperation. According to van der Schyff et al. [38], the enactive approach "also strongly implies the exploration of 'alternative' approaches to creative musicking [emphasis in original] that develop the unique possibilities of a given group or individual". We identify this approach as a way of engaging with real-world practices and to look beyond academic and institutional settings. Restating the questions posed by [24], rather than asking, *how do we design a DMI for adoption?* We should ask instead, *How does a tool connect to real-world performance practices?* And, *How does the tool engage with both academic and professional communities that sustain these practices?*

In its current form, a NIME pedagogy of performance may not be as integrated and structured as its music conservatory counterpart given the heterogeneity of interactive system designs and musical practices. However, we do not interpret NIME's diversity as a problem. An enactive-ecological pedagogy is able to accommodate the diversity

of systems (and subsequent practice) without imposing a rigid, rule-based performance practice like the Western music conservatory tradition. Additionally, this pedagogical approach maintains an open and collectively generated pedagogy that adapts to both individual and collective needs, as well as being responsive to external factors outside of the community. A NIME performance practice responds and adapts to the idiosyncrasies of particular DMIs, while being both informed and informing community and ecological trends and activities.

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