

The Story of The Max Lab: A Thirty-Six-Year Collaborative Journey

Sasha Leitman

sleitman@ccrma.stanford.edu

Center for Computer Research in Music and Acoustics (CCRMA),
Stanford University Stanford, CA, USA

Matthew Wright

matt@ccrma.stanford.edu

Center for Computer Research in Music and Acoustics (CCRMA),
Stanford University Stanford, CA, USA

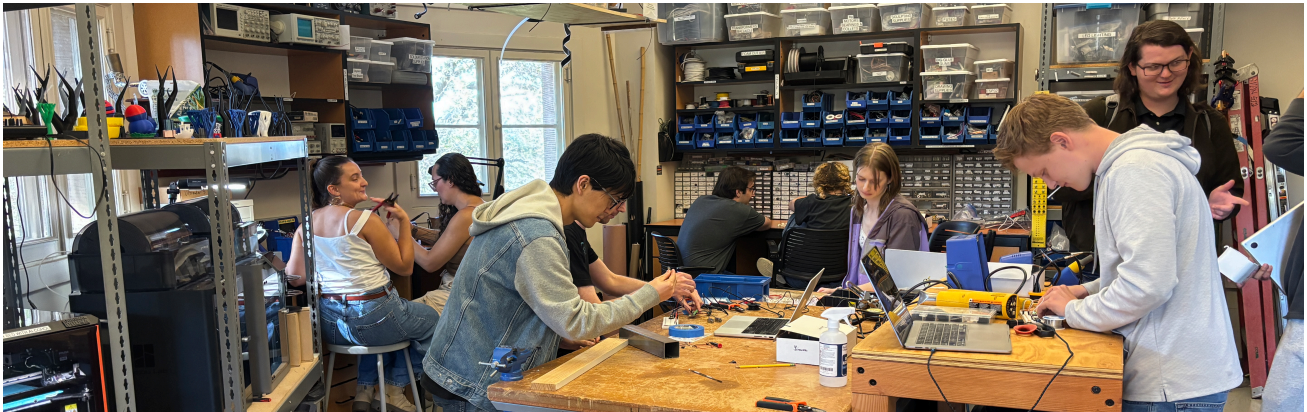


Figure 1: Students and researchers at work in the Max Lab.

Abstract

This paper reports on and reflects upon the thirty-six-year history of a prototyping laboratory at our computer music center: the Max Lab at Stanford University’s Center for Computer Research in Music and Acoustics (CCRMA). Over this period, the lab has been used by hundreds of students, faculty, researchers, and creatives. It has evolved into a living artifact of practice within the field of New Interfaces for Musical Expression (NIME). We examine the role, value, and challenges of shared workshop spaces, and situate resources and physical space within NIME pedagogy. We trace the evolution of our laboratory over time, highlighting key developments in its design and use. Finally, we articulate the guiding principles and practical strategies that have sustained this dynamic and creative environment.

Keywords

NIME Teaching, Pedagogy, Community, Prototyping, Art Spaces

1 Introduction

Creative spaces dedicated to designing and making physical objects go by a wide range of titles, including Creative Space, Studio, Lab, Prototyping Lab, Makerspace, Fablab, Workshop, and Shared Machines Shop. While each term has cultural implications, particularly within specific fields, there are significant overlaps. Dickel et al. [11] describe these spaces as “real-life laboratories” which “provide niches for experimental learning that expand the scope of established modes of research and development.” Here we will simply say “lab.”

Corazzo [9] describes these creative spaces: “For us, it is a physical space where people gather, work, inspire each other, learn new things, and connect. Participating in the space brings us into a relationship with like-minded people who stimulate our thinking. It is fun, pleasurable, safe, and healthy. In some spaces, collaboration plays a central role while in others it is neither an imperative nor a consideration.”

Many NIME papers have discussed pedagogy [2, 5, 10, 14, 15, 18, 20, 21, 25, 26, 31, 35, 42, 43, 45]. In many of these courses and at many institutions that publish in NIME, students and researchers use a physical prototyping lab to develop their work. The resources provided can be as influential as the curriculum presented. These resources are sometimes listed, but their design and history are rarely examined in NIME research, even though they reflect human labor, institutional constraints, and relationships. Physical making happens in physical spaces, which shape our research, teaching, and communities.



This work is licensed under a Creative Commons 4.0 International License.

NIME '26, June 23–26, 2026, London, UK

© Copyright held by the owner/author(s).

This document is an account of our 36-year history and our approach, an autoethnography of an individual lab and examination of the role and challenges of such spaces. While grounded in an academic environment, many lessons come from collective art spaces and also apply to other settings. The work of building and nurturing shared spaces for creativity is both vital and frequently unacknowledged. Given that such work is rarely documented or published, a full-scale comparison of similar labs is beyond the scope of this paper. Likewise, our goal is not to provide a prescription for replicating our lab, as each space and community is unique. It is also not an attempt to draw direct lines between the choices we have made and the resultant outcomes. The development of a space for physical creation is far too entangled among people, technology, and environments to draw direct, conclusive lines of outcome. Finally, this paper is not about the technology used within individual courses, (which is under the instructors' purview) or chosen by users for their own work. Technology changes, but the lab's basic structure sustains these adaptations because so many of the basic needs remain the same.

2 Background and Value of Creative Spaces

This section discusses relevant literature on the value(s) of shared collaborative making spaces, including prototyping, artistic spaces' role in the community, and how these spaces can broaden community members' perspectives

2.1 Prototyping Space

Physical making and prototyping have been widely studied across cognition, education [3, 13, 29, 34], and philosophy. The role of physical creation can be one of actualization and imagination as Dickel et al. describe: "Prototyping turns an intangible and inaccessible future into a tangible and accessible object. It transforms expectations into experiences, fictions into facts. They are both epistemic objects that are supposed to facilitate learning, and material promises of a realizable future" [12]. It can be educational and informative as Sydow [23] articulates: "Physical manifestation of ideas is a powerful learning tool and shows the errors in more ephemeral sketching techniques."

Learning through making goes beyond testing ideas; it includes understanding materials, processes, and the world around us. Lehrman and Ryan [27] write about their work in NIME education, "knowledge is formed not just through theory, but through practice and the tangible transmission of skill, where materials teach the maker."

Environments that foster physical making can inspire new avenues of interaction [16] and provide space for open exploration. Wilkinson and Petrich say, "It's fooling around directly with phenomena, tools, and materials. It's thinking with your hands and learning through doing. It's slowing down and getting curious about the mechanics and mysteries of the everyday stuff around you. It's whimsical, enjoyable, fraught with dead ends, frustrating, and ultimately about inquiry" [44].

2.2 Artistic Space, Community, and Apprenticeship

While prototyping is often associated with engineering and product design, creative spaces for physical making are equally foundational to artistic practice [32]. In addition to providing resources for

exploring materials and processes [6] and space for refining craftsmanship [36], they also play a key interpersonal role. Cartwright writes, "the studio is not only a space for students to make art or design, but also a space to learn to be artists, designers, and architects" [8]. Setola and Leurs [37] define four metaphors for creative learning spaces and the processes they enable; their "pub" phase, in particular, leverages community engagement and relationship-based reflection. Koomen and Blundel [22] detail the role of apprenticeship within workshops in the development of practitioners, as they acquire key competencies for their craft beyond the scope of traditional academic practice. Our creative and prototyping spaces can be places where students and researchers learn side by side as they develop their craft and explore new materials.

2.3 Widening of Possibilities

Balsamo argues that technology and culture are inseparable and that technical imagination is foundational to the design of meaningful work [1]. The notion that artistic and engineering mindsets can entwine and work in synchronicity is foundational to much NIME research, but the broader culture often considers these two modalities to be worlds apart. Creative spaces are excellent places to find a common meeting point between these two approaches and to encourage users to feel comfortable exploring less familiar areas.

Thomas [38] observes that many university students in engineering and design do not have prior foundational experience with making, tinkering, or taking things apart. This lack of prior, low-stakes engagement with materials inhibits their learning and their imagination. Rectifying this lack of experience can have profound effects on the education of students in STEAM fields. Soomro et al. [38] provide a literature review that shows the effectiveness of makerspaces in fostering creativity in STEAM education. Jankowska and Atlay [17] describe the positive effect of using creative spaces on students' engagement in engineering fields. Xu et al. [45] observe that creative spaces can not only help students integrate their learning through practical application but can also profoundly affect their perception of the field of engineering and what it means to be an engineer.

Likewise, these creative spaces can provide non-engineers with hands-on experience in engineering skills that profoundly affect their creative trajectory and empower them to engage with realms they previously considered too daunting to attempt.

3 Human Design of Creative Space

Much has been written about the architectural design of creative spaces [39,40, 41]; however, these assume a pristine starting point and a degree of control that is rarely achievable. Section 3 explores relevant literature on the human and community design of creative spaces, as well as reflections on the individual challenges and particularities that individual spaces might encounter.

3.1 Community Design

Shared creative spaces exist within wider communities and institutions, which strongly influence their character. Panchia et al. highlight the role of conflict and experimentation in shared creative spaces [33]. Braybrooke and Smith examine the many social and economic structures in which makerspaces form and the varied goals

of these institutions [7]. Boeva describes the lingering effects of social structures such as past design movements, cultural notions of skill, and persistent gender imbalances on contemporary makerspaces [4].

3.2 Material Evolution

Shared creative spaces are both evolving entities and physical artifacts of the work that has been and is being done in them. Nikolaidou examines artist studios to create schema maps of the artist's process and techniques: "The studio of an artist is a complex space that contains and reflects the individual's artistic journey related to materiality, philosophy, inspiration, and thinking" [31]. This same approach could be applied to many shared creative spaces - the lab itself records how the space is used, which materials are most inspiring, and how legible the infrastructure is to users. Often, even users' prior emotional state can be inferred from the detritus left behind.

A lab's infrastructure also documents how the space has been altered to meet the needs of a changing user base. Maestri and Wakkary describe the ongoing process of repair and modification as part of creative engagement with the home [30]. The same can be said of a workspace - the design of our project is entwined with the maintenance and repair of our tools. This is a reality that was true for non-digital craftspeople, and it remains true in our hybrid making spaces as well. Sydow et al. document how practitioners modify and maintain digital fabrication machines: "Treating the machine as a material offers an alternative perspective on our interactions with technology" and locate these modifications within "a surrounding 'Maker Culture' of caring, sharing and experimentation" [24]. Interacting with tools and machines as materials that can be both intimately known and developed to suit our own practice is similar to the refinement of a master craftsman's toolbox. It also follows that the entire lab or workspace can be approached similarly, with the lab and the users molding and modding to fit one another's aspirations and limitations.

3.3 Requirements

As described above, each space is unique and faces its own circumstances and challenges. The authors have collectively worked in over 20 shared makerspaces over 20 years, informing these requirements of shared creative workspaces:

Space - The basics that make a space comfortable and safe include access control, ventilation, temperature control, and noise mitigation.

Budget - One of the biggest constraints is the budget, which must include regular maintenance and restock (because things break and expendables run out).

Organizational System - An agreed-upon organizational system for materials, tools, documents, and equipment needs to be established. Without this, it is difficult for users to contribute and be good citizens.

Access and Safety - Decisions need to be made about who has access to the space and when. Basic safety equipment and protocols should always be prioritized.

Support Staff - Your kitchen does not do its own dishes, and a lab does not maintain itself. While it is best to make things as low-maintenance as possible, some amount of regular upkeep and repair will always be required. This can come from faculty, staff, students, student workers, and/or volunteers.

Onboarding - Some form of onboarding and documentation will be required to teach people how to use the space and its tools effectively, respectfully, and safely. The time and resources for this should be allotted. The nature of this onboarding will depend on the space's goals and users' backgrounds.

Bureaucratic Relationships - Creative spaces differ from other spaces, often eliciting heightened excitement and/or suspicion from the bureaucratic entities surrounding them. Whether landlords, supervisors, building managers, or safety managers, building positive relationships with these power brokers is extremely important.

Community Relationships - Community collaborations are often vital to creating a vibrant and functional creative space. Neighbors, related organizations, and complementary academic departments are just a few of the examples of possible community relationships.

Shared Ethos - A lab eventually needs to form/choose a shared ethos for how it should run, so that rules and expectations do not change too often. This ethos can be hands-off or hands-on, it can have a singular creative goal or be flexible to users' interests, it can be strict or permissive, open or guarded.

Pedagogical Needs and Restraints - If the workspace is in an academic setting, careful thought should be given to the organization's teaching and learning needs, as well as the students' (and teachers') skill levels.

4 Our Lab

Section 3 noted that each lab encompasses its own unique set of circumstances; here, we detail the specifics of our lab as a case study.

4.1 History of the Lab

In 1985, Max Mathews retired from a long career at the Acoustical and Behavioral Research Center at Bell Laboratories. He was allowed to keep a small assortment of tools, test equipment, and electronics components, which he used to create a home workshop comprising what we would today call a makerspace. His own research was mainly focused on new musical interfaces - the Radio Baton and Radio Drum - and accompanying software.

In 1987, Max accepted a position at CCRMA to co-teach the NIME-related course Music 250a [2, 28, 43, 45] and continue unsupervised research. Preparing to move from New Jersey to California, Max calculated that moving costs would be approximately \$1 per pound, providing a simple metric for choosing what to bring, including a drill press, oscilloscope, frequency generator, power supply, and enough electronic components to build and test simple devices. CCRMA gave him a room with a walk-through closet for working on projects and meeting with collaborators, colleagues, and students: the Max Lab was born.

This space has always also been our building's central *shared* resource for prototyping and making, maintained by the course's teaching staff, where faculty, researchers, and students work together.

CCRMA's building, The Knoll, is considered historic and is subject to strict regulations that limit many desired modifications. It suffered major earthquake damage in 1989, which was not repaired until 2004–2005. While this caused plenty of inconvenience, it also gave us greater freedom in using the space during those years, as we did not have to be too careful about new carpet or pristine paint. This ethos of ownership within a historic building has continued to shape our workflow and possibilities.

In 2005, after renovations, the Max Lab moved into a keycard-locked room with prebuilt benches and storage, which we quickly modified. The space was equipped with carefully fitted workbenches and storage, which we did not design and promptly began to alter. Max was particularly adept at using scrap materials to modify workspaces, and this sense of ownership over our own space continued to shape the ethos of our lab. Max, Sasha, and Michael Gurevich began expanding the lab's tools and resources. As Max reduced his hours at CCRMA, Sasha became the official lab manager, continuing to build its resources with Max's input.

A detached garage also deemed historical had been "taken over" by the resident university archaeologist and biologist in the preceding years. As we did not see anyone ever using the space, we worked with the relevant parties and leveraged university relationships to gradually obtain access. We found both biological and archaeological specimens and samples that had been forgotten about for a decade, whose removal was both fascinating and revolting. By 2012, we had full ownership and began to develop the space for more messy work and hazardous tools whose use we needed to supervise.

In 2012, CCRMA needed to install an EEG-shielded room, and the metal structure was deemed too heavy for the second-floor concrete floors. The Max Lab abandoned its first-floor enclosed room, moving upstairs to its original location (just across from the Garage), an opportunity to carefully design the lab as we thought it should be, modifying the layout and furniture from the renovation. This current space is approximately 27 ft x 18ft.

4.2 Lab Uses and Courses

Approximately 130 people use the lab over the course of the year, and a key feature is the variety of ways it is used. As the single workshop in the building, it is used for all classes involving electronics hardware or component fabrication, including courses on physical interaction design, sound art, Fundamentals of Computer-Generated Sound, acoustics, analog synthesis, and composition.

In addition to the courses that use the lab, all center users have access to it and can use it for their own creative projects as well as for courses in other departments. This includes students and researchers from departments as varied as Music, Art, Medicine, Neuroscience, Electrical Engineering, Product Design, Mechanical Engineering, and Computer Science. The lab also serves as the staff's central resource for hardware upgrades and maintenance throughout the building.

We have not consistently documented every user, class, and research outcome that relied on the lab's resources. In preparation for this paper, we have counted 63 NIME papers that have been

extensively developed in the Max Lab. Links to this list and a partial list of courses offered can be found in the appendix.

4.3 Our Challenges and Advantages

In this section, we discuss the particular challenges and advantages that our lab faces. We offer these observations as one example of the varied ways that creative spaces adapt and respond to the conditions in which they operate.

4.3.1 Open corridor

Except 2005–12, the primary room of our lab has also functioned as a building corridor: anyone with access to the building can enter the lab at any time. While some storage can be locked, most resources are available for free. While this is primarily a challenge, one positive aspect of this arrangement is the frequent foot traffic through our lab, which helps build community and engagement.

4.3.2 Unstaffed hours

The lab has spent most of its life relatively unstaffed. Even when a full-time staff member has had the lab as one of their many responsibilities, their hours have varied, and there has been substantial unstaffed time when users continued to use the lab. The combined effect of open access and the high number of unstaffed hours means that the space requires significant personal responsibility and independence from users.

4.3.3 Personnel

Despite these challenges, we also have had personnel advantages. Historically, our lab was established by a pioneer of our field. What began as Max Mathew's personal project did not need to be justified in terms of an institutional curricular or research goal. He had brought his own equipment. His position as an elder meant that he was granted a high degree of autonomy and respect for his research interests. The lab was allowed to grow slowly and organically. Each move into a renovated space provided a natural opportunity to properly equip the lab with basic tools and materials.

As the lab evolved, it was overseen by two people who also served as managers of the entire building, with some autonomy over resource allocation. During the period when CCRMA gained access to the garage and the lab had to move, the first author both managed the lab and also oversaw the renovation of these spaces. This meant that very little institutional translation was needed; the people caring for the lab handled the bureaucratic footwork themselves.

4.3.4 Separate Spaces

Finally, we are very fortunate to have two spaces. This has allowed us to make a very natural separation between the clean, relatively safe resources available to all and the more hazardous, dirtier processes that are more carefully restricted and mentored.

4.4 Goals

In this section, we discuss our core goals for the lab.

4.4.1 Physical Thinking Space for Prototypes and One-Off Projects

The lab is designed to be a space to manifest ideas physically. It is best suited to prototypes and one-off art projects. One guiding phrase we often use is that "We developed the lab to be a place where one of us could make a rough prototype of an idea at 2 am." By this, we mean

that there are enough functional hand tools, basic electronics, and scrap materials to get an idea “out of our head” and into a working mockup without external resources. As projects progress, it is common to engage other resources - other workspaces around campus, more specifically tailored materials, external businesses such as PCB manufacturing, or learning from people more expert in a particular process.

However, that first hypothetical moment is often crucial for ideation and clarifying our ideas. By having the space and materials to make ideas real before progressing to refinement, we can tangibly interrogate those ideas and think in real-world materials.

The digital world is a powerful tool for research in NIME and at our center. However, as educators and creators, we are aware of how easy it can be to create something in the digital world through CAD files and concept drawings, which can obscure key concerns that would be immediately visible if those ideas were physically prototyped sooner.

As projects are refined, users can use some of the more restricted tools to create more complex or precise versions of their ideas. These tools and resources, however, continue to place the onus on the real, physical manifestations of their evolving ideas.

4.4.2 *Useful to a Wide Range of Users*

The lab is designed for use by the entire user base at our center. Although certain tools and materials may require special training, permission, or purchase, the same basic resources are available to undergraduate students as to our faculty. This requires that the lab be legible and functional for people with a wide range of skills and aspirations.

Additionally, the lab is maintained as a resource for creative, research, and maintenance tasks. Users creating sound art sculptures, graduate students designing acoustic test equipment, and staff members maintaining audiovisual equipment all share the same space and resources. This is both a challenge and an opportunity for collaboration and intellectual cross-pollination.

4.4.3 *An Integrated Learning Environment*

In addition to being a space for building, the lab must also be a space where users are supported in learning new skills and expanding their knowledge of what is possible. In addition to the courses and workshops taught in the lab or that use the lab for project-based work, we also help users outside of those classes reach their goals. The assumption is that, when possible, our staff will make themselves available to help users with their projects and guide them to appropriate self-study resources. While users in the lab have a high degree of independence, they are not left alone to succeed or fail in seclusion. The space itself becomes a framework for observing what people are working on and co-creating learning opportunities.

4.4.4 *A Welcoming Environment*

A corollary of the learning environment is the need for the lab's ethos to remain as welcoming as possible. The lab functions as a place for people to broaden their hands-on skills and realize nascent ideas. Both endeavors can entail vulnerability and overwhelm for some users. This stress is often further compounded for users who are part of underrepresented groups within our field and the broader STEAM fields. By working on concrete and interpersonal ways to make the

lab more welcoming, we can do our best to mitigate factors that might discourage users from engaging with the lab's resources.

This goal can prove challenging to keep at the forefront of our minds when we are faced with so many competing demands - multiple users, safety concerns, and a desire to maintain an orderly lab space. While there is no official diagnosis and we have not found any prior literature to support this assertion, our experience across a wide variety of shared workshops and collaborative spaces has taught us that it is very easy, even for well-meaning people, to succumb to “Grumpy Lab Manager Syndrome”.

Despite these challenges, being welcoming remains a primary and essential goal of this shared space. It increases the space's creative and research productivity, enhances engagement, and fundamentally makes our working lives more joyful.

In addition to this interpersonal approach, we also strive to make the space a welcoming environment for all users through regular upkeep and the concrete principles and strategies described below.

4.5 Principles

Here, we outline the broad principles that have evolved in our lab, which have come to define the choices we make. In many cases, these principles did not originate as conscious decisions but evolved organically. Despite the lack of initial intention or foresight, we have come to see these elements as essential to our lab's culture and operations.

4.5.1 *User Respect and Benefit of the Doubt*

We treat our users with respect and generosity, especially by giving them the benefit of the doubt when problems occur. While a small minority may misuse the lab, most users want to act responsibly, and many perceived discourtesies are misunderstandings. As noted in Section 4.4, it's easy to assume the worst when you're the one fixing messes and broken equipment.

Recently, a skilled student worker repeatedly caused severe blockages in the 3D printer. The issue turned out to be a subtle slicer infill error. We realized that, had this been a regular student, we might have blamed carelessness rather than a software fault.

4.5.2 *Physical Legibility*

We organize the lab to be physically legible. After a brief orientation, users should be able to find resources and keep the space safe and clean without help. This supports our respect for users. The clearer our systems, the more likely users are to care for them. Though imperfect and evolving, improving this legibility helps users participate in maintaining the space.

4.5.3 *We Use the Resources that We Provide.*

Those who maintain the lab also use its tools for their own creative and research work and to support other parts of CCRMA. While sharing a single workspace began from necessity, its benefits are clear. Using the same resources gives us insight into what works, what's missing, and what's broken. We quickly notice hazards and inefficiencies because they impede us. Improving the lab for ourselves strengthens it for others.

4.5.4 *Same Space for Students and Faculty/Researchers*

Faculty and staff often work on their own projects alongside students as they work on theirs. While this can mean more common

interruptions, it also provides a more integrated approach to mentoring and teaching. We can answer questions and offer advice while their work is in progress, and we can simultaneously learn from the varied skill sets of our users.

4.5.5 Incremental Development

Many labs are started with an initial budget to create a working prototyping lab from scratch. This presents an enviable opportunity to create an intentional, well-appointed lab. As described in Section 4.1, our lab has instead evolved incrementally from a closet to two separate rooms. Our gradual expansion has allowed us to tailor our growth and resource acquisition to the needs of our users at the time each resource was added. This piecemeal development has meant that our space has grown organically, and we have been able to evolve with our users as their focus and requirements have changed.

4.5.6 Real Materials: Less Foam Core and More Scrap Wood

As described in Section 2, physical making supports learning through direct engagement with real materials. While we provide resources like cardboard and clay for sketching, the lab emphasizes materials suited to robust prototypes. Whether textiles, wood, metal, or scrap electronics, we encourage rapid first functional iterations—often favoring scrap wood over foam core.

Musical instruments, sound art, and interactive musical objects require physical robustness and attention to materials that many that many digital systems do not. The temporal nature of sound and human physical limits shape interaction, and these constraints are easily overlooked when development remains too abstract.

4.5.7 Community Investment, Engagement, and Education

As discussed in Section 2, part of craftsmanship is developing and maintaining our knowledge of tools. The development of our lab has taught those in charge to be better makers, so it follows that engaging users in that process can be both educational and invigorating. In addition to engaging highly involved users in choices about new resources, we also hold regular “work parties” to address specific tasks. We try to focus these sessions on opportunities for learning rather than just cleaning up the lab. Examples have included building a new metal workbench, learning to build labeled wooden boxes using the CNC wood router, creating a visual color system for resistors, and learning to test and fix a large pile of broken electronics that had accumulated in the lab.

Each event was entirely voluntary. The focus was on learning new, practical skills that would not be taught in typical university courses but that are nonetheless useful for people involved in physical making and audio technology. This type of outreach strengthens users’ engagement with the space and deepens their understanding of the resources and space.

5 Strategies

In this section, we discuss specific strategies for resources and maintenance.

5.1 Tools

5.1.1 Bad tools are dangerous tools.

If a tool is annoying to use, either because it is dull, poorly made, or ergonomically poor, it is tempting to misuse it or use it unsafely. This tendency can lead to dangerous practices that are not worth the risk.

5.1.2 Small tools are often more important than big tools.

Institutionally, it can be easier to justify budget allotments for the purchase of large tools than small, workaday detail tools. However, those smaller tools - quality wire strippers, for example - often make an outsized difference in the day-to-day functionality of a workspace.

5.1.3 Commit to a single manufacturer's power tool system.

Committing to a single manufacturer's power tool system can simplify operations and reduce overall costs as you expand your tool resources. Most major brands offer collections that all operate on the same power system. While we originally bought power tools piecemeal, a silver lining of the theft we experienced in 2024 was the opportunity to unify our tool system.

5.2 Electronic Supplies

This section covers the electronic supplies we typically keep in the lab. In addition to following the principle that they are ones we would be willing to use for our own projects, there are other observations and strategies worth noting.

5.2.1 Sensors

We keep a core set of sensors that has remained approximately 70% unchanged over the last twenty years. We primarily use well-known electronics vendors to ensure continuity and quality control.

5.2.2 Microcontrollers and Boards

Every year, there are more variations of microcontrollers, development boards, and single-board computers. While we sometimes purchase new boards for testing, we primarily stock well-proven tools with strong user bases and good online support via documentation or user forums.

5.2.3 Electronic components

We stock a basic set of through-hole passive components and common small ICs for NIME and basic audio work. For surface-mount parts or additional ICs, we help source them as needed, but don't maintain a broad inventory due to the scale and variability of requirements. Keeping too many options has proven to create clutter and waste.

5.2.4 Surplus

We also receive surplus electronic components and devices from donations. We sort them for usefulness and dispose of the rest. Usable items are placed in relevant lab categories but are not formally cataloged or restocked.

5.3 Non-Electronic Materials

We keep a range of wood, textiles, metal, plastic, and hardware, restocking common fasteners annually and adding small supplies of

plywood for laser cutting and woodworking. Most other materials come from project surplus or donations. Materials are stored in labeled bins, including scrap electronics and “Doodads”—uncategorized objects that enter the lab informally but often inspire new work.

5.4 Organizing and Maintenance

Over time, we’ve found that tidy spaces tend to stay tidy, while disorder compounds and can become distracting or even hazardous. Clear, well-maintained organization encourages users to preserve that order. A good system should reduce maintenance effort and make tools easy to find and return, helping users stay focused with fewer interruptions.

5.4.1 Make it Easy and Visually Clear.

Many users do not know the names of specific tools or parts. We have found that using stacking bins for tools and clear boxes for parts has greatly improved adherence to our organizational system, as even if people do not know the name of an item, they can visually match it with others.

5.4.2 Make it Flexible

While it is tempting to have a perfectly fitting slot for each tool, that is a system better suited to a private toolbox not shared with others. In shared, communal workspaces, more generic bins and boxes allow better flexibility in tool choice and replacement.

5.4.3 Make it Standard

Pick a brand and style of container that has been around a long time. This increases the likelihood that the same system will be available when you need to replace or add additional containers.

5.4.4 Individuals’ Storage

We keep reusable boxes in the lab for individual projects and ask users to store their work in one of these boxes labeled with their name. These boxes are stackable, which makes it easier to avoid accidentally disposing of work-in-progress. It also helps us encourage users to remove old projects.

5.4.5 Weed Like A Garden

One way to think of lab maintenance is like a vegetable garden. We are not surprised that our garden continues to need weeding and watering. If we do that work regularly, it stays light, and we might even find it calming and meditative. Doing this regularly, in small bits, is also a way to maintain awareness of how the lab is being used.

6 Conclusion

An (admittedly corny) working title of this paper was “A Love Letter to our Lab.” It is a space that has shaped our own creative work and the work of our community. Spaces for creative exploration of physical materials can have a profound effect on communities, students, researchers, and creatives. These spaces are sculpted by the stories built within them and the communities that surround them. We have explored relevant literature detailing their importance. We presented the story and choices of our own lab as an example of one long-running space. We shared our goals, principles, and strategies to help others co-create their own spaces for physical making. We

hope some of our ideas will help NIME researchers and others to advocate for, design, and make the best use of their own labs.

Ethical Standards

The principles and practical strategies described in this paper are used to facilitate inclusivity and accessibility for all of our users. We work to minimize our environmental impact through the reuse of materials and guiding users towards best practices. We acknowledge that our lab exists within a large, private, well-funded university; however, we believe that much of the approach that we describe in this paper can be applied to a wide range of communities.

Acknowledgements

We wish to thank the many members of our community who have enriched the Max Lab over the last 36 years.

References

- [1] Anne Balsamo. 2011. *Designing Culture: The Technological Imagination at Work*. Duke University Press. <https://doi.org/10.1215/9780822392149>
- [2] Edgar Berdahl and Wendy Ju. 2011. Satellite Ccrma: A Musical Interaction And Sound Synthesis Platform. Proceedings of the International Conference on New Interfaces for Musical Expression, 173--178. <https://doi.org/10.5281/zenodo.1177957>
- [3] Paulo Blikstein. 2013. Digital Fabrication and ‘Making’ in Education: The Democratization of Invention. In *FabLab*, Julia Walter-Herrmann and Corinne Büching (eds.). transcript Verlag, 203–222. <https://doi.org/10.1515/transcript.9783839423820.203>
- [4] Yana Boeva. 2018. Break, Make, Retake: Interrogating the Social and Historical Dimensions of Making as a Design Practice. York University, Toronto, Ontario.
- [5] John M. Bowers, John Richards, Tim Shaw, Robin Foster, and Akihiro Kubota. 2023. Raw Data, Rough Mix: Towards an Integrated Practice of Making, Performance and Pedagogy. In *Proceedings of the International Conference on New Interfaces for Musical Expression*. <https://doi.org/10.5281/zenodo.11189230>
- [6] Kit Braybrooke. 2018. Hacking the Museum? Practices and Power Geometries at Collections Makerspaces in London. Retrieved from <https://ssrn.com/abstract=3210671>
- [7] Kit Braybrooke and Adrian Smith. 2018. Liberatory technologies for whom? Analysing a new generation of makerspaces defined by institutional encounters. *Journal of Peer Production* (2018). Retrieved from <https://hdl.handle.net/10779/uos.23459486.v1>
- [8] Lillian K. Cartwright. 2017. Introduction: What Are Creative Art Spaces and Why Do They Exist? *World Futures* 73, 1 (January 2017), 1–5. <https://doi.org/10.1080/02604027.2017.1311128>
- [9] James Corazzo. 2019. Materialising the Studio. A systematic review of the role of the material space of the studio in Art, Design and Architecture Education. *The Design Journal* 22, sup1 (April 2019), 1249–1265. <https://doi.org/10.1080/14606925.2019.1594953>
- [10] Gideon D’Arcangelo. 2002. Creating A Context For Musical Innovation: A Nime Curriculum. (June 2002). <https://doi.org/10.5281/ZENODO.1176406>

- [11] Sascha Dickel. 2022. Prototyping Evidence: How Artifacts Demonstrate Technological Futures. In *Evidence in Action between Science and Society: Constructing, Validating, and Contesting Knowledge*. Routledge.
- [12] Sascha Dickel, Jan-Peter Ferdinand, and Ulrich Petschow. 2014. Shared Machine Shops as Real-life Laboratories. *Journal of Peer Production* (2014). Retrieved from <http://peerproduction.net/>
- [13] Craig R. Forest, Roxanne A. Moore, Barbara Burks Fasse, Julie Linsey, Wendy Newstetter, Peter Ngo, and Christopher Quintero. 2014. The Invention Studio: A University Maker Space and Culture.
- [14] Michael Gurevich, Ben Knapp, and Sergi Jordà. 2011. A Workshop on NIME Education. In *Proceedings of the International Conference on New Interfaces for Musical Expression (NIME)*.
- [15] Jiffer Harriman. 2015. Pd Poems And Teaching Tools. In *Proceedings of the International Conference on New Interfaces for Musical Expression (NIME)*. doi.org/10.5281/ZENODO.1179074
- [16] Mattias Jacobsson. 2013. *Tinkering with interactive materials: studies, concepts and prototypes*. Computer Science and Communication, KTH Royal Institute of Technology, Stockholm.
- [17] Maja Jankowska and Mark Atlay. 2008. Use of creative space in enhancing students' engagement. *Innovations in Education and Teaching International* 45, 3 (August 2008), 271–279. <https://doi.org/10.1080/14703290802176162>
- [18] Alexander Refsum Jensenius. 2013. An Action–Sound Approach to Teaching Interactive Music. *Organised Sound* 18, 2 (August 2013), 178–189. <https://doi.org/10.1017/S1355771813000095>
- [19] Paddy Johnson. 2019. TIPS FOR MAKING ARTIST SPACES SUSTAINABLE. Retrieved February 9, 2026 from <https://thecreativeindependent.com/tips/how-to-start-and-sustain-an-artist-space/>
- [20] Sergi Jordà and Sebastian Mealla. 2014. A Methodological Framework For Teaching, Evaluating And Informing Nime Design With A Focus On Mapping And Expressiveness. *Proceedings of the International Conference on New Interfaces for Musical Expression*. <https://doi.org/10.5281/ZENODO.1178824>
- [21] Ajay Kapur and Michael Darling. 2010. A Pedagogical Paradigm For Musical Robotics. *Proceedings of the International Conference on New Interfaces for Musical Expression*. <https://doi.org/10.5281/ZENODO.1177821>
- [22] Philip Koomen and Richard K. Blundel. 2018. Developing craft practice within and between workshops: an inter-generational comparative study. *Making Futures* 5, (September 2018).
- [23] Sophie Landwehr Sydow. 2022. *Makers, Materials and Machines: Understanding Experience and Situated Embodied Practice in the Makerspace*. Department of Computer & Systems Sciences, Stockholm University, Stockholm.
- [24] Sophie Landwehr Sydow, Martin Jonsson, and Jakob Tholander. 2022. Modding the Pliable Machine: Unpacking the Creative and Social Practice of Upkeep at the Makerspace. In *Creativity and Cognition*, June 20, 2022. ACM, Venice Italy, 220–233. <https://doi.org/10.1145/3527927.3532804>
- [25] Hans Leeuw and Jorrit Tamminga. 2012. Nime Education At The Hku, Emphasizing Performance. (June 2012). <https://doi.org/10.5281/ZENODO.1178321>
- [26] Ulrich Lehmann. 2012. Making as Knowing: Epistemology and Technique in Craft. *The Journal of Modern Craft* 5, 2 (July 2012), 149–164. <https://doi.org/10.2752/174967812X13346796877950>
- [27] Paul D. Lehrman and Todd M. Ryan. 2005. Bridging The Gap Between Art And Science Education Through Teaching Electronic Musical Instrument Design. *Proceedings of the International Conference on New Interfaces for Musical Expression*. <https://doi.org/10.5281/ZENODO.1176768>
- [28] Sasha Leitman. 2017. Current Iteration of a Course on Physical Interaction Design for Music. *Proceedings of the International Conference on New Interfaces for Musical Expression*. <https://doi.org/10.5281/zenodo.1176197>
- [29] Sylvia Libow Martinez and Gary Stager. 2013. *Invent to learn: making, tinkering, and engineering in the classroom*. Constructing Modern Knowledge Press, Torrance, Calif.
- [30] Leah Maestri and Ron Wakkary. 2011. Understanding repair as a creative process of everyday design. In *Proceedings of the 8th ACM conference on Creativity and cognition*, November 03, 2011. ACM, Atlanta Georgia USA, 81–90. <https://doi.org/10.1145/2069618.2069633>
- [31] Katherine Moriwaki and Jonah Bruckner-Cohen. 2007. Midi Scrapyard Challenge Workshops. *Proceedings of the International Conference on New Interfaces for Musical Expression*. <https://doi.org/10.5281/ZENODO.1177201>
- [32] Andriana Nikolaidou. 2023. Codifying An Artist's Studio: An Ontology For The Analysis Of Artistic Space And Process. *ArtMatters International Journal for Technical Art History* (2023).
- [33] Bhavisha Panchia, Carly Whitaker, and Chad Cordeiro. 2022. The Studio as a Shared Collaborative Space: Notes on a Prototype. Retrieved February 9, 2026 from <https://www.e-flux.com/architecture/interdependence/500032/the-studio-as-a-shared-collaborative-space-notes-on-a-prototype>
- [34] Seymour Papert, Idit Harel, Massachusetts Institute of Technology, and Media Laboratory (Eds.). 1993. Situating Constructionism. In *Constructionism: research reports and essays, 1985-1990* (2. print). Ablex Publ. Corp, Norwood, NJ.
- [35] Emily Robertson and Enrico Bertelli. 2014. Conductive Music: Teaching Innovative Interface Design And Composition Techniques With Open-Source Hardware. *Proceedings of the International Conference on New Interfaces for Musical Expression*. <https://doi.org/10.5281/ZENODO.1178921>
- [36] Richard Sennett. 2008. *The craftsman*. Yale university press, New Haven (Conn.).
- [37] Bruno Setola and Bas Leurs. 2014. The Wild, The Pub, The Attic and The Workplace: A Tool for Negotiating a Shared Vision on Creative Learning Spaces. In *DS 78: Proceedings of the 16th International conference on Engineering and Product Design Education (E&PDE14), Design Education and Human Technology Relations, University of Twente, The Netherlands. (DS / The Design Society)*, 2014. The Design Society, Glasgow, United Kingdom.

- [38] Sohail Ahmed Soomro, Hernan Casakin, Vijayakumar Nanjappan, and Georgi V. Georgiev. 2023. Makerspaces Fostering Creativity: A Systematic Literature Review. *J Sci Educ Technol* 32, 4 (August 2023), 530–548. <https://doi.org/10.1007/s10956-023-10041-4>
- [39] AnnMarie Thomas. 2014. *Making makers: kids, tools, and the future of innovation* (1. ed ed.). Maker Media, Sebastopol, CA.
- [40] Katja Thoring, Pieter Desmet, and Petra Badke-Schaub. 2019. Creative Space: A Systematic Review of the Literature. *Proceedings of the Design Society: International Conference on Engineering Design*. <https://doi.org/10.1017/dsi.2019.33>
- [41] Katja Thoring, Roland M. Mueller, Pieter Desmet, and Petra Badke-Schaub. 2018. DESIGN PRINCIPLES FOR CREATIVE SPACES. 2018. 1969–1980. <https://doi.org/10.21278/idc.2018.0233>
- [42] Enrique Tomás. 2020. A Playful Approach to Teaching NIME: Pedagogical Methods from a Practice-Based Perspective. *Proceedings of the International Conference on New Interfaces for Musical Expression*. <https://doi.org/10.5281/ZENODO.4813280>
- [43] Bill Verplank, Craig Sapp, and Max Mathews. 2001. A Course On Controllers. *Proceedings of the International Conference on New Interfaces for Musical Expression*. <https://doi.org/10.5281/ZENODO.1176380>
- [44] Karen Wilkinson. 2014. *The Art of Tinkering: Meet 150+ Makers Working at the Intersection of Art, Science and Technology*. Weldon Owen, Incorporated, Erscheinungsort nicht ermittelbar.
- [45] Scott Wilson, Michael Gurevich, Bill Verplank, and Pascal Stang. 2003. Microcontrollers In Music Hci Instruction: Reflections On Our Switch To The Atmel Avr Platform. *Proceedings of the International Conference on New Interfaces for Musical Expression*. <https://doi.org/10.5281/ZENODO.1176571>
- [46] Wei Xu, Jia-Chen Chen, Ye-feng Lou, and Hang Chen. 2024. Impacts of maker education-design thinking integration on knowledge, creative tendencies, and perceptions of the

engineering profession. *Int J Technol Des Educ* 34, 1. 75–107. <https://doi.org/10.1007/s10798-023-09810-4>

A Appendix One

Information about the lab can be found at:

<https://ccrma.stanford.edu/maxlab>

A list of NIME papers that present work developed in the Max Lab can be found at:

<https://ccrma.stanford.edu/maxlab/publications>

A list of courses and workshops that have been taught in the Max Lab can be found at:

<https://ccrma.stanford.edu/maxlab/courses>