INCLUSIVE MAKERSPACES BRIDGING ACCESSIBILITY GAPS IN ACADEMIC LIBRARIES

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Abstract: Makerspaces have become fixtures in academic libraries, offering technologies such as 3D printers, laser cutters, vinyl cutters, electronics workbenches, and sewing machines. These spaces promise to democratize design, prototyping, and hands-on learning. Yet a growing body of evidence suggests that typical makerspaces inadvertently exclude significant user populations, including students with mobility impairments, visual or hearing disabilities, neurodivergent learners, and those with chronic health conditions that affect energy or sensory processing. This article argues that accessibility gaps in academic library makerspaces are not merely technical problems of equipment placement but systemic issues rooted in design assumptions, staffing models, and institutional policies. Drawing on disability studies frameworks, universal design principles, and case studies from North American and European academic libraries, the article proposes a holistic model for inclusive makerspace development. This model addresses physical access, sensory environments, assistive technology integration, staff training, and programmatic design. The central argument is that bridging accessibility gaps requires shifting from a compliance mindset, focused on minimum legal standards, to an inclusion mindset, focused on proactively removing barriers to full participation. The article concludes with an actionable framework for librarians, makerspace managers, and university administrators seeking to transform their makerspaces from sites of accidental exclusion to models of genuinely equitable access.

Keywords: inclusive makerspaces, academic libraries, universal design, accessibility gaps, neurodivergent inclusion, assistive technology

Introduction

The rise of makerspaces in academic libraries represents one of the most significant spatial and pedagogical shifts in the profession since the advent of information commons. Over the past fifteen years, thousands of university libraries have converted study carrels and compact shelving into vibrant workshops where students can design, fabricate, code, and craft. Proponents celebrate makerspaces as equalizing forces that provide all students, regardless of major or prior technical experience, with access to expensive prototyping tools. The underlying promise is powerful: a first-year humanities student with an idea for a disability accommodation device can learn to use a 3D printer alongside an engineering senior building a drone prototype. In this vision, the makerspace is a great equalizer.

Reality has proven more complicated. Observational studies and accessibility audits have revealed that many academic library makerspaces are, in practice, less accessible than the older library spaces they replaced. Wheelchair users encounter workbenches designed for standing posture. Visually impaired students face touchscreen interfaces that provide no haptic or auditory feedback. Neurodivergent learners confront the sensory onslaught of multiple simultaneous noises, bright flickering lights, and unpredictable crowds. Students with chronic pain or fatigue find that a single three-hour workshop is physically unsustainable, yet no alternative scheduling or pacing options exist. These barriers are not usually the result of malice or even conscious neglect. They stem from a set of unexamined assumptions about who the typical maker is and how making happens. The typical maker, in the implicit model underlying most makerspace designs, is a nondisabled undergraduate with full use of their hands, typical vision and hearing, average sensory processing, and the ability to stand, focus amid noise, and sustain energy for extended sessions. Any user who deviates from this profile faces what disability scholars call a misfit between their bodymind and the built environment.

This article addresses the accessibility gaps in academic library makerspaces by asking a forward-looking question: how can librarians and makerspace managers move beyond retrofitting accessibility as an afterthought toward designing inclusive spaces from the outset? The argument unfolds across five interconnected domains. First, I examine the physical configuration of makerspaces, including furniture, equipment placement, and circulation pathways. Second, I consider the sensory environment, including lighting, acoustics, and the availability of quiet or low-stimulus alternatives. Third, I analyze the technological interface between users and making equipment, focusing on the need for alternative access methods. Fourth, I address the human infrastructure of staffing, training, and service models. Fifth, I explore programmatic design, including workshop structures, appointment systems, and documentation. Throughout, the guiding framework is universal design, which holds that environments and products should be usable by all people to the greatest extent possible without the need for specialized adaptation. Universal design is not a checklist but a process of iterative inclusive redesign.

Physical Access Beyond the Wheelchair Ramp

Most academic librarians understand physical accessibility primarily through the lens of the Americans with Disabilities Act or similar national accessibility codes. They ensure that doorways are wide enough, that there is an elevator to the makerspace floor, and that restrooms are compliant. These are necessary but insufficient conditions for genuine physical access in a makerspace. The distinctive challenge of makerspace accessibility lies in the work surfaces and equipment. Standard makerspace workbenches are typically thirty-six to forty inches high, an ergonomic compromise that accommodates standing users and perching on high stools. For a wheelchair user whose chair has a seat height of nineteen to twenty-one inches, these benches place the work surface above chest level, making it impossible to see the top of a laser cutter's bed or to reach a 3D printer's build plate. The standard solution, an adjustable-height table, is rarely present because it is expensive and because many makerspace tools cannot be easily relocated.

A deeper problem is the physical arrangement of equipment. Makerspaces often organize tools in dense configurations to maximize tool variety within limited square footage. A 3D printer farm might be arranged on industrial shelving with narrow aisles. A soldering station might be tucked into a corner with knee space blocked by storage bins. A sewing machine might rest on a fixed-height table with no clearance underneath. Each of these arrangements creates a unique accessibility barrier. The wheelchair user cannot navigate the narrow aisle. The user with a service dog cannot find space for the dog to lie beside them. The user who uses crutches cannot both balance and reach a soldering iron placed at the back of a deep counter. The cumulative effect is that a space with a dozen different tools may feel accessible overall if each barrier is minor, but the user who cannot access one tool and then cannot access another may finally conclude that the entire space is not for them.

Remediation strategies exist but require planning and investment. The most effective strategy is to distribute accessible workstations throughout the makerspace rather than concentrating them in a single accessible corner. A single adjustable-height 3D printer placed near the entrance, with clear floor space for a wheelchair turning radius, signals that accessibility is a design priority rather than an afterthought. Similarly, portable work platforms that can raise or lower a tool's effective work surface allow users to adapt a standard bench to their seated or standing height without relocating the tool. For laser cutters and other large floor-standing machines, the requirement is clear floor space in front of the control panel at a height reachable from a seated position. These modifications are neither technologically complex nor prohibitively expensive. Their absence reflects not a lack of resources but a lack of conscious design attention.

Sensory Environments and Neurodivergent Inclusion

Physical mobility access, while critical, represents only one dimension of makerspace accessibility. A growing recognition within librarianship concerns sensory accessibility, especially for neurodivergent users, including those on the autism spectrum, those with attention deficit hyperactivity disorder, and those with sensory processing differences. Makerspaces are, by their nature, noisy environments. Fans cool 3D printers. Vacuum systems remove laser cutter fumes. Users converse, sometimes loudly, over machine noise. Music plays from personal speakers. The cumulative decibel level in a busy makerspace often exceeds eighty decibels, comparable to city traffic. For a neurotypical user, this noise may be an acceptable cost of accessing tools. For an autistic user with auditory hypersensitivity, the same noise level can produce physical pain, cognitive shutdown, or an inability to process spoken instructions.

The visual environment presents similar challenges. Makerspaces often use overhead fluorescent lighting, which produces an imperceptible to most but highly distracting for some flicker at the frequency of alternating current. Bright task lighting, screen glare, colorful filament spools, and cluttered countertops combine into a visual field that overwhelms the ability to focus on any single element. For a user with attention regulation differences, the makerspace becomes a landscape of distraction in which the soldering iron, the 3D printer status screen, the discarded prototype, and the movement of another user all compete for attention simultaneously. The result is exhaustion rather than productivity.

Solutions involve creating what universal design advocates call adjustable challenge. The same makerspace can accommodate diverse sensory profiles by offering graduated levels of sensory intensity. A quiet making room, separate from the main makerspace, might contain only low-noise equipment such as hand tools, a single silent 3D printer with vibration dampening, and a sewing machine on a rubber mat. This room might have dimmable warm lighting, sound-absorbing panels, and visual clutter minimized by closed storage. Users who need low sensory input can make in this space. Users who thrive on the energy of a bustling workshop can remain in the main space. Importantly, the quiet making room should not be labeled or positioned as a special accommodation. It should be presented as a legitimate making environment for anyone who prefers it, just as libraries offer both quiet study rooms and collaborative seating areas.

Descheduling sensory access as exceptional reduces stigma and normalizes the reality that different makers need different conditions for their best work.

Assistive Technology Integration and Interface Design

A third accessibility gap concerns the interfaces through which users control makerspace equipment. Most tools assume that users can see a flat screen, read text of a standard size, touch a mouse or trackpad with fine motor precision, and hear audible alerts. For users who cannot perform one or more of these actions, the tool becomes unusable regardless of physical access to the machine itself. Consider the typical 3D printer workflow. The user prepares a digital model in slicing software, an interface dense with buttons, sliders, and numerical readouts. The software provides no screen reader compatibility. The user transfers the file to the printer via a USB drive or WiFi, both requiring fine motor control. The printer interface then presents a menu on a small monochrome screen navigated by a single rotary encoder. A blind user cannot perform any of these steps independently. A user with essential tremor cannot reliably select the correct menu item. A user with no use of their hands cannot turn the encoder.

The solution is not to reject such tools but to layer accessible alternatives over standard interfaces. Speech control systems, already common in smart home devices, can be adapted to control makerspace equipment. A user saying start print on the blue printer could trigger the same action as a button press. Screen magnification and screen reader software can be installed on the dedicated computers that run slicing software, but only if library IT policies permit such installations and only if staff have tested compatibility. Perhaps most importantly, makerspaces can maintain a set of low-tech assistive tools that bridge the gap between standard interfaces and user needs. A large button that connects to a computer via USB can replace a mouse click. A foot pedal can replace a keyboard command. A tactile overlay can mark the positions of critical screen buttons. These adaptations cost little but require staff to know they exist and to offer them proactively.

Beyond equipment interfaces, makerspaces must address the accessibility of their documentation and instruction. Standard makerspace training materials consist of printed handouts, online videos with no captions, and in-person demonstrations that assume the learner can see the instructor's hands and hear their voice. An inclusive makerspace produces documentation in multiple formats: large print, plain text, audio description, and video with both captions and sign language interpretation. The principle is redundant presentation, not because every user needs every format but because any given user may need one format, and no one can predict which format that will be. Redundant documentation also benefits users with situational disabilities, such as a learner who has forgotten their glasses or a learner trying to follow instructions in a noisy environment where they cannot hear a video's audio.

Staff Training and Service Models

Technology and design modifications, however extensive, will fail without corresponding changes in human infrastructure. Makerspace staff, often a mix of full-time librarians and student workers, are typically trained in tool operation, safety protocols, and basic troubleshooting. They are rarely trained in disability awareness, accessible communication, or assistive technology. As a result, a user who needs help with an accessibility accommodation may encounter staff who are well-intentioned but unprepared. A staff member might tell a wheelchair user that the adjustable-height table is broken and that they should come back another day, not out of malice but out of uncertainty about how to solve the problem. A staff member might assume that a user who does not maintain eye contact is not paying attention, when in fact the user is autistic and listening more carefully than anyone else in the room.

Training must address both concrete skills and underlying attitudes. On the concrete side, all makerspace staff should be able to demonstrate basic proficiency with assistive technologies present in the space. They should know how to enable screen reader software, how to connect a large button switch to a computer, and how to adjust lighting levels in the quiet making room. They should know what to do when a user asks for help that falls outside their training, such as whom to contact or what alternative resource to suggest. On the attitude side, training should introduce the social model of disability, which distinguishes between impairment and disability. Impairment is a bodily condition such as being unable to walk or to see printed text. Disability is what happens when the environment fails to accommodate that impairment. Under the social model, a makerspace that cannot be navigated by a wheelchair user is not a space that serves nondisabled people and also has a wheelchair user problem. It is a space that is broken and needs repair. This reframing shifts responsibility from the disabled user to the makerspace designers and operators.

Service models also require rethinking. The standard makerspace service model assumes drop-in access during open hours, with staff available for brief questions. This model disadvantages users who need extra setup time, who require assistance that exceeds a brief interaction, or who cannot tolerate the unpredictability of a drop-in environment. An inclusive makerspace supplements drop-in hours with appointment-based access, during which a staff member dedicates uninterrupted time to a single user. Appointment-based access is not a separate service for disabled users only. It should be openly available to anyone who prefers scheduled support, including anxious beginners, users with complex projects, and users who simply value predictability. By mainstreaming appointments, the makerspace avoids singling out disabled users for different treatment while still providing the accommodation they need.

Programmatic Design and Universal Access to Learning

The final domain of inclusive makerspace development concerns the programs and workshops offered within the space. A makerspace can be physically accessible, sensorily tolerable, technologically adaptable, and well staffed, yet still exclude users through the design of its learning opportunities. The typical makerspace workshop follows a standard format: a single two-hour session in which the instructor demonstrates a tool or technique and participants follow along. This format embeds multiple unexamined assumptions about learners. It assumes that all participants learn at the same pace, that no one needs to repeat a demonstration, that no one needs a break, that written handouts are sufficient for those who cannot hear or see the demonstration, and that the workshop’s cognitive load is appropriate for all attending.

Universal design for learning offers an alternative framework. Instead of designing a single workshop pathway and then accommodating learners who cannot follow it, universal design for learning asks instructors to build multiple pathways from the start. A workshop on 3D modeling might offer the same content in three modes: a live demonstration for learners who learn by watching, a written step-by-step guide for learners who learn by reading, and a hands-on guided practice session for learners who learn by doing with direct feedback. The workshop might be offered in two durations, a standard two-hour session and a four-hour session with built-in breaks and slower pacing. Documentation from the workshop might remain available online indefinitely, so that learners who need repetition can revisit the material without stigma. These design choices benefit not only learners with identified disabilities but also the exhausted graduate student, the non-native English speaker, and the perfectionist who wants to review each step multiple times.

Beyond workshop design, makerspaces should reconsider their project intake and support processes. A student with an idea for a making project but no experience with any tool faces a daunting entry barrier regardless of disability status. For a student with a disability, the barrier is compounded by uncertainty about which tools can be adapted and whether staff will be helpful or dismissive. An inclusive makerspace offers a low-stakes consultation service in which a staff member meets with a student, discusses their project idea, and collaboratively identifies accessible pathways to completion. This consultation might reveal that the student does not need to learn every tool. They might need only a single adapted tool and some confidence that they belong in the space. The consultation shifts the makerspace from a collection of tools to a relationship of support.

Conclusion and an Actionable Framework

Bridging accessibility gaps in academic library makerspaces is not a one-time project but an ongoing process of listening, learning, and redesign. No makerspace will ever be fully accessible to every potential user, because human variation is infinite and resources are finite. The goal is not perfection but progress toward a space that actively welcomes users who have historically been excluded. I conclude with four actionable principles drawn from the analysis above. First, conduct an accessibility audit that goes beyond legal compliance to include physical, sensory, technological, and programmatic dimensions. Use the audit not as a shaming exercise but as a roadmap. Second, involve disabled users as consultants, not just as testers of existing designs but as co-designers of new ones. Pay them for their expertise. Third, build redundancy into every aspect of the makerspace, redundant workstations, redundant documentation formats, redundant service models, so that no single barrier defeats a user. Fourth, adopt a culture of continuous accommodation in which staff assume that any user might need an individualized solution and treat the request for accommodation as normal and welcome.

Academic library makerspaces emerged from a beautiful idea, that hands-on creativity should not be reserved for elite engineering students but should be available to all. Fulfilling that idea requires confronting the uncomfortable truth that many makerspaces have replicated the exclusions of the wider world rather than dismantling them. The good news is that the tools of inclusion are known, tested, and often surprisingly affordable. What has been missing is not knowledge but will. The same libraries that led the way in creating makerspaces can now lead the way in remaking them as spaces where everyone, regardless of bodymind, can say with honesty, yes, this place was built for me.

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