



Visualizing the Unseen Design Work of Educators

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ABSTRACT

Educators are often described as practitioners and can be subject to deficit-oriented characterizations that position their work as focused on the passive dissemination of knowledge. This pictorial argues that educators are designers, and their curation of learning environments and experiences constitutes an underappreciated and complex design practice. Further, the design work that educators engage in is significant and consequential as it can define or reimagine who participates and what is valued in educational spaces – playing an important role in creating more equitable educational outcomes. In this pictorial, we leverage photos captured and curated by educators of their learning environments in library makerspaces and youth-serving technology centers to make their unseen design work and impact visible. Beyond making educators' expertise more visible, this pictorial also offers design considerations for designers of technologies, materials, and experiences that may be situated in educational environments.

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CSS Concepts

• Human-centered computing

INTRODUCTION

Educators are typically positioned as practitioners rather than designers. While this characterization speaks to educators' deep and embedded knowledge of facilitating learning in their environments, it misses an opportunity to uncover and learn from educators' design practices. Schön [26] argues that practitioners do not simply apply techniques to solve simple problems; instead, they engage in ongoing reflection and creative ideation to hone their practice. This is true of educators. The curation of learning environments and the experiences learners have in these environments constitute a design practice that is informed by a deep knowledge of the learner, community, and materials, historical, and cultural context of the learning environment. In this pictorial, we argue that educators are designers and the design practices of educators are consequential and deserve consideration as these practices define and reimagine who participates and what is valued in educational spaces [4]. Furthermore, we present their design work in this pictorial to provoke discussion on who designs and how this design work can look like and its implication for interaction design especially for products and experiences that aim to become embedded in everyday lives.

Learning environments extend beyond the formal school classroom. This pictorial focuses specifically on educators located within out-of-school learning environments that provide access to a wide range of materials, tools, technologies, and mentorship for learners of various ages. We refer to these spaces as both "makerspaces" and "community technology centers" to reflect how each organization describes their context. Learning is a process of becoming that unfolds in many environments [13,16,19], all of which have unique affordances and constraints that shape educators' design practices. Material and technology-rich learning environments have the potential to engage learners in meaningful experiences, particularly learners who have

historically or persistently been excluded from STEM (science, technology, engineering, math) environments [24]. However, the ways that these spaces are designed and how educational opportunities are enacted can also perpetuate this exclusion [1,3,4,9,14,27]. This further underscores the need to examine how educators design environments, and what implications their design choices have for learners.

Illuminating how educators design in material and technology-rich environments benefits greatly from a visual, photo-rich description [17]. We build on the prior work of other pictorial authors to use this format to make visible the social, material, and cultural context of learning environments, calling attention to the aspects of "community-based work that [are] 'rendered invisible' by current practices such as text-based archival formats" [22,28]. Blevis [2] argues that photo-visuals can be "knowledge-building artifacts intended to create both things that make you think, as well as things that matter." In this pictorial, we build on the documentation practices of the Reggio Emilia network of infant/toddler centers from Reggio Emilia, Italy, where educators use documentation to reflect on learning and their learning environments ("things that make you think") and to communicate the powerful image of the child to community members such as parents, other educators, and policy makers ("things that matter").

The professional knowledge and design practices of educators are often overlooked and undervalued. When we recognize educators as designers who do complex, multilayered work, what can designers and researchers in other disciplines learn? Towards that end, this pictorial is guided by the following question: **What does the unseen design work of educators look like, and what are the local and broader implications of recognizing and making sense of this design work?**

PROFESSIONAL KNOWLEDGE AND PRACTICE AS DESIGN WORK

An educator's knowledge goes beyond the material considerations of their space or their pedagogical approach, it includes intimate understandings of the social, relational, and cultural dynamics that shape how learning occurs [29]. Beyond designers of spaces and experiences, educators are designers of possibility, growth, community, and belonging to create transformative learning experiences, especially for marginalized groups who have been systematically and historically excluded from these spaces [25]. Educators must be firmly anchored in the day-to-day realities of meeting their learners' and communities' needs to design toward these values.

The location of an educator's design practice within a learning environment facilitates a unique and valuable understanding of how designs hold up in implementation. Just as contractors may develop understandings of what will last in the built environment in ways that architects might not [11], educators develop understandings of what tools, materials, and other innovations will hold up in their specific learning environments that are far removed from the contexts of original designers. This understanding, or professional knowledge, often emerges from the constant tuning [17] and infrastructuring [8,19] work that educators must do to ensure that educational opportunities are sustainable and equitable for their learners. For example, when introducing a new tool such as a physical computing kit, educators must do re-design work to create conditions that enable these new innovations to be taken up. This work can include creating resources for learners to get started, rearranging their space so that the tools are accessible, creating and displaying examples that inspire possibilities, and designing activities that meaningfully connect to the interests

and cultural practices of community members [8,10,13,17].

This pictorial highlights how educators leverage their professional knowledge to position designed technologies equitably and sustainably in a community-serving context. A closer examination of educators' design work has implications for designers of technologies and designers who aim to do community-engaged or participatory design.

CONTEXT

This pictorial features photos from partner educators located within a network of public library makerspaces and youth-serving community technology centers in the Mountain Region of the United States. These organizations are similar in that each provides free access to a variety of tools, technologies, and materials to their community members and are staffed by full-time educators who facilitate learners' experiences. While some educators were previously formal classroom teachers, others have backgrounds in fine arts, music, library sciences, and one educator was even formerly a member of the same community space she now facilitates. A key difference between these organizations is that the public library makerspaces invite community members of all ages to participate, whereas the community technology centers target middle school and high school aged youth specifically. Both organizations aim to serve nondominant groups [6] that have been marginalized from technology-oriented spaces because of race, ethnicity, class, or immigrant status. This commitment to educational equity directly impacts how educators in these spaces work. Creating experiences for specific communities often requires an element of "re-design" in order to make the tool, technology,

or experience meaningful and accessible to the community [13].

PARTICIPATORY PHOTO VOICE

Six educators representing four public library makerspaces and two community technology centers participated in a photo-prompt survey as our primary contacts. Our use of photo prompts was inspired by a combination of "photovoice" participatory research techniques [16] and our experiences with the Reggio Emilia approach to documentation which uses media such as photos to reflect on pedagogical decisions and to communicate what is valued in learning environments to various stakeholders.

The prompts sent to educators were:

- Photograph something that makes your space more accessible to a specific community, group, or person
- Photograph something that welcomes a specific community to your space
- Photograph something you wish you could change about your space
- Photograph something in your space that's overlooked that you wish more people (e.g. colleagues, people who don't come in would appreciate
- Free choice - Photograph something special or important! Tell us more about why you picked that thing.

We sent photo prompts according to educators' preferences, either sending prompts and receiving images via text or visiting educators in their spaces where they directed our photo-taking and talked about the prompts with us. The final images included in this pictorial represent a mixture

of photos captured by educators and photos captured by the authors. Although these spaces are public, any photos including visitors faces have been de-identified for privacy and for this reason, many of the photos in this pictorial were captured during hours in which the spaces are closed to the public. After we collected photos, we organized the images according to the prompt to surface any similarities or emerging insights. Through collective discussion we began to identify some emergent, non-exhaustive themes. We also shared these images and early insights with our educator partners, including several educators who did not participate in the survey (pictured below), inviting them to react to, discuss, and annotate the images.

In the following pages we reflect back initial themes that emerged from this process and use the images to visualize how educators design environments to support diverse interests, needs, community and cultural identities and how educators design to celebrate communities of learners.



HOW TO READ THESE PHOTOS

A primary goal of this pictorial is to support readers in recognizing and valuing the thoughtful design work that educators engage in, this requires attunement to the educator's environment. To facilitate this, we begin by offering two images of educators' environments; one community technology center (top), and one library makerspace (bottom). The spaces represented in this pictorial are visually rich and can be overwhelming in detail. Take a moment to take in the details and carefully consider both the big picture and the small details present in the photos. **What do you notice about how these spaces are designed?**

In the following pages, we will offer prompts for noticing educators' design decisions in selected images and we invite the reader to notice certain themes or details within those images with the goal of supporting the reader in "tuning" their sensitivity to educators' design practices [17]. The captions and annotations on each page summarize and represent educators' commentary, insights, and observations as they participated in the photovoice survey.

It is important to note that the physical environment that we focus on in this pictorial is only one element of the design processes that educators engage in. Equally important are the pedagogical or facilitation practices educators leverage, the relationships they build with learners, and the community members who participate in these spaces. While community members play important roles in shaping the design of these spaces, in this pictorial we are focusing specifically on elevating and understanding the design processes of educators.

Finally, we note that these photos represent a single moment in time of educators' ongoing design and infrastructuring work. What is captured in the photos featured in this pictorial may become a permanent feature of the environment, or may change the next day. As educators reflect and tune their spaces to better meet the needs of their communities, their spaces become both artifacts of design and evidence of an ongoing iterative design practice.



A well-organized craft room featuring two tall metal shelving units. The left unit holds supplies like paper, glue, and various craft kits. The right unit holds a sewing machine, fabric, and more craft supplies. A desk with a chair is visible in the foreground.

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This display is located in a library makerspace focused on textile and fabric crafts. The example projects educators curated here suggest various **possibilities within the realm of textile and fabric crafts**, from creating accessories like hats with a knitting machine to felted artwork and crocheting decorative pieces. However, this display **also acknowledges and represents possibilities beyond fabric crafts** by educators' inclusion of items like 3D printed objects, machine-cut paper crafts, and handmade jewelry.



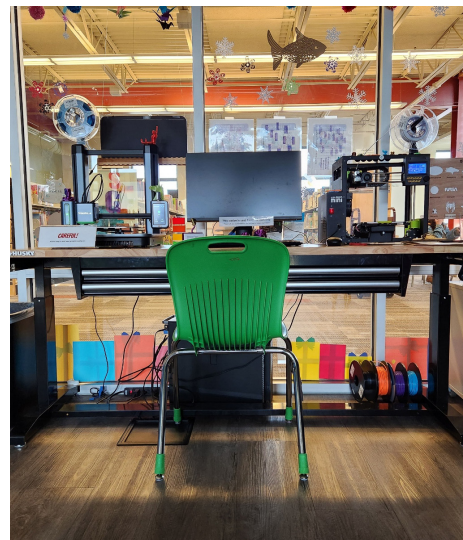
1961

Designing to support diverse needs (1/2)

Designing with attention to the needs and preferences of diverse individuals and communities is a crucial element of an educator's design practice that can deeply influence how comfortable or safe learners feel in these spaces, and educators design for both known *and anticipated* needs within their communities. In viewing the following images, we invite you to **notice the often subtle and overlooked design moves that educators enact to support the needs of their community members.**



Youth-serving community technology centers feature kitchen and snack areas and "living room" areas where teens can **relax and socialize** after school. Spaces to "hang out" are important features in learning environments that serve youth in particular [11].



This 3D printing workstation features two 3D printers, which are set up to **support two different kinds of learner needs**: young or novice learners who are new to 3D printing and may need extra support and older or more experienced learners who want more functionality and complexity in their 3D printing design processes.



Learning environments are sometimes viewed as quiet spaces. Makerspaces push back on this dominant notion and can be quite noisy with the sounds of people talking, machines running, and tables and chairs moving. Offering headphones to makerspace visitors **acknowledges the sensory needs of learners** who may be sensitive to noisy environments.



This library makerspace leverages adjustable-height and modular furniture in the areas where visitors work on projects. **Adjustable height tables support a wide range of visitors** as the height of the table can be raised to accommodate visitors who use mobility devices like wheelchairs or the height of the table can be lowered to accommodate young children.

Designing to support diverse needs (2/2)

Educators within the library makerspaces, in particular, must be able to support both young children and adults, as their makerspaces are open to community members of all ages. In these images, we invite you to **notice how educators design the physical space to support multi-age participation.**



The built environment often ignores young children's needs. Educators use tools like step stools to **help children access important areas** like sinks **independently**. Educators also bring the materials to a child's level, for example, by moving important jewelry-making tools to the bottom of a pegboard organizer where children can more easily reach them.

This library makerspace serves a large number of families with young children. Educators in this space combined individual tables to create longer shared table spaces, **creating more flexibility in how families can position themselves** within the space.

Designing to support diverse community and cultural identities

The spaces featured in this pictorial are embedded within community organizations such as public libraries and community centers, and educators aim to welcome and recognize the diverse cultures represented in the communities these organizations serve. Often, educators draw from their diverse cultural backgrounds as they engage in this design process. As you view the following photos, we invite you to **notice how educators use materials, space, and language to support diverse cultural identities.**



Educators translate library makerspace flyers into the three languages **most commonly spoken in the surrounding community**. They are labeled in the appropriate language, **decentering English as the default** and dominant language.



A library makerspace educator who identifies as Hispanic created a paper craft activity to celebrate Hispanic heritage month. Some library makerspaces choose to display these portraits year-round in their spaces.



An artifact displayed in one library makerspace features a tote bag designed for a Vyshyvanka day workshop facilitated by an educator who drew from her Ukrainian heritage to engage community members, particularly the local Ukrainian immigrant community, in creating and fabricating their own traditional Vyshyvanka designs.

Designing to celebrate communities of learners (1/2)

Educators design spaces that celebrate participants' learning, growth, and creativity and cultivate community. In this way, educators design choices position their learning environments as not just a space that learners use, but a space that belongs to them. In these photos, we invite you to *notice how educators use displays and documentation to celebrate and cultivate their communities of learners.*



Outside of a community technology center, a nicely framed gallery of art created by previous youth members decorates the walls. The gallery aims to **inspire current youth** and to communicate that **previous members are always welcome** in the space.

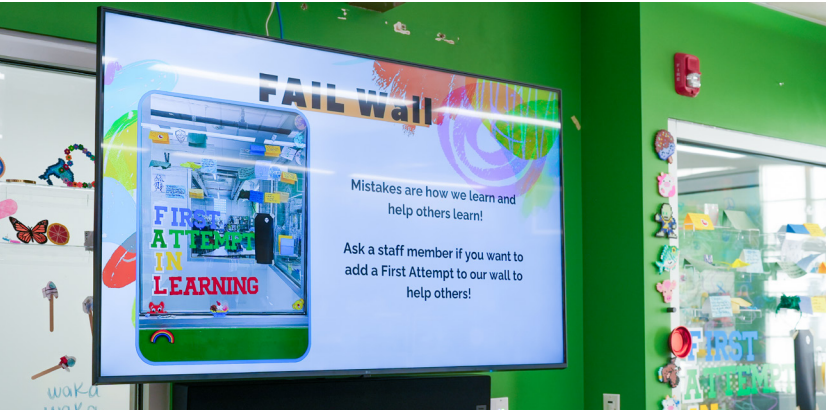


A closet door features **labeled photographs of community members' creations**. Not everything learners create in these spaces can be left behind to inspire others. There is limited space to display artifacts, and many learners want to take home their creations. Documenting learners' creations through photos and displaying those photos in their space allows educators to **celebrate the growth and creativity** of their learners and **community members to learn from one another**, no matter what kind of project it is or where it ends up.



Designing to celebrate communities of learners (2/2)

Educators' celebration and recognition of learners goes beyond displaying artifacts and documentation. In these photos, we invite you to *notice how educators design ways to actively engage participants in collectively reflecting on and sharing their experiences.*



Educators invite participants to share their mistakes to **help others learn** by writing about or sharing an artifact on the "FAIL" (First Attempt In Learning) wall.



Educators created and curated an art exchange where learners can leave behind arts and crafts they have created, and anyone can take home a piece of art. While the invitation for learners highlights that they "don't need to be an artist to participate," the **curated display creates a sense of value and meaningfulness.**

ANOTHER LOOK

Now that you have had the experience of noticing and observing how educators design environments to support diverse interests, needs, community and cultural identities and how educators design to celebrate communities of learners, we offer one final invitation– we invite you to **return to page four** to review the makerspace photos and consider them through this new perspective. **What do you notice about how these spaces are designed? What do you see in these images now that you might not have noticed before?**

DISCUSSION

We return to the theme of DIS this year, which asks questions like “Why design?”, “Who designs?” “What does design look like when everyone designs?” and “How can design imagine new relations to ourselves, our societies, and the environment?”.

In this pictorial, we answer the question “Who designs?” by demonstrating that educators are designers. We visualize what design “looks like” when educators are recognized as designers, focusing particularly on the complex constellation of decisions that shape the physical and material learning environment and can be visualized through photography.

Throughout the pictorial we invited readers to notice and recognize educators’ design work. We highlighted several themes that both capture these educators’ design work, and provide considerations to the broader design, research, and education community. Those themes can be summarized as follows: design environments to support and celebrate diverse interests, needs, and cultural and community identities.

Critically, we frame these items as themes to consider

in the design of a creative learning environment, rather than guidelines to implement because these themes must be tailored to local community contexts by stakeholders, such as educators, in those spaces. In this pictorial, these broad themes were made specific by educators as they designed for the local communities they serve and balanced their personal values as well as the values of the organizations they are embedded within. Additionally, we recognize that educators’ perceptions of equity and how they design for equity in their spaces are a constantly shifting and ongoing practice [23]. The images captured here represent a single moment in time and educators’ spaces will likely change over time as they refine how their spaces are organized in order to better serve their communities and strive towards equitable engagement and participation.

We reiterate that the design practices of educators matter because of the critical roles educators play in shaping who participates in learning opportunities and who is welcomed in learning environments. However, the work of educators can speak to design more broadly. Designers creating products, tools, or experiences that may be situated within a community or educational context as well as creative environments that engage diverse audiences can take away insights from educators’ design work visualized in this pictorial.

Specifically, we suggest that designers who want their work to be taken up in learning environments consider the infrastructuring or tuning work that educators must do to make designs work for their learning environments and consider how they can adapt their designs to reduce this friction for educators. Next, we reiterate the suggestions originally posed by Resnick and Silverman [20] to design for “wide walls,” not just “low floors” and “high ceilings,” and encourage designers to consider how their designs attend to or accommodate diverse interests, needs, and identities. Finally, designers can benefit from working directly with educators as they create new tools or experiences. Ghoshal

and Dasgupta remind the field of an important tension in HCI research, “value dilution” occurs when “despite the best efforts from designers and users alike, values get lost, diluted, and distorted once technologies are put into practice” [5]. Just as Ghoshal and Dasgupta suggest that staying close to the intended audience for a technology can help reduce value dilution, we suggest that staying close to educators’ design perspectives, which are directly informed by their work with community members, can reduce value dilution when designing technologies and experiences for learning environments.

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