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Abstract

This study explores the experiences of undergraduate student staff working in a university makerspace, focusing on how they describe the development of technical skills, leadership capacities, and peer mentorship. Using qualitative methods, five semi-structured interviews were conducted with student staff active in Spring 2025. Transcripts were coded using a combination of open and in-vivo coding techniques. Findings reveal that student staff experience a role progression from technical support to proactive leadership and ultimately to representing and shaping the makerspace culture. These insights align with and extend prior literature on student roles in academic makerspaces. The study highlights how intentionally supporting student leadership, peer mentorship, and community-building are central to the educational impact of academic makerspaces.

Introduction

University makerspaces have become a vital nexus of STEM education, particularly in engineering disciplines. These ecosystems cultivate student advancement by leveraging hands-on design, fabrication, and problem-solving that complement and enhance formal curricular instruction. The ecosystems are formed from physical spaces, design curriculum, tools, machines, materials and training with a goals of promoting innovation, creativity, and student engagement. But, the culture of these programs, the center of these communities of practice rests on the individuals who ensure these spaces function day-to-day, establish personal connections and offer guidance and mentorship: In this case, a highly empowered undergraduate student staff.

Student staff in university makerspaces play a hybrid role that merges technical expertise, peer instruction, and leadership. These roles extend beyond basic operational duties; student staff are often the facilitators of learning, the bearers of

culture, and the first point of contact for new users. However, the development of student staff how they learn, lead, and construct meaning through their work remains understudied in makerspace research.

This paper addresses that gap by exploring the experiences of student staff employed in a large public university's makerspace. Using qualitative interviews and thematic analysis, we examine how student staff describe their growth in three areas: (1) technical skill development, (2) leadership capacity, and (3) peer mentorship. Through this exploration, we highlight the ways in which student staff are both shaped by and actively shape the cultural and pedagogical landscape of academic makerspaces.

Related Work

Makerspaces have received considerable attention in engineering education as sites of informal learning and creativity. Much of the early literature focused on user experiences emphasizing learning through making, interdisciplinary collaboration, and the development of design thinking skills [9]. More recent work has begun to explore the roles and identities of staff, particularly student staff, who support the daily function of these spaces.

Hunt and Culpepper [3] emphasized the importance of student leadership in building inclusive makerspace cultures, arguing that peer leaders are crucial to fostering a welcoming and empowering environment. Similarly, Crose et al. [4] noted that student-run makerspaces often reflect and reproduce the social dynamics of their peer groups, making the leadership and cultural sensitivity of student staff especially significant.

Chambers, Dowell, and Bedard's two studies [5], [6] provide a critical lens on how student staff conceive of their own roles. Their phenomenographic work identifies a progression from "presence" (being there to help), to "activity" (proactively

supporting curriculum), and finally to “representation” (modeling and sustaining the makerspace’s values). This role typology mirrors broader educational models of situated learning, where learners become full participants in a community of practice.

From a critical perspective, Andrews and Boklage [2] argue for a more inclusive understanding of student agency in makerspaces. Drawing from Yosso’s Community Cultural Wealth framework [7], they suggest that student staff bring valuable forms of capital resistance, aspiration, and social knowledge that are often unacknowledged by formal systems. These assets shape how students navigate and contribute to the makerspace, particularly those from historically excluded identities.

Mentorship, a recurring theme in this literature, is framed as both a learning strategy and a cultural mechanism. Buckner et al. [8] and Barrett et al. [9] emphasized that structured peer mentorship programs can help scaffold technical learning, democratize access, and build community. In this context, mentorship is not merely instructional it is relational, identity-affirming, and integral to the ethos of a successful makerspace.

Our study extends these bodies of work by providing a grounded qualitative account of how student staff narrate their experiences across technical, leadership, and cultural dimensions. It contributes to a growing recognition that makerspace employment is more than a job it is a transformational learning experience.

Methods

This study employed a qualitative interview approach to gain rich, contextualized insights into student staff experiences. We selected a purposive sample of five undergraduate student employees working in a large, interdisciplinary university makerspace during the Spring 2025 semester. All participants held roles that included equipment management, peer training, and supporting events or workshops.

Data Collection

Interviews were conducted between March and April 2025. Each session lasted between 16 and 30 minutes and took place either in person or via Zoom, depending on participant preference and availability. Interviews followed a semi-structured protocol, allowing flexibility to explore emerging themes while maintaining consistency across conversations. Questions addressed participants’ pathways into the makerspace, their evolving responsibilities, their views on mentorship and leadership, and how they felt their role had impacted their academic or personal growth.

All interviews were audio-recorded with participant consent and transcribed immediately using a verbatim transcription protocol. Following each session, the interviewer created a detailed memo capturing key observations, early insights, and potential connections to existing frameworks. These memos

were instrumental in sensitizing the analysis and aligning with reflexive qualitative practices [10].

Data Analysis

We conducted a two-stage coding process. First, transcripts were open-coded to capture both a priori categories drawn from the literature (e.g., technical skills, leadership, mentorship) and emergent in-vivo themes. Then, excerpts were grouped into thematic clusters for interpretation and synthesis. Coding was conducted iteratively, with regular comparison across transcripts to identify patterns and anomalies.

To support trustworthiness, we triangulated data sources by linking themes back to memos and cross-checking interpretations with multiple transcripts.

Ethical approval was granted by the university’s IRB, and all participants provided informed consent. Identifying information was removed or anonymized, and participants had the opportunity to review their transcripts for accuracy.

Results & Discussion

The analysis revealed four overarching themes from nine codes illustrate how student staff experience their roles: (1) developing technical competence, (2) navigating leadership and responsibility, (3) engaging in peer mentorship, and (4) constructing identity and community within the makerspace (see figure 1).

Code	Definition	Type of Code	Example Quote	Theme
Technical Skills	Development of hands-on knowledge and operational expertise with tools and technology.	Deductive	"You learn the machines by breaking them, fixing them, and teaching others."	Developing Technical Competence
Personal Projects	Exploration through self-initiated projects that build technical and design fluency.	In-vivo	"I did a bunch of my own projects which taught me how to use all of this."	Developing Technical Competence
Leadership	Emergent roles involving responsibility, initiative, and coordination of peer efforts.	Deductive	"People started asking me first, and I realized I was sort of the lead now."	Navigating Leadership and Responsibility
Initiative and Responsibility	Taking ownership of tasks, workflows, and decision-making in unstructured settings.	In-vivo	"I just started doing more and taking over tasks because they needed to get done."	Navigating Leadership and Responsibility
Mentorship	Reciprocal relationships of guidance and knowledge-sharing between peers.	Deductive	"Being a part of leadership... has always been a way for me to give back to those leaders that really taught me."	Engaging in Peer Mentorship
Peer Learning	Informal teaching and learning that happens collaboratively among student staff.	In-vivo	"We all just sort of figure things out together."	Engaging in Peer Mentorship
Community Identity	Sense of belonging and identity shaped by the culture and relationships within the makerspace.	In-vivo	"Before working here, I wasn't sure I belonged in STEM. Now, I'm mentoring others."	Constructing Identity and Community
Belonging	Feeling accepted and supported in a peer environment.	In-vivo	"The makerspace became a second home—people who get me, who challenge me."	Constructing Identity and Community
Awareness of Hierarchy	Recognition of one's place in the organizational structure and its impact on confidence and authority.	Deductive	"I'm just a normal staff member."	Navigating Leadership and Responsibility

Table 1: Coding Structure and Themes

Developing Technical Competence

All participants described entering the makerspace with varying levels of technical expertise, but each noted

significant growth through hands-on learning. The opportunity to work with machines on personal and institutional projects gave them not only technical fluency but also troubleshooting confidence. As one participant stated, *"You learn the machines by breaking them, fixing them, and teaching others."*

This type of experiential, self-directed learning supports Barrett et al.'s [9] findings that personal projects are an essential component of learning in makerspaces. Students were also expected to remain updated on evolving technologies and mentor others, which reinforced their own learning through teaching.

Navigating Leadership and Responsibility

Students often expressed surprise at the degree of autonomy and responsibility they assumed over time. Leadership was not always formally assigned but was cultivated through initiative, consistency, and the willingness to step in where needed. This aligns with the "representation" stage in Chambers et al.'s [6] typology.

Leadership also included emotional labor managing user frustrations, facilitating difficult conversations, and maintaining team morale. Participants described becoming "go-to" people not because they were appointed, but because they earned trust. One participant explained, *"People started asking me first, and I realized I was sort of the lead now."*

Peer Mentorship as a Core Practice

Mentorship emerged as both a personal value and a structural mechanism. Participants described the process of being mentored by former staff and internalizing not only technical practices but also cultural norms. This mentorship was often informal and relational, embedded in side conversations and shared shifts.

Mentorship was reciprocal; participants found meaning in helping others. For example, one participant recounted a moment when a newer student succeeded at a task after several failed attempts: *"I saw myself in them. That moment reminded me why this work matters."*

Community and Identity Construction

Perhaps the most profound theme was how students saw their makerspace experience shaping their identity. The makerspace was often described as a "third place" between home and school one where they felt respected, empowered, and challenged. Many credited the experience with changing their academic trajectory or affirming their interest in engineering.

One participant shared, *"Before working here, I wasn't sure I belonged in STEM. Now, I'm mentoring others. That changed how I see myself."* These identity shifts affirm research by Andrews and Boklage [2] that centers makerspaces as affirming sites for marginalized students.

Conclusion

This study underscores the complex, multifaceted roles student staff occupy within academic makerspaces. Through qualitative interviews, we found that students grow significantly in technical skill, assume emergent leadership, and engage deeply in mentorship all while contributing to a sense of community and identity formation. These roles are not accidental; they emerge from a culture of trust, autonomy, and peer learning that is cultivated over time.

Our findings extend prior literature by providing a thick, grounded account of what makerspace work means to student staff and how it shapes their growth as engineers and leaders. We affirm that makerspaces are not just laboratories for innovation they are laboratories for identity, collaboration, and cultural construction.

Institutions would benefit from investing not only in makerspace infrastructure but in **intentional hiring, training, and recognition of student staff**. Future studies could examine longitudinal outcomes or compare multiple institutional models to further strengthen best practices in this area.

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