Negotiating Tensions of Autonomy and Connection in Makerspace Cultures: A Qualitative Examination of a University's Makerspaces

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Negotiating Tensions of Independence and Connection in Makerspace Cultures: A Qualitative Examination of an Interdisciplinary Student Team

Abstract

For engineering students, the culture and development of university makerspaces is highly driven by tensions of independence and connectedness between and among students and faculty. These tensions are a result of the power dynamics and perceptions pertaining to engineering students' relationships with those of authority, such as faculty and other engineering students. While makerspaces seek to foster a feeling of autonomy and create an educational environment that inspires creativity and collaboration, there remain underlying tensions that constrain students' abilities to take full advantage of the resources that are available to them. Such tensions and their impacts are not easily measured through quantitative research methods. This study used ethnographic methods of participant observation as well as unstructured and semi-structured interviews over the course of two years in university makerspaces at a large comprehensive public East coast university in order to investigate the educational tensions that characterize university makerspaces for engineering students. To do so, we trained one graduate researcher and two undergraduate researchers in ethnographic methods and analyzed their field notes and transcripts over the span of two years through qualitative processes of inductive analysis. For this paper, we examined patterns and themes related to independence and connectedness as it corresponded to engineering students' relationships with other students and faculty. This research introduces the emerging themes regarding how students negotiate tensions of independence and connectedness with faculty and other engineering students in and around makerspaces through managing strategies of delegating tasks, maintaining accountability, reframing alliances, choosing connection as preferred operational mode, and segmenting behaviors. Further, our analysis reveals how these tensions emerge between faculty and students to create an engineering identity for the students. Finally, we frame the different meanings of independence and connectedness in university makerspace cultures and discuss the implications for the design of makerspaces that cultivate educational experiences that enable students to successfully manage these tensions.

1 Introduction

For academic makerspaces, the kinds of interactions students have with others in and about makerspaces impact their experiences as makers and shape how those spaces inspire creativity, collaboration, and culture. Further, these interactions impact a student's willingness to explore their own creative avenues and can leave a student feeling encouraged to work with others and welcomed to be a part of a community or not. In this way, a makerspace becomes more than simply a physical space that houses certain equipment and machinery; it evolves and transforms into a unique culture. Such a culture can and should be a space where students have

independence and the freedom to create as well as having the opportunities to collaborate with their peers and navigate the terrains of inspiring creative design together.

For engineering students especially, there have been initiatives across numerous campuses to build makerspaces that encourage creativity and collaboration. In many cases, the space has adopted and imitated the framework of a commercial makerspace; thereby, initiating a new breed of makerspaces: academic makerspaces. However, no one makerspace is the same. The foundation elements behind academic makerspaces remains consistent – an open space with tools and resources for students to design, build, create, and test their ideas. Yet, how these academic makerspaces have and continue to unfold, develop, and grow remains diverse. This diversity is evident in the widespread and unique qualities and histories that characterize the numerous makerspaces that exist for students.

Building these spaces is not without its challenges. Challenges arise from inability to acquire space, lack of resources to equip the space, or lack of financial support necessary to concurrently pursue the visions of students, staff, faculty, and administrators associated with the space. While these visions can vary and result in conflicting expectations, tensions emerge that inherently affect the space as it develops. Even so, tensions accumulate when more roadblocks occur, such as finding reasonable locations and space to build a usable and accessible makerspace on a university campus. Ultimately, once the makerspace is built, further tensions can evolve while students begin to explore the space and pursue creative avenues. Such tensions arise between students and the authority figures within the space and are of particular interest for this research.

In this paper, we introduce our findings from a qualitative study of students in and around creative spaces at a large comprehensive public East coast university. In this approach, we use ethnographic methods of participant observation, unstructured and semi-structured interviewing in order to identify patterns and themes regarding independence and connectedness in student relationships with other students and faculty. From these data, we identified qualitative themes associated with (1) the tensions that emerge between students and authority in and around creative spaces, (2) how students negotiate tensions of independence and connectedness with both faculty and other engineering students in and around makerspaces, and (3) the different meanings of independence and connectedness that exist in university makerspace cultures. We discuss our findings and implications for designing makerspaces that foster an environment that provides students with the support and ability to navigate these tensions.

2 Background

2.1 Makerspaces

There is no clear, prescribed definition attributed to makerspaces. This is largely due to the fact that the term “making,” which is the foundation for makerspaces, is intentionally been left vague and is not clearly defined (O'Connell, 2015). The purpose for this definitional ambiguity is to

avoid constraints to the variety of creative avenues involved in making. Nevertheless, this does not deter from educational and professional consensus regarding what makerspaces are and what making entails. One way to look at a makerspace is as an open environment, non-traditional machine shop where users, students in this case, are allowed to design, build, test, and collaborate (Barrett et al., 2015; Forest et al., 2014; Hlubinka et al., 2013; Kurti, Kurti, & Fleming, 2014). Makerspaces allow collaboration between age-groups and those with different levels of expertise or different interests and skills. A makerspace intends to encourage diversity and students from a variety of disciplines to explore and enhance their creative desires.

Academic makerspaces shift the learning mode from being passive to active, and for the students, the primary objective of the space is creating (Kurti et al., 2014), and it is through creating that students are learning. Makerspaces are an informal learning environment, and to foster this, the learning space itself must shift. The design of a typical didactic classroom, where the desks are facing a whiteboard and the teacher - typically a faculty member - lectures at a podium evolves; it evolves into a space with workshop tables and chairs, machines and tools at easy reach, and the students becoming "teachers" through collaboration, independence, and autonomy.

2.2 Fostering Learning in Makerspaces

In 2004, the National Academy of Engineering (NAE) described the qualities of the Engineer of 2020 (*The engineer of 2020: Visions of engineering in the new century*, 2004). The NAE highlighted the following attributes as essential for an Engineer of 2020: strong analytical skills, practical ingenuity, creativity, communication, business and management knowledge, leadership, high ethical standards and professionalism, dynamism, agility, resilience, flexibility, and the habit of lifelong learning. While developing these qualities may seem a lofty feat to accomplish, these benchmarks for success in engineering introduced the need to generate alternative teaching environments in education that foster opportunities for a student-engineer to acquire this diverse skill set (Zabudsky, Rayegani, & Katz, 2015).

Makerspaces offer students the opportunity to build this diverse skill set. Makerspaces encourage hands-on learning which not only allows students to manage the learning process but also encourages them to develop solutions to problems by harnessing their own creativity and collaborating with others (Kurti et al., 2014). While these students begin to learn more and grow more acquainted with the space, they can take on mentorship roles and encourage creative and innovative learning for others (Kurti et al., 2014). Because this innovation is an inspired activity, the environment of makerspace is critical to its success in providing means to inspire creativity and hands on problem solving and learning; a successful makerspace environment encourages deeper thinking and creativity by providing an open, thought provoking space with right equipment for innovation (Kurti et al., 2014). Such equipment promotes individualized problem solving rather than the didactic method that many schools implement today, and this helps to

foster a engaged approach to problem solving within students that also allows them to utilize what they learn in class in a practical setting (Burke, 2015; Loertscher, 2012). Makerspaces can teach students an open-ended, more innovative way of thinking making them more capable of producing creative solutions (Bowler, 2014).

2.3 Experiential Learning, Situated Learning, and Communities of Practice

Having the potential to support creativity, independence, and autonomy for students, makerspaces encourage experiential and situated learning experiences through communities of practice. Experiential learning is not merely a technique that can be utilized to provide students with an experience from which they can learn, but a philosophy of education (Dewey, 1986; A. Y. Kolb & Kolb, 2005). This experiential learning philosophy is characterized by several tenets: learning is (1) a process not an outcome, (2) relearning, (3) resolving conflicts, (4) holistically adapting to the world, (5) interacting with the environments, and (6) creating knowledge (Kolb 1984). This perspective is built on the notion that knowledge is created from reflecting upon a transformative experience, exemplified through the processes of the Experiential Learning Cycle (D. A. Kolb, 2015). The cycle has four stages through which a person learns: concrete experience, reflective observation, abstract hypotheses, and active testing. Each of these stages are implemented in a makerspace.

Experiential learning practices focus on a student-centered approach to education. Lee and Hannafin (2016) argue that in student-centered learning

> *Students assume increased autonomy and responsibility for their own learning. Often students identify individual learning goals to pursue external goals. Students build upon unique background knowledge and experiences and further explore, select, and use tools and resources. Students navigate unspecified paths, monitor progress, and develop personal strategies (p. 708).*

Student-Centered Learning approaches are grounded in situated learning and constructivist theories of the development of knowledge. Situated learning takes the student out of the classroom and into a community where the student can learn through participation and practice in the lived world (Handley, Sturdy, Fincham, & Clark, 2006; Lave & Wenger, 1991). Situated learning theory argues that knowledge is socially-constructed rather than an abstract and symbolic entity (Berger & Luckmann, 1966; Blackler, 1995). It is through situated learning theory that promotes active participation in communities of practice which cultivate identity and connection to both work and other participants (Wenger, 1998).

A community of practice occurs when a group of people work together and learn within a domain of interest, in this case engineering. Communities of practice facilitate the quest for an identity and learning through experience and social interaction with others. A community of

practice involves social processes in which members negotiate competence within a domain of expertise (Farnsworth, Kleanthous, & Wenger-Trayner, 2016). In a community of practice, participants both guide and receive guidance from one another as they work shoulder to shoulder (Kriner, Coffman, Adkisson, Putman, & Monaghan, 2015). Communities focus on *knowledgeability*, which differs from knowledge acquisition. Knowledgeability surpasses the quest for information and looks to the *experience* and *identity* that emerges from living and practicing in a domain.

Engagement in communities of practice can vary in terms of periphery, marginal, or full participation, where periphery and marginal participants only somewhat engage with the culture or space while full participation has complete immersion in the culture (a full member). A periphery or marginal participant's advancement in membership within the community of practice can be hindered or promoted depending on how power is managed in the space. This leads to concerns regarding power dynamics within a community and how these participants, especially newcomers, interact with a space (Contu & Willmott, 2003; Huzzard, 2004). If a newcomer holds little knowledge on the domain and fails to even pass an expected threshold, then tension can build from the newcomer being unable to enter into the community. Even more tension can arise when students have conflicting obligations to different communities or organizations, having multiple communities where they are marginal or periphery participants. This causes a student to have to navigate their identity, time, and availability to take part in the different learning environments, creating intra-personal tensions.

RQ: How do students in a community of practice on a university campus understand the role of relationships with other students and faculty in the development of their identities?

RQ1a: What are the underlying meanings of the tension between independence and connection in a "maker" community of practice?

RQ1b: What management strategies do students employ to navigate the tension between independence and connection in a "maker" community of practice?

3 Methodology

Over the course of two years, the researchers employed ethnographic methods of participant observation as well as unstructured and semi-structured interviews of multiple makerspaces on a large comprehensive public East coast university with an enrollment of over 20,000 students. Three student researchers engaged in participant observation of multiple makerspaces across campus, including spaces in engineering and industrial design as well as for the general student population. Further, one of the researchers participated in weekly meetings of an elite group of

students from various academic majors who were brought together to focus on cultivating innovation and change regarding spaces at their university. The fieldwork involves over 50 hours of observations and resulted in 243 pages of single-spaced field notes. This paper presents the findings regarding first five observed meetings of the elite student group. The elite student group consisted of a sophomore engineering student, junior engineering student, senior graphic design student, and a senior architect student. This small group serves as a case study of a community of practice in a university setting.

Data were collected and analyzed in multiple phases, characterizing the iterative practices of qualitative research (see Figure 1). As part of a larger research project, the team began with broad research goals to describe and understand the culture of makerspaces. First and foremost, it is important to note that culture is constructed through communication processes, including but not limited to the verbal and nonverbal features of interpersonal interactions. Field notes collected as part of this case study contained detailed descriptions of interactions between group members. As data were collected, transcripts were read multiple times by the first author and were shared with the research team during the data immersion phase to gain familiarity with the data and discuss emergent interpretations (Tracy, 2013). Throughout the early ethnographic observations of the first author, the tension between independence and connection emerged as a dominant theme in the students' talk across all five meetings of the student group, meeting Owen's (1984) criteria of recurrence, repetition, and forcefulness. This led the research team to refine the broad research question inquiring about the construction of makerspace culture to focus interpretations on this emergent dynamic, asking: "what does this tension mean to the students" and "how is it managed by the students?" (RQ1a and RQ1b).

Second, using the processes of constant comparison, the first author coded the data line-by-line using an analytic process called primary cycle coding (Tracy, 2013). Primary cycle coding seeks to provide a thorough description of the data through a process of sorting and categorizing the data to assign meaning (code) to every unit of data. This phase of coding gives special attention to creating *in vivo* codes that give primacy to the participants' voices (e.g. "dominating," "nervous laughter," "make something happen"). The process of primary cycle coding is repeated on each new set of field notes collected. Secondary cycle coding begins after all data are collected, or as in this case, after a phase in the data collection process has concluded. During secondary cycle coding (Tracy, 2013) the first author identified relationships between the first level codes, bracketing them into broader categories of meanings and strategies of behavior (e.g. delegating). Figure 1 showcases the iterative process of qualitative data collection and analysis, as the research team must remain open to refining and revising their interpretations as new data are collected.

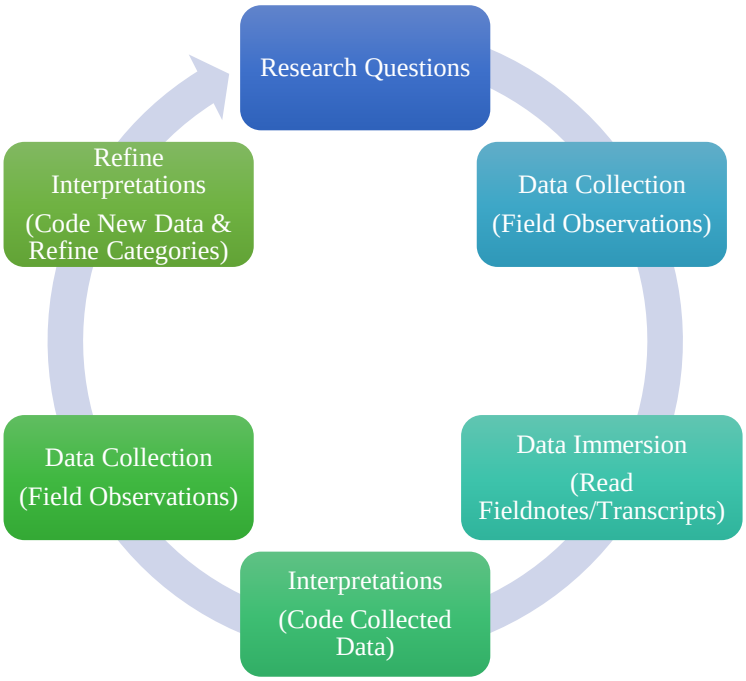

Figure 1: Showcase of the process for qualitative data analysis.

4 Findings

4.1 Meanings of Independence and Connection

The tension between independence and connection surfaced in varied ways in interactions among the small group and demonstrated the centrality of this tension in their emergent identities as engineers. Specifically, the tension was expressed in students' relationship, with group members, faculty, and the administration/institution. A summary of the meanings of the tension of independence and connection is highlighted in Table 1 at the end of the section.

Students expressed the tensions between independence and connection in their relationships with others students as well as their relationships with faculty. In their relationships with students, this dialectical tension is experienced as a simultaneous pull toward recognizing the necessity of interdependence upon others (connection) and the desire to be in control of their own work and time (independence). Thus, it is not surprising that tensions between students are largely felt in team environments, such as the elite group or Capstone team members. Expectations for successful team functioning was observed as a recurring feature of makerspace culture in this study. In group settings, tensions arise in instrumental activities and social relationships. In instrumental contexts, tensions arise around workload, deadlines, time management, and project demands. While in relational contexts, the tension emerges in terms of relatability and (inter)dependence (i.e., I can relate to you, and I know who I am in relation to you). The boundaries between the instrumental and relational contexts are blurred in these team settings

and students often express such competing tensions simultaneously, recognizing both a wanting for independence from group members and a wanting for connection with others in their group. For example, in the following passage taken from the collected field notes, in students' efforts to control their work, time, and resources, they strive to develop a level of autonomy. While deadlines and project demands are imposed upon the students, students reconcile the fact that they do not have control over deadlines and project demands by creating their own deadlines regarding what needs to be done in a project and by what time. This manipulates, resolves, and masks over the reality that the original deadlines are not within their own control. Regardless that there are uncontrollable factors in their projects and assignments, students make use of independence through the means that are available to them.

> *Bill starts the meeting by saying that he was "slammed with work" and proposes that the meeting will simply be a "planning meeting." Bill, still looking at his computer screen, asks "Is Isabel coming?" Miley responds, "yeah, she texted that she is running late." Bill and Miley plan to have at least each interview one person for their assignment by tomorrow (Wednesday) night. Meanwhile, their assignment overall is due Thursday night. … Near the end of the same meeting, Isabel is looking at her screen. Her eyes widen and she cries out "this is going to be so much." Miley confirms that it is annoying. Isabel is swaying a little "It's just going to be so much. I'm so nervous!" She is laughing at her own nervousness presumably. Miley proposes that they make a plan and then leave. They then list what they need to do and by when they need to have their work done.*

Furthermore, in the above passage, students sought to maintain and preserve their identity/role in the group while also desiring relatability and support from the group members so as to resonate the feeling of connection with their teammates. For example, an engineering student wants to be recognized for their role as the engineering student. They also wish to be able to relate to their teammates and find solace in being able to rely on their teammates' abilities as a graphic design student or architecture student. These degree paths (i.e., engineering student, graphic design student, architecture student) oriented the students to be able to understand his or her relationship to each other in the group. For example, the engineering student could recognize that the graphic designer should, by trade, be able to craft aesthetically appealing and intriguing graphics.

The tensions felt between students and faculty relationships occur both in the classroom and in out-of-class interactions, such as in makerspaces. Students expressed the desire and gratefulness for when they were given the opportunity by faculty to actually make change on the campus – prescribing them independence. However, students were only able to do so given the permission, support, and access via faculty. So long as faculty with motivation and interests were not in short supply, students felt a closer connection to the faculty who granted the students greater independence in their work. In these instances, the tension is experienced in relationship to the

power differential. That is, students feel dependent – connected to – their faculty for their expertise, access to resources, support and help, and interest in students' lives.

In aligning themselves with the faculty in other contexts, the students expressed an "us" vs. "them" tensions between themselves (with the faculty) and the university as an institution. In this case, the students recognized their interdependence upon the university for resources and curricula (connection), while simultaneously honoring the grassroots initiatives that set them apart as independent from that institutional authority. When asked to name the biggest weakness at the university, students responded that the faculty aspire for innovation and change but are rejected by the institution. Specifically, this is expressed as a frustration with the lack of funding given to faculty initiatives that support innovative student scholarship and creative activities. As such, they feel aligned with the faculty in support of innovation (connection) and disconnected and separated from the support of their university as an institution (independence).

Table 1: Meanings of the tensions between connection and independence.

Relationships	Connection	Independence
Student to Student (in Teams)	Reliability and Relatability	Preservation of Identity
Student to Faculty	Support	Opportunity
Students (& Faculty) to Institution	Funding and Support	Innovation

4.2 Managing Strategies

Students negotiate and manage these tensions of independence and connection in a variety of ways. The following describes the strategies that students use to cope with and navigate the tensions described above, Fig. 2.

Figure 2: Managing strategies that students use to negotiate tensions.

Delegating tasks. Because students are not in control of the project demands, they recognize the value in being able to control how they are to go about completing the project demands. As such, they achieve levels of autonomy against the project by determining who does what and achieve levels of independence through each individual having their own task to complete. For example:

> *Bill changes the subject back to our assignment "So we need to do a lot of interviews apparently. I say that Ryan should just interview all his freshmen." Miley responds "I agree." Bill – "We can also do sophomores. I have a neighbor who is a transfer." Miley – "Okay, did you make a Google Doc Bill? Isabel, do you want to start our submission?"*

In the above exemplar, the students negotiate the delegation of tasks to make sure that the tasks of the project are accomplished, creating some control over one's own work in the face of interdependence with others.

Maintaining accountability. Students manage connection and independence with each other through establishing deadlines, managing timelines, and setting meetings. The ability to rely on each other pertains to feelings of connection with each other. Should one student fail to effectively complete their portion of the project then connection levels drop and dependence on that student becomes distorted – seeing as the student cannot be depended on. This also transfers to the accountability that students have for the university makerspaces. For example,

> *Now that they have just submitted their interview summary, Bill finalizes what they have to do next "So we need to get these interviews in. Come back. Knock out some work." Miley agrees "I'm going to say have the interviews done by Thursday. If we organize our page by seniors… one summary for seniors, one summary for sophomores, one summary for freshmen then we will look like overachievers!" Isabel reminds them that we need to "brainstorm 30 ideas next time that we work."*

In this case, accountability is showcased by the team reminding each other of the different goals that they have and how they are going about achieving them together, articulating the connective effort and ability to rely on one another.

Reframing alliances. Students ascribe faculty as having more similarity to themselves than to the administrators or the institution. Students latch on to the motivation and support that faculty provide and assume the faculty to be more willing to drive change for the students. This builds the connection that students have to faculty. This connection is further strengthened through faculty demonstrating interest beyond just teaching the students, but in also demonstrating interest in the life of the student beyond school. For example, in the following interaction

between a professor and a student, a professor showcases support through both providing tips for the working on a project and asking about the student's personal condition.

> *A guy from Jimmy Johns walks in. Even though Dr. Smith already had dinner, he says that it looks really good to him. Dr. Smith continues - So the project – what are they doing with it? It looks at everything in the university and then you are to pick a place. There are certain things to do at that space, you can interview previous group members from last year on how to make it or modify what they had. Before the stakeholder official meeting, have a couple meetings beforehand. It's good to talk to people with a little more power. Email for interviews and record them if you can.*
>
> *Dr. Smith turns to Bill, "you doing alright?"*
>
> *Bill has been sniffling and says that he must be catching something.*

Choosing "connection" as preferred operational mode. Students showed interest in working with students of other disciplines, in space being inclusive, in building relationships with faculty, in having access to resources on campus, and in having the support of the institution. The connection with others and the university facilitated this greater ability for independence for the students. If the students could work in interdisciplinary groups, then they would be able to form their identity in their discipline and participate in a community had multiple domains to work within. For example, in the following conversation between Bill and Miley they showcase the value of connection with others as the preferred way to learn.

> *Bill says – The university has high motivation. Since it isn't really known for innovation, it is a good time to be innovators so that we can really implement change that will be taken seriously on this campus. It is also highly motivated in spurring innovation and entrepreneurship because as a school, we are pushing to become more innovative and inclusive campus (accepting of nontraditional ideas). Also Dr. Johnson is letting us edit the space. We as students actually are able to edit empty spaces. The faculty has funds for that. They are trying to actually get the students funds and wanting the students to do something about it. Even more so, we have a lot more relationships with faculty here than other campuses. Albeit, our engineering program isn't really big. Actually it is a big strength because students get more say.*
>
> *Miley says - There's like a lot of professors that want to have innovation but the people like facilities management don't see the importance. You have professors motivated to get stuff done but as an institution not everyone is there yet.*

***Segmenting Behaviors*.** In some contexts, students operate with preference for autonomy and in others wanting connection. Operating in polls is context or topically driven. For example, younger students need greater support otherwise they feel isolated/overstimulated, while more advanced students value independence from faculty.

> *Isabel pipes up about "I was surprised that when I was talking to them about [the orientation for freshmen], how stark the difference was. One guy felt that he didn't need support. They didn't really recognize that there were opportunities for them. Freshmen (in general) are overstimulated when they are in a new environment."*

In this example, the group identifies that students, in this case freshmen, are heavily overstimulated and in need of support for understanding their opportunities, but also do not necessarily feel the need for support in certain aspects of their college experience.

All of these strategies that students employ serve to manage and negotiate the felt tensions of independence and connection with other students, faculty, and the institution. In their efforts to manage these tensions, students craft their identity. For engineering students, building an engineering identity results in a level of both inclusivity and exclusivity. Students found themselves craving a level of engineering identity, something to call their own. Yet, students also found the value in and craved interdisciplinary collaboration and interaction. Ultimately, this gave way to utilizing management strategies between the tension of inclusivity and exclusivity in order to build independence and connection in the identity of an engineering student.

5 Discussion

Engineering students want to build their own engineering identity through their work, interactions with other students, and with the spaces on campus. In order to begin building their identity, students manage tensions between independence and connection that manifest from relationships with other students, with faculty, and with the institution. Students feel independence when their relationships with other students, faculty, and the institution provide support and connection. They are able to build independence and connection through delegating tasks, maintaining accountability, reframing alliances, choosing connection as preferred operational mode, and segmenting behaviors. These articulate that strategies that students employ in order to cope with the tensions of studying at a university and participating in communities of practice.

Through these tensions and managing strategies, students in a community of practice on a university campus can understand the role of relationships with other students and faculty as it pertains to the development of their identities. A student entering into a community of practice, such as a makerspace community, has the identity of a newcomer, yet still remains on the outer

perimeter to the community. Such an identity as a newcomer or a person on the outer perimeter can resonate with a student and leave them in a state that might hinder them from advancing in the community, a community where they can develop and strengthen their identity as an engineer. If the student is able to understand the tensions and implement the managing strategies then they can navigate the system, integrate into the community, and build their engineering identity.

A makerspace has different roles than that of the classroom. Whereas in the classroom the professor is the teacher and the student is the learner, a makerspace obscures the distinction of clear cut roles and the student takes on a teacher-learner role. While there are individuals of authority in a makerspace, the teacher-learner role presents gives students a new form of power, a power that lets them have more control of their work, their interactions, and their independence. However, a student's independence and also their desire for connection is met with unclear boundaries of what is acceptable and agreeable to do in interactions with other students, student of authority, group members, staff, and faculty in a community of practice and in the less restricted environment of a makerspace. The tensions that we have uncovered in this research illustrate what tensions may be manifesting in university makerspaces, where independence and connection intersect and engineering identity is prevalent.

The foundation for the making that occurs in a makerspace is project work. In order for a project to be finished, there are tasks that must be completed, deadlines that must be met. The work is completed in an environment that houses numerous resources of equipment, space, and people – and tensions arise from the access to resources, space, and people. Managing these tensions where a student may desire to make on their own but needs and wants the support of a community's member, requires a strategy in order to efficiently and effectively complete a project. Students can delegate tasks in group project efforts in the makerspace, or even in an individual project they recognize that certain tasks will require certain resources and they delegate these tasks in their project timeline. Further, the students manage accountability in their efforts to keep the makerspace a functioning and working makerspace. Moreover, faculty-student relationships may err on the side of a less strict demeanor in the makerspace environment, where students have greater authority. Lastly, the students can determine when they would like to simply "hang out" with other students in the makerspace, when they need assistance from other students, or when they would benefit from working independently – depending on the circumstance. Further ethnographic work on makerspaces will investigate the tensions and managing strategies of students and how this compares to that of the student group.

In makerspaces, students are constantly in interaction with their peers, staff or technicians, and even faculty. The space highlights a new dynamic where faculty are not the teachers of the space, but learning occurs through the students and their interactions with the space, with peers or other members in the space. Students seek out independence in the makerspace through individual

projects and building on one's own while also pursuing the connection of the community, support, and help if needed. The tensions presented in this paper imply that students build their identity as makers and members of the community of practice by means similar to the managing strategies (delegating tasks, managing accountability, reframing alliances, choosing connection, and segmenting behavior). In this way, we can begin to identify how these themes develop in the ethnographic participate observations of makerspaces.

6 Conclusions and Future Work

Recorded observations of the elite student group meetings showcase tensions of independence and connection that students have with each other, with faculty, and with the institution. While students interactions in the elite group constitutes only a small case study of a community of practice, the findings of meanings and managing strategies can help to identify the meanings and managing strategies that evolve in the makerspace setting and community. Especially in the university makerspace where interactions vary between classwork, leisure, and research, the meanings interpreted through this data analysis articulate the tensions that are potent in an interdisciplinary student team. Through this study, it is evidenced that students do want autonomy and connection and that students are inherently recognizing and working to alleviate tensions between each other, with faculty, and with the institution.

While the scope of this research addresses the observations of the elite student group, further data regarding observations from the elite student group and ethnographic field work in makerspaces will be analyzed and explored further. Additional interviews and survey data will be collected based on corresponding themes that arise. It is anticipated that the results of this study will be further expanded in the ethnographic data analysis, which will demonstrate how to improve and support university makerspaces. Moreover, the whole dataset that was collected over the two years will be analyzed and more work will also seek to explore other themes and patterns that exist in the makerspace culture. In particular, we will continue ethnographic methods for evaluating the impact that forming identity and managing access into makerspaces has on student collaborative and independent efforts.

Acknowledgements

This work is supported by the National Science Foundation through Award No. DUE 1432107 and 1431923. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the authors and do not necessarily reflect the views of National Science Foundation.

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