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Innovate UNC: A Study of Technology-Enhanced Spaces Supporting Innovation Across the UNC System

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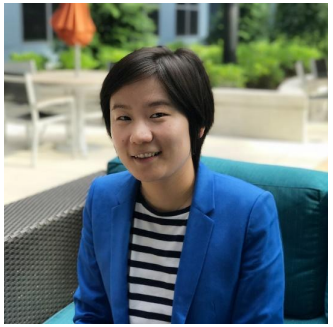

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UNC Faculty Fellows Program

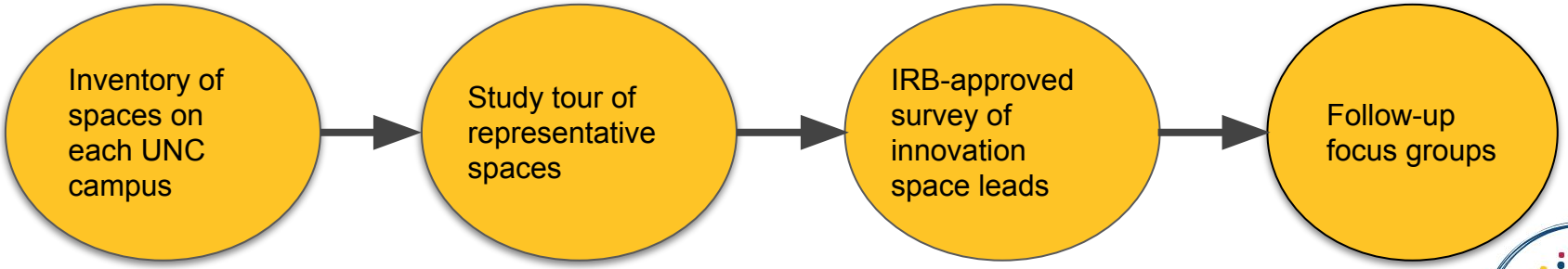
- UNC Faculty Fellows program was founded in 2016 with the goals of engaging faculty in issues related to academic affairs, offering mentorship and learning opportunities, and promoting the effectiveness of the System and its constituent institutions
- 2021 cohort of Fellows created a **digital education and online course** (DEOC) that enabled over 900 faculty and staff to learn the basic principles of designing an online course
- Our 2022 cohort of Fellows completed a **system-wide study of technology-enhanced teaching and learning** in campus spaces that support innovation

Scope of Study

Goals:

- To characterize different types of innovation spaces across the UNC system
- To identify areas of potential growth and collaboration

Scope and Timeline:



How do you define innovation?

Definitions of Innovation

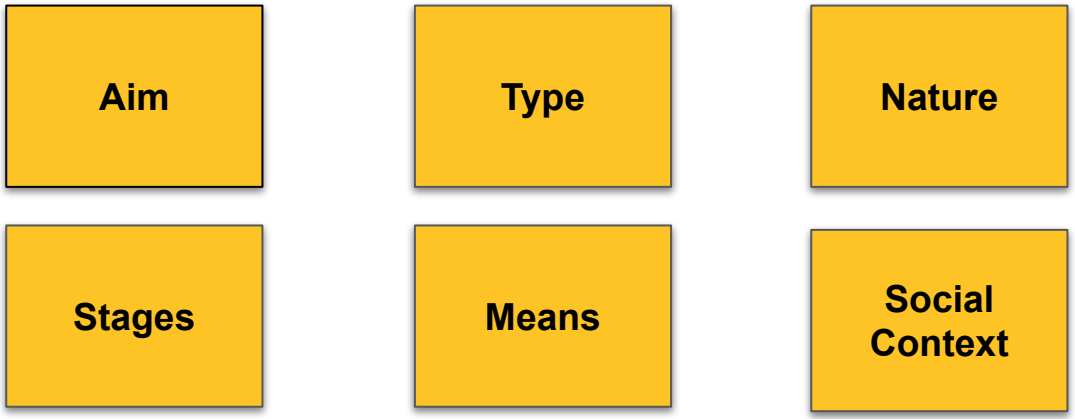
- "the multi-stage process whereby organizations transform ideas into new/improved products, service, or processes, in order to advance, compete, and differentiate themselves successfully in their marketplace" (Baregheh et al., 2009, p. 1334)

- "furthering societal efforts for new and multidisciplinary problem-solving, whether linked to economic change, social adaptations, or educational tools" (Bjorklund et al., 2019, p. 552)

- "innovation is about... identifying or creating opportunities... new ways of serving existing markets... growing new markets... rethinking services... meeting social needs... improving operations--doing what we do but better" (Tidd & Bessant, 2021, pp. 4-5)

Study Framework

We profiled three types of spaces across the UNC system (*makerspaces/design studios*, *entrepreneurship centers*, *innovative classroom/teaching spaces*) using six definitional categories recommended by Baregheh et al. (2009) to fully characterize innovation:



Related Research Questions

1. What aims of innovation are emphasized in the spaces studied? Do aims differ across the spaces studied?
2. What types of innovation are generated in the spaces studied (i.e., product, process, position, paradigm)? Do types differ across the spaces studied?
3. What is the nature of innovation in the spaces studied (i.e., sustaining or disruptive)? Does the nature differ across the spaces studied?
4. What stages of innovation are applied in the spaces studied? Do innovations in campus spaces evolve passively by chance or actively through cognitive input? How far do innovations in campus spaces evolve?
5. Who are the internal and external stakeholders required for the spaces studied to function? What interactions between these stakeholders are most critical to encourage?
6. Not including people, what means or inputs are required to support the spaces studied? What intentional decisions were made about space design to support the aforementioned innovation stages?

Methodology

- Multiple case study design (Yin, 2017) in which multiple cases of each space type were solicited across UNC System campuses; comparisons made within types (e.g., differences within the makerspace/design studio group) and between types.

- Procedures: inventory of spaces of interest across system; study tour of representative spaces in Triangle (NCSSM, PBS NC, NC State, UNC-CH); literature review and survey design based on conceptual framework; IRB approval; survey distributed June '22, reminder sent July '22; four follow-up focus groups held on Zoom in October '22.

- Data analysis: descriptive statistics and chi-square analyses of survey data; cross-case analysis of focus group transcripts

Results: Aims of Innovation

"overall result that organizations want to achieve through innovation" (e.g., enhance knowledge, enhance social development, offer aesthetic value) (Baregheh et al., p. 1332; Baskaran & Mehta, 2016; Cai 2017; NAE, 2015)

Aims of Innovation	Makerspace/ Design Studio (n=14)	Innovative Classroom Space (n=15)	Entrepreneurship/ Incubator Space (n=5)	Overall Percentage (n=34)
to enhance knowledge	28.6%	66.7%	20.0%	44.1%
to enhance social development	14.3%	13.3%	0.0%	11.8%
to offer aesthetic value, arts and creative products	28.6%	6.7%	0.0%	14.7%
other	28.6%	13.3%	80.0%	29.4%

Results: Aims of Spaces as an Innovation

- provide support for courses and strive to help students make connections with disciplinary concepts:

  We've also seen like a lot of faculty get interested in us and incorporate us in their classes, and that gets more student engagement ... having these projects applied in their curriculum. [makerspace/design studio]

- address multiple needs (classes/meetings/symposia/presentations):

  ...during Covid we we met in a faculty learning community in one of the active learning classrooms and the faculty loved it and thought it was great. And you know we were all focused on computerated design tools, and so we could all sit at different stations and share screens and interact and stuff. And it was great. And I think that's not a bad outcome, because that could lead to faculty gaining experience with the tools and the environment, and to be able to use that in a classroom learning structure. [innovative teaching space]

- provide alternative pathways for students to learn technical or interdisciplinary concepts that might not otherwise be part of a course:

  One of the classes that I teach are with honors college students, predominantly premed engineering students. Because my space is in the School of Art and Design, I introduce them to working with their hands, and I find that they feel from their coursework it's a nice break. It gives them a fresh perspective that begins to complement the way they process information in their more science-based disciplines. [makerspace/design studio]

Results: Types of Innovation

"the kind of innovation as in the type of output or the result of innovation, e.g., product or service" (Baregheh et al., 2009, p. 1331); paradigm (changes in mental models framing purpose); position (changes in context in which products/services are introduced); process (changes in operational/logistical design)

Types of Innovation	Makerspace/ Design Studio (n=15)	Innovative Classroom Space (n=15)	Entrepreneurship/ Incubator Space (n=5)	Overall Percentage (n=35)
product/service innovations	53.3%	26.7%	40.0%	40.0%
paradigm innovations	0.0%	0.0%	20.0%	2.9%
position innovations	33.3%	26.7%	0.0%	25.7%
process innovations	6.7%	20.0%	0.0%	11.4%
other	6.7%	26.7%	40.0%	20.0%

all of the above

Results: Types of Innovation

in focus group discussions, there was more evidence of process innovation compared to the survey:

- changes in how teaching/learning is delivered

> *...recently in a very entrepreneurship way, [students] are saying, well why don't student-initiated activities have as much or more priority than academically-initiated activities? ... They have agency, and that's a value of the school. And so they are talking about means of of prioritizing more of a student work that doesn't come through formal programs in the school. So that's got a strong entrepreneurial bed to it which you know we support. We just figure out how to do that. [makerspace/design studio focus group]*

- unique modes of networking/collaborating

> *Our organization works together, how we work with our developers, community partners, services. I know very well our office of sponsored programs person who manages the core facilities and centers because we've twisted that up in an impressive gymnastic yoga way, and so we spend a lot of time together on ... How do we manage it? Who needs to be providing oversight in the university? How does it work financially? [entrepreneurship focus group]*

Results: Nature of Innovation

- “The form of innovation as in something new or improved” (Baregheh et al., 2009, p. 1331)
- Participants were asked if innovations in their spaces were more sustaining (incremental changes to improve) or disruptive (transformative)

Nature of Innovation	Makerspace/ Design Studio (n=13)	Innovative Classroom Space (n=13)	Entrepreneurship/ Incubator Space (n=5)	Overall Percentage (n=31)
sustaining innovation	61.5%	53.8%	20.0%	51.6%
disrupting innovation	23.1%	23.1%	20.0%	25.8%
other	15.4%	23.1%	40.0%	22.6%

Results: Nature of Innovation

In focus groups, participants alluded to innovations that were more disruptive/transformative:

We have instances where the making and the doing is actually not the goal, the goal is incidental, and the goal is to have something that can use AI and move around. And so we've been able to accomplish the making of the platform so they can focus on their computer science or AI course work. And that is, you know, that has been transformative. And we have students now who are working on the more advanced higher level stuff because the mechanical systems are more easily constructed with our Fab lab. (Makerspace/design studios focus group)

The product of our space is actually the changing of the mind of the students to not live in a world where things are given to them that they can manipulate. But if they have the opportunity to create those things and manipulate the world just like, we don't want to just pass these exams or jump these hurdles to succeed academically. As a citizen, you can actually create things. You can create art, you can create things, and that is what we are instilling in the student. It's not the thing that they made, but the attitude, and the transformation of self from a consumer to (a) creator. (Makerspace/design studios focus group)

Look at innovation, entrepreneurship and those processes, what we're really doing here is, we're empowering leadership, adaptive leadership, the ability for these folks to be able to take their own initiative and figure (things) out, in some cases on their own, and many more cases in collaboration with others. How to lead the positive change that's going to be needed to make that transformative change. It goes back again to that self actualization point that you had. We need to be intentional about empowering that and not by chance or incidental. (Entrepreneurship space focus group)

Results: Stages of Innovation

"all the steps taken during an innovation process which usually start with idea generation and end with commercialization" (Baregheh et al., 2009, p. 1332); participants were asked if innovations in their spaces were more incidental (0) or intentional (10)

	Makerspace/ Design Studio (n=13)	Innovative Classroom Space (n=13)	Entrepreneurship/ Incubator Space (n=5)	Overall (n=31)
Mean, Standard Deviation	M=6.2, SD=1.7	M=8.1, SD=1.2	M=8.2, SD=1.3	M=7.3, SD=1.7

trending intentional, but perhaps more room for incidental design compared to other spaces

Results: Stages of Innovation

Participants were also asked about the evolution of innovation in their spaces--chance (unrecognized, never repeated), individually learned and repeated by individual, individually learned and ultimately acquired by others

Levels of Innovation	Makerspace/ Design Studio (n=13)	Innovative Classroom Space (n=13)	Entrepreneurship/ Incubator Space (n=5)	Overall Percentage (n=31)
chance innovation, unlearned and not repeated	23.1%	0.0%	0.0%	9.7%
individually learned and repeated	46.2%	15.4%	20.0%	29.0%
individually learned, acquired by others	30.8%	76.9%	60.0%	54.8%
other	0.0%	7.7%	20.0%	6.5%

Results: Stages of Innovation

Participants shared how the intentionality of an innovation is related to the structure of the space, the project at hand, and the level of complexity of a system:

Yeah, there is this serendipitous kind of moment with a lot of students or makerspace users where it's like you (have) an idea pops up, and you're like Oh, I could maybe do something with that. And I think where it becomes really critical is that your organization has lowered the barrier to the resources that they would need to act on those ideas. (Makerspace/design studios focus group)

Most of our projects have come in with intention. Usually it's people trying to make repairs or small parts and stuff. So a lot of our users tend to already be familiar with the concept of a makerspace, and want to use it and walk away with the product that they had in mind. So I rarely see somebody kind of coming in and making. I think that has to do with how our space is just built. It's very fishbowl-like. So I don't feel like there's a lot of comfort there, like our glass walls, and the ability to make an experiment as much. (Makerspace/design studios focus group)

I would kind of echo that my active learning classrooms are scheduled. And so there's a design and a purpose when students are in there. However, our new E-sports arena that's opened up recently is a place where that incidental innovation happens when students can go in there and learn with the unreal engine and create their own discoveries and work through through that process, because that's a space where students have the freedom to just schedule their own time and pursue their own interests. (Innovative teaching and learning space focus group)

Results: Stages of Innovation

When asked how innovations generated from their spaces most commonly evolved, focus group participants noted in many cases these spaces are inspiring users to take innovations farther to the point that they can be utilized/acquired by others:

With the spaces that I am representing. We've had some sort of prominent digital humanities projects that have inspired others to create content for the spaces. (Innovative teaching and learning space focus group)

We certainly design our programs and processes to help our teams and our idea makers reach a satisfactory conclusion to their idea. We also work to nip ideas in the Bud, that are not going to be able to go forward, you know, if there's already a product or service out there. You know we want to help folks identify that early so that they can move on to the next great idea that they're gonna have. (Entrepreneurship space focus group)

Just given the nature of the Industrial Design department like that is kind of their goal, is to see something to completion. Under classroom work they don't get to see all those iterations because of the timelines that were mentioned before. But then I'll see later on those projects will get revisited because they're like passion projects that people really want to see fleshed out. They really want to see them finalize. So they'll push it even more so, even if it's not part of the class. They'll still take the opportunity to explore that a little bit more. There have been some classes. Their piece has gone on to be manufactured, and has been on to like this more innovative part. (Makerspace/design studios focus group)

Results: Social Context of Innovation

"any social entity, system, or group of people involved in the innovation process or environmental factors affecting it" (Baregheh et al., 2009, p. 1332)

Social Context of Innovation	Makerspace/ Design Studio (n=13)	Innovative Classroom Space (n=13)	Entrepreneurship/ Incubator Space (n=5)	Overall Percentage (n=31)
Internal Staff	100%	100%	100%	100%
Other Key Supporters (Non-Staff)	66.7%	28.6%	80%	51.6%
Participants/Users/Students/ Faculty	91.7%	50%	100%	74.2%
External Stakeholders	83.3%	57.1%	100%	74.2%
Other	66.7%	57.1%	80%	64.5%

Results: Social Context of Innovation

Survey respondents highly valued the services provided by student workers.

And thanks for mentioning our students. That's the one thing I was gonna add that, you know we have a team of staff. , but one of the ways that we have provided services, specifically, data science consulting services is through hiring a team of graduate students whose staff to physical spaces and virtual appointments, and provide a lot of support to campus and I.

Respondents also valued collaboration across their departments and institutions and across the UNC System.

I would shout out the University Maker Spaces Google Group. It's a group that I joined shortly after I starting working here. It's really helped shape what I think a maker space can be and what our Maker space should be. And I really value those collegial relationships and the sharing that's done across even beyond the unc system right?

You know we have students who are learning, and you know these kind of very silo domains of expertise, and there was a report that had come up called the Coast Pup report, but this is back in the early nineties, and it's essentially talked about the need for developing more multidisciplinary interdisciplinary, you know, people who had backgrounds that were much more diverse and crossed across disciplines

But the social context… The way I started defining sustainability is that sustainability is a function of the durability of authentic, mutually beneficial. And during relationships again, i'll say that again. Sustainability is a function of the durability. And we'll try to do more… not just give money and forget about it, but to actually build relationships.

Results: Means of Innovation

"the necessary resources (e.g., technical, creative, financial) that need to be in place for innovation" (Baregheh et al., 2009, p. 1332)

Means of Innovations	Makerspace/ Design Studio (n=13)	Innovative Classroom Space (n=13)	Entrepreneurship/ Incubator Space (n=5)	Overall Percentage (n=31)
Physical space	100%	92.9%	100%	96.8%
Equipment	100%	85.7%	100%	93.5%
Technology	100%	85.7%	100%	93.5%
Materials/Supplies	100%	71.4%	100%	87.1%
Web-Based Resources	58.3%	57.1%	80%	61.3%
Monetary Funding	75%	92.9%	80%	83.9%
Other	16.7%	14.3%	0%	12.9%

Results: Means of Innovation

The greatest need for all of the innovation space and programs across the board was physical space followed by equipment and technology (see Table 8). However, there is clearly a relationship between monetary funding and the ability to acquire resources like physical space, equipment, and even time.

> *I think we're in transition of old ways of being measured and looking at new ways to measure and evaluate space utilization that we're not there yet. (Innovative Teaching/Learning Space)*

> *So you know, I'm thinking about. I'm not sure if this fits the category. But I think one of the innovations that happens commonly is that we manipulate time. And so we're always trying to optimize and change the way we use time for our classes.*

Discussion

Divergence between innovation spaces

Makerspaces and Design Studios	Innovative Teaching Spaces	Entrepreneurship Centers
• Promote aesthetic or creative aims • Student driven learning and mentoring • More opportunities for tinkering and play	• Promote aim of advancing knowledge • Shared spaces for collaboration between students and faculty	• Promote aims of business growth and knowledge transfer • Partnerships between academics and external stakeholders • Prevalence of seed funding

Discussion

Convergence between innovation spaces

- Similar use of design models (design thinking, engineering design process)
- Common output of product/services innovation
- Implementation of interdisciplinarity (i.e. engineering & art)
- Connection to disciplinary concepts taught in courses

Discussion

The Innovation Mindset in Higher Education

- The **creation of innovation spaces is an innovation** in higher education.
- Innovation spaces and programs facilitate **transformation of mindset.**
- Innovation space and programs foster **self-actualization.**

Recommendations

- Encourage the development of characteristics such as disruptive innovation and paradigm innovation that are not normally associated with spaces in higher education
- Train educators and other stakeholders in educational environments to value their role as innovators and cultivators of innovators
- Capitalize on the potential of students to help with the creation and maintenance of innovation spaces
- Track innovation in higher education using metrics that capture the collective contributions of individuals over longer periods of time

What has worked well for you in developing or maintaining your innovation space or program?

Conclusions

- Understanding the nature of innovation in higher education can help us design more effective innovation spaces.
- Innovation spaces in higher education have the potential to create impactful changes in mindset that can enable innovation over longer time frames and can enable individuals to more flexibly respond to changes that occur in society.
- Efforts to make the physical environment, the technology in the space, and the curriculum in innovation spaces and programs more accessible may enable more incidental and disruptive innovation.

Summary, Any Questions?

	Aims of Innovation	Type of Innovation	Nature of Innovation	Stages of Innovation 0 incidental to 10 intentional	Stages of Innovation (Cycles)	Means and Social Context of Innovation
Makerspaces and Design Studios	• Offer aesthetic value, arts, and creative products (28.6%) • Enhance knowledge (28.6%) • Enhance social development (14.3%)	• Product/service (53.3%) • Position (33.3%)	• incremental (61.5%) • disrupting (23.1%)	• design thinking d.school process, human-centered design, eng design • intentional but closer to incidental than other space types: M=6.2, SD=1.7	• indiv learned, repeated (46.2%) • indiv learned, acquired (30.8%) • not learned or repeated (23.1%)	Inputs required: physical space (75.6%); equipment/ technology (73.2%); funding (70.7%); materials (68.3%); Web-based resources (training, data sets, databases) (53.7%) Personnel required: internal staff (82.9%); participants/ users (students/faculty) (63.4%); external stakeholders (58.5%); other key supports (non-staff) (43.9%)
Innovative Teaching and Classroom Spaces	• Enhance knowledge (66.7%) • Enhance social development (13.3%) • Offer aesthetic value, arts, and creative products (6.7%)	• Product/service (26.7%) • Position (26.7%) • Process (20.0%)	• incremental (53.8%) • disrupting (23.1%)	• design thinking, human-centered design, lrng. community design • intentional/active: M=8.1, SD=1.2	• indiv learned, acquired (76.9%) • indiv learned, repeated (15.4%) • not learned or repeated (0.0%)	
Entrepreneurship Spaces and Centers	• Other (80%) [grow/impact small businesses and transfer knowledge] • Enhance knowledge (20%)	• Product/service (40%) • Other (40%) [All of the above] • Paradigm (20%)	• other (40%) [both], incr. (20%), disrupt (20%)	• clients operate on a continuum: initial concept, D&D, piloting, implementation • intentional/active: M=8.2, SD=1.3	• indiv learned, acquired (60.0%) • indiv learned, repeated (20.0%) • not learned or repeated (0.0%)	