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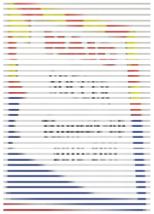
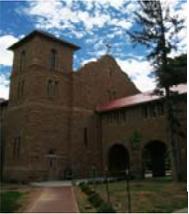
# Investigating Culturally-Contextualized Making with the Navajo Nation

POWERING THE NEW ENGINEER TO TRANSFORM THE FUTURE

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## Who am I?

- Taught middle school math during 2010-2011 at St. Michael Indian School
- Coached the middle school soccer team
- Started an after school engineering club



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## Who am I?

- Started graduate school at the University of Florida
- Have come back to the Navajo Nation every year
  - Workshops on 3D printing and robotics
  - Organized the first Diné STEM Gathering
  - Started and coached several robotics teams



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## Motivation

Native Americans are highly underrepresented in the engineering field

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## Motivation

- Students from the Navajo Nation are excited to learn about engineering
- The Navajo Nation needs talented young engineers to address the issues facing their communities (energy, water, etc.)

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## Motivation

One way people are promoting engineering education is by having people work in a makerspace

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## Motivation

A makerspace is a place where people can learn STEM concepts through projects that involve making things

*A community garden for making artifacts*

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## Motivation



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## Motivation

Why makerspaces?

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## Motivation

Teaching engineering through making is a natural fit for the Navajo Nation because the Diné are some of the world's most talented makers

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## Motivation

Not interested in simply putting a Western makerspace on the Navajo Nation

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## First Research Question

- In what ways do the Navajo describe the experience of making?

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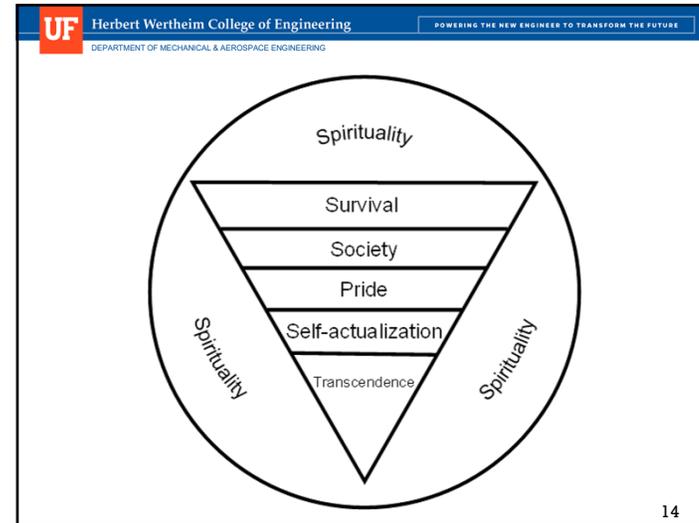
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## Methodology

- Semi-structured interviews were given to 18 participants
- Protocol included open-ended questions like:
  1. What does the word, "making," mean to you?
  2. What role do you believe making plays in the Navajo culture?

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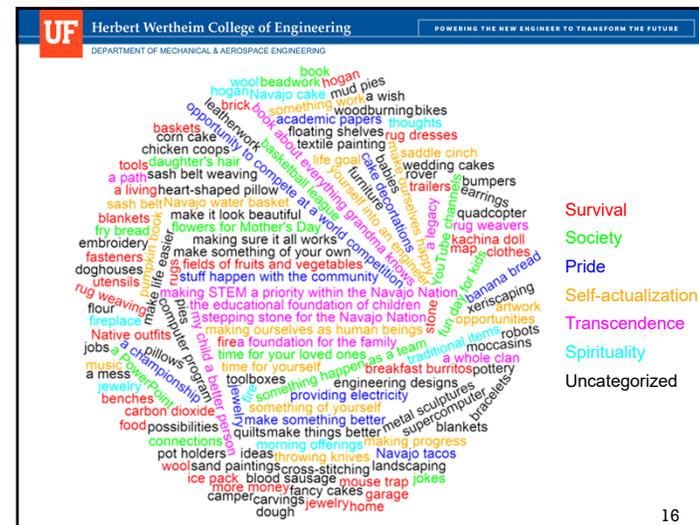
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### Examples of the Different Categories of Making Described by Participants

Pseudonym	Example	Justification	Category
J	rug weaving	was her grandma's livelihood	Survival
S	tools	making driven by need	Survival
E	fry bread	joked that one needed to know how to make fry bread if they wanted to get a husband	Society
L	daughter's hair	learns from others via tutorials and pictures	Society
M	banana bread	prefers to make rather than buy because she believes her products are the best	Pride
B	work as a lineman	proud of being able to provide a community with electricity	Pride
T	opportunities	he made opportunities that allowed him to experience things he may not have experienced otherwise	Self-actualization
M	Navajo water basket	weaves to satisfy her yearning to learn	Self-actualization
T	a path	proudest achievement is helping to pave the way for others	Transcendence
Y	making STEM a priority within the Navajo Nation	believes it would benefit the people of the Navajo Nation	Transcendence
E	morning offerings	form of prayer	Spirituality
Y	thoughts	process of thinking is sacred	Spirituality
B	babies	-	Uncategorized
L	a supercomputer	-	Uncategorized

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## Second Research Question

- How can the Navajo experience of making be integrated to design a culturally-contextualized makerspace?

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## Design Specifications

- The makerspace must be a physical place
- The projects conducted in the makerspace must be hands-on
- The makerspace must have a place where makers can store personal tools
- Makers should have the ability to learn through observation
- The makerspace must have a facilitator that can assist makers
- Makers should be able to choose which projects they wish to work on
- The makerspace should be environmentally friendly
- The makerspace should focus on celebrating *who* is made there, not *what* is made
- The makerspace should be located somewhere that maximizes how many people from the Navajo Nation have access to it
- People in remote areas of the Navajo Nation should have access to the makerspace

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## First Design Concept

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## First Design Concept

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### First Design Concept

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### Second Design Concept

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### Third Design Concept

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### Future Work

- Interview more participants with an updated protocol that is informed by the results of this study
- Further explore the spiritual component of making

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## Future Work

- Refine the designs of the makerspace
- Build and evaluate the makerspace
- Develop curriculum for the makerspace

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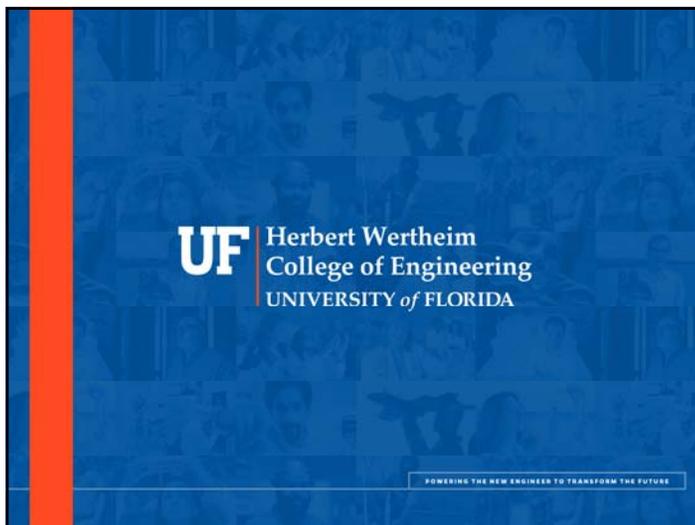
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## Thank you!



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## Survival

- Recognizes that making can be used to aid the survival of the Diné people

“They were makers of bricks. They were a maker of living, to stay alive and to eat. They, they, they made fields and fields of fruits and vegetables to stay alive.”



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## Society

- Describes making as a social act to communicate ideas and build relationships



"I have little kids that are fans and they come up to me and they're just so cute. And you know, I'm like, I try to like give them the most positive, you know, interaction that I can you know. I give them hugs, and I always say thank you and stuff like that. And it's a, it's just, um, very gratifying. It's satisfying and awesome. That's why I make."

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## Pride

- Making instills the participant with a sense of pride



"I go above and beyond because it has my name on it and I want it to last. I want it to last. I want it to be durable and I want it to, um, [indecipherable], it, it's a piece of me and I w-, I want it t-, to represent my workmanship and I want it to be good."

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## Self-actualization

- Describes how making helps them fully realize themselves



"When somebody says making that's, that's basically what I think of. It's something to build, to, to, to make your life better."

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## Transcendence

- Understands that making benefits a maker's community and future generations



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## Transcendence

“My náli [paternal grandmother], um, she said that the most important thing for a Navajo person was to continue themselves. And she like, saying that in Navajo like it’s kind of, you kind of have to interpret that for yourself. And the way to understand it is, you know, you have Navajo children. You teach them a Navajo way of life. And you teach them to be Navajo and speak Navajo. And you create that and you continue it, you know, for generations to come. And so that, as a, as a maker that is one of the most important things that I think of, you know, creating Navajo beings who are, you know, very knowledgeable, very, very, very grounded and you know, intelligent and resourceful. That make, making that, you know, creating that would be a lifetime achievement. [laugh] So that, that includes everything, you know, the weaving, any jewelry making, any, any songs, and even how to pray, you know, that is a, a great [indecipherable] incredible, um, talent.”

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## Spirituality

- Views making as a spiritual act



“As a Navajo, making a fire, that’s very sacred. And understanding the respect for the fire and what it does for you and what you can do for it. I mean, everything’s a living thing to us as Navajos and fire is one of them.”

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## Spectrum of Participant Understanding of the Experience of Making

Category	B	C	D	E	G	H	J	L	M	N	R	S	T	U	V	W	X	Y
Survival	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Society	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X
Pride	X	X	X	X		X		X	X				X	X	X	X		X
Self-actualization	X	X	X	X	X		X		X	X			X	X	X		X	X
Transcendence		X	X							X			X	X		X	X	
Spirituality	X	X	X	X				X								X	X	

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## Deepest Expressed Category by the Participants

Spirituality?	Survival	Society	Pride	Self-actualization	Transcendence
No	H	L, R, S		D, J, U	N, T, V, X
Yes			W	B, G, M	C, E, Y

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## Methodology

- The majority of participants were NTU students from the following programs:
  - Electrical Engineering
  - Diné Culture, Language, and Leadership
  - Mathematics
  - Building Information Modeling
  - Computer Science
  - Industrial Engineering
  - Early Education
  - Metrology

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## Methodology

- Noticed that there was a lot of variation in responses while collecting data
  - Motivated the use of phenomenography to analyze the data
- Also noticed that participants often spoke about their motivations for making when trying to describe the experience
  - Motivated the use of Maslow's Theory of Human Motivation

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## Methodology

Maslow's Hierarchy of Needs

The diagram is a pyramid divided into six horizontal sections. From top to bottom, the sections are:
 

- Transcendence:** looking beyond the needs of oneself and helping others\*
- Self-actualization:** achieving one's full potential\*
- Esteem:** self-respect, appreciation, prestige\*
- Love:** affectionate relationships with other people\*
- Safety:** physical safety, financial security\*
- Physiological:** food, water, sleep\*

\*Maslow, A. H. (1943). A theory of human motivation. *Psychological Review*, 50(4), 370-398.  
 \*Koltko-Rivera, M. E. (2008). Rediscovering the later version of Maslow's Hierarchy of Needs: Self-transcendence and opportunities for theory, research, and unification. *Review of General Psychology*, 10(4), 302-317.

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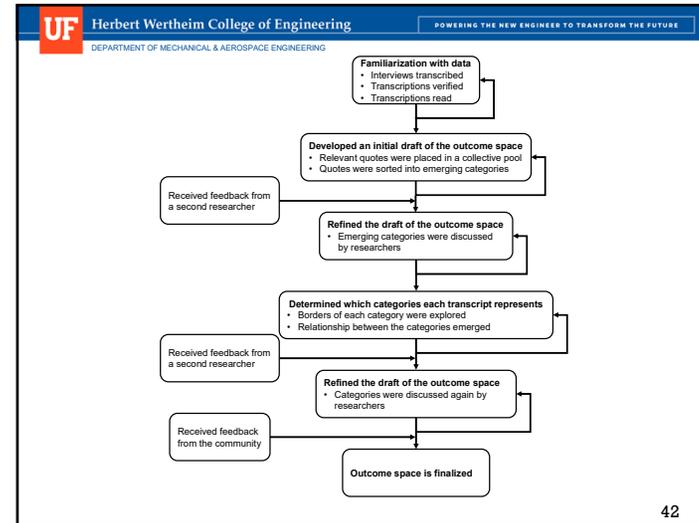
## First Design Concept

A 3D architectural rendering of a room interior. The room has bright blue walls and light-colored wooden flooring. In the foreground, there are several small, round, light-colored tables with green chairs. In the background, there are desks with computers, a whiteboard, and a dark cabinet. The lighting is bright and even.

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<b>Justification of Consistency in the Research Design</b>					
Research Question	Research Question	Epistemology: Constructionism	Theoretical Perspective: Critical Inquiry	Methodology: Phenomenography	Methods: Semi-structured Interviews
		Allows for the possibility of multiple truths	Question challenges the prevailing understanding of making	Methodology addresses the wide variety of ways that the Diné describe the experience of making	These methods are suited to create understanding of abstract phenomena that are not easily quantified
Epistemology: Constructionism			Challenges conventional research design by allowing for the construction of a design that includes pieces from multiple disciplines	Has the ability to reconcile the possibility of multiple truths	Knowledge is constructed through the interaction of researchers and participants
Theoretical Perspective: Critical Inquiry				Helps the Navajo Nation to add their voice to how the experience of making is understood	Questions are phrased in a way that allows participants to answer questions in their own terms without being influenced by prevailing understandings
Methodology: Phenomenography					Allows participants to qualitatively describe their experience of making
Methods: Semi-structured Interviews					

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<b>Interview Protocol</b>	
<b>Overview:</b>	
1) Tell me a little about yourself.	
a. Age? b. Ethnic background?	
<b>Making:</b>	
2) What does the word, "making," mean to you?	
3) Do you consider yourself a maker?	
Yes	
a. Describe what makes you a maker?	
i. How did you learn?	
ii. How did you develop your skills?	
iii. What was your motivation (making a living, spiritual, for fun, etc.)?	
b. Describe what it means to you when you make something.	
i. Describe the context of when you make, location, frame of mind, etc.	
No	
c. Who do you perceive as being a maker?	

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<b>Interview Protocol</b>	
4) What role do you believe making plays in the Navajo culture?	
5) What are examples of making that you have seen in the Navajo culture?	
6) Describe your understanding of engineering?	
7) How does engineering affect your daily life?	
a) What are some types of engineering problems you would like to solve?	
8) What do you see as the relationship between making and engineering?	
<b>Wrap-Up:</b>	
9) Is there anything else you would like to add?	

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