

Applying the Wrong Theory Protocol to Youth's Designing and Making

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DRL AISL& ITEST 2053160 PIs: Hsi, Oh, & Porcello



Land Acknowledgement

I respectfully acknowledge that the land I live and work on is the ancestral territories of Indigenous peoples, including the Ohlone, Muwekma, Confederated Villages of Lisjan, and Miwok whose continued care of these lands allows me to be here today. I commit to listening to, learning from Indigenous voices and ways of knowing in my work.



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MAKING WAVES

with radio

To raise awareness and scientific understanding of radio frequency communications and wi-fi technologies for youth, families, and the general public.



DRL ITEST & AISL # 2053160 PIs: Hsi, Oh, & Porcello (2020 - 2023+)

Team & Collaborators



Project Leadership



Sherry Hsi, PI
BSCS Science Learning



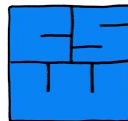
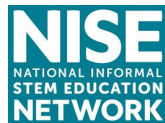
Darrell Porcello, Co-PI
Children's Creativity Museum
National Informal STEM Network



HyunJoo Oh, Co-PI
CodeCraft Group
Georgia Institute of Technology



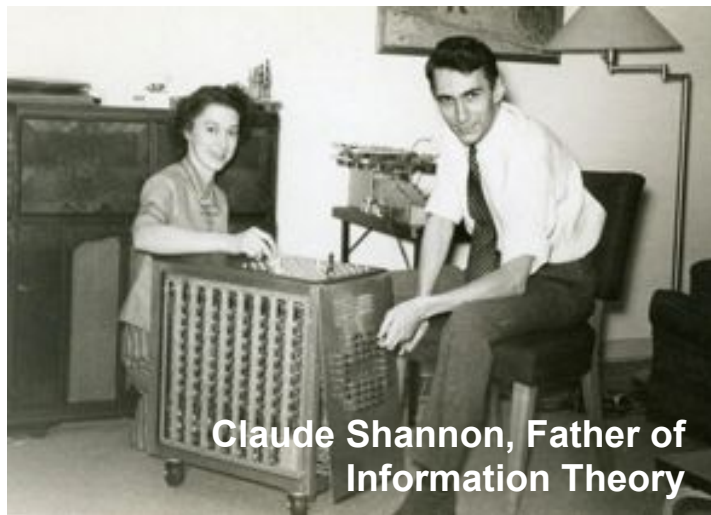
Valerie Knight-Williams
External Evaluator
Knight-Williams Communications



Global Alliance
of
Community
Science
Workshops



AM/FM Radio



Radio in entertainment media



Examples of current radio communication applications

- Cell phones, airpods
- Contactless payment
- Radio astronomy
- GPS satellites & navigation
- WiFi & 5G service
- IoT environmental sensors



Radio Camp

Radio Camp 2022



Radio Crafters Camp
Explora, Albuquerque
STEM & engineering design



Radio Explorers Camp
ElectricGirls, New Orleans
IoT & coding / Teknikio



Coding & Couture Camp
Assemble PGH, Pittsburgh
STEAM + Wearables

Learning Innovation Design Challenge

- Create a compelling learning experience that engages a group of youth (ages 11 to 15) with diverse interests in 15 hours
- Raise awareness and understanding of “big ideas” in radio and radio technologies
- Position youth as intentional designers who must formulate the problem and design solutions

Activity organizing frames

- 1) **Explore:** What are radio communication devices? Past, present, and future.
- 2) **Design:** What goes into designing a radio communication system for ourselves and others?
- 3) **Imagine:** How do we design the future of radio systems so everyone can get access?

Content Themes

Physics of Radio

What are radio waves

How waves work
EM spectrum, wavelengths,
& frequencies

Radio waves in space
& through space

Blocking radio waves &
interference

Radio Communications Technology

How radio signals carry information -
modulation, analog/digital conversion

Transmitters & receivers

Data encryption & security,
encoding & decoding

Signals: amplification, regeneration,
jamming, & frequency hopping,
5G and beyond

Antennas & MIMO - resonance,
bandwidth, modern antennas &
antenna arrays

Sensor networks & IoT

Radio in Society

Radio devices at home and
around town (how
communities and people use
radio)

Spectrum allocation &
crowding

Rights, Ownership, & Piracy
(Industry cooperation
services, pirate radio)

Myths, Health, & Well being
(radiophobia)

Shaping radio futures and our
roles

Camp at a glance



Whole class discussion



Embodied game



Hands-on project



Community building

Day 1

Day 2

Day 3

Day 4

Day 5

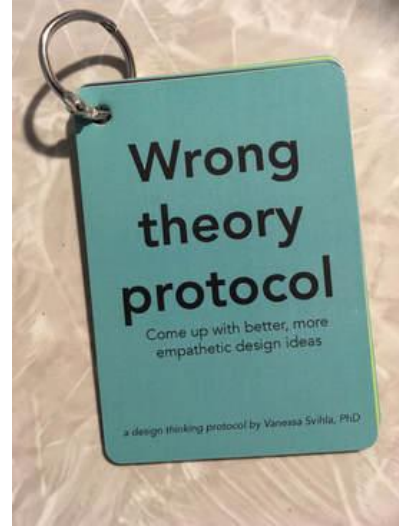
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|------------------------------|----------------------------|---------------------------------------|-----------------|------------------------|
| Pre-assessment | Ice Breakers | Radio present | WTP | Open work time |
| Ice breakers | Game - telephone | Consensus model | | |
| Consensus model | Deconstruct a radio system | Game - interference & signal strength | | |
| Game | Game | Game | | |
| Rado past problems/solutions | Coding lesson | Coding lesson | | |
| Make lighthouse | Make a MyTalkie | Final project intro | | |
| Consensus model | Consensus model | Radio future | Final Project | Showcase & Celebration |
| | | WTP | | |
| | | | Post-assessment | |

Snapshots of Radio Crafters Camp @Explora July 18-22, 2022



Wrong Theory Protocol <http://www.vanessasvihla.org/>

- A design thinking tool that helps students understand and generate novel ideas about the problem
- Dr. Vanessa Svihla's NSF CAREER award - research on framing and reframing agency
- Encourage risk taking in ideation and generating more empathic solutions while discouraging design fixation
- Researched with high school students, undergraduates, teachers, and professional designers
- Solutions generated with WTP have more empathy in creative ideation



Svihla, V., & Kachelmeier, L. (2022). Latent value in humiliation: A design thinking tool to enhance empathy in creative ideation. *International Journal of Design Creativity and Innovation*, 10(1), 51-68.

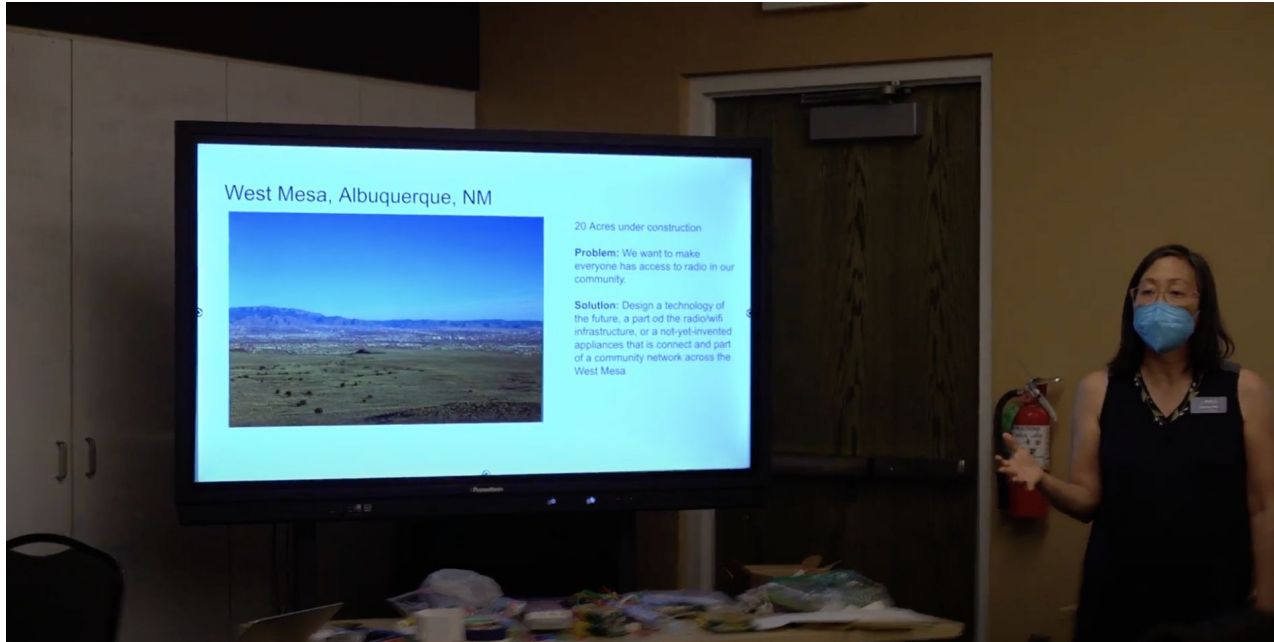
Wrong Theory Protocol

1. Problem Definition
2. Stakeholder - Who might be the stakeholders?
3. What design features do these stakeholders need?
4. Constraints & Design Requirements - An engineering design constraint is limitations on the design, such as available funds, resources, or time. What constraints do you need to attend to?
5. Wrong Theory Design
 - Look back over the needs constraints, and requirements you have identified. **Now violate these!** Your task is to come up with the worst possible design It should both **harm and humiliate**. It does not address needs and violates constraints!
6. Generate beneficial ideas

Issue: There are no systems of radio communication in ABQ West side!

Problem Definition

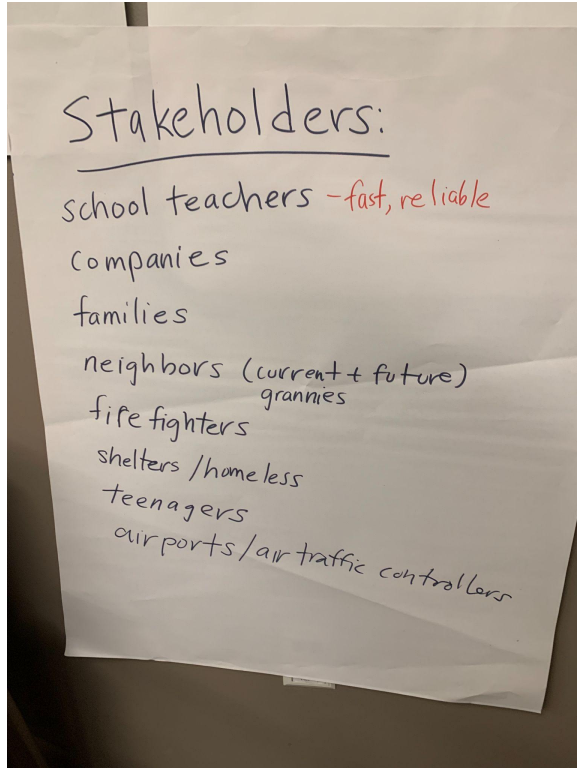
The entire area located on ABQ Westside (aka West Mesa) is about 20 acres under construction. It has no radio communication systems. Design a solution to this community problem.



ABQ Westside model (cardboard)



Who might be the stakeholders?



Needs of Stakeholder

What design features are needed in their radio system?



-



Worst possible designs that harm and humiliate

"The police don't know anything."

"One in six people are just in jail."

"We bring back debtors' prison."

"We everything is just a monopoly every single industry is monopolized there are no corporate regulations."

"One dictator decides everything."

"You don't have access to listen, the conversation that is happening."

"The IFS (intensive family services) goes down."

"Every small child gets their own gun."

"There's only one school it only has room for 30 children"

"The Internet it gives you an electric shock every time."

"Absolutely every everything on fire."

"(wires) are completely exposed."

"We should make it that the only place to eat it's just Taco Bell. You can't eat anywhere else."

"We should make it that the only place to eat is just about any any vegan."

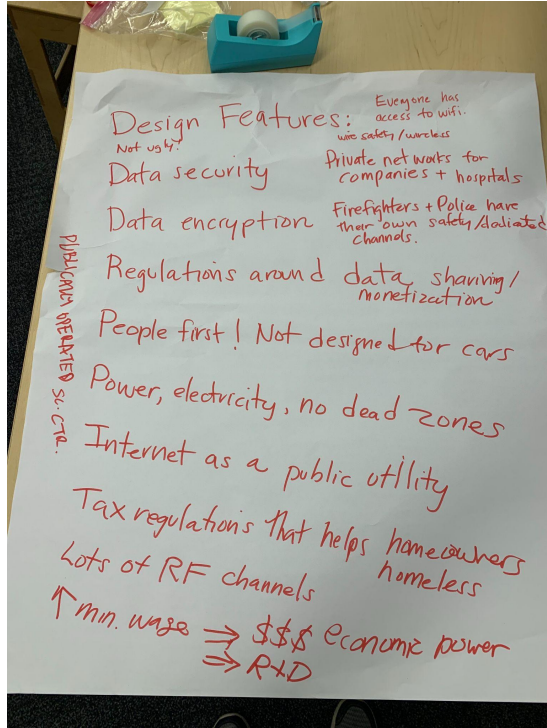
"Vegan Taco Bell"

"What's even better idea of all of the Amazon packages not being what they ordered."

"It's all just going to be frozen meat loaf."

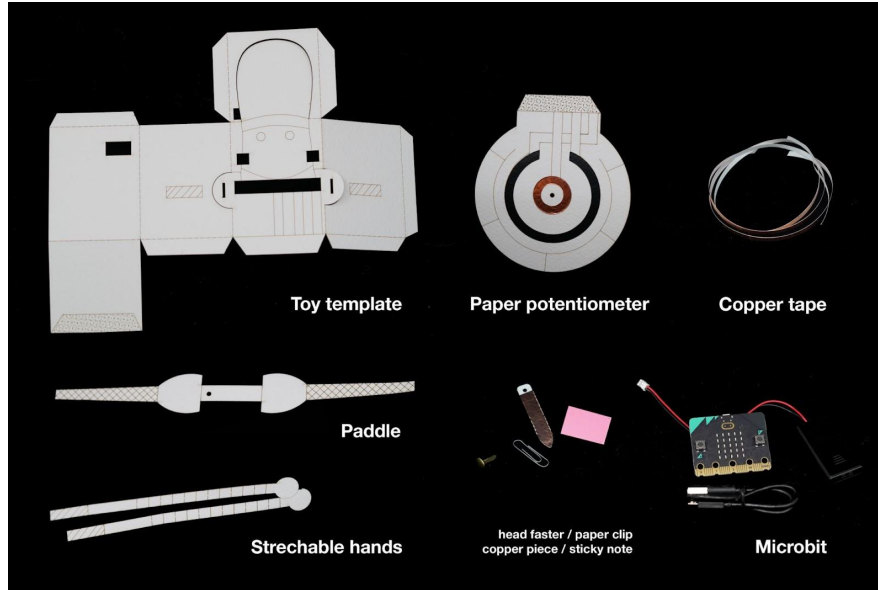
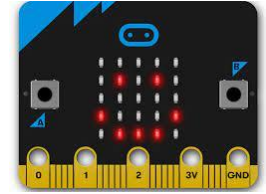
"What if it's like the nuclear football get shipped to the President?"

Generated positive design features post-WTD



- Not ugly
- Everyone has access to wi-fi
- Wire safety, wireless
- Data security and data encryption
- Regulations around data sharing/ monetization
- Private networks for companies and hospitals
- Fire fighters and police have their own dedicated channels
- People first! Not designed for cars
- Power, electricity, no dead zones
- Internet as a public utility
- Tax regulations that help homeowners & the homeless
- Lots of RF channels,
- Publicly operated science center
- Increase the minimum wages to help increase economic power and more R & D

MyTalkies craft kit with micro:bit radio

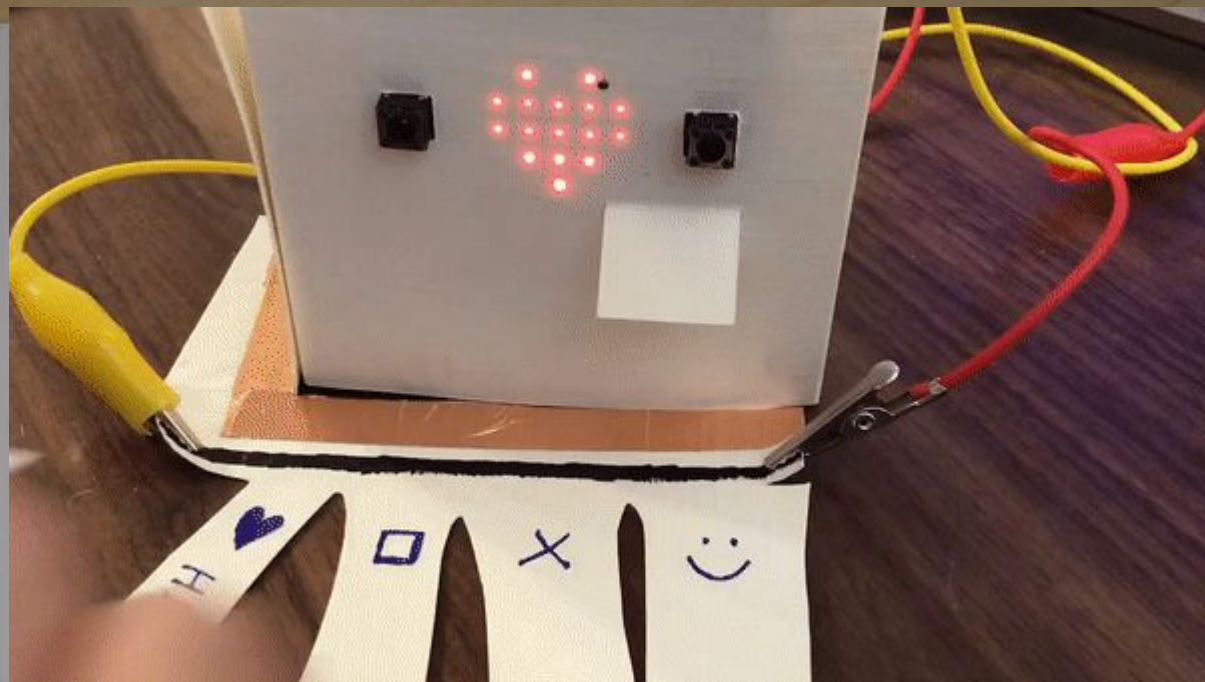


Yu, J., Hsi, S., Van Doren, S., & Oh, H. (2022) My:Talkies: Designing a Craft Kit to Support Learning about Communication Devices through Making. In IDC '22: ACM Conference on Interaction Design and Children, June 27–30, 2022, Braga, Portugal. ACM, New York, NY, USA,

Potentiometer



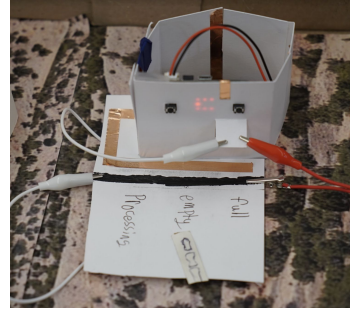
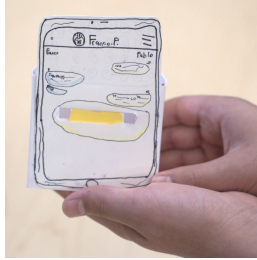
Pressure
sensor



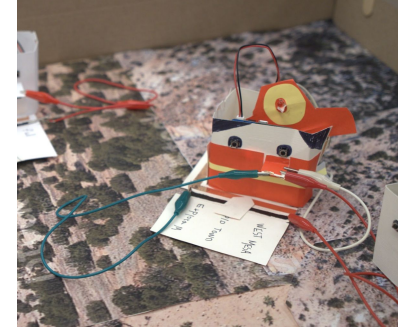
Systems of radio communications for ABQ Westside



Super smart cell phone



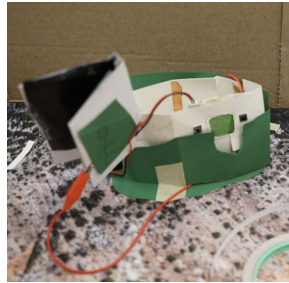
Food donation & distribution system



Fire alert system



Smart lake sensing and town alert



Smart water tower



Tornado alert system

Voices of campers

“ I liked sending messages because even though it was hard once we finished it was fun to see the results.“

“....learning from my mistakes because I made a lot of mistakes and I got to see what was the problem.”

“I liked that we had freedom for most of the time because I like doing what I want.”

Discussion & Questions