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Constructing the Future from Where We Already Stand: A Workshop Bridging Latine Everyday Ingenuity and Connected Learning

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Constructing The Future From Where We Already Stand: A Workshop Bridging Latine Everyday Ingenuity and Connected Learning

This qualitative study introduces an innovative approach to engaging Mexican American youth in participatory design practices and speculative fiction, by harnessing the interplay between Everyday Ingenuity (i.e., engineering) and Connected Learning Spaces. Latine and non-Latine youth in the United States exhibit lower rates of pursuing engineering compared to their counterparts in Mexico and other Latin American countries, revealing systemic challenges in U.S. pedagogical practices hindering youth from pursuing and completing engineering degrees. This design-based research study highlights how cultural ingenuity embedded in everyday practices, manifested through "make do" artifacts crafted from unconventional resources, can be integrated into asset-based pedagogies like Connected Learning to reimagine engineering education. Participants include Mexican American middle and high school-aged youth in Southern California, USA, alongside Mexican American adult mentors and researchers. Study participants collaboratively designed a prototype workshop targeting future youth who may not consider engineering as a career, utilizing speculative fiction (e.g., Latinofuturism) to ignite interest while tapping into existing creativity, collaboration, and resourcefulness inherent in everyday engineering problem-solving. This holistic approach aims to render engineering more relevant and accessible to learners from marginalized populations.

"The word 'engineer' derives ... from the Latin root ingeniarius *... someone who is ingenious in solving practical problems… In the words of Henry Petroski, 'To engineer is human.'"*

— David Blockley [1]

Unknown to many, Latine youth in Mexico and other Latin American countries are more likely to study engineering than Latine and non-Latine youth in the United States, confirming systemic problems with the pedagogical practices in the United States that deter youth from initiating and completing degrees in engineering [2]. The current engineering classrooms and workplaces are dominated by white males and burdened by Herculean barriers to entry for members of minoritized populations, while ironically, engineering activities began as practices of the humbler populations in Classical Antiquity [3], [4], [5]. Researchers, policymakers, and educators need alternative methods to create inclusive, effective programs and curricula for minoritized populations to pursue engineering. Thus, I embark on a broad and deep inquiry regarding native and local socio-cultural systems and conditions that may already support students to connect to and access engineering in the United States. Stakeholders could transform and enrich engineering education by infusing it with the ingenuity of everyday practice that is *already* culturally relevant and present in the lives of Latine people. In other words, we can construct a better future *from where we already stand.*

This study extends previous research on the cultural wealth of *Everyday Ingenuity* [5], [6] within productive youth spaces, known as *Connected Learning Spaces* [7]. Its aim is to deepen this understanding by involving Mexican American youth, who have thrived in Connected Learning spaces, in co-designing an introductory engineering workshop that harnesses everyday ingenuity. Therefore, the research question is: *How can we co-design a workshop that utilizes everyday ingenuity to foster Mexican American youth participation in engineering?* Participatory

Design and speculative fiction principles were utilized to involve participants as designers and experts in their own culturally rooted everyday ingenuity. This project positioned both participants and the author as co-designers of a workshop prototype, targeting younger Mexican American youth as our future users.

Background

Growing up as a quiet kid in Mexico, I loved spending my free time assembling and painting model airplanes and one day, I decided to make my own. I built the cylindrical body of the plane by experimenting with a discarded soda bottle and *papier-mâché*, a crafting technique I had learned in school to make *piñatas*. I used a few leftover materials and a couple of common tools. I made the wings from cardboard and used some leftover paint to match the design of a Mexican airline. When it was finished days later, I beamed with pride at my creation and my parents praised my efforts. That very simple example, nothing extraordinary, depicts the impact of interest-driven and meaningful engineering activities in my life. I was a maker, a creator, and a future engineer. Now decades after that experience, I can still feel the joy I felt after producing an artifact through my own ingenuity that represented a challenge for my younger self. I am certain that both the interest-driven activities, as well as my family's support of my creative endeavors, were consequential in my life. They contributed to my decision to become an engineer and fueled my current conviction that engineering can be, at its core, accessible and inclusive, regardless of age, gender, race, socio-economic or cultural factors.

Everyday Ingenuity

My youthful effort in making a homemade airplane model is an example of "ingenuity of everyday practices" [8] and engineering-based activities that may appear ordinary and often taken for granted. Ingenuity is one type of expertise that is frequently deployed to solve ordinary, everyday, practical problems [8]. Everyday ingenuity is known in different countries and cultures by different names. For example, in Mexico, "*el ingenio mexicano*" is commonly displayed in repaired artifacts and improvised fixes [9]. In Cuba, the phenomenon is called "*inventos*" [10]. In India, they call these creative and improvised solutions "*jugaad*"[11], [12]. In Brazil it's "*gambiarra*"[13], and "*makeshift* [1]" [14] or "*jerry-rigged*" [15] in the United States. In under-resourced communities, the artifacts and solutions that emerge from everyday ingenuity and an engineering mindset are deeply embedded as cultural practices. However, societal perceptions and historical traditions, often shaped by the dominant majority, impose restrictions on what is considered a "legitimate" expression of engineering practice. This implicit definition tends to disregard the ingenuity inherent in everyday practices. I believe there is an opportunity to foster diversity and enhance the engineering field by embracing the voices and contributions of minoritized populations through the inclusion of these cultural practices. By expanding our understanding of engineering, we can enrich the field with a broader range of perspectives and experiences.

Connected Learning Spaces

Connected Learning (CL) [7], [16] is an asset-based pedagogy that is interest-driven and oriented toward opportunities. This type of learning starts with the interest of the young learners

[1] "That with which one makes shift; a temporary substitute, especially of an inferior kind, an expedient" [14].

supported by caring individuals and linked to educational, economic, and civic opportunities. This approach is socially embedded in relationships and in cultural contexts that support it [17], [18]. Connected learning is meaningful and deeper in the sense that it is close to the learner's environment, identities, and their own multiple ecologies [19], groups, and cultural contexts. This framework acknowledges the richness of cultural practices to empower minoritized youth to participate in society in a way that maintains and upholds their own identity.

Apart from in-school instruction, the presence of new media and technologies (e.g., social media, smartphones) have led to a more collaborative, networked, and sociocultural learning landscape in the 21st century. For years, youth have thrived in *Connected Learning Spaces*, such as youth centers in some public libraries (e.g., YOUMedia, see [20]), physical or digital spaces (in-, out-of-school, or hybrid) dedicated to promoting social connections that embrace diverse backgrounds and "provide expert guidance for young people to pursue their unique interests" [21]. In short, these spaces sponsor interest-driven projects, provide affinity-based mentorship, and broker connections to opportunities (e.g., business creation, access to scholarships, encouraging civic participation).

Participatory Design and Speculative Fiction

This study is driven by a deep-rooted aspiration to (re)imagine and transform the engineering landscape for Mexican American youth, fostering accessibility and inclusivity. Participatory Design (PD), a culturally-situated design practice where users act as co-designers, embodies a democratic essence, trusting that young co-designers can offer insights into youth interests and what would engage their age group [22], [23], [24]. By involving study participants in the design process, we accessed their insights and life experiences to address key questions such as "how, why, where, and by whom" [25, p. 174], enriching the engineering-focused workshop's design.

This reimagining is facilitated through Participatory Design, which is inherently future-oriented: towards that which does not yet exist. *Speculative Fiction* emerges as a powerful tool to foster imagination and envision alternative possibilities, including genres like science fiction, horror, and fantasy [26], [27]. Philosopher Maxine Greene asserts that speculative fiction and science fiction "move [people] to imagine alternative ways of being alive" [28, p. 4]. Therefore, speculative fiction has proven effective in enriching participatory design by stimulating alternative and innovative ideas [29], [30]. Essentially, Mexican American participants served as experts in their culturally-rooted everyday ingenuity. These individuals had already flourished within their Connected Learning Spaces, receiving support to nurture their interest-driven learning under mentorship. Immersed in participatory design principles and speculative fiction, we all envisioned an introductory workshop aimed at introducing other youth to new possibilities, opportunities, and pathways into engineering.

Methods

Settings and Participants[2]

The research primarily took place within "The Club" and the "MERIT" program. "The Club" is a nonprofit organization dedicated to supporting low-income Mexican American youth in Southern

[2] All participant and organization names have been pseudonymized for confidentiality and privacy purposes.

California, USA. Serving a small community of 20-30 middle and high school-aged youth, The Club offers after-school programs. In 2019, the author became deeply involved as a youth mentor within The Club's community, forging swift connections with staff, youth members, and mentors. The MERIT program engages youth in public schools, introducing them to the fields of science and engineering. Participants included Mexican American youth, former Club and MERIT participants, volunteer facilitators, and graduate students.

The study's participants exhibited diverse educational backgrounds and career aspirations. Former members of the Club were: **Aaron**, a freshman in a prestigious university's physics program; **Antonio**, a transfer student pursuing electrical engineering; **Maria**, majoring in psychology with a history of caretaking; and **Katerina**, studying hospitality management after considering the biomedical field. **Cianni**, a freshman studying civil engineering with interests in law, was the only member from MERIT. Three Latine facilitators contributed to the study's design sessions: **Guzman**, a program manager at The Club; **Yuri**, an entrepreneur and artist with experience in Latine youth program management; and **Laura**, an Education PhD student and former electrical engineer striving to increase Latina STEM participation. **Saul**, an Education PhD student and former engineer, served as a research assistant, aiding in data collection and analysis. The inclusion of diverse Latine participants and facilitators enriched the study's exploration of everyday ingenuity and engineering interest within Connected Learning Spaces. Through collaborative efforts, the study sought to illuminate the contextual nuances shaping youth engagement and learning experiences within community-based settings.

Data Sources

The data for this study were derived from virtual co-design sessions with the participants, each spanning between fifty and one hundred minutes. Detailed plans of the design sessions are provided in Appendix A to contribute comprehensively to the field. Data sources encompassed various elements, including the video recordings of the planning and timeline (detailed in Appendix A) design sessions. Additionally, the study incorporated accompanying field notes recorded by a research assistant, notes on the digital board Google Jamboard® (refer to Appendix C), and photos depicting examples of everyday ingenuity. Notably, examples of ingenuity from other countries were sourced from a 2009 online blog by Marjoram & King [31].

Analytical Technique

I employed a deductive approach in analyzing the data, guided by the concepts and theoretical frameworks of everyday ingenuity and Connected Learning Spaces. Transcriptions were segmented to highlight emerging ideas related to leveraging everyday ingenuity, following the guidelines of Corbin and Strauss [32]. To ensure trustworthiness and credibility, I triangulated my interpretations with the research assistant's observation field notes and sought clarification from study participants.

Data collected from the various sources underwent Narrative Analysis or Narrative Inquiry [33], [34], focusing on human experiences conveyed through stories [35], [36]. Specific attention was given to responses concerning (a) everyday ingenuity artifacts, (b) comparisons between engineering and everyday ingenuity, and (c) speculative ideas and stories framing the design workshop. Integration of additional relevant information from various sources, such as

favorite photos from the online blog [31] and responses on the online board, complemented the analysis. The subsequent section presents the findings from each session chronologically.

Findings

During the three design sessions, particularly the brainstorming segments, the collaboration between Latine participants fostered culturally relevant dialogue and idea generation. This collaboration effectively aligned with the study's objective: "To co-design a connected learning workshop that harnesses everyday ingenuity to encourage participation of Mexican American youth in engineering."

Design Session One - Examples of Everyday Ingenuity

The subsequent section originates from an activity during the first co-design session, where I presented instances of everyday ingenuity and asked participants to share their observations and preferences for each example. This exercise aimed to align our understanding of the meaning of everyday ingenuity and familiarize participants with the artifacts, drawing inspiration from the problem-solving aspects, materials utilized, and the contextual environments in which everyday ingenuity manifests. Figures 1 to 3 display the participants' words about the everyday ingenuity examples sourced from the online blog by Marjoram & King [31] categorized into Furniture, Outdoors, Indoors, and Transport.

Figure 1 *Shower Curtain Rail*

Photo by Yvette King. Permission to include in this report granted by blog curator Amy Marjoram. SOURCE: https://modoff.wordpress.com/category/indoors/

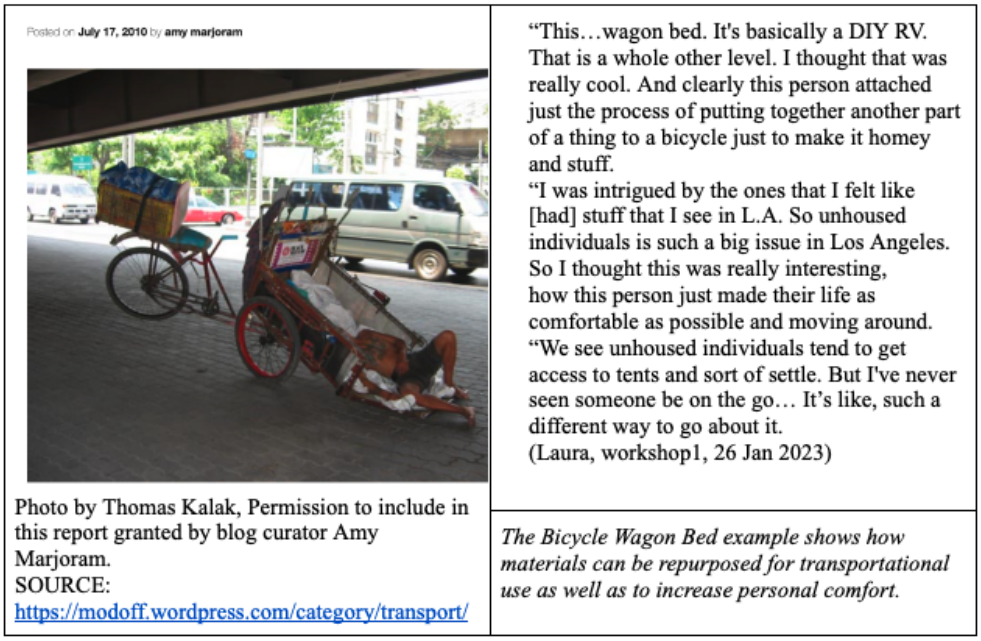
"What I like about it is the use of the tennis balls. And I just love it when we look at things and we automatically assign its usage. Obviously, here's a solution that uses the item and then in a different type of manner

"I really like when I see things that are meant for another purpose, but then we see it used to solve a problem or solution as a solution towards something else. I thought it was pretty cool how they put little chains down to make it go lower" (Guzman, Session1, 26 Jan 2023)

The Shower Curtain Rail example shows how materials can be repurposed for home use.

Figure 2 *Chair Repair*

Figure 3 *Bicycle Wagon Bed*



The collection of the blog photos served as a catalyst for participants to recognize and reflect on the prevalence of everyday ingenuity in their own lives and cultural contexts. It prompted discussions among participants and facilitators about their parents' involvement in everyday ingenuity and the reuse of items in their childhood households. This exercise helped participants to recall personal examples of everyday ingenuity when presented with photographic examples, underscoring the ubiquitous nature of this phenomenon as an inherent aspect of family life. This approach proves beneficial in prompting the identification of current instances of everyday ingenuity among study participants, particularly when they initially struggle to recall any such examples.

Design Session Two - Comparing Engineering and Everyday Ingenuity

In session two, our primary objective was to align our understanding and definitions of engineering while exploring the integration of everyday ingenuity. Using the online Google Jamboard®, we exchanged responses to questions such as "What is engineering and everyday ingenuity?" "What do engineers do?" and "What do they need to know?" The aim was to elucidate the definitions of engineering and everyday ingenuity, identifying commonalities and disparities in the skills and knowledge required for each domain. All quotes in Appendix B originated from the workshop co-designers, including both youth and facilitators.

The exercise revealed a recognition that everyday ingenuity could augment formal engineering studies and practices. When discussing engineering, participants emphasized the use of math, science, and physics as tools to address large-scale industrial challenges. Conversely, everyday ingenuity was perceived as community-focused problem-solving, characterized by "passion, freely tinker[ing] and try[ing]," and even the creation of entertaining artifacts "to make life more fun or easier." Participants noted that everyday ingenuity thrived on creativity and resourcefulness, offering swift and practical solutions tailored to personal, familial, or community needs.

Notably, both engineering and everyday ingenuity aimed at problem-solving, yet differed in the dominant tools utilized (i.e., math, science), the scale of impact, and the proximity to end users (i.e., family, friend, community). This expanded perspective prompted exploration into how engineering could be enriched through the cultural lens of everyday ingenuity. The emphasis on culturally relevant problem-solving inherent in everyday ingenuity provided a strong foundation and mindset for formal engineering practices. Adopting this perspective could render engineering more culturally attuned and effective in addressing community challenges, while empowering underrepresented groups to envision themselves as engineers and engage in engineering practices at various scales.

Design Session Three - Ideation and Prototyping

Having clarified the concepts of everyday ingenuity and engineering in the preceding two sessions, session three centered on creating a prototype for a Connected Learning workshop emphasizing everyday ingenuity. Collaborating with mentors and facilitators, we outlined the parameters for our workshop prototype:

- Target participant age range: 12-18 years
- Prototype Workshop duration: 30-60 minutes daily for five days
- Project-based activities inspired by everyday ingenuity
- Incorporation of an overarching speculative narrative and storyline

During our codesign sessions, we agreed to structure the workshop prototype also within a speculative narrative framework. The workshop would commence with a narrative prompting participants to envision themselves in the future. For instance, inspired by mentor Laura, one narrative option involved encouraging participants to reflect on their ancestors' perspectives and consider technological advancements since their time. Participants would contemplate future innovations, such as flying cars or Martian colonies. In response to this concept, Aaron remarked:

> I think that's a great idea. I think it's very interesting because I've never thought of it that way, where it's like what you said, "today is the future of yesterday". And I think that at least for me, oftentimes when people discuss futurism and future technologies and stuff like that, I have a lot of skepticism because I feel like a lot of the appeal is the fact that all of these things are impossible. And a lot of times, or like, impossible right now. And a lot of times I feel like we get carried away with the fantasy part of it. But I think for a skeptic such as myself, hearing that, and thinking about, like, oh, in 1950, what did my grandparents have and what do I have now, right now that would be impossible to them? The things that we're thinking about today for the future of tomorrow, they seem impossible, but this [referring to the video conference call] was impossible (Aaron, codesign session 3c, 4 feb 2023).

Aligned with participatory design principles, participants collaboratively generated and built upon ideas using small color notes on the online Google Jamboard® (see Appendix C). The ideation process generated these emerging themes, (1) food-related innovations, (2) clothing and textiles, and (3) musical instrument creation. Given the workshop's goal of also incorporating speculative storytelling elements to nurture creativity and cultural empowerment, we suggested presenting engineering challenges within future-oriented contexts around these three themes.

(1) Food-related innovations. For this challenge, participants would imagine they are in the future and want to prepare regional and cultural meals (e.g., *carne asada* [grilled steak]), but they do not have any grills or appliances. They must rely on recyclable materials to creatively prepare and preserve the food. This is one of the key conversations: (Transcript excerpts of all key conversations detailing the ideation process are in Appendix D.)

Guzman:	I was thinking something that Mexican families have are tortillas, right. Almost all Mexicans eat tortillas… Because if you think about Mexican, food is, like, something so cultural, right. And there could lie some sort of also activity in…
Author:	So how does ingenuity look in food?
Guzman:	Food carts. Food trucks, too. I think there'd be a lot of engineering in a food truck. Reimagining a food truck.
Author:	That would be a very cool… project. I'm just thinking about how do we remake an old car … just reimagine it.
Antonio:	And how do you imagine where they take that idea? They could probably start, it could probably be an activity where they originally start just by drawing it, or they create, like, bullet points.… [I]t'll help them put their imagination on it and be able to kind of redesign it. I think that would be really helpful for them as a start.
Author:	And maybe also telling them that, okay, we're not going to use or buy expensive materials, but where can we get from the community?
Antonio:	I've actually seen people add speakers to a cooler. It was very unique, where you can open it up and you'll see the speakers, and then the doors would slide and you could go into the cooler. There's different ways that you can use things that we generally already have, just improve it.
Guzman:	Something that I saw was a portable grill that it's obviously made of metal, but it collapses, and so you can make *carne asada* anywhere because it's just like it's just this foldable grill that 's just a box, but it's metal and it has the grill.

(2) ***Clothing and textile creation.*** Another speculative narrative option for the future workshop participants would include imagining being in a future open-air clothing “tianguis” (market) where environmental laws prohibit the creation of new clothing. Instead, they must repurpose existing clothing and explore innovative designs or incorporate electronics (e.g., sensors) to create "clothing of the future" for sale.

(3) ***Musical instrument creation*****.** For this other narrative option, participants could bring small broken furniture pieces into musical instruments. Tasked with providing music for a future party without access to traditional instruments or music players, they must discover how to create instruments from discarded materials or enhance existing designs with embedded technologies.

Final Workshop Design Summary

The co-design sessions resulted in the development of the following workshop prototype plan. On the first day, participants would explore and discuss everyday ingenuity using similar blog sites as in the ideation process. Following this, facilitators would introduce a speculative, future-based narrative and scenario, outlining activities such as clothing creation, food preparation innovation, and musical instrument creation.

Participants would select one speculative scenario to expand upon throughout the remaining workshop sessions. Days two to four would be dedicated to creating their projects, with participants presenting and discussing their creations on the fifth day. The workshop parameters and schedule of the prototype are outlined in Appendix E. In summary, the co-design participants crafted this workshop design prototype, laying the groundwork to engage Mexican American youth in both practicing culturally-relevant everyday ingenuity and envisioning participating in legitimate engineering practices.

Discussion

Despite the page constraints of this practice paper submission, I use the appendices to provide detailed insights from key conversations and diverse perspectives for practitioners to expand upon this work. The study engaged mentors and former youth participants from Connected Learning Space programs in a participatory design process. This aimed to harness the cultural practice of everyday ingenuity and create a tangible design example—a Connected Learning, engineering-focused workshop—for potential youth participants of The Club. The design sessions yielded valuable insights into this initial iteration of crafting such a culturally relevant workshop.

One of the primary objectives of the workshop was to underscore the significance of everyday ingenuity as a fundamental aspect of engineering. Despite its prevalence across cultures, everyday ingenuity is often underappreciated. Thus, it was crucial to help the participants grasp the pervasiveness of everyday ingenuity. In preliminary interviews preceding the workshop design sessions, participants struggled to provide examples without visual aids. Recognizing the need for clarity, we dedicated a design session to explore everyday ingenuity, supplementing it with various photo examples sourced from the blog collection [31], showcasing artifacts crafted through everyday ingenuity. The collection of photos prompted reflections from both participants and facilitators on their parents' resourcefulness and the repurposing of items in their childhood homes. It was remarkable how quick the participants associated everyday

ingenuity with their family experiences. As a researcher, this technique proved invaluable in bridging participants with the concept of everyday ingenuity. Their reactions affirmed its cultural relevance and significance to integrate hands-on, culturally resonant practices with engineering. Establishing a personal understanding of the concept among all co-designers empowered them to harness everyday ingenuity when generating workshop ideas.

In the second co-design session, I asked the co-designers to define the terms "engineering" and "everyday ingenuity." A noteworthy insight emerged from Aaron, who labeled everyday ingenuity practices as "functional engineering" and emphasized their essential role as a form of *community cultural wealth* [37], crucial for minoritized individuals. This type of engineering reflects self-sufficiency and reliance on community resources. The co-designers' responses underscored the significance of integrating traditional engineering tools, such as science and math, with the inherent creativity, collaboration, and resourcefulness involved in addressing everyday challenges through ingenuity. This amalgamation has the potential to render engineering more pertinent and accessible, especially for learners in minoritized populations.

Limitations

It is important to acknowledge some limitations in this study. Firstly, the specific subset of participants may not fully represent the diverse stories and experiences of all low-income Mexican American youth. Additionally, the author's limited familiarity with the use of speculative fiction techniques in Participatory Design processes was a first-time endeavor, which could have influenced the implementation of these techniques.

Conducting interviews and design sessions in a virtual setting introduced typical technical challenges and delays associated with remote meetings. The virtual environment posed challenges in anticipating participants' responses, resulting in instances of talking over each other or hesitancy to speak. These dynamics may have influenced the effectiveness of the co-design sessions. Future endeavors could involve the actual implementation of the co-designed prototype workshop within The Club, offering an opportunity to evaluate its impact and effectiveness with real young users.

Conclusion

This study highlights the significance of employing alternative methods to develop inclusive engineering education initiatives for minoritized populations. By exploring native socio-cultural systems and conditions, we can pinpoint existing pathways nurturing connections to engineering across the United States. *Constructing The Future From Where We Already Stand* involves integrating culturally relevant ingenuity from Latine communities into engineering education, paving the way for a more enriched future.

Through the application of Participatory Design and speculative fiction principles, participants assumed the role of co-designers, molding a workshop prototype tailored to the needs and interests of younger Mexican American youth. This collaborative endeavor embodies a proactive approach to cultivating engagement and involvement in engineering among minoritized populations.

APPENDICES

Appendix A

Co-Design Sessions Timeline

Date	Session Details
Facilitators Video Call 34 min	Attendees: Guzman, Laura, & Yuri ● Brief presentation of Everyday Ingenuity and Connected Learning Spaces features ● Introduction of Speculative Fiction examples (e.g., comics, movies) ● Presentation of planned Design Sessions Structure and Timeline
Session One 50 min	Attendees: Aaron, Antonio, & Katerina. Facilitators: Guzman & Laura ● Introduction of participants and facilitators ● Introduction to **goal** and **purpose**: *"To co-design a workshop that leverages everyday ingenuity and speculative fiction to promote Mexican American youth participation in engineering."* ● Watched a video clip about the Paraguayan "Cateura Recycled Instruments Orchestra" [38] as an example of everyday ingenuity. The instruments for this youth orchestra come from the neighboring landfills. ● Shared explicitly the purpose of co-design with the study participants as experts as Mexican-American youth interested in STEM fields. ● Aligned understanding of all attendees to the practice and field of Design by: a. Sharing *current understanding* of the term from prior experiences b. Watching a video clip [39] from professional designers sharing their *definition of Design* c. Notion of multiple possibilities and *no one solution* d. Talk about designers are comfortable with *uncertainty* ● Exercise to get acquainted with artifacts produced by everyday ingenuity and encourage making meaning of the phenomena using four webpages of the collection from the Blog [31]: a. **Muebles** / Furniture https://modoff.wordpress.com/category/furniture/ b. **Espacios Interiores** / Indoors https://modoff.wordpress.com/category/indoors/ c. **Espacios Exteriores** / Outdoors https://modoff.wordpress.com/category/outdoors/ d. **Transporte** / Transport https://modoff.wordpress.com/category/transport/ ● Quick review of purpose, co-design, and everyday ingenuity. End of session.
Session Two 1:10 hr	Attendees: Aaron, Antonio, Katerina, Maria. Facilitators: Yuri, Guzman, Saul ● Quick review of last session's topics: Co-Design, Everyday Ingenuity ● Used a shared online tool (Google Jamboard®), share with each other our understanding on: What is engineering?, What do engineers **do** (practices)?, and What do "good" engineers need to **know** (knowledge)? ● Talked about the problematic situation for our design effort. Shared about the issues with low participation in education and workplace settings for minorities in the US a. Current statistics of graduates in engineering in the 2020 OECD [40] and about low participation of Latine

	b. Call for a revolution in engineering education in the article "stuck in 1955" [41] ● Talked about "everyday ingenuity" as an alternative to respond to transform engineering education for Latine populations ● Using the Google Jamboard® and notes, share with each other our ideas on: What **is** *everyday* ingenuity?, What do *everyday* engineers **do** (practices)?, and What do "good" *everyday* engineers need to **know** (knowledge)? ● Introduce speculative fiction definition [27], visual art artifacts from video clip from MARVEL Studios "*Wakanda Forever*" [42]—as an example of African and indigenous speculative aesthetic. ● End session presenting "Design Phases" diagram [43, p.15] with suggested 5 phases (discovery, interpretation, ideation, experimentation, evolution) and how divergent and convergent thinking is needed throughout.
Three 1-hr sessions for ideation and co-creation of workshop prototype	Attendees Session 3a: Author, Antonio, and Guzman Session 3b: Author, Cianni, and Laura Session 3c: Author, Aaron, and Saul ● Ideate and brainstorming activity using small notes on the shared online tool (Google Jamboard®). ● Group common ideas and choose top three ideas to create a prototype including design parameters (e.g., age group, session duration), problematic situation, and themes for project-based activities based on everyday ingenuity.

Appendix B

Engineering vs. Everyday Ingenuity

Questions	Engineering	Everyday Ingenuity
What is it?	"The application of applying **mathematical and scientific concepts** towards **solving problems** and creating **better** alternatives for **everyday living**" "Finding **innovative** and **creative** ways to measure and build, while using **math** and **physics**"	"Ways to solve problems with **limited resources**" "Solving problems quickly and simple to help the **community**" "Solving problems with the **resources they have** and making their **everyday lives a little easier**"
What do they <u>do</u>?	"**Plan**, develop, test, and problem solve" "**Measure**, collaborate, communicate, build, create, research"	"**Fun** way to create your **personal** artifact" "Find a way to **make life more fun or easier**" "Live life and find novel ways to **improve or invent things**"
What do they need to <u>know</u>?	"Mathematics" "**Math, science, physics**" "Engineers **must be good at math, physics, and communication**"	"No limits in needing to know anything. They can **freely tinker and try** things without knowing much about the whys" "Creativity and **out-of-the-box** thinking" "Creativity, passion, problem-solving"

Appendix C - Collaborative Ideation Online Board[3]

Appendix D - Transcript Excerpts: Key Conversations in the Ideation Phase

Food-related Innovations Ideation

Guzman:	I was thinking something that Mexican families have are tortillas, right. Almost all Mexicans eat tortillas… Because if you think about Mexican, food is, like, something so cultural, right. And there could lie some sort of also activity in…
Author:	So how does ingenuity look in food?
Guzman:	Food carts. Food trucks, too. I think there'd be a lot of engineering in a food truck. Reimagining a food truck.
Author:	That would be a very cool… project. I'm just thinking about how do we remake an old car … just reimagine it.
Antonio:	And how do you imagine where they take that idea? They could probably start, it could probably be an activity where they originally start just by drawing it, or they create, like, bullet points.… [I]t'll help them put their imagination on it and be able to kind of redesign it. I think that would be really helpful for them as a start.
Author:	And maybe also telling them that, okay, we're not going to use or buy expensive materials, but where can we get from the community?
Antonio:	I've actually seen people add speakers to a cooler. It was very unique, where you can open it up and you'll see the speakers, and then the doors would slide and you could go into the cooler. There's different ways that you can use things that we generally already have, just improve it.
Guzman:	Something that I saw was a portable grill that it's obviously made of metal, but it collapses, and so you can make *carne asada* anywhere because it's just like it's just this foldable grill that 's just a box, but it's metal and it has the grill.

Clothing Ideation

Author:	What do you guys think about this clothing or e-textile kind of wearable kind of idea? How can we extend that, too? Or other options.
Cianni:	Like, to make it into a workshop.
Laura:	Right.
Author:	We envisioned having the kids starting with a narrative, like a made-up story about someone from the future contacting us or something. And then we have to create something for them.
Cianni:	Well, maybe like you said, they contact us from the future, just notifying us that the clothing industry has been increasing their contamination and contributing to global warming. And therefore we cannot there's like a regulation put up by...What is it called? Like an international agreement to reduce the sale of clothing, and therefore, you have to repurpose clothing for a sustainable future…You know how in Mexico they have "*tianguis o sobre ruedas*" [open air market or shops on wheels]? Maybe they have to collect the clothes from there…And then we have to repurpose it because the stores are not selling clothes anymore, because there's too much contamination…Clothing industry contamination.
Laura:	But yeah, sort of like I think that'll be cool to create Cianni's point, like some kind of policy thing that's affecting workers.

Musical Instrument Ideation

Aaron:	I definitely think that woodworking might be one of the topics that we should look at.
Author:	What are some other ideas that you would move forward to keep exploring the topic?
Aaron:	…[T]he other day on TikTok, I saw a video of some six year old playing a tuba made out of literally just plastic. I don't know how they made it, but it looked homemade and it sounded good. And they had, like, a drum set, and they were just playing, like, *banda* [music genre from Northern Mexico]. They're just playing *banda*.
Author:	Oh, really?
Aaron:	Yeah, and it sounded good. But physics of sound, all that tying back into how important music is to our culture, et cetera, et cetera.
Author:	Yeah, you're right. Physics of sound.
Aaron:	I built [one instrument] out of, like, PVC pipes. That's not very expensive. And it sounded like I could play, like, "twinkle, twinkle, little star" on it. I could play scales on it.

Appendix E - Workshop Prototype: Parameters and Schedule

Parameters	● Participant age range: 12-18 years ● Workshop duration: 30-60 minutes daily for five days
Day One	● Talk about Everyday Ingenuity present in the youth communities (use the following blog to initiate the conversation: https://modoff.wordpress.com/category/furniture/) ● Introduce workshop participants to a future narrative/scenario ○ Clothing Creation ○ Food Preparation Innovations Creation ○ Musical Instrument Creation ● Participants choose an activity to work on for the week (project-based activities inspired by everyday ingenuity)
Day Two	● Work on chosen activity
Day Three	● Work on chosen activity
Day Four	● Work on chosen activity
Day Five	● Project Presentations and Discussion

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