Celebrating Refugee Innovation: Shifting from Deficit to Asset-Based Engineering Perspectives

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Abstract

Refugee communities exhibit remarkable innovation as a means of survival, yet engineering's engagement with refugee communities often comes from a deficit-perspective, where we impose our technologies onto their communities. This research seeks to shift perspectives from a deficit-based view to an asset-based approach by highlighting and celebrating these communities' innovations and experiences (Gravel et al., 2021). Specifically, we interviewed student refugees to understand what engineers can learn from refugee innovation. Using qualitative methodology and engaging participants throughout in a co-design process, the data was analysed through qualitative content analysis (Elo & Kyngäs, 2008). These interviews offered valuable insights into refugees' daily lives, survival strategies, and engineering innovation. The stories shared illustrate how these existing skills can be cultivated within refugee camps, particularly when development opportunities are provided by organizations such as the UN. These opportunities contribute to the resilience of individuals and help strengthen the communities they are rebuilding. By exploring refugee experiences and innovations, this research promotes a broader perspective on community-driven engineering and asset-based understandings of refugee communities. Future work could be used in engineering classrooms, allowing students to engage with diverse perspectives and create more effective, culturally relevant engineering solutions for the communities they serve.

Keywords: Asset-based, Innovation, Refugee Community, Resilience, Community Engagement

1 Introduction

For many families across the world when civil war strikes, they seek refuge in neighbouring countries. Uprooting their lives and families, all for the sake of survival. However, in these foreign lands, refugees often find themselves innovating out of necessity by solving infrastructure problems, starting small businesses, and adapting to new environments (Oesch, 2020; Tomaszewski et al., 2016).

Frequently, the narrative surrounding these communities focuses on what they lack, framing them through a deficit-based lens (Cun, 2024; Lester et al., 2023). As a result, a asset-based perspective is helpful to bring when thinking about refugee communities and their need for aid, especially in technical solution-based fields like engineering. This research seeks to shift this perspective from a deficit-based approach to an asset-based one, where the innovative solutions that emerge within refugee communities, driven by resilience and necessity, are recognized.

This study catalyzes broader conversations in engineering education, encouraging future engineers to embrace the lessons learned from refugee innovations. This shift not only enriches engineering practice but also encourages greater social and cultural understanding, ultimately leading to more impactful and inclusive designs for communities worldwide. The guiding question for this study is: *What can we, as engineers, learn from refugee innovation to foster more collaborative and contextually informed approaches to community design?*

Myself, Pelumi, my engagement with refugee issues extends beyond the academic sphere. As an undergraduate student volunteer with the Student Refugee Program, I have worked alongside students in the student refugee program and formed close bonds and appreciation for their stories and journeys. These experiences have shaped my appreciation for the ingenuity and agency of refugee communities and have influenced my interest in asset-based approaches to engineering problems. While I do not share the lived experience of being a refugee, I have been mindful of how my background and values may shape the research process and approached interviews and literature analysis with an open mindset. My goal in this research

has been to centre the perspectives of refugees themselves, acknowledging that my role is to facilitate the amplification of their insights rather than to define them.

2 Background Literature

The background provides firstly an overview on research about refugee engineering infrastructure and innovation through a few case studies and reports outlining research and knowledge in these areas. Secondly, an overview of deficit vs. asset-based approaches are overviewed and their relation to the mindset used in this research project.

2.1 Refugee Innovation

Infrastructure

Host countries often enforce specific laws governing individuals with refugee status as they reside in the new environment. While some nations anticipate refugees' stay to be temporary, the reality is that many camp-based refugees reside in camps for extended periods, often exceeding a decade (Tomaszewski et al., 2016). As infrastructure and development needs grow within these camps, communities strive to address their requirements within the legal frameworks established by host countries. For instance, in Jordan's Al-Hussein camp, researchers have examined how residents navigate the delicate balance between state and non-state actors to maintain the camp's intended temporary nature.

The Al-Hussein Refugee Camp provides insight into the regulatory challenges associated with infrastructure development in refugee settings. Development usually refers to planning interventions aimed to generate improved standards of living in less developed parts of the world (Smith 2008 as cited in Oesch, 2020). Researchers have documented the urban development processes within the camp and the obstacles encountered when creating infrastructure. For example, the Community Infrastructure Program in Al-Hussein was not labelled as a comprehensive urban development initiative but rather as an "anti-poverty subsidized" approach, as a result, the approach to improvement isn't about longevity or thriving communities, but rather about meeting the minimum need (Oesch, 2020).

An architect for the corporation stated that in the camp, 'we were just allowed to put in infrastructure'. Hence, urban planning in its conventional form—that included architects, civil engineers, and social analysts—in the sense of programmed and displayed transformation had hardly existed in this space (Oesch, 2020). Yet, it was clear that the camp had undergone a process of urban development as canvas tents were long gone, and its materiality had blended with that of the city. Refugee communities and those assisting them had to find different ways to develop the area so that maintained the camp's "permanent temporary" status through unconventional urban planning approaches acceptable to residents and the broader refugee community.

Innovation

Upon arrival at refugee camps, individuals often receive initial assistance from organizations like the United Nations and various NGOs to help them settle. However, these camps are frequently situated in rural areas lacking essential resources such as electricity, water, and sustainable food sources. Even when basic infrastructure exists, services can be inconsistent, compounded by the "permanent temporariness" that characterizes many refugee camps (Tomaszewski et al., 2016). Studies utilizing satellite imagery have shown that refugees often relocate their shelters to be closer to relatives, markets, service offices, or areas with better electricity access (Tomaszewski et al., 2016).

Literature shows global instances where refugees created diverse and locally relevant innovative solutions to meet their needs. Innovation can identify ways in which external interventions can contribute to creating an environment where people are empowered to find solutions to their problems. It can allow us to consider

the types of facilitation and infrastructure required to allow people to help themselves in more sustainable ways (Betts et al., 2015). In Uganda, refugee-led organizations are actively engaged in creative problem-solving, developing or adapting products and processes to address daily challenges and create opportunities. This bottom-up innovation process often results in solutions that are better tailored to existing needs and more readily accepted within the community. For example, in a Ugandan refugee camp, Abdi founded the first computer games shop out of spare parts using skills in mechanics and electronics gained from his previous job in Somalia. In Uganda, Claude established a milling business and established other income-generating businesses, such as selling water from his milling plant (Betts et al., 2015).

In the Al-Hussein camp, the Jordanian government's policy of granting citizenship to Palestinian refugees facilitated their socioeconomic integration into Amman (Betts et al., 2015). This policy enabled refugees to buy and sell land and properties outside the camp and move freely, thereby influencing the camp's development and its relationship with the surrounding urban environment (Tomaszewski et al., 2016).

2.2 Asset-Based Framework

Engineering education researchers understand that diverse thinking and including different ways of thinking improve innovative ideas and design outcomes (Samuelson & Litzler, 2016). However, often in an attempt to be more inclusive to underrepresented groups and support their persistence in engineering, deficit-based approaches are used. For example, underrepresented students may be given information on how they can enhance their cultural or social capital to better succeed in engineering—the underlying assumption being that they are 'lesser' and need to change themselves in order to fit in and succeed. These approaches do not recognize or foster the brilliance that already exists in diverse learners (Martin & Wendell, 2021). Asset-based approaches instead aim to acknowledge "students' unique identities, backgrounds, and experiences, and leverage their assets for teaching and learning" (Budinoff & Subbian, 2021).

In the last decade or so, asset-based approaches have had increased attention and scholarship, with research showing how they benefit students' identity and achievement, acknowledge students' lived experiences and backgrounds, and aim to reduce marginalization (Budinoff & Subbian, 2021). In 2021, there was even a special issue on asset-based approaches in engineering education, outlining across multiple contexts, demographics, and methodologies (Martin & Wendell, 2021). Specifically, scholars in this area emphasize the importance of relationships and community being central to leveraging students' assets and unique skillsets.

Within refugee communities specifically, using asset-based approaches has been found to be valuable as it leverages existing networks to mobilize change and build on existing capacities and assets (Lester et al., 2023). Asset-based approaches have also been used for similar studies investigating the resettlement of refugee students in science, leveraging assets and cultural wealth to support their learning (Cun, 2024). Overall, an asset-based approach to this research was taken as it provided an opportunity to learn from experiences in refugee communities, leverage their wealth of knowledge in infrastructural and innovative engineering approaches.

3 Methodology

Interview data was collected in Summer 2024 from two participants, who agreed to be called Malith and Adol in research publications. A co-author of this paper has experiences as a Gazan refugee and brings insights to the innovation experienced in Gazan Communities. Both Malith and Adol, came from South Sudan and went to refugee communities in neighbouring African countries, Kenya and Uganda. They both came to University through the Student Refugee Program, where they are studying engineering. Interviews followed a semi-structured format, with some questions determined in advance but with flexibility in structure. Questions started with getting to know each other and acknowledging power differentials (based on trauma-informed research guidelines from (Edelman, 2023)), and then asked about engineering, innovation, and resilience. Specifically, a co-design interview process was followed where participants were encouraged to take an active role in the interview process, reframing questions and directing the flow of conversation. In practice,

this meant the interviewee helped clarify the kinds of questions to ask when approaching a community from an asset-based lens. For example, Adol said, *"but now it's okay, 'how can we make it better?' I think for me it would be 'how can we create more awareness' because people are less informed."* I responded, *"that's very true… it is more about how we can make it better, how can we bridge that gap,"* as her insight broadened my perspective on framing refugee innovation as also being about raising awareness.

Future work will continue to engage the participants in the co-design process to review the findings, correcting and validating results, and further adding their expertise and perspectives to the research. For example, the second interviews conducted in Summer 2025 used more open-ended, co-design-oriented questions, allowing participants to elaborate on earlier conversations and suggest ways their experiences could enhance the module. Where the modules aim is to help students understand the importance of designing *with* communities rather than *for* them. In the final stage, participants will each review the module individually, providing feedback and suggestions for improvement.

The interview data analysis following Elo and Kyngäs' qualitative content analysis process (Elo & Kyngäs, 2008). Qualitative content analysis was a valuable approach for the data, as well as given the scope and expertise of the researchers, with this work being conducted as part of a 4-month undergraduate student research project. Specifically, the first author transcribed the data manually to immerse herself into the data. Next, she did a first round of qualitative coding through NVivo software. From there, she did a second-round coding, finding common themes across the data and collecting them together in the results presented here in this paper. The second author acted as a validator throughout the process, where regular weekly meetings were used to reflect on the findings, explore different interpretations of the data, and iteratively review the themes that were emerging. This paper is the first publication of this data, and further research will continue to iterate and refine the results, including exploring more in depth qualitative analysis methods such as narrative analysis.

4 Findings and Discussion

4.1 The Need to Survive: Challenges and Background Stories

To truly understand the refugee experience, we must hear firsthand accounts of survival and resilience in the face of immense challenges.

Malith shares his story:

"Umm...My story is that I'm from a country that experienced civil war, not all of it, but for some part of my life I lived as a refugee. And part of that life is having to figure out a way to live in the camp comfortably and how to get things done with the limited resources that we had... you just had to do it."

His account reveals the hardship of displacement caused by civil war and the necessity of adapting to life as a refugee. Survival was not a choice but a requirement, shaping every aspect of daily existence.

Adol describes her abrupt transition to becoming a refugee:

"Never at, and one point, was I expecting to be a refugee it just happened abruptly (…) There was a conflict in the government. Just one night we woke up at three AM, guns were everywhere… If you were not strong enough—or if you were not a soldier, then you had to seek refuge."

In an instant, Adol's life changed. One moment, her family was resting at home, and the next, they were fleeing for their lives. The familiar world she had known became unsafe overnight. There was little time to prepare, and families could only carry the essentials, "*You get one saucepan, salt, a little bit of food, what you would cook, you get a matchbox."*

A sense of strength in numbers emerged as families moved together in search of safety. Adol recounts, *"You would just move with the people who were moving because people would know what the safest place is to move to. And that time we went to the Nile [River] Bank."*

For Adol, this was a new and uncertain experience, but for her mother, it was a repetition of history. Having lived through civil war before, her mother shared her wisdom:

"So, my mom said this [the civil war] is not going to stop so soon, because she had had that experience before. So we are going to go somewhere near the border. So that if something happens in the country we can go to the neighboring country because that's what happens when a country is in war, you can seek refuge in the neighboring country." Her mother's words highlight the unspoken solidarity among nations that take in refugees during times of conflict.

Adol's journey ultimately led her to Uganda:

"So we went to the border and from there it was just a lot of chaos, people were fighting and killing people a lot. So we went to Uganda and that's how I became a refugee, the war continued and we never went back home. And we did not want to go back home. So that was my journey."

Adol's story, like Malith's, illustrates the resilience required to survive and the reality of not returning to the home they once knew.

4.2 Survival and Necessity Catalyses Innovation

The greatest innovations are born out of a need for survival. In refugee camps, constant survival becomes normalized. As Adol explains, *"We just tried to fit into the environment. Like survival of the fittest, we had to survive."*

The word "survival" suggests an individual or community has faced a life-threatening situation and found a way to overcome it. Humans have an innate ability to adapt to their environment in order to survive. In refugee camps, limited resources force individuals to maximize what little they have. As a result, those who think outside the box stand the best chance of survival—this is where adaptation through innovation begins.

Malith reflects on this process:

"I think living in a refugee camp and seeing the innovations that came through actually gives you perspective on how modern civilization came to be. Because these things were not always there. But someone had to be creative with what they had. Sometimes, where there is need, people tend to be creative…"

His words capture the essence of innovation born out of necessity—making the most of limited resources to meet essential needs. Throughout history, societies have faced similar challenges. When confronted with scarcity, people responded by creating solutions: shelter to escape the elements, hunting and farming to acquire food. Necessity drives problem-solving, and survival often becomes the catalyst for invention. Innovation is rooted in identifying a need and finding a way to meet it. This principle also exists in engineering and problem-solving. In refugee camps, as individuals develop solutions to their daily struggles, a sense of independence emerges. What begins as a means of survival gradually evolves into a system that not only meets basic needs but also improves upon them. This transformation is what allows communities to move from merely surviving to truly thriving.

Gazans have shown remarkable ingenuity in adapting to scarcity. Farmers have found ways to grow food in limited spaces. Even under siege, people find creative ways to repair homes and restore. Although sometimes there is a conflicted feeling, for example Nada describes, "Air and water pollution from relentless bombings and the burning of waste make the environment toxic, and some people, out of desperation, burn tires and garbage to extract fuel, worsening the pollution even more." Here, the necessity of survival fosters innovation sometimes at the expense of personal values (such as that of sustainability).

4.3 The Independence Required to Survive

When refugees first arrive at a camp, the United Nations High Commissioner for Refugees (UNHCR) provides essential resources, including land, shelter materials, and food. However, these resources are meant for short-term living conditions, requiring refugees to innovate and adapt for long-term sustenance. This necessity-driven problem-solving process directly connects to engineering, innovation, and resilience.

Engineering and Innovation Through Necessity

Engineering is fundamentally about designing solutions to meet human needs using available resources. In refugee camps, where resources are scarce, innovation becomes a survival mechanism. Malith highlights this when he describes the basic materials provided:

"And that free land usually comes with things like poles, some iron sheets, some canvas that was supposed to be used as tents for the camp. But most of the time you realize that those tents are not convenient for all weather, say for example in rain it's not as convenient, rain, cold season, it's not as convenient."

This statement depicts the ability for structural problem-solving; how can individuals create durable, weather-resistant shelters with limited materials? Communities think critically and apply engineering principles such as material optimization and environmental adaptability. Additionally, Adol explains how resources are sometimes repurposed or traded to meet emerging needs:

"They [the UNHCR] know you don't have anything, and they give you everything for you to be a bit comfortable. So, we started selling some things to the residents (…) For people to get money, buy iron sheets, or if you wanted anything else you would just sell what you had."

This reflects the entrepreneurial mindset essential to engineering innovation by identifying problems, finding solutions, and reallocating resources effectively.

Skill Development as a Path to Innovation

Beyond immediate survival, the transition from reliance on aid to self-sufficiency requires education and skill development. To address this, the UN supports training programs that provide refugees with technical skills, Malith describes this opportunity:

"There was a tertiary institution called Don Bosco. Don Bosco is a school sponsored with the UN to teach technical skills, from plumbing, electrician work, the basic computer skills, and masonry, so those guys were able to get those skills from there. As much as everyone built their own houses there were bigger places like shops where... a little bit of expertise was needed, and that's where these people came in and for pay they would do what they do best."

This initiative is a clear example of engineering education at work. By equipping refugees with skills in construction, infrastructure development, and technology, these programs foster independence and create opportunities for long-term sustainability.

Nada Explains that, "Despite the destruction of schools and universities, the pursuit of education continues. Makeshift classrooms are created in tents, homes, or online where possible. Teachers and students show incredible dedication, using any available means to keep learning alive. Education is not only a right but also an act of resistance and hope for a better future."

A common theme amongst many refugee communities is a desire for the right to education and to grow beyond the current circumstance. Malith and Nada both explore the importance of growth and progress towards independence through skills and education to lead to a thriving community.

Resilience and Resource Management

Resilience is the ability to adapt to adversity, and in refugee communities, this is evident in their ability to rebuild their lives despite hardships. The UN's gradual shift from direct aid to skill-building reinforces this principle as refugees develop resource management skills.

Nada gives insight that "The people of Gaza are not simply victims of war; they are agents of resilience and change. Through solidarity, creativity, and unwavering spirit, they continue to find ways to live, solve problems, and hope for a peaceful tomorrow."

The refugee experience demonstrates that engineering and innovation are driven by necessity, and resilience is built through adaptation. By developing technical skills and applying creative problem-solving, refugees engineer solutions that transform their communities. This mirrors how engineering functions in broader society, identifying problems, maximizing limited resources, and continuously improving solutions for a better future.

As Adol explains:

"Now they are reducing what they are giving people. Because they are providing people with skills, they are supporting people in so many ways, so you can be able to support yourself and not lean on the UN, because the UN has a lot of responsibilities."

This shift highlights the importance of self-sufficiency and long-term development. Instead of relying solely on external aid, refugees gain the ability to sustain themselves and contribute to their new communities. This is where engineering and innovation come full circle, by applying learned skills, individuals create businesses, build infrastructure, and strengthen economic resilience.

In refugee contexts, skills development and resource management are highly intentional, guided by a clear understanding of needs and how effectively applied skills and resources can address them. This deliberate approach promotes continuous skill improvement and innovative resource use. Ultimately, the ability to innovate and adapt in the face of hardship is what allows refugee communities to transition from mere survival to thriving and rebuilding their lives.

There is a clear understanding of the balance between asking for help and asking for self sufficiency. Nada demonstrates this through her plea: "I call on the world […] to see us as human beings who can make a difference if given the chance. Please do not let this dream die in the rubble of war. Help us build a future where our children can thrive in peace, with knowledge, dignity, and dreams that no war can destroy."

4.4 Cross Cultural Adaptation:

When refugees move from the country of their nationality to a neighboring country, they are faced with learning how to navigate a new culture in their laws and way of life. When coming to a host country, there are a set of rules and regulations outlining the rights and expectations of refugee communities. Because refugees are considered temporary residents of the land, refugee camps are intentionally kept separated and confined from the host country and do not allow refugees to seek legal employment.

Successfully integrating into a new country involves a delicate balance between adaptation, innovation, and compliance with legal and cultural frameworks. Refugees also have set rules and regulations in the countries they seek refuge in, as their status of residence is often considered temporary. As a result, understand the balance between innovation and creating a life in this new environment while still abiding by the rules and regulations, and customs of their new environment.

Adol explains her experience in Uganda:

"Absolutely, I think Ugandans are really nice people (…) but there are those few individuals that are not happy you are there, because they think you are taking your resources, their land(…)But in terms of safety, it was the same for everyone. Also, because we were protected people, we had the UN."

Adol's words depict a duality that exists when integrating into new cultures that is often experienced by many: Knowing that one is welcome into a country yet feeling the tension of navigating resource use. By having security and safety provided by the UN whilst understanding the laws and regulations of the host country, it brings into consideration this idea of context-centered innovation where refugee communities can thrive in innovation and growth while respecting the citizens of the land they reside on.

Adol further explained:

"We needed to have houses, but you couldn't go to the nearby forest or bush and just get trees because that is not your land, and it's for the government. And people started making bricks, that's when the idea of—I would say Mini technology because we weren't using concrete, but people started making bricks out of mud."

The understanding of ownership of land depicts a respect for the land that communities have and a recognition of being a guest in a new environment. From an engineering perspective, projects in refugee communities must account for the legal, cultural, and social dynamics of the host country. Engineers working in humanitarian settings must design solutions that align with local regulations, available resources, and environmental constraints. For instance, sustainable construction methods, like those employed by Adol's community, can inspire engineers to develop alternative building materials that do not rely on deforestation or costly imports. By integrating engineering principles with cultural awareness and legal considerations, infrastructure can be developed that supports refugee resilience, fosters economic opportunities, and strengthens relationships between displaced populations and host communities. This intersection of engineering and social responsibility is essential for creating lasting, ethical, and practical solutions in humanitarian settings.

4.5 The Balance of Improvement and Community Empowerment:

Imagine a thriving city filled with professionals—doctors, lawyers, engineers, and scientists—who have spent years building their careers, homes, and lives. Now, imagine a crisis forcing them to leave everything behind, abandoning not only their material possessions but also their professional identities. However, their knowledge and expertise do not vanish; instead, they carry these skills with them into the places where they seek refuge. In this new environment, there is an opportunity to reimagine how their abilities can be applied to rebuild their lives and support their families.

This reality reflects the experience of many displaced people. Before becoming refugees, they developed knowledge and skills in areas such as agriculture, infrastructure, and mechanics—expertise that once served their daily lives. Nada sheds light on the ways in which community expertise is used to provide solutions in the communities. She explains that ,"Additionally, due to the shortage of electricity and cooking gas, many families have turned to solar panels for heating, cooking, and lighting. However, since solar energy relies heavily on sunlight, power interruptions still occur on cloudy days, which are common in Gaza across various seasons. To address this issue, electrical engineers have proposed a programmed device that connects to the solar panels and reduces energy consumption based on sunlight and cloud conditions."

Adol and Malith's stories illustrate how these existing skills can be further cultivated within refugee camps, particularly when development opportunities are provided by organizations like the UN. These abilities not only contribute to the resilience of individuals but also help strengthen the communities they are rebuilding.

Merging Outside Expertise with Local Insight

When experts and problem solvers engage with developing areas, there is often a risk of misjudging community needs—either by underestimating or overestimating them—when there is insufficient understanding of the people they aim to support. While documentation can provide some context, the most meaningful insights come through direct engagement with the culture and community itself. By building connections and listening to those affected, communities can articulate their needs, ensuring that assistance leads to improvements and innovations that have a genuinely positive impact.

Adol provides insight into this balance through an analogy:

"Okay, what does it mean to be structurally sound? It doesn't just have to be beautiful. Now, this is where the civil engineers come in. These people could have helped us—maybe we could have made better houses. Because it was a lot of work. You would construct a house, then it collapses, and you have to redo it. And that's hard, right?"

Her words highlight the balance between external expertise and local ingenuity. Refugee communities have demonstrated remarkable innovation by building their own shelters with limited resources, yet there remains an opportunity to enhance these methods with engineering principles. Rather than imposing foreign solutions, engineers can collaborate with communities, equipping them with foundational knowledge to refine and strengthen their existing innovations.

This approach mirrors the function of tertiary institutions, where individuals acquire fundamental skills that they later expand upon to create businesses and improve their communities. By applying this principle to humanitarian settings, knowledge-sharing fosters sustainable development, allowing displaced communities to transition from makeshift survival strategies to long-term, self-sustaining solutions.

Empathy and Understanding in Humanitarian Efforts

Malith offers important advice on working with refugee communities:

"I would advise anyone who goes to a refugee camp to actually know that these are people with different backgrounds. These are people who will actually appreciate any little help that they receive; they are very grateful people. And no matter how small the help that comes, they will still take it. Also, some of them have traumatic pasts—having seen war happen, having seen people die with their own eyes, having seen their parents or their relatives get murdered. Those traumatic experiences stay with them. So when you approach them, approach them from a place of understanding. Because sometimes, they might react in a way you didn't expect."

Malith's words emphasize the importance of empathy in humanitarian efforts. Assisting is not just about offering resources; it is about understanding the people behind the need. A trauma-informed approach fosters genuine connections and ensures that the help given is both meaningful and respectful.

A Sustainable Approach to Support

Ultimately, the most effective form of support does not replace or overshadow the skills and knowledge that already exist within a community—it enhances and amplifies them. When assistance is provided with cultural awareness and collaboration, it fosters long-term sustainability rather than dependence.

Innovation, engineering, and resilience thrive when local knowledge and external expertise work together. The goal is not to impose pre-existing solutions but to empower communities to refine and expand upon their strengths. In this way, displaced individuals can move beyond survival and towards self-sufficiency, rebuilding their lives.

5 Conclusion

These preliminary results from this research project highlight refugee community resilience, ingenuity, and innovative skillsets. Refugee communities typically exist within scarcity, meaning community members quickly learning resource management and creative problem solving, two skills essential in engineering education. These stories of management of limited resources in refugee communities can be shared to support learning of students in engineering classrooms, to showcase and celebrate innovative solutions and emphasize the importance of asset-based approaches to working with communities.

Many of the findings talk about balance: providing assistance that's not too much and not too little. This balance is best achieved through collaboration with communities, ensuring we are leveraging both our

expertise as external partners, and the community ingenuity as experts of their own local context. When working with communities, engineers must understand how to avoid imposing foreign solutions and instead leveraging local assets to strengthen existing innovations.

The stories shared in this paper provide incredible insight into refugee experiences and innovative mindsets in refugee communities. Themes and findings emerging from this analysis will inform future work that aims to develop engineering modules that integrates participants' insights to authentically represent innovation in refugee environments. Ultimately, this project seeks to enrich engineering education by broadening students' perspectives on what innovation is and encouraging them to approach design with greater inclusivity; showing that engineers can empower and partner with the communities they serve, resulting in more equitable and innovative outcomes. Following the initial research, in Summer 2025 the work continued by applying the lessons learned to develop a first-year engineering module which will be piloted in Winter 2026. Students, as future engineers, need to understand how to work with communities, to support and nourish the innovation and resilience that exist within these communities. We need to foster skills in our students where they truly value the local, community knowledge that refugees hold. We will close with a quote from Nada that represents this incredible knowledge that exists within the people of Gaza:

"The people of Gaza are not only victims of war, they are people of resilience and strength. Palestinians have an unyielding spirit and a deep will to build a better, peaceful future. Living through hardship and repeated conflicts has shaped them into people with remarkable creativity, ingenuity, and skills that are rare to find elsewhere. We deserve the chance to live, to learn, and to contribute."

6 References

Betts, A., Bloom, L., & Weaver, N. (2015). *Refugee Innovation—Humanitarian innovation that starts with communities*. Humanitarian Innovation Project, University of Oxford.

Budinoff, H., & Subbian, V. (2021). Asset-based Approaches to Engineering Design Education: A Scoping Review of Theory and Practice. *2021 ASEE Virtual Annual Conference Content Access Proceedings*, 36727. https://doi.org/10.18260/1-2--36727

Cun, A. (2024). Beyond "dangers" and "hardships": An asset-based exploration of a resettled refugee student's interest and experience in science. *Pedagogies: An International Journal*, *19*(4), 612–627. https://doi.org/10.1080/1554480X.2023.2282995

Edelman, N. L. (2023). Trauma and resilience informed research principles and practice: A framework to improve the inclusion and experience of disadvantaged populations in health and social care research. *Journal of Health Services Research & Policy*, *28*(1), 66–75. https://doi.org/10.1177/13558196221124740

Elo, S., & Kyngäs, H. (2008). The qualitative content analysis process. *Journal of Advanced Nursing*, *62*(1), 107–115. https://doi.org/10.1111/j.1365-2648.2007.04569.x

Lester, H., Ryakhovskaya, Y., & Olorunnisola, T. S. (2023). Asset-based community development approaches to resilience among refugees and recent migrant communities in Australia: A scoping review. *International Journal of Migration, Health and Social Care*, *19*(2), 77–96. https://doi.org/10.1108/IJMHSC-09-2022-0098

Martin, L., & Wendell, K. B. (2021). Reflections on Asset-Based Pre-College Engineering Education to Promote Equity: An Introduction to the Special Issue. *Journal of Pre-College Engineering Education Research (J-PEER)*, *11*(1). https://doi.org/10.7771/2157-9288.1325

Oesch, L. (2020). An Improvised *Dispositif*: Invisible Urban Planning in the Refugee Camp. *International Journal of Urban and Regional Research*, *44*(2), 349–365. https://doi.org/10.1111/1468-2427.12867

Samuelson, C. C., & Litzler, E. (2016). Community Cultural Wealth: An Assets-Based Approach to Persistence of Engineering Students of Color. *Journal of Engineering Education*, *105*(1), 93–117. https://doi.org/10.1002/jee.20110

Tomaszewski, B., Tibbets, S., Hamad, Y., & Al-Najdawi, N. (2016). Infrastructure Evolution Analysis via Remote Sensing in an Urban Refugee Camp – Evidence from Za'atari. *Procedia Engineering*, *159*, 118–123. https://doi.org/10.1016/j.proeng.2016.08.134