Mitigating Rural Flight: The Role of a Place-based Engineering Curriculum in Strengthening Community Assets (Traditional Research Paper)

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Abstract

Education research in rural communities often delivers a deficit perspective on professional opportunities for teachers and students, regularly underscoring the challenges of recruiting and retaining a college-educated workforce in rural spaces. Recent literature in rural education urges the cultivation of a positive outlook: recognition of what existing community assets can provide to rural residents in order to combat "rural outmigration." In this paper, we discuss curricular development and participant perceptions during an asset-focused, community-based engineering design program, "DeSIRE" (Developing STEM Identity through Research and Exploration). As a National Science Foundation (NSF) Innovative Technology Experiences for Students and Teachers (ITEST) project, DeSIRE is a school-university-community collaboration (SUCC) with goals to broaden participation in engineering and strengthen the science, technology, engineering and mathematics (STEM) identity of minoritized middle school students and teachers in a rural southeastern state. Operating in two middle schools since 2020, DeSIRE features a formal, three-part manufacturing engineering curriculum that was designed around the commodities of local industry partners in the areas of biopharmaceuticals, food process engineering, and energy systems. Through collaboration with companies including Pfizer, Cummins, Kaba Ilco Corporation, LS Cable & System, Hitachi, and Poppies International, students were exposed to project-based content grounded in local STEM career opportunities that would enable them to pursue fulfilling careers within the community they are from.

Using a Rural Cultural Wealth framework, we provide a lens on how curricular development and implementation of the DeSIRE course highlights rural ingenuity and resourcefulness in order to address the community's need to bolster the engineering workforce. Further, using qualitative data analysis of student focus groups and teacher interviews, we present multilevel findings of how the program has supported and strengthened the way students and teachers think about opportunities in their rural space. This paper serves as an informational tool for K-12 schools, universities, and engineering industry and community partners toward the development of new partnerships, as well as a hopeful demonstration of how SUCCs can shift the mindset of participants to potentially reduce rural flight.

Keywords: school-university-community collaboration, rural cultural wealth, research-practice partnership, community engagement, rural engineering education, middle grades education

Introduction

Rural flight or *rural outmigration* is a commonly-referenced phenomenon in sociology and rural education literature. The term refers to the outmigration of people from rural areas to urban or

suburban areas, specifically for the purpose of finding better economic opportunities, improved living conditions, and access to amenities [1], [2]. People from rural spaces may choose to leave their communities because of deeply-rooted perceptions that include limited job prospects, inadequate education and healthcare facilities, and a perception of a higher quality of life in urban centers [3]. Rural flight has contributed to significant declines in rural population over decades and as a result, rural areas have had to grapple with a shrinking labor force that challenges the sustainability and inhibits the growth of small towns.

In educational contexts, rural flight may also be referred to as "brain drain" [4]. Brain drain refers to the emigration of well-educated rural people to urban areas to seek better educational and professional opportunities. Brain drain is especially used in reference to students interested in science, technology, engineering and mathematics (STEM) careers, as many STEM-related careers require a four-year (or more) advanced degree that essentially forces the rural student from their community in order to attend university [5]. Moreover, once the student receives the college-level education, they are more likely to stay in the urban area because jobs that are not in rural places tend to have higher salaries, advanced research and work facilities, and better resources for personal and professional development [6].

Rural flight is a large issue not only in STEM fields, but also in teaching and education. In the context of teacher recruitment and retention, rural flight refers to the phenomenon where qualified teachers, particularly those with specialized skills and experience, are attracted to and prefer teaching positions in urban or more affluent areas over rural or remote locations [7]. This trend can result in a shortage of qualified educators in rural schools, leading to challenges in providing quality education to students in those areas. This trend is especially notable for STEM teachers, which can be considered "specialty" content areas given the national drive for STEM education in recent decades [8]. While there are significant barriers to rural teacher recruitment and retention, such as limited professional development opportunities and inadequate pay, there are also benefits to rural schools that are often overlooked. For example, many rural teachers express a great sense of belonging within the community as well as support from colleagues and the broader community, especially if they were also raised in the area [9]. To sum it up, rural teacher recruitment is more than content specialization; it is also social in nature, and success as a rural teacher can be dependent upon knowledge of existing community assets and people [10].

Using an Asset-Based, Community-Engaged Research Approach

Utilizing community-engaged research approaches with a focus on existing rural assets involves multi-stakeholder collaboration in order to identify, understand, and leverage the strengths and resources within rural communities. Instead of using a deficit-based lens, where rural spaces are seen only through their challenges and insufficiencies, researchers must recognize that rural areas already possess unique strengths, including cultural richness, local expertise, natural resources, social

networks, and more, *without their intervention* [11]. By emphasizing these existing assets, researchers can work alongside community members to co-create sustainable solutions that build upon local strengths, which fosters a sense of ownership and empowerment within the community [12]. By taking an asset-based approach to rural education work, research can lead to more effective and culturally responsive outcomes while facilitating a deeper understanding of the community's needs, challenges, and aspirations [13]. Ultimately, the hope is that by attending directly to what the community expresses as needs rather than what the researcher sees as needed, the work will have a longer-lasting, more significant impact on the community.

Conceptual Background

To inform our study and guide our analysis of the data, we used the Rural Cultural Wealth (RCW) framework by Crumb et al. [14]. The RCW framework includes four tenets that are "grounded in asset-based ideology that acknowledges rural residents' multiple strengths and resiliency strategies": (1) rural community unity, (2) rural resourcefulness, (3) rural familism, and (4) rural ingenuity (p. 4). These tenets are briefly described in Table 1 below.

Table 1. Definitions of Key Tenets of Rural Cultural Wealth

Concept	**Key Definition**
Rural Community Unity	Describes the way that rural communities have the ability to effectively collaborate in order to address crises, disasters or other social tensions.
Rural Resourcefulness	Refers to the way that rural people overcome social limitations through resilience and self-advocacy.
Rural Familism	Describes the cultural capital that lies within collective generational care within familial networks (kin) for the goal of gaining upward mobility and combatting oppression or adversity.
Rural Ingenuity	Refers to the way that rural people (or schools) come together to develop innovative solutions to shared community problems using social and/or human capital.

Using this conceptual framework as a backdrop, we sought to explore how the curricular development and implementation of the DeSIRE course highlighted rural assets, particularly rural ingenuity and resourcefulness, in order to address the community's need to bolster the engineering workforce to prevent rural flight.

The Role of the Industry Partners: School-University-Community Collaboration (SUCC) Development

During the development of DeSIRE*,* one objective was to leverage existing community partnerships – what Crumb et al. refers to as "school-community-university collaborations", or SUCCs – to bolster efforts in building STEM workforce capacity in two neighboring rural counties [14, p. 8]. In the initial stages of project development, school district-level administrators connected us with a local community organization, which we will call Connect (pseudonym), whose mission is to improve educational opportunities for students in the target area by facilitating collaboration between local schools, community colleges, community-based organizations and employers. Through Connect, the project team has been able to forge connections with six local companies including Pfizer, Cummins, Kaba Ilco Corporation, LS Cable & System, Hitachi, and Poppies International, all of which had existing partnerships with Connect to bring STEM opportunities to K-12 students in the county.

Professional representatives from those companies have collaborated on the DeSIRE project in a number of ways, specifically (a) providing support in the development of course content and(b) serving as guest speakers in the classroom(s) and at DeSIRE events. Input from the industry representatives was sought throughout the project regarding the vocabulary, skills (technical and essential), and knowledge necessary for students to be successful in their respective industries. While the project development and implementation would not traditionally be considered participatory or action research, the project team has made a concerted effort to incorporate the input from our industry partners into the content of the advanced manufacturing course, with a goal to create *authentic* engineering design experiences and activities for the students.

School-University-Community Collaborations (SUCCs) as a Solution to Rural Flight

Crumb and colleagues [14] theorized the concepts within Rural Cultural Wealth (RCW) as a derivation of Yosso's 2005 [15] Community Cultural Wealth framework. We have previously used the common terminology of "research-practice partnership" to describe our work on DeSIRE*,* but the use of SUCCs here is intentional and points to the need for community-engaged work from outward-facing, public universities. SUCCs can also be an effective format for power sharing, as university-situated researchers can help connect rural schools and community leaders to state or federal funding that they may not otherwise have access to or the bandwidth to pursue [14]. Crumb et al. [14] determined that while relationship building within the community of work can be a lengthy and socially complex process, it is "fundamental to establishing transformation in rural

schools whose leaders and approaches are historically entrenched in deficit ideology" (p. 8). As a major goal of this project and this study, we are actively challenging deficit ideology about rural schools by boosting communication about existing community assets through the context of curricular development, teaching, and learning.

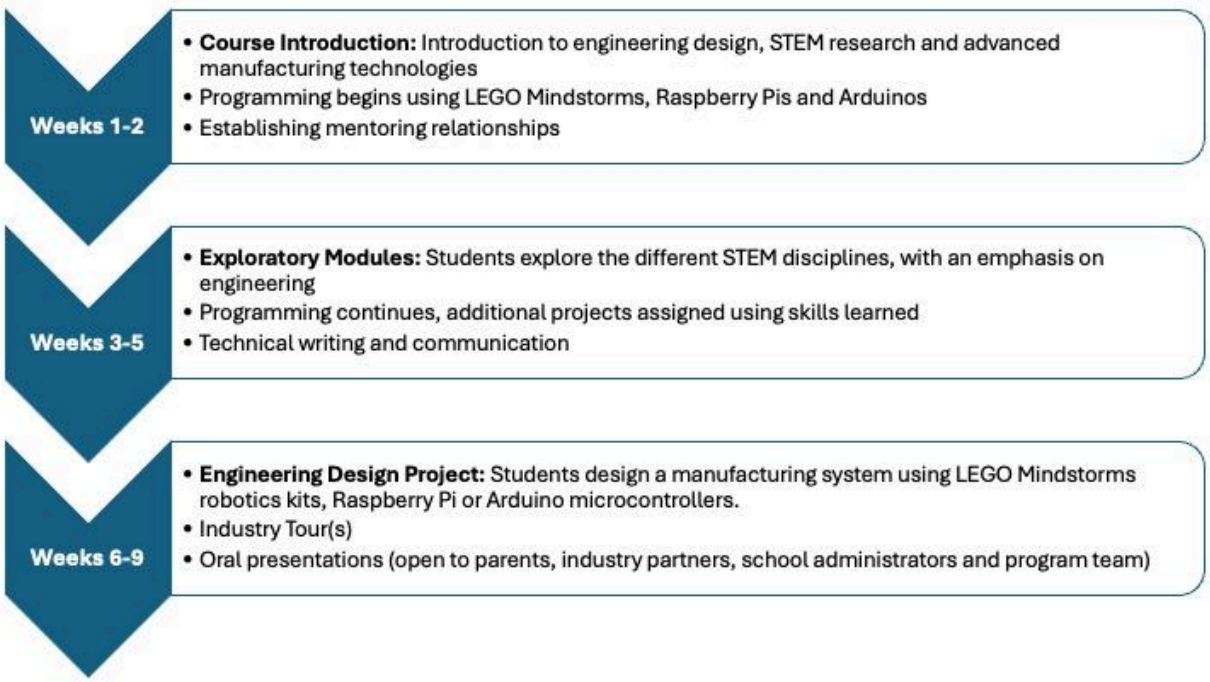
Context: Curricular Development for the Engineering Design Course

This project features a hands-on, three-part engineering design elective course for middle grades (6-8) students. Over the course of the three middle school years, participating students engage in engineering design experiences aligned to local advanced manufacturing technologies and practices in three areas: food science, pharmaceuticals, and energy systems. One or more companies represented within industry partnerships fall into each of the content areas, allowing students to make clear connections between professional opportunities within their community and the information presented in class. The project-based course content offers opportunities for students to engage in growing soft skills like critical thinking and collaboration, as well as technical skills with tasks such as building circuits and learning computer coding. Students in the program have participated in industry and university tours, and also receive mentoring from engineering college-aged students who come to their school during the DeSIRE class period. Lastly, a subset of interested students may opt to participate in a university-sponsored STEM program which offers recurring Saturday programming and a summer camp experience.

There are two curricular developers for the course: (1) a retired engineer, and (2) a former K-12 STEM teacher, both of whom now work to create STEM outreach opportunities for children. With input from industry partner representatives and the two program teachers, the curriculum developers created a dynamic curricular guidebook that includes engineering content, a variety of activities, and comprehensive lesson plans that are used by the teachers. All information can be customized to meet specific school and student needs, within the pace of a traditional nine-week class time frame (shown in Figure 1 below). Specialty materials needed to conduct lessons (e.g., Arduino boards, mousetraps, materials for 3D printing, etc.) are mailed to each school as requested from the university partner.

One teacher from each school has received customized professional development and coaching to learn the course content in the curricular guidebook and associated pedagogy needed to teach the information to students. A minimum of forty hours of professional development are offered during the summer and at various points throughout the school year. Additionally, the curriculum developers have worked diligently to develop meaningful relationships with the teachers. These relationships have allowed teachers to feel confident and comfortable contacting the curriculum developers on an ongoing basis for support as needed throughout the project [21].

Figure 1. Sample 9-Week Curriculum Template for Engineering Design Course



Purpose of the Study

The purpose of this study is threefold. First, we seek to contribute work that casts a positive, opportunities-driven light on engineering opportunities for rural students, teachers, and community partners. Second, this paper and the DeSIRE project will serve as a case study for other community-engaged engineering education researchers to use for their own school-university-community collaborations. Third, through qualitative methods, we aimed to answer the following research questions:

1. How and to what degree does the engineering design-focused program impact teacher STEM content and pedagogical knowledge and awareness of STEM educational pathways and occupations?
2. How do school-university-community collaborations influence student and teacher perceptions on proximal workforce opportunities within their rural space?

Methods

Qualitative research can gather data that spans beyond quantitative research, where meaning making and understanding the details of human experiences are the primary goal [16]. Details that may not be shared through collection tools like numerical data on student outcomes are examined further in traditional qualitative methods. Given that the purpose of this study is to uncover the perceptions of

the teachers and students of the DeSIRE class, a qualitative research design was the best way to achieve this purpose.

Participants

We utilized three methods of qualitative data collection in the form of focus groups, interviews, and observations with the students (n=145), teachers (n=2, one at two different rural middle schools), and STEM outreach professionals (n=2, employed directly by the university partner).

Here we make two notes about the teacher participants. First, rurality is at play, and the two middle schools in question are small: one school serving approximately 300 students total and the other serving approximately 120 students total. Because of this, the engineering design course ran as an elective class, and only one teacher taught the program at each school (n=2). Second, in rural schools, it is a common occurrence for teachers to take on multiple roles, which occurred in this project [In the initial phases of the project, we sought to identity *engineering teachers* in rural schools to teach the curriculum we developed. However, teacher attrition became a problem. Over time, two "digital literacy coaches" at the school – one who was a prior history teacher and another who was a prior career and technical education teacher – became the primary engineering design course teachers at each school. As they taught the engineering curriculum as an elective course, they also both continued to serve their schools as digital literacy coaches.

Data Collection and Analysis

Focus groups were conducted with student participants (n=8) and served as an opportunity for us to schedule conversations with multiple participants at one time in order to not take up too much instructional time. Additionally, our intention was to provide a comfortable and collaborative space for the students to share their experiences with us as researchers and to maintain engagement after hearing each other share their thoughts [17]. Individual interviews were conducted with the teachers and industry partners and allowed them to share more detailed and intimate information with us that may not have been shared in a more public, open space, but also allowed us to utilize probing questions to get to the details of an experience through a reflexive process [18], [19]. Finally, classroom and special event observations were utilized to get a better understanding of the physical layout of the class and to further understand the learning and social dynamics between students and with the teacher in a natural setting [20].

We chose to analyze the data together in order to identify overarching themes across the participant groups. We did this for two reasons. First, to build richness in our data set even with a small sample due to the small school populations. Second, this study investigated the influence of a strategic SUCC on teacher *and* student perceptions of what the local community could offer in terms of the workforce. In this case, both the teachers and the students were equally vulnerable to rural outmigration. As such, the intent of the analytic approach was to uncover a shared experience regarding the potential of rural outmigration – by place, not by role – for the purpose of creating a shared cultural voice.

Findings

Through multiple interviews, focus groups, and observations with students, teachers, and industry partners over the course of four years, our research team deductively identified five major pathways that illuminate how school-university-community collaborations (SUCCs) can capitalize on existing rural community assets for the purpose of reducing rural flight: (1) using industry connections as a mode of strengthening teacher identities, (2) demystifying community assets through engineering exploration, (3) addressing student and school needs through SUCC engagements, (4) addressing student misconceptions about engineering as a career option, and (5) investigating school-community advocacy for STEM education. Below is a description of each finding, with a sampling of elaborative quotes from participants for the purpose of illustration.

Industry Connections as a Mode of Strengthening Teacher Identities

One of the most significant, yet incidental, findings from DeSIRE is the engineering identity development of the teachers over time. This project initially sought out to understand how, if at all, a middle school engineering design course could influence *student* self-efficacy and interest in advanced manufacturing engineering. However, through hands-on professional development that included just-in-time training from university-funded STEM outreach professionals, the two participating *teachers* began to gain competence and confidence in teaching engineering to their students [21]. This finding was particularly salient because neither of the teachers were STEM teachers prior to their participation with DeSIRE. Instead, both of them were in "digital literacy coach" roles within the school, and taught other subjects (career and technical education, and history). One teacher gained such an affinity for the advanced manufacturing engineering content that he independently sought out a summer externship hosted by one of the local engineering industry partners:

> Actually, I signed up to be part of the "Teacher At Work" program and I was lucky enough to get in there [at Industry Partner]. And so, I spent four days at [Industry Partner] and crawled the plant from one end to the other. So I have a better understanding of what to tell people. The [Career and Technical Education (CTE)] department has always taken tours of a lot of the businesses so that we would be able to tell and show students what was available for their future. So I know there were a lot of things that are available, but not only that, we also know how fast things are changing. Here's an example. When I went to [Industry Partner], when I worked here at this school in 1998, we took all the students to the plant for a tour and they had this little golf cart train and they drove us all through the plant. Well, 1998 was 24 years ago. There was only one section of that plant that has the same equipment in it, that everything else has been changed.

This teacher had been employed by the school district for more than 20 years at the time of the interview, and as we talked, he discussed his perceptions of how the rural community had changed

over the years. Not only did his experience with the "Teacher at Work" program change his perception of the local engineering industry, but he also developed a positive self-perception of himself as a *problem-solver*, as he took direct action to obtain professional development (PD) opportunities that he might not have otherwise had a chance to participate in. The teachers' interest in developing engineering content knowledge on their own time also advanced their pedagogical content knowledge (PCK). One teacher expressed that through PD for implementation of DeSIRE*,* he gained pedagogical skill in allowing students to lead and "fail" as an important part of the engineering design process:

> So, one thing that I've shifted to, I guess, during this class, is letting students take the lead. I think with it being more project-based, it's natural to let students take the lead, but we are following the motto of failing forward here at our school. And so, we take that with fidelity, and we make sure that our students are understanding that there is a time and place that failure is okay, because we learn from that and we step forward from it. And so, I'll give an example of the hand sanitizing dispenser that we created. I gave students the challenge, and then that was it. I didn't give them directions on how to do it. I gave them hints and tips and I was a thought partner with them, but they took the lead. And I think that might be the most powerful thing that we can do for students. Because when they finally achieve it's like, wow, I did that all by myself. And that's a really powerful thing that you wouldn't want to take away from anybody. So, I would say that'd probably be the biggest lesson.

Engagement in the experiences provided by the industry partners, such as activity relevance in biopharmaceuticals (inspired by an industry partner) and teacher externships, allowed for teacher self-exploration that resulted in stronger identity alignment with role of "*rural engineering teacher"* with the goal of reaching more students:

> I know that in the beginning, it was the pipe dream to have this STEM teacher come in and do these STEM things, and link it to advanced manufacturing and stuff. But unfortunately with our teacher pool here in the state, and I guess me being a perfect example, knowing that you don't have to have STEM content background in order to make it work is refreshing within itself. Because for instance, we're still struggling to find a math teacher, and we start school in a week and a half. So, how can you find a STEM-only teacher? A lot of [rural] districts, they're not going to be able to do that successfully. But having a way of building and promoting self-efficacy through professional development modules and sessions would help ease that burden, I think, and show that it doesn't have to be a STEM person. It could be anybody.

Demystifying Community Assets through Engineering Exploration

During focus group discussions with the student participants, we found that DeSIRE was facilitating new perceptions about how the advanced manufacturing engineering industry partners operated

within their rural community. Here, we heard from two students about how they were "seeing" the industry in the area for the first time:

> STUDENT 1: I learned that things are more than you see it, because when you in this area, and in [the next county over], when you drive around, you see a bunch of [Industry Partner] buildings. And I just thought it was just a building. And then when I learnt about it, you learn about what's inside of it. You know what they do. And it just gives you a different perspective, because it's like…this thing's been in front of you all this time, and you ain't know nothing about it.
>
> STUDENT 2: And learning about the progress it takes to manufacture all of these items, the stuff, it's really interesting.

We also found it significant that when most of the students talked about gaining understanding of what jobs were available within the local advanced manufacturing engineering companies, they did so within the bounds of their interactions with their DeSIRE teacher:

> We worked with our teacher, and he was talking about a bunch of different companies, and he mentioned a DeSIRE industry partner. And coming into this, I didn't realize how many different things could be a part of STEM. I just thought it could be electricity and that kind of stuff.

Earlier, we provided an excerpt from an interview with a teacher who did an engineering externship. During the externship, despite spending only four days in the plant, the teacher was able to identify what his students would be doing if they were to obtain jobs in the plant after graduation because he participated in industry-developed "teacher training" and watched engineering happen in real time. This salient experience not only strengthened his connection to engineering, but also to the importance of emphasizing existing local community assets to his students:

> So talking about all these things [how the items are made locally], I think helps the students realize what is available. And I also explained to them, a lot of companies have to hire from outside of the state to fill a job…they can have a different experience. Our students live here, their families are here, their friends are here and they need to know that there are good paying jobs right here, where they can be happy and still be near their families. You probably realize this, but a lot of grandparents move from wherever they are, to where their children are to help them with their grandchildren. Well, that would eliminate worker shortage and it would eliminate all that stuff. And people would just have a better life. And it's a win-win situation for everyone.

Addressing Student and School Needs through SUCC Engagements

In the third year of DeSIRE, the two participating schools and the university partner collaborated to develop a "Student Showcase" event that included opportunities for student participants to engage with community members. A number of groups were invited to the event, including the project industry partners, school administrators, and the students' parents and families. In preparation for the showcase, the students worked together in groups to develop an academic poster that highlighted some of their work that was related to the advanced manufacturing content they were receiving in the DeSIRE course.

Direct observations during the event revealed a significant shift in power dynamics between the students and the "adults" (industry partner representatives, parents, teachers and administrators). As the students presented in a rented, shared community space, the industry and university partners were encouraged to speak directly to the students and ask them questions about their work. By allowing for reciprocal teaching, wherein the student teaches the "experts," the students were able to see themselves within the role of a leader in the context of engineering education. Professionals not only asked the students about their work on display, but also about their future career goals. Through opportunities to discuss their *imagined futures* within rooms of local industry partners, families, and other community members, students demonstrated a clear understanding that there were work assets within the community that they could be part of once they graduated high school, if they so desired. Furthermore, interpersonal connections were built between the students and the industry partners during this event that may lead to the opening of doors for student co-ops, internships and careers upon education completion (high school or higher education).

While there were clear advantages to the student showcase event, there were also implementation challenges. As noted in the methodology section, the two middle schools that participated in DeSIRE, are very different demographically, despite being in the same county and school district. As one teacher stated:

> But then the other school had trifolds, and then I was questioned, "Why don't you have trifolds?" I was like, "Well, I didn't know I was supposed to bring trifolds." They brought their Arduino boards and they're lighting it up and they're showing…I didn't know they had to have a trifold. Just little things like that.

When he said that he was "questioned," he is referring to a conversation he had during the event with his school administrators. These small social wedges that existed as a result of socioeconomic (and therefore, resource) inequality between the two schools at times led to chasms within the broader partnership, as described here by one of the DeSIRE program administrators:

> It starts with leadership. It starts with, when I say leadership, I'm speaking of the K-12 school that's being partnered with. That school commitment to the project itself. That commitment to

> their students and expanding their student technical vitality, enrichment, learning something that will expand beyond their traditional math, reading, and basic core curriculum. So if you don't have an education leadership that sees the value…I'm trying to put this into context that if you can't create an ecosystem that starts with buy-in, as well as the dynamics of bringing in two schools together, or multiple schools that in themselves have different dynamics in terms of the socioeconomics that the students, as well as the parents, bring to the table, because now you have a different dynamic that those parents expect in some cases.

Because it was a purposeful integration between the two schools, the school showcase event put the differences in resources and needs on full display in front of all partners within the SUCC. The impact of bringing or not bringing a trifold may seem insignificant, but in conversations with the teachers following the event, the research team uncovered some deeply-rooted insecurities in appearing *less competent* than desired in front of industry professionals, university professionals, and school administrators. This is an important consequence that university collaborators should note when working with school teachers, as will be discussed further in the section on implications and future directions.

Addressing Student Misconceptions about Engineering as a Career Option

Widely represented in engineering education research, student participants in the program came into the *STEM program* course with remarkable misconceptions about what engineering is and what engineers do. When asked what parts of the project were going well, one teacher participant shared the following:

> I think one of the things that we're doing well is building their capacity of understanding, to know that they're capable of doing it. I think when people hear the word "engineer" or "STEM" anything, they have this fallacy: it's got to be really hard, or I can't do this. And then just trying to make it more tangible for them to see that, no, I just gave you a task and you reached the end goal and you have a working product, so clearly, you can do it. I think [that] is probably the biggest takeaway.

While this might sound like a simple accomplishment of effective pedagogy and instructional strategy at play, we emphasize that because the teachers in DeSIRE were not STEM teachers, they had to sufficiently combat their *own* misconceptions about engineering before they could guide student understanding about engineering. The STEM outreach professionals who conducted the teacher professional development sessions for the project had to specifically target these misconceptions: "We just reemphasize working with them from where they are, understanding their baseline, and giving them respect, giving them time and never making them feel pressure."

Through careful PD sessions with the curriculum developers, the teachers on the project were able to scaffold their engineering content knowledge based around previous experiences with engineering or

related concepts, creating new schemas for engineering teaching and learning. One of the projects in the class required students to use Arduino boards and Tinkercad to model how stoplights would work within their rural community, with special attention to school traffic flow and community dis/ability needs. One teacher talked about how that activity led him to see engineering in a new light:

> All the time I just taught CTE. I was never really interested in coding. I knew that I was interested in technology and manufacturing and students doing, having, and obtaining goals and being successful in their [career or job] search. But DeSIRE has allowed me just to connect manufacturing and technology together. So this past year, in our county here, [a community organization] has a competition where one group of students has to invent something. And another set of students had to create a machine and then take a robot and program the robot. And it's a big competition. The coding is a huge piece and is been made so much easier over the years…when I coded in college, I had an eight inch floppy disc, put it in the machine and I used Basic and we had to type in every letter. And so, coding has completely changed, but the relevance of coding has just become more and more and more important in everything that we do. So I think combining technology and coding to get the technology to do exactly what we want to do is the ticket.

This teacher also saw DeSIRE as a way to help students make sense of available career opportunities to address national, community, and personal needs:

> What I have always explained to students that this was about manufacturing. And some of the jobs and abilities, the opportunities that they would have in manufacturing. So I go down through the list of sponsors…working at Industry Partner (IP) 1 or IP2, or IP3 or IP4 or IP5, they're all completely different. And so someone would think, "Well, I don't want to stand there and make cupcakes all day or put frosting on cupcakes all day, but I don't want to get dirty and work on an engine all day." I'm just broadening their knowledge of how everything works and on all the different opportunities. I understand, not everyone's going to be an engineer. We use the engineering process to promote the manufacturing design and opportunities, but there is so much more.

Investigating School-Community Advocacy for STEM Education

The fifth pathway is both a finding and a pressing step forward for future direction and research. As one of the teachers explained as we approach the end of the grant period for DeSIRE*:*

> As far as the community, we highlight a lot of what we do on our Facebook. I just don't know. There's not enough publication that I would like that talks about the good things that we're doing. And I brought that up to [project administrators] over the summer about, hey, can we get something out there that highlights the data or whatever it is that you all are pulling together, just showing the growth of the program and growth of kids? And the growth of

> opportunity just so we can say, "Hey, community, this is what your kids are participating in." So I feel like that's a big piece that's missing.

Project dissemination is a critical component of community-engaged work, especially work that is geared toward solving a particular problem within the community itself – in this case, the fact that rural STEM teachers were hard to recruit to the schools and that students who do pursue STEM careers fail to return to the rural community to work. As one student put it:

> Well, when I first heard of STEM, I thought it was just going to be things that deal with electricity and that kind of stuff. I didn't think you'd be open to so many other jobs and stuff. And then when we got here, he [the teacher] told us about it, and I was honestly shocked, because I just didn't think there were that many opportunities that came with STEM.

A repeated theme found in the data from student focus groups highlights this fact that students and families were just unaware of what opportunities even existed locally. If rural flight is of concern to a rural community, it makes sense that one step would be to get information about what is available out into local news sources, as well as school dissemination platforms, just as this teacher recommended:

> Many more of the students are [now] interested in STEM careers. I spoke with a father this morning. He was explaining to me that he wants his daughter to continue on in the STEM field. That seems to be the theme with just whatever parent that I come in contact with. People understand that STEM is important now, always evolving and is going to continue to be really important in the future. STEM can take you in the direction that you want to go instead of the direction that someone else would like to guide you to go.

Discussion

From our findings, there are a series of implications for university researchers, school administrators, teachers, industry partners, or community leaders who seek to replicate this work or use it as an informative model. First, universities who enter SUCCs with the intention of reducing rural flight or encouraging students and teachers to remain in rural areas must address the needs of the community from the perspective of the people who live there. There is a famous saying in rural education that goes, “when you’ve seen one rural town, then you’ve seen one rural town” [23]. Rural spaces are not a monolith, and had our research team entered our SUCC without researcher reflexivity, we may not have uncovered how DeSIRE actually worked within the schools that participated.

Second, while our project team provided teacher PD that included both content and pedagogical skill development, one of the teachers became so invested in DeSIRE that he sought out opportunities on his own. It is notable that this was a veteran teacher with more than 20 years of experience in the district. Early-career teachers, or teachers who are new to the rural area, may need additional support in finding local PD, extension opportunities, or funding. The externship and other local community

events were of great benefit to the teacher who participated, as his engagement in the events ultimately led to a greater connection to engineering as well as a deeper understanding of the community. Further, investment in the development of rural teachers can contribute to a greater sense of connection and happiness within the teacher workforce, which may increase retention and therefore prevent the rural flight of *teachers*.

Third, as students are building their competence in engineering content, there must also be opportunities to exhibit their knowledge gains in ways that promote and affirm their identities as rising experts within their rural space. As demonstrated from the student showcase event, students gained educational autonomy within a state of power sharing, where they got to teach and lead in front of well-known SUCC partners and leaders. Additionally, student participants gained a broader understanding, not only of what engineers do, but of how engineering exists within their rural communities. Students discussed "seeing" engineering companies in their town for the "first time," as if the connection to hands-on activities during the DeSIRE course gave them a new lens through which to see career opportunities within the area.

Finally, we must address that rural people are socialized toward communal language. The Rural Cultural Wealth framework outlines the importance of rural community unity and resourcefulness, and our findings highlight the way that rural people value shared responsibility, power and support. Their educational and professional opportunities should reflect and support these values. Future research on this topic could include power sharing structures and opportunities within SUCCs, the quantitative impact of an intervention program like DeSIRE on student academic outcomes or teacher retention rates, or community and parent perceptions of SUCCs (especially in conjunction with the service mission of public universities).

Conclusion

The purpose of this study was to understand how a school-university-community collaboration could use existing community assets to support the reduction of rural flight, or "brain drain," by influencing student and teacher perceptions of local workforce opportunities. Through meaningful relationship building between various stakeholders, partners contributed to curriculum development, event programming, and general educational support of the teachers and students. As a result, a nine-week middle school engineering design course was created, where curriculum was adapted based on the assets and needs of the community. The findings indicated that the course encouraged student and teacher interests in both the engineering topic(s) and their local community. We conclude that a targeted intervention using community-driven curricular development can positively influence students and teachers interested in engineering education. When the pedagogical focus shifted to include community assets, participants discovered that engineering career opportunities already existed in their local rural space – some hidden in plain sight, like the building they passed by every day – mitigating the pressure for rural flight.

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