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Board 374: Replicating a Community-Engaged Educational Ecosystem: First-Year Findings

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Replicating the Community-Engaged Educational Ecosystem:
First Year Findings

Introduction

With transition to the knowledge-based, mobile, and global economy, STEM skills are increasingly important. They are key to stabilizing and rebuilding our middle class, as STEM jobs generally provide higher wages and have above average job growth [1]. There is, however, a growing divide between those who can and cannot engage. Underrepresented minorities, women, first generation students, and low socio-economic status (SES) students still generally have disproportionately lower engagement and higher attrition in STEM fields. This is critical to both equity and our competitive advantage in the United States [2].

These challenges are compounded in many communities in the United States, particularly the Rust Belt or deindustrialized Midwest, because they struggle more than others to attract, develop, and retain the STEM skills in their workforce. These cities often have poverty rates double the national average, lower educational attainment, and larger percentages of those underrepresented in STEM. So, while attraction, engagement, and retention in STEM disciplines is a national imperative, its *importance within these regions is particularly acute* in order to compete in the knowledge economy.

Through support from an initial *IUSE Exploration and Design Tier for Engaged Student Learning & Institution and Community Transformation* grant, researchers and staff at the University of Notre Dame's (UND) Center for Civic Innovation, developed, piloted, and examined a model leveraging what we know about STEM engagement, project-based learning (PBL), academic community engagement, and asset-based community development [3-12]. The resulting *Community-Engaged Educational Ecosystem Model (C-EEEM, pronounced 'seam')* [4, 13] is now being replicated in Youngstown, Ohio and Louisville, Kentucky through the *NSF IUSE Development and Implementation Tier*. The interdependent network of educational institutions and municipal, nonprofit, and industry organizations that form the C-EEEM collaborative community infrastructure, together with training and real-word applications [4-6, 13-16], contrasts approaches of individual partnerships or disassociated projects. As such, it better targets the engagement, skill, capacity, and economic deficits with which many deindustrialized cities struggle.

By providing a complex context while supporting personalized learning and professional skill building, the C-EEEM design meets conditions identified as the future of engineering education [17]; yet, this learning environment also supports a range of STEM disciplines. The original pilot contributed to our understanding of how to build learning environments that support 1) student outcomes related to STEM attraction, motivation, and retention; 2) student outcomes related to place attachment; and 3) outcomes in the community of the South Bend-Elkhart region [4-6, 13, 14]. This paper presents the findings from the first summer of replication. We provide an overview of implementation, and present statistically significant student outcomes across sites; due to the scale of first year replication, however, we breakout replication sites with only descriptive statistics.

Replication Sites

The C-EEEM replication, as noted, focuses on cities in the Midwest. In part, replication sites were chosen for similarities to the pilot site region, such as a decline in population in the 20th century. Challenges aside, these cities offer corresponding opportunities [18]. Louisville is a special case; despite is losing population each decade from the 1970s on, a county merger in 2003 nearly doubled the population of the city for the following census. Otherwise, as with South Bend and Youngstown, it has disinvested neighborhoods in its urban area and population demographics reflecting a high number of those underrepresented in STEM fields. Historically, these challenges have manifest in as vacant lots, economic stagnation, and reduced tax base and fewer resources to address them – making partnerships attractive community partners.

Youngstown State University (YSU) and the University of Louisville (UofL) are the anchor institutions for the replication cities. For both, engineering serves as the host for the C-EEEM initiative – the College of Science, Technology, Engineering and Mathematics in Youngstown and the J.B. Speed School of Engineering in Louisville. Overall gender and racial demographics for the three schools are generally similar, with notably higher Hispanic and African American populations at UND AND and UofL respectively (Table 1).

Table 1 Anchor Institution Statistics

	%Women Students	%Women Engr	# of Undergrads	Undergrad Racial Characteristics		
				White alone	Black/AA alone	Hisp/Latino
University of Notre Dame	48%	42%	8,833	64%	3%	10%
University of Louisville	55%	23%	15,634	70%	12%	5%
Youngstown State University	54%	17%	11,835	75%	8%	4%

Replicating the C-EEEM

Elements of the Model.

The Community-Engaged Educational Ecosystem Model can be understood as a hierarchy of nested layers (Figure 1); it requires network-building and sustained collaborations not only between and within educational institutions, but also between and across community organizations [19]. These stakeholders form the framework or '**collaborative infrastructure**' in which authentic community-based projects are developed and delivered for the immersive

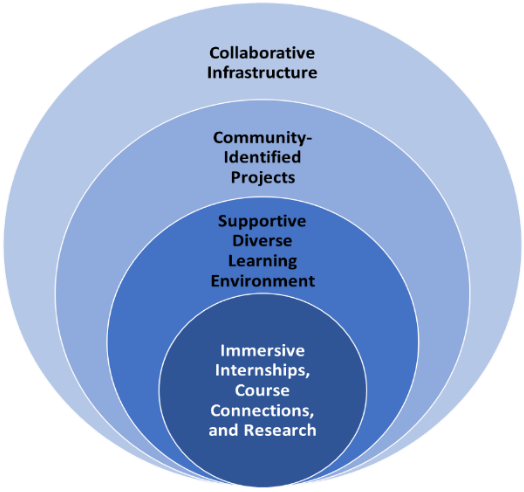

Figure 1 C-EEEM Hierarchy

internships, as well as for course connections to long-term projects and independent research. The sustained collaboration fosters co-created **community-identified projects** that over time are part of larger, complex community issues. Through gradual and steady development of mechanisms within the educational institutions for targeted recruitment and network building for faculty and community mentors, sites create a **supportive and diverse learning environment**. In the South Bend-Elkhart Region and the C-EEEM pilot, building the faculty and community networks for mentorship have enabled faculty training for community-engaged pedagogy and community partner training for working with college-aged project teams. Finally, the **Immersive internship** with reliable deliverables to partners is the center of the C-EEEM; they both seed development and expansion of the partnerships, and provide opportunities for students to fully connect projects and the community.

Implementation of the Replication

To further facilitate the replication, the UND Center for Civic Innovation also developed and shared orientation materials and strategies. These were intended not only to ease the initial launch at each site, but also help to align activities with the overall objectives of the grant – from partnership development to student and community outcomes. Both the Youngstown and the Louisville replication sites relied significantly on the structure and content of the South Bend-Elkhart pilot in the first week of internship delivery. At both replication sites, however, the delivery within this structure was unique; all sites varied activities for team-building and local subject matter experts for the majority of their core training workshops. For example, at the Youngstown site, the Team Building and Leadership module was broken into a Leadership recording provided by South Bend-Elkhart site and Team Building/Team Dynamics workshop delivered by a Youngstown State University faculty member.

The Youngstown Site

As the C-EEEM host, YSU partnered with the Economic Action Group (EAG) in the delivery of the internship. EAG, a community nonprofit involved in redevelopment activities in Youngstown, served as a core collaborator and the Site Coordinator for the Youngstown site replication. EAG worked with the City of Youngstown and YSU to scope three projects in its inaugural year, with two selected for implementation by the students; representatives from each organization served as project mentors. The first intern team worked with Youngstown Division of Code Enforcement on an algorithm to quickly assess vacant lots within a neighborhood to make recommendations for the future of the lot. This assessment tool increased efficiency and capacity in Youngstown's redevelopment efforts. The second group worked with a city engineer to identify a way to more easily assess the repair condition of city roads; this was achieved by designing and piloting a device that attaches to the shocks of a vehicle while traversing target roads. Based on the South Bend-Elkhart pilot underscoring the importance of integrating exploration of 'the cool' of the city into the internship, the Youngstown replication site ensured that there were weekly half-day outings and lunch at local restaurants (see Table 2). Interns concluded their work with presentations at a breakfast event, which was well covered by the Youngstown Business Journal.

Table 2 Youngstown Exploration Activities

Week	Sites Around Youngstown	Local Restaurants
1	Mill Creek Park Tour	Wedgewood Pizza
2	Historical Center of Industry & Labor	Mahoning Valley Restaurant (MVR)
3	Tour of Mahoning Ave. and CRP properties	Primanti Brothers
4	Youngstown Neighborhood Development Corporation (YNDC);	The Federal
5	Team explorations of Mahoning Ave	Casa Ramirez Mexican Restaurant
6	Youngstown Business Incubator (YBI)	Avalon Downtown Pizzeria
7	North of YSU Neighborhood	Dalia's Caribbean Kitchen
8	The Flea	V2 Bar & Grill

The Louisville Site

As noted, the UofL team served as Site Coordinator for Louisville C-EEEM replication site. Faculty, staff, and a doctoral student from the university, as well as collaborating community partners, served as mentors to each project team. UofL scoped three projects with the community in its inaugural year. The first project, Beargrass Creek, will be an ongoing, long-term project where the designated team collects an analysis of debris in Louisville's Beargrass Creek, which feeds into the Ohio River. The goal of the community partner is to 1) demonstrate the ongoing need through analyzed and visualized data, 2) access funding, and 3) engage the City of Louisville more in creek clean-up. The second project examines walkability in downtown Louisville and is also a long-term project with the City of Louisville and the Louisville Metro Government. By tracking and mapping things like heartrate through Fitbit data, data can be translated to stress levels in particular environments and inform urban investments. This will improve walking conditions and reduce things like the urban heat island effect. The third project was focused on bringing awareness and solutions to food security issues in Louisville's West End. The team was focused on access and implemented initiatives to reduce disparities across the broader Louisville metropolitan area. Similar to the Youngstown replication site, Louisville tried to integrate exploration or adventure activities into the internship – the primary one in the inaugural year was a whole-cohort (faculty, staff, all three teams) canoeing trip on the Ohio River in the second week. All of the intern teams concluded their work with both presentations to stakeholders and poster presentations at the University of Louisville.

Methods

The University of Notre Dame, as the pilot site, developed survey instruments modified from the initial pilot and coordinated data collection from students across all three sites. Researchers used the Qualtrics platform to digitally deliver all student data collection instruments. These included weekly check-in surveys for program feedback, reflection prompts intended to strengthen the experiences, and the primary final post-internship survey instrument. Researchers from all sites reviewed and approved the final instruments.

The design of the final post-internship survey began with the original pilot instrument that was informed by findings from place attachment, innovation ecosystems, and high impact practices for STEM motivation and retention [3-12, 20, 21]. From this, researchers augmented the final post-internship survey with considerations for recent research examining Self Determination Theory (SDT)[12, 22, 23] and pedagogical environments [24]; there were many overlaps to relevant items with the pilot instrument, so additions were few. The instrument was a retrospective-pre/post, primarily focused on dispositional shifts using quantitative Likert-type scaling. The retrospective-pre/post has been shown as a more sensitive to estimating shifts in unfamiliar settings [4, 25-27].

Protocols for research for all three sites were approved by the Institutional Review Board (IRB) at the University of Notre Dame. Consent, assent, and parental consent approvals for participation were delivered through Qualtrics forms. Across all of the sites, five students declined to participate, which left a total of 53 participating in the study from which researchers analyzed results. Researchers used SPSS software for quantitative data analysis (i.e., Paired - Samples T Tests, Cohen's D) of the survey information, but summary descriptive statistics and graphics were produced using Microsoft Excel.

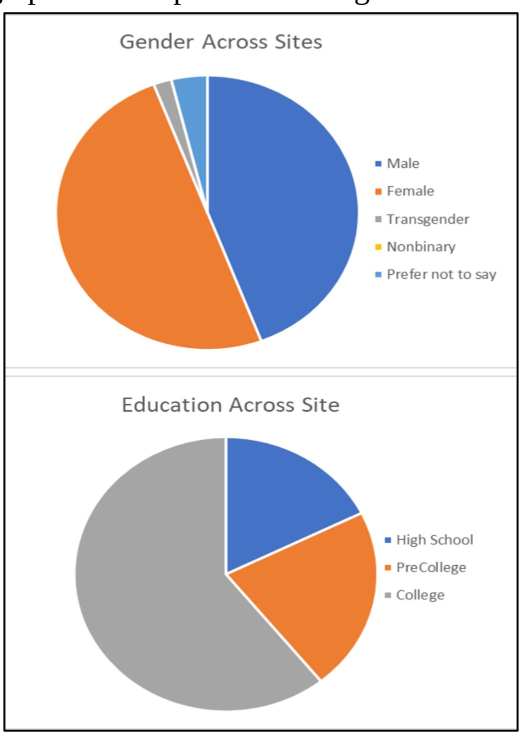

Figure 2 Gender and Education Level

Findings and Discussion

Demographics Across Sites

Age and gender demographics across the sites reflected the long-term aims of the grant with roughly one third high school/precollege and relative parity of male to female participants (43% v 49%) (Figure 2). However, the pilot South Bend/Elkhart site, being larger and having well-developed programming with high schools, impacted the numbers disproportionately. Differences in replication site demographics included lower female recruitment for both Louisville (30%) and Youngstown (14%). For high school participation, replication sites were not expected to have high school representation in the first year of the grant. Nonetheless, the Louisville site was able to recruit two high school students.

Socio-economic status (SES) was also self-described, with more than 25% across the three sites identifying as Lower Middle income to Lower income (Figure 3) In this case, the replication sites showed greater participation of underrepresented groups, with nearly 30% identifying in this category. About 9% across all three sites preferred not to identify their socio-economic status.

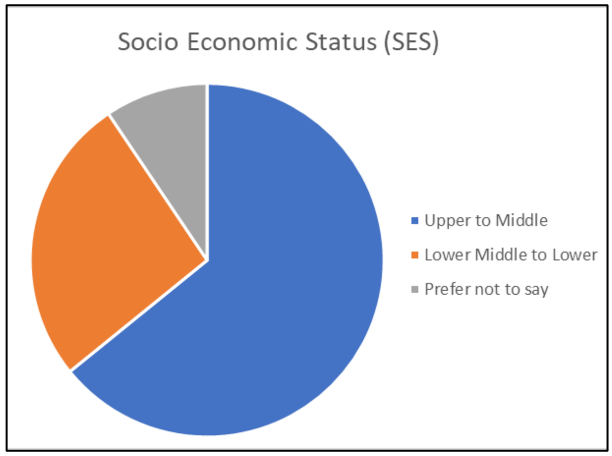

Figure 3 Socio Economic Status

Researchers also asked interns how they self-identify racially/ethnically, with all racial categories expressed without Hispanic ethnicity (e.g., ‘White alone, non-Hispanic’). The distribution across the three sites is shown in Figure 4. Again, the pilot site disproportionately impacted the numbers, with underrepresented minorities (URM) having low numbers. The Louisville replication site had one non-white intern and the Youngstown replication site had two non-white interns.

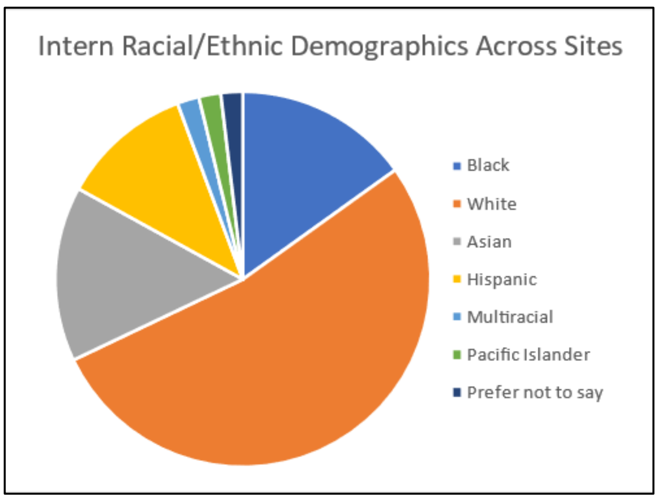

Figure 4 Racial/Ethnic Demographics

Student outcomes

For this paper, key constructs related to the grant outcomes and original findings from the pilot were pulled from the final survey for analysis. These grouped into three broad areas of interest – *contribution and attachment to the region, confidence and experience in STEM*, and *problem-solving and teamwork skills*. Researchers ran Paired-Samples T Tests to determine statistically significant differences student experiences from the internship and Cohen’s D to estimate the effect size of the internship (Tables 4-6). Given the size of the cohorts in the inaugural year for the replication sites, researchers performed both of these statistical analyses across all three sites but broke out descriptive statistics for the replication sites. This allowed for general comparisons.

Table 2 Contribution and Attachment to the Region

Question	TTEST	pvalue	Cohen's D	Effect Size
I feel a connection to the (PLACE) region.	5.16	<0.001**	0.544	Medium
I can make meaningful contributions to society through STEM skills.	3.07	0.0017*	0.379	Small
I can imagine myself living in this region at some point after I graduate.	5.11	<0.001**	0.465	Small
I understand how positive change happens in communities	7.86	<0.001**	0.990	Large
My work will impact others	3.62	<0.001**	0.538	Medium

Table 5 STEM Confidence and Experience

Question	TTEST	pvalue	Cohen's D	Effect Size
I have identified, accessed, cleaned and/or analyzed data in addressing a real-world issue	6.70	<0.001**	0.934	Large
I am comfortable collecting information and analyzing it.	5.18	<0.001**	0.728	Medium
I would do well in a field that uses technical skills.	2.87	0.003*	0.257	Small
I feel confident that I could take things I learn and apply them to challenges in real-world situations.	6.47	<0.001**	0.933	Large

Table 6 Problem Solving and Teamwork Skills

Question	TTEST	pvalue	Cohen's D	Effect Size
I am comfortable speaking in front of groups about my work.	5.27	<0.001**	0.647	Medium
I enjoy solving open-ended problems that do not have a single solution.	4.18	<0.001**	0.326	Small
I am confident that I can manage conflict or tensions when working on a team.	2.84	0.003*	0.348	Small
I know how to apply design thinking to problem-solving in the real world.	8.89	<0.001**	0.990	Large
I enjoy problem-solving with people with different perspectives.	3.52	<0.001**	0.436	Small

Due to response trends and the low likelihood of the internships having a negative impact on most of the outcome domains, the tables (Tables 4-6) show *p values* based on a one-tailed tests. Nonetheless, two-tailed tests were run for all of the questions provided; all were still statistically significant, and most were still highly significant. Based on the Cohen's D statistic, the intervention had a small to large effect size on all of the areas of interest on the grant.

In the replication sites, descriptive statistics for the same areas of interest were visualized to ensure aggregation of data did not obscure important strengths, weaknesses, or differences across the sites. Figures 4 and Figure 5 show the changes interns experienced at each site.

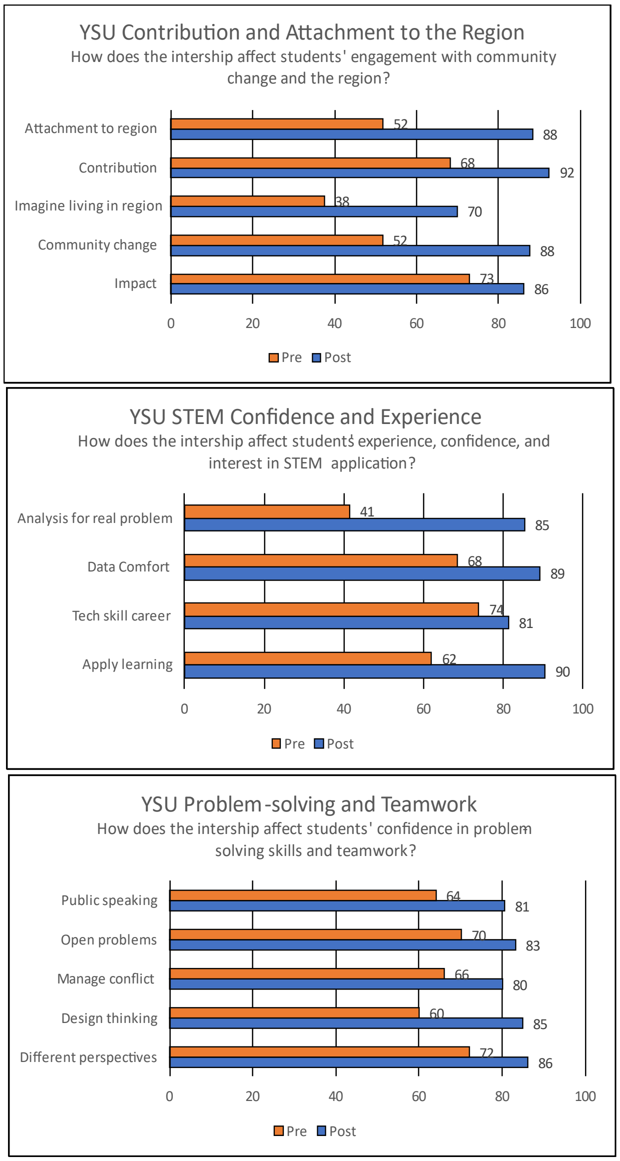

Figure 4 Youngstown Cohort 1 Outcomes

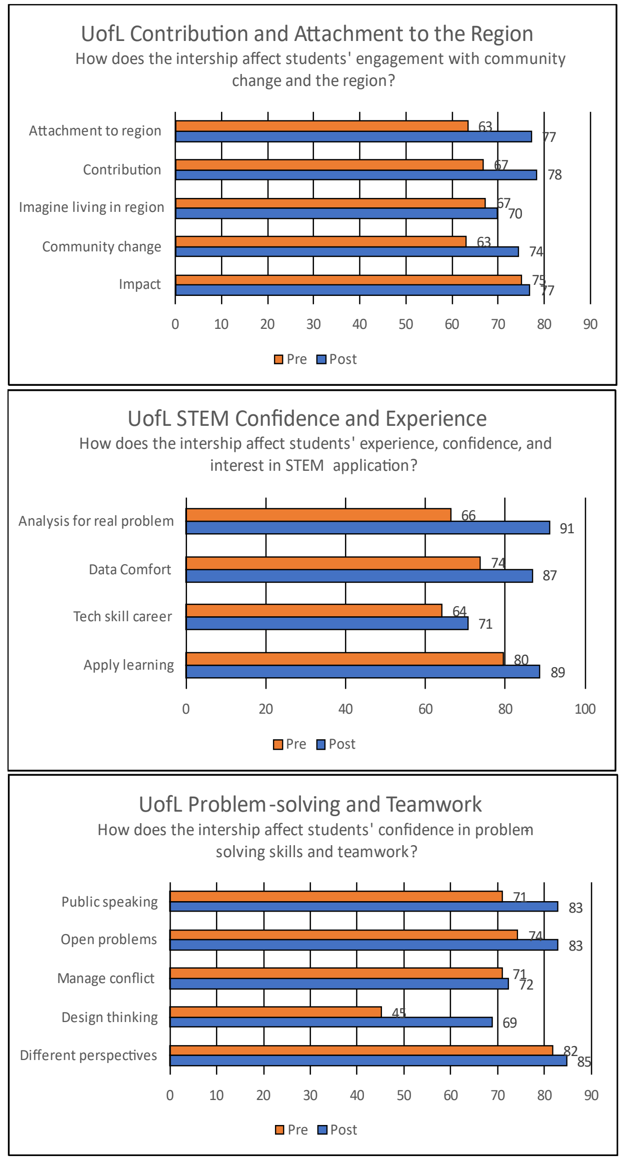

Figure 6 Louisville Cohort 1 Outcomes

While each replication site showed gains across the different areas of interest, it is important to remember that the survey instrument is designed to measure experienced *change*. The closer any individual intern is to the ceiling of their skill or confidence level in a particular area, the less likely they are to see large changes inside of the internship. For this reason, we have referred to it as a ‘gateway’ internship, which would influence recruitment strategies for the higher education institutions.

Community outcomes

In the first year of the C-EEEM replication, the primary community outcomes are expected to be project-based. Across the three sites, interns implemented 16 community-identified projects, with a minimum of one community partner mentor per project. Initially through program coordinators, and then refined by interns, negotiated deliverables for each project with the community partner organization. Products from the work ranged from primary data collection/analysis (e.g., renewables comparison) to piloting new methodologies (e.g., road assessment).

Long-term, C-EEEM sites are expected to see other changes. Beyond the potential for revitalization in the neighborhoods of focus in the respective cities through ongoing projects, the efforts should also show network development over time [5]. As noted, the aim is to build an interdependent 'ecosystem,' whereby educational institutions and community entities form the community infrastructure not only for the real-world projects into which interns contribute, but other initiatives can develop.

To this end, a partnership survey was delivered via Qualtrics at the replication sites to ascertain the perceived benefits and initial network development. All of the responding community partners from both replication sites strongly agreed (more than 90% level of agreement) with the statement *"This collaboration expands the capacity of my organization's work*." Similarly, all of the responding partners indicated that they had both increased the number of organizations that they interact with in the community, and they have deepened or enhanced the relationships with organizations in the community. The response rate from community partners was 50% or above at each replication site.

Implementation – first year lessons learned

Given the aims of the grant and the design of the C-EEEM, diversity is an important component. The original pilot underscored the importance of *multidimensional diversity* [5, 6] into the design – meaning diversity across multiple domains, such as education, gender, race, age, and socio-economic status (SES), to create 'behaviorally complex teams,' which research identifies as correlated with better performance outcomes [28] and greater innovation [29]. To ensure that there is adequate participation of groups traditionally underrepresented in STEM, the recruitment process at each of the replication sites will likely need to be refined over time. This is consistent with experiences with the original pilot in South Bend-Elkhart, as relationships and networks for targeted recruitment developed over the first few years.

In this inaugural year, each replication site approached recruitment differently. The Louisville C-EEEM replication site, similar to South Bend-Elkhart, gathered applications, conducted interviews and assembled three teams with students from a variety of majors and at a variety of levels of education, including high school. For the Youngstown C-EEEM replication site, recruitment of student interns was solely through referral. Recruitment was at STEM students finishing their first year, especially engineering, mathematics, and computer science, but in the end all seven interns were engineering majors. Moving forward, each site will identify networks and approaches that provide a broad array of applications, which may include facilitating the application process for certain groups (e.g., first generation or low SES). Again, at least in the pilot, methods to facilitate recruitment for intentionality toward diversity took time a few years.

Next Steps

The Community-Engaged Educational Ecosystem model approach has a vision for building a regional educational ethos, one where STEM learning through project-based challenges that contribute to long-term challenges in a community becomes the norm. Cultural change is both slow and difficult to measure. Aside from implementation refinements, next steps for the replication efforts will include additional data collection on the contextual elements of the sites. Although the replication cities themselves may have similarities, each region and its anchor institution has a unique set of assets with which to address the broad challenges of its region. Site distinctions affect the form and/or the characteristics of the C-EEEM replication, as the collaborative infrastructure is fundamentally an asset-based approach [4, 5]. Consequently, identifying and documenting assets, deficits, and cultural aspects of the context will help future replications to understand the different approaches to developing a community-engaged educational ecosystem and within what community and institutional settings. This may also allow us to understand the relationship between different approaches to C-EEEM development within a context (e.g., partnership development, collaboration norms) and student and community outcomes themselves. Because our emphasis is on understanding how to build and sustain a stable learning environment for high impact practices, part of this next phase is to also get clarity on how these outcomes create a value proposition for the different stakeholders in the respective regions.

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