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# A Program to Engage Undergraduate and High School Students in Community-Based Research

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## Abstract

Community-based research (CBR) is a practice that engages researchers in collaborative, change-oriented, and inclusive projects in the community. One common example of CBR is university-community collaboration in which students and researchers come up with ideas, perspectives, and knowledge at each stage of the project with the goal to address community needs. The community is mainly involved in identifying the research questions for the projects and making decisions about how the results of the research-focused projects will be implemented. This paper presents a replication of a model focused on university-community collaboration, student engagement and Science, Technology, Engineering, and Math (STEM) attraction and retention using three research-focused projects addressing community needs. The three projects are (1) empathic design project aimed at improving quality greenspaces and pedestrian streetscape experience, (2) food justice project to study the disparities in food access between local regions, and (3) analyzing water quality in a local creek. The projects provided a unique opportunity for students to directly experience and contribute to the research process. In addition, students worked closely with their academic peers and community partners who served as collaborators and mentors. The study reports on the impact of the program on student learning and tendency to stay back in the community. The program's collaborative nature and its effect on students' satisfaction while working on specific projects are also examined. Furthermore, the program helped develop and sustain university-community partnerships. The community stakeholders participating in focus groups were satisfied with the process of identifying community projects and also expressed their satisfaction with the students' work.



**Keywords:** Community-based research, community engagement, project-based learning

## 1. Introduction

The growing criticism of higher education's insensitivity to challenges faced by adjacent neighborhoods and communities, the perception that the intellectual work of professors is largely irrelevant to society, and the growing concern that graduates leave institutions disengaged from political issues have fostered community-engaged research (Strand et al., 2003). Community-based research (CBR), which is a form of community-engaged research, "is a partnership of students, faculty, and community members who collaboratively engage in research to solve pressing community issues" (Strand et al., 2003). In traditional academic research, the research question is developed from existing theoretical or empirical work and qualified researchers conduct the research. However, in CBR, the research question is identified based on a community problem or need, and the research process is conducted by qualified researchers, students, and community members. In addition, everyone involved in the research process is a teacher, learner, and contributor to the final research product which makes CBR fully collaborative. University researchers (i.e., faculty and students) provide research expertise that community members may lack which can be of great value to the desired project outcome. The community members are critical in identifying the research need and questions as well as disseminating and implementing the results. CBR aims to address community problems, especially where its residents are helpless, oppressed, or economically deprived.

Preferred community change evaluation models focus on outcomes to determine if a project had any impact (Stoecker, 2012). One such model is Theories of Change (TOC). The role of community engagement activities, their contribution, and their effect on intended community goals or outcomes can be understood and evaluated using this model (Gooding et al., 2018). According to Janzen et al. (2017), TOC helps in (1) concept clarification and increases the likelihood that partners are in agreement, with a shared understanding of the program (2) providing a comprehensive pathway for the implementation of CBR, and (3) evaluating CBR projects. TOC helps the research team understand how the chosen activities can lead to achieving community engagement long-term goals. To use TOC, the long-term change needs to be identified and the conditions necessary to achieve the change should be established. The TOC approach has been used in a wide range of CBR projects, including those focused on health promotion and environmental sustainability. However, the difficulty of measuring intangible outcomes and the power dynamics between university and community partners can make the evaluation of community engagement challenging (Stoecker et al., 2010).

An effective community-university partnership positively impacts students and CBR project quality. Students involved in CBR engage in active learning. They engage in some activity that forces them to reflect and think about what they are doing (Beckman & Hay, 2003; Michael, 2006) and apply their academic knowledge to community-identified problems (Strand et al., 2003). Examples of activities students engage in include developing questionnaires, conducting interviews, taking field notes, and analyzing data. These activities enable students to learn better compared to textbook-bound and classroom learning where the aim is to absorb information for a period of time and regurgitate it on an exam (Strand, 2000). Through direct participation in community research projects, students better understand community problems and community research contexts and can become essential assets in community building (Anderson, 2002). As equal research team members, students develop leadership, communication, teamwork, problem-solving, and practical research skills. Furthermore, CBR projects provide students with a meaningful research experience (Beckman et al., 2011). The collaborative nature of CBR enhances the quality of research because ideas, resources, and expertise are brought to the table by all participants. For example, the faculty (or university) provides resources for the research, students deliberate about the research problem, and community members bring perspectives, language, and knowledge about the community not known to other research team members.

Creating a collaborative and long-lasting community-university partnership can be challenging. According to Stoecker (2012) one of the challenges that researchers face when engaging in CBR projects is the power dynamic between researchers and community members. Researchers have more expertise and resources than community members which can create an imbalance of power (Israel et al., 1998; Stoecker, 2012). Another challenge of CBR is the lack of trust between researchers and community members (Cargo & Mercer, 2008; Stoecker, 2012). Like other forms of research, differences in belief, language, value, and perspective can make CBR challenging to implement (Wallerstein & Duran, 2010). Despite these challenges, CBR reduces the gap between theory, research, and practice (Israel et al., 1998).

This paper discusses a program that is part of a collaborative initiative funded by the National Science Foundation (NSF) and is being implemented in the U.S. Rust Belt region, which is a region that experienced industrial decline starting in the 1950s. The project specifically targets three rust belt cities: South Bend IN, Louisville KY, and Youngstown OH. The program was initialed by Notre Dame University in South Bend, IN and is replicated to the other two sites. The replication seeks to explore the possibilities of leveraging community engagement activities together with STEM skill development in this region to help improve STEM labor retention. This study mainly discusses the project implementation in Louisville KY.

The term "rust belt" is used to describe cities that are characterized by declining industry, aging factories, and a falling population. "Rust Belt" has been associated with the region of Northern and Midwestern states, primarily around the great lakes; and parts of Kentucky, including Louisville, are included in some designations of the rust belt. Shown in Figure 1 is a sample map of the rust belt counties published online by Lyman Stone, Advisor at Demographic Intelligence, in an article titled "Where Is the Rust Belt?". In this map, the dark green areas indicate places that are Rust Belt. The paler areas are places where there's a case to be made for it, but data suggests there are missing factors to be definitively included in the Rust Belt.

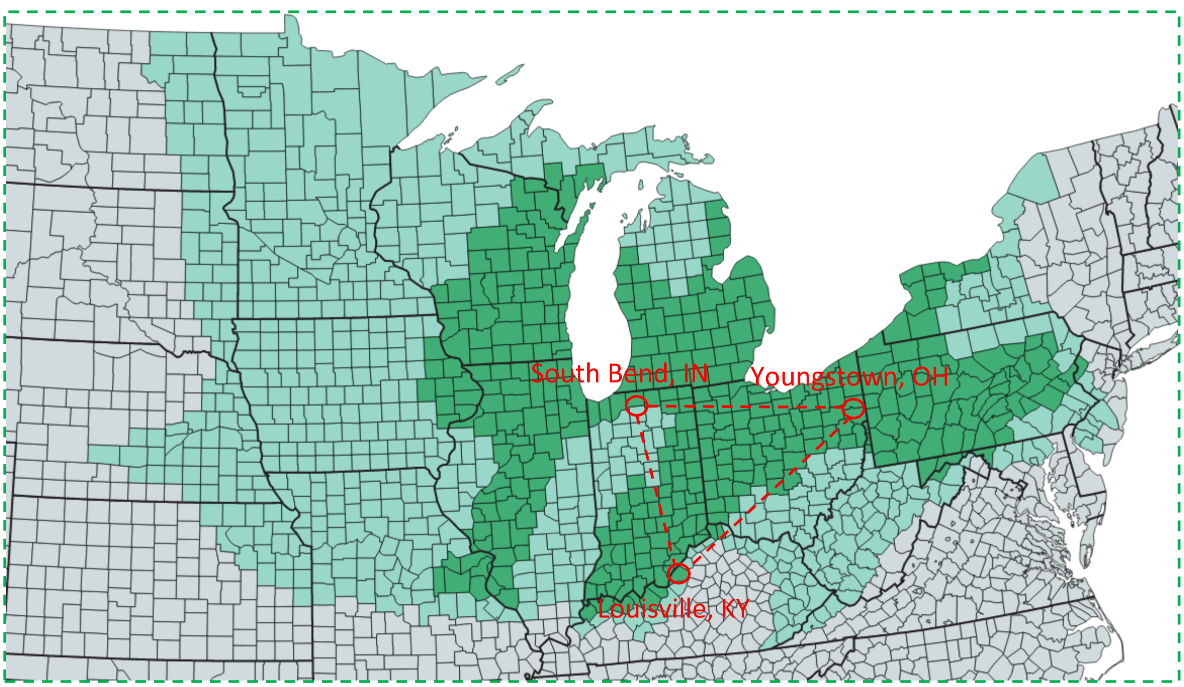


Figure 1: A sample map of the "rust belt"

According to a report by Metropolitan Policy Program at Brookings, Louisville had become highly vulnerable, economically and socially, and the city's worn infrastructure and increasingly depopulated core to its high-wage and strike-prone workforce made it more Rust Belt than Sun Belt. Louisville is commonly described as the northernmost city of the American South and this location has been the dominant influence on the city's history as a regional center of trade, commerce, and manufacturing. Louisville has traditionally been a manufacturing center for durable goods such as appliances, cars, and trucks. However, the city has had high poverty levels and a declining population since the 70s (the City's population decreased from 740,000 in 1970 to 617,790 in 2019). Rust belt cities have an overabundance of real-world challenges in areas such as health, security, and sustainability. Hence, Louisville was an ideal city for the development and study of CBR. The goal of this research is to evaluate the effect of CBR on student learning and the tendency to stay back in the community.

The rest of this paper is organized as follows. **Section 2** discusses literature related to CBR in community engagement and student learning. **Section 3** provides an examination of the Louisville replication from the lens on which the CBR program is based. **Section 4** discusses the implementation of the CBR program. A detailed description of the CBR projects is provided. In **Section 5,** the effectiveness of the program is evaluated. Finally, the conclusions and future work are discussed in **Section 6.**

## 2. The CBR Lens

CBR is often used in fields such as public health, education, and community development to promote social change and address issues of social justice. A study by Minkler (2010) found that a CBR approach led to changes in policies and systems aimed at reducing the health disparities in a low-income, ethnically diverse community. In another study, Minkler et al. (2010) used CBR to study the working conditions and occupational health status of immigrant workers. CBR projects have been increasingly adopted to engage and teach students research methods. For example, Chapdelaine and Chapman (1999) described the use of CBR projects to teach students the methodology for psychology research and the impact on students' learning. Costigan (2020) discussed the use of two CBR projects to advance student learning in research and coursework and illustrate to students what it means for research to have an impact. Mello-Goldner (2019) described the integration of CBR in a two-semester course and its impact on undergraduate students. Through the engagement with external community organizations, students were provided with a larger and more varied data set. In addition, students completed a conference-style poster and learned how to present results to the college community.

Despite the rewards that come with adopting or implementing CBR, it can be challenging to meet community needs and university requirements (McGovern et al., 2021). CBR requires more time and resources than traditional research methods (Strand et al., 2003), and it can be difficult to maintain community participation throughout the research process. Different models and frameworks have been proposed in the literature for sustainable campus-community engagement. For example, Martinez et al. (2012) developed a research-as-curriculum model to engage community members, faculty, and students in public health research. A CBR model for teaching social work research courses was developed by Anderson (2002). The study's long-term goal was to contribute to the community's research skill base. Wood et al. (2019) developed the Bowman Creek Educational Ecosystem to attract and retain diversity in STEM fields by creating a community-engaged learning environment to meet STEM employment projections.

Qualitative and quantitative techniques have been utilized to evaluate the effects of CBR on students, faculty, and the community. Glazier and Bowman (2021) used qualitative data from student evaluations, assignments, and community feedback to evaluate the effect of a research project that brought undergraduate and graduate students out of the classroom and into the community. Wood et al. (2018) collected pre and post-test data using a digital survey instrument that included quantitative Likert-type scaling and qualitative open-ended questions. Data was collected through reflections, interviews, and ethnographic observations to understand the effect of community-engaged STEM projects on students. Furthermore, data was collected from community partners regarding building networks of reciprocity for collaborative project development. Cullinane and O'Sullivan (2020) used qualitative semi-structured interviews to find out students' views on the community-based project, the partnership with academic staff, and what difference the project made to them. This paper discusses the community-based projects worked on by university-community partners and evaluates the effect on students.

## 3. Examining the Replication of CBR Program in the Louisville Site

The framework in **Figure 2** describes the Louisville replication of the initial pilot of the Bowman Creek Educational Ecosystem, from which the Community-Engaged Educational Ecosystem Model (C-EEEM) was distilled (Wood et al., 2020). The C-EEEM program has three core elements which are multi-scale collaborative infrastructure, student learning for STEM and social responsibility, and neighborhood asset-based community development. The long-term relationship development with community partners, which forms the collaborative infrastructure, enables the real-world application of learning by students to co-create projects addressing community challenges. These elements distinguish C-EEEM from many other STEM project-based learning models.

In the first phase of the framework, the project team consisting of students and community partners is identified. In the second phase, from the pool of potential research projects, three projects are selected based on factors such as resources and time constraints. The first two phases represent the inputs that are required to implement the program. In the third phase, the causal relationship between different components of the program and the desired outcome is explored. Detailed descriptions of the phases are provided below.

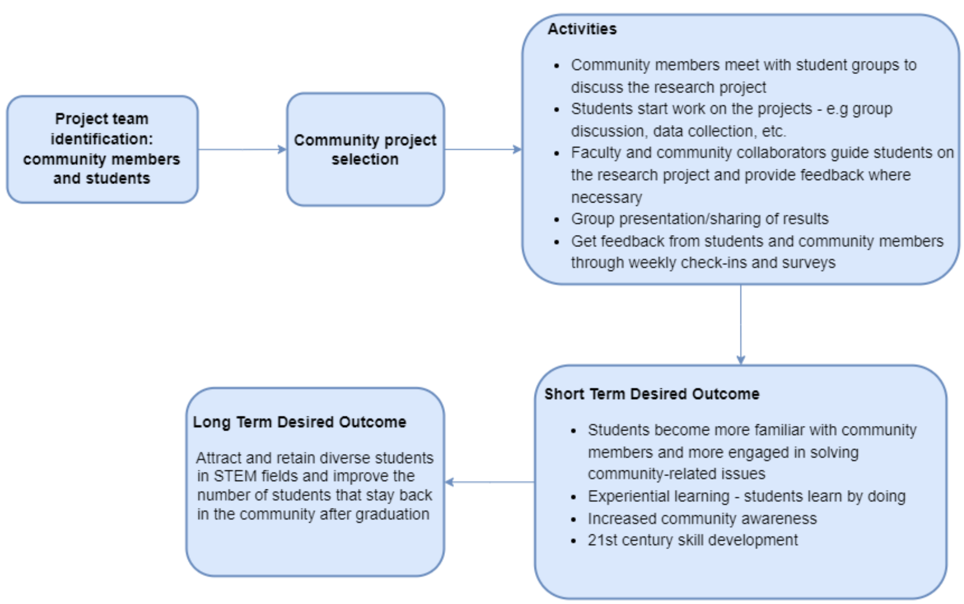


Figure 2: CBR implementation and evaluation framework

### 3.1. Project team identification

The CBR team comprises students, faculty, and community members. Before deciding on the projects to work on, the research team identified potential community collaborators that can help develop a pool of potential community projects. Community partners help identify the projects as well as serve as mentors for the students.

Interested students submit their application on the project website. The students need to provide information about their background and why they are interested in working on community projects. At the end of the application process, the applicants are interviewed, and the top applicants are selected.

### 3.2. Project selection

From the pool of potential research projects, projects that are entirely community-based, provide necessary service to the community, and will be of interest to the students are selected. The selected projects represent different community challenges such as urban sustainability and health equity. Students are assigned to a project using their educational information, types of skills they would like to develop, and project preference ranking. The students that form a project group are made to be as diverse as possible. Three to four students are assigned to a project and work as a group. Working in groups can help improve understanding through sharing of information and concepts.

### 3.3. Theory of Change

TOC is used to link long-term goals to interventions or activities. It is an essential tool for program planning, monitoring, and evaluation. It helps to identify the key components of a program, the desired outcomes, and the pathways by which those outcomes are expected to be achieved. The original pilot, the Bowman Creek Educational Ecosystem, from which the C-EEEM program was distilled, had a TOC that outlined the need for long-term community outcomes in addition to student and institutional outcomes. Similarly, for the Louisville replication, team activities within the community engagement program made small changes that contribute to a long-term goal. Once the projects are selected, the interns, who are composed of high school and undergraduate students, meet with community collaborators to discuss the projects. The goal of this meeting is to allow the interns to gain a better understanding of the project and the need for the research. Students work in groups during the project's data collection and other phases and are guided by community collaborators and faculty. At the end of the program, the interns present a report of their findings, problems, and issues encountered during the research process to community members and colleagues. The interns are also interviewed to evaluate the community engagement program.

## 4. Implementation

This section discusses the implementation of the community engagement program in one site, Louisville KY. For the first year of the program, a total of 23 students comprising of both undergraduates and high school students applied for the program. From this application pool, 11 students from diverse backgrounds were selected to participate in the program. Project teams comprised of 7 undergraduate and 4 high school students (**see Figure 3**) from a range of majors such as geography, engineering, computer science, philosophy, politics, and economics. The following subsections provide a description of the three selected projects.

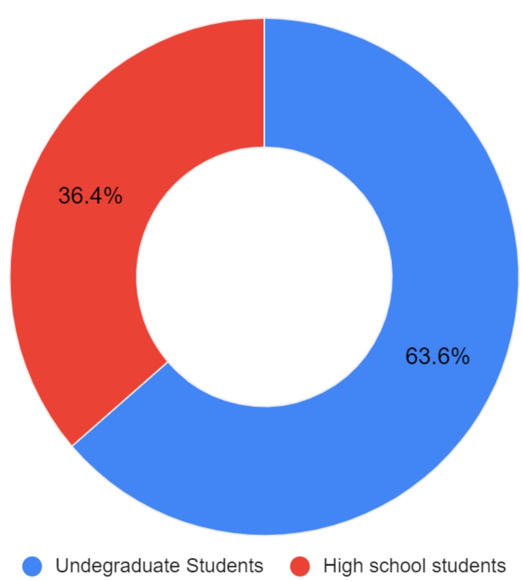


Figure 3: Program participants by educational level

### 4.1. Analysis of Water Quality in Beergrass Creek

Beargrass Creek is one of the largest creeks in Jefferson County, KY. It is a popular destination for recreational activities. However, pollution has made it unsafe for use. This community-based project was implemented to plan long-term solutions and awareness campaigns for Beargrass Creek. To achieve this, background research was conducted to identify accessible locations in the three forks of the Creek. Trash-specific data was collected using the marine debris tracker app and lastly, the data collected was analyzed to identify trends and hotspots using Google My Maps. The trash per mile and the potential causes of pollution for each key location were determined. **Figure 5** shows the litter analysis by location. From the analysis, the confluence of all three forks gave the highest value of trash per mile. The reason for the high trash per mile value at the confluence include (1) Close proximity to traffic and crowded residential areas (2) Natural debris buildup (3) Inaccessible to the public for cleanup. During the course of the project, the interns faced a couple of limitations such as accessibility limits for data collection and unsafe Creek conditions. At the end of the research, the interns proposed a couple of interventions to reduce pollution in the creek.

- Litter interceptor to prevent roadside runoff of medium-sized litter
- Litter boom, a floating barrier to catch trash and prevent it from flowing downstream
- Multiple Creek cleanups per year
- Raise awareness by educating residents

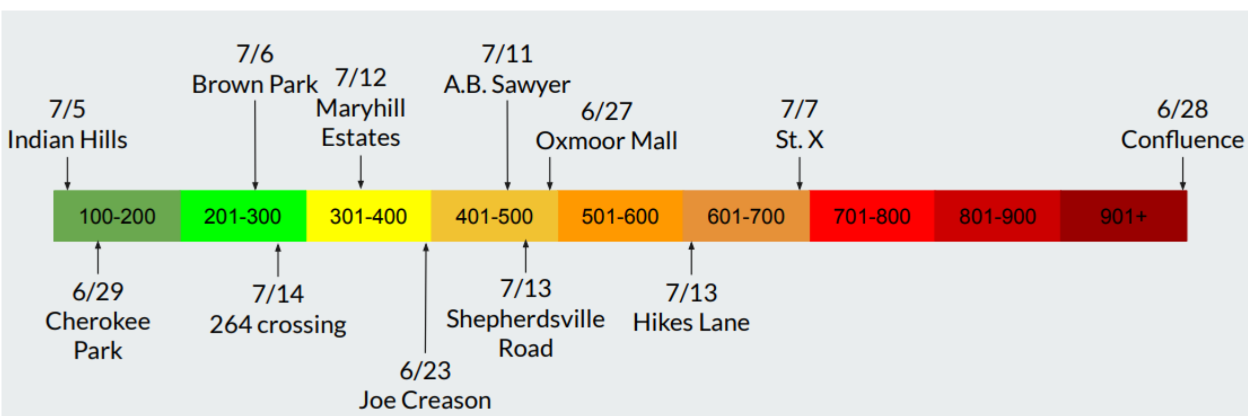


Figure 5: Litter analysis by location in trash per mile

### 4.2. Food Access Mapping

Food apartheid in Louisville disproportionately impacts households in the West End, where the median household income for black families is about $40,000 less than the East End, and the life expectancy is as much as 13 years lower. This project termed The Bok Choy project was done to expand upon a 2018 map of Louisville's food ecosystem to spotlight the continuing geographic disparities in access to healthy food. Interns were asked to document the produce sections of Kroger in different areas and observe the difference in products offered between neighborhoods of different classes and ethnic makeup. The findings from the Bok Choy project are shown in **Table 1.**

Table 1: 2022 Bok Choy Project (* indicates West End neighborhood)

| Zip Code | Bok Choy Available? | Organic Options | Poverty rate % | Black Population % |
|---|---|---|---|---|
| 40212* Portland | NO | 4 | 37.9 | 60.1 |
| 40211* California | YES | 7 | 34.1 | 93.9 |
| 40208 U of L | YES | 18 | 36.6 | 29.4 |
| 40206 Clifton | YES | 21 | 10.6 | 9.3 |
| 40205 Highlands | YES | 22 | 6.4 | 2.6 |
| 40207 St. Matthews | YES | 23 | 6.5 | 3.5 |
| 40243 Middletown | YES | 26 | 5.6 | 5.6 |

The results show that neighborhoods with higher percentages of Black people and high poverty rate tend to have significantly diminished access to healthy food options. Despite having the second highest poverty rate, Zip Code 40208, located in the southern part of Louisville, has a surprisingly high number of organic options and Bok choy available. This may be due to the fact that University of Louisville is located in this Zip Code. In addition, the interns gathered data on more than 700 locations that provide any kind of food to Metro Louisville's residents. This data was used to highlight food inaccessibility in the city of Louisville. The interns contacted various organizations actively involved in alleviating food insecurity in the city of Louisville and proposed educating the public about food insecurity by promoting the food access map.

### 4.3. Empathic Design for Pedestrians

Poor urban design fails to meet the needs of people who occupy and visit an area, reducing their safety and potentially raising their stress levels. The summer community project "empathic design for pedestrians" involved designing public spaces and infrastructure with the needs of pedestrians in mind. An experiment was designed to evaluate urban design and safety in downtown Louisville. The team used smartwatches to collect the heart rate data of pedestrians as they walked along specific routes at set times of the day (**see Figure 6**).

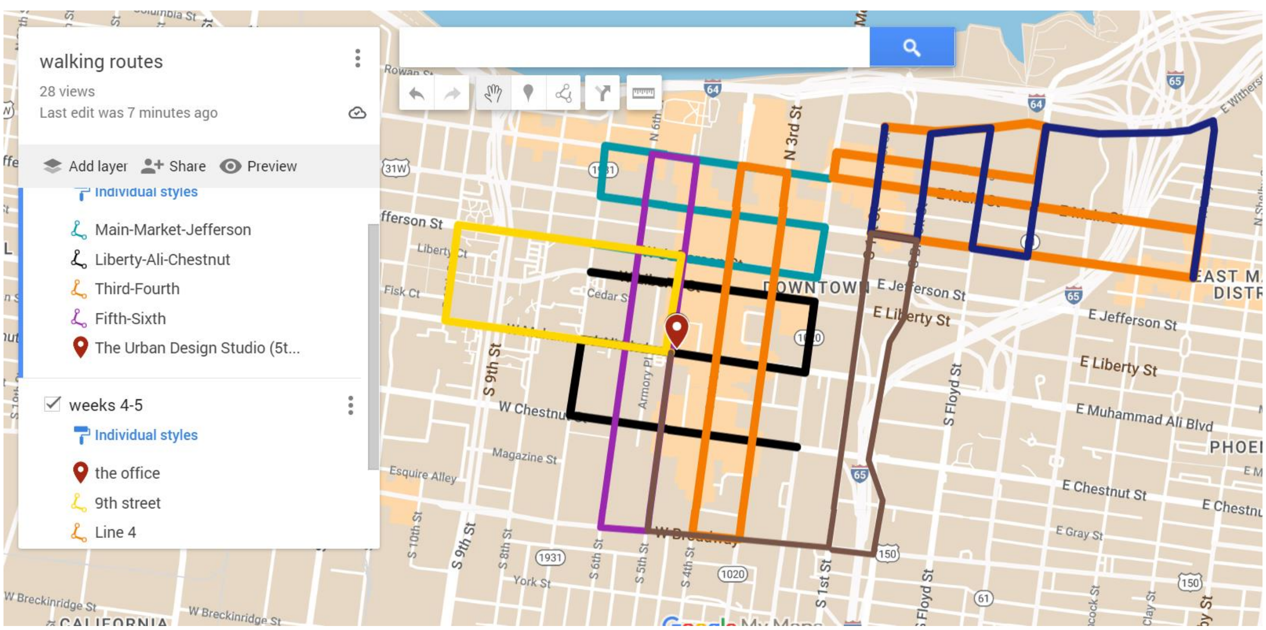


Figure 6: Routes walked in the study

The collected data was analyzed and used to identify high-stress areas (**see Figure 7**). A hybrid safety and urban design scoresheet was developed to identify the cause of stress in the area of study. Factors such as accessibility, safety, comfort, and enjoyment of the public space and infrastructure were considered. Based on the analysis, the interns proposed a couple of solutions to reduce pedestrian stress such as (1) widening sidewalks (2) commissioning public art (3) redesigning bus stops, and (4) pedestrian-friendly traffic signals


Figure 7: Stress level throughout the walked routes

## 5. Evaluation

At the end of the summer program, the interns presented a report of their findings, problems, issues encountered during the research process, and the next steps to community members and colleagues. The interns were also interviewed to evaluate the effectiveness of the community engagement program. A survey was sent to community partners at the end of the program to share their experience and the data collected will be used to build stronger collaborations.

### 5.1 Student Evaluation

Weekly check-ins were sent to the interns to get their feedback on how they feel working on a specific community project and the support received from community members. From the data collected from the weekly check-ins, **Figure 8** shows that the average satisfaction of interns working on the Empathic Design and Beargrass Creek projects increased with time with the empathic design showing a greater increase from the start to the end of the program. This increase can most likely be attributed to an increase in team communication (**see Figure 9)** and coordination (**see Figure 10)** as the program progressed. The Food Justice team did not find their project interesting which is reflected in the drop in project satisfaction level by the end of the program. In addition, the Food Justice team struggled with team communication and coordination between the third and fifth week which may have had an effect on the project satisfaction level. All the students strongly agreed that they were very well supported during the course of the program. Furthermore, each of the interns was interviewed virtually via ZOOM to determine if the goals of the program were achieved. During the interview, the interns were asked questions such as:

*What did you expect? What did you actually get in terms of your expectations?*

*Do you feel connected to the Louisville region? Why do you feel connected to it?*

*Did you like feel very involved, or connected to people or places, or just like the region as a whole?*

The interview was transcribed, and the responses of the interns were analyzed using wordcloud (**see Figure 11**). The interns' perceptions of skill development were positive. Interns mentioned the program was good and beneficial and indicated an increased attraction to the region. Furthermore, the interns valued their contact with community partners.

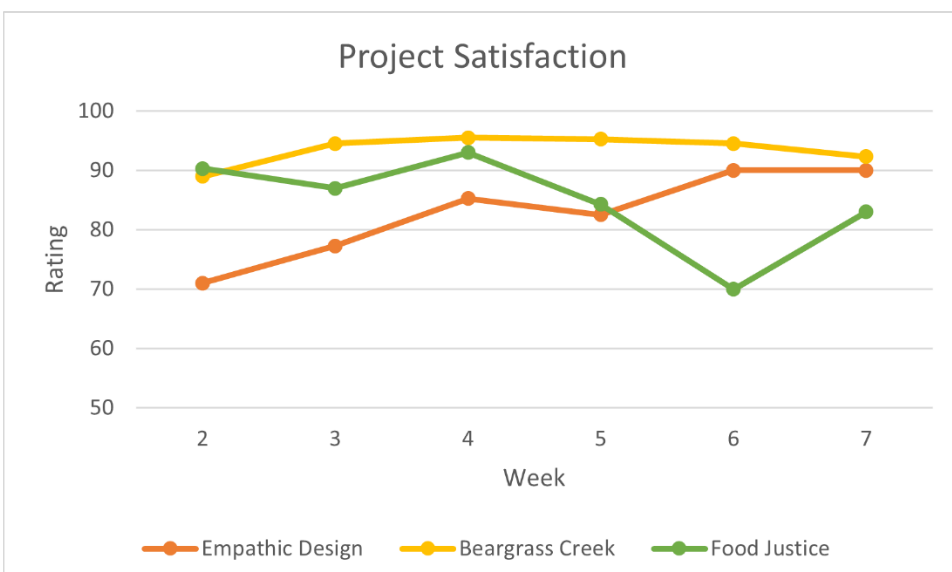


Figure 8: Project satisfaction rating by interns

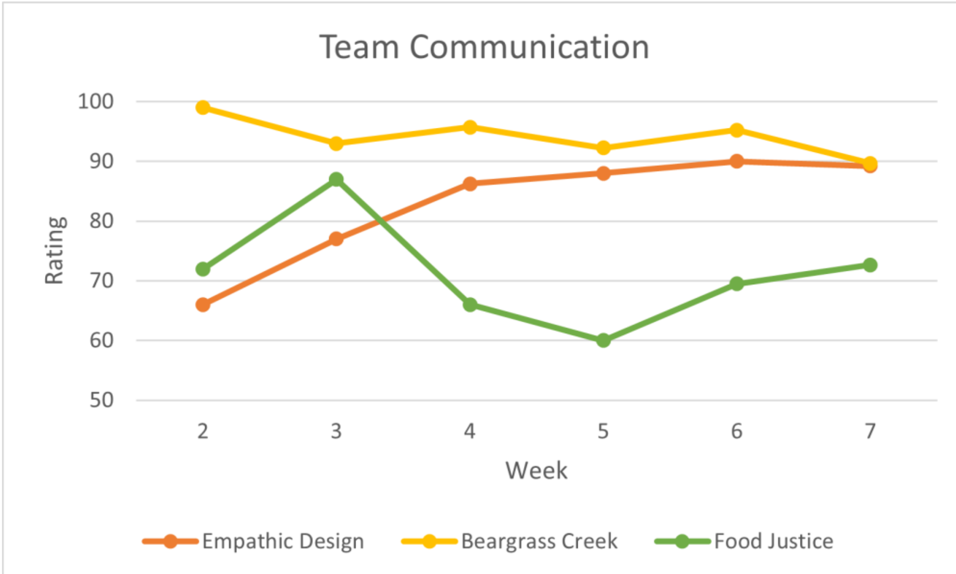


Figure 9: Team communication

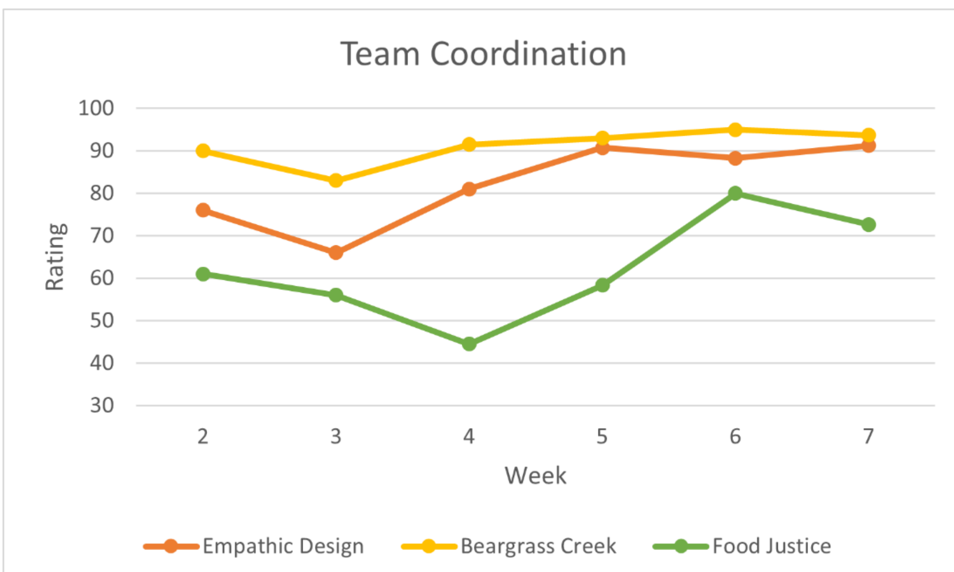


Figure 10: Team coordination


Figure 11: Wordcloud of intern responses

**5.2 Community Partners' Feedback**

At the end of the program, a digital survey instrument that included quantitative Likert-type scaling and qualitative open-ended questions was utilized to collect post-program feedback from community partners. From the feedback, community partners agreed to have seen positive changes in the community as a result of the collaboration with the C-EEEM internship program. The community partners expressed satisfaction with the projects and the collaboration as a whole. They also provided feedback on how to improve the program in the future. Sample feedback is included below.

*"I thought the entire mentor relationship worked very well. The student team was well engaged and I felt the progress and light-bulbs coming on."*

*"The interns were enthusiastic and responsive. They met all their deadlines in time and adjusted when needed. There should be a meeting of all mentors at the beginning of the project to compare/contrast program milestones."*

*"My research is community based. In general, all the researchers I mentor must do work in the communities they study before any academic work is completed. They have to earn the trust of that community and get their consent. Due to the heavy focus on empirical data, the interns did not get as much hands on experience as I would have liked. They still did a great job though."*

*"We have decades of work in the community and it aligned very well. Our partnership was based on a new innovation, so some of my answers don't reflect action yet on them because we are still establishing the best ways to move forward with it."*

## 6. Conclusion and future work

This paper described the replication of a CBR program in Louisville KY. The program was designed to engage students and community partners in initiatives to address community needs, leveraging the principles of CBR and other high impact practices. Although the CBR methodology can be resource intensive, the reward is great. The CBR projects provided a unique opportunity for students to collaborate with community members and achieve the program's short-term and long-term goals. In this program, students were randomly assigned to teams which may have had an effect on their satisfaction levels based on the feedback from the students. Future work will focus on developing a project skill matrix to effectively assign students to community projects while considering factors such as project interest, career goal and team dynamics. In addition, more work will be done on expanding the projects to other community needs, related topics and regions. Multi-site data will be collected and analyzed to compare the similarities and differences between the different project sites.

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