JSO JOURNAL of STEM OUTREACH

Vol. 3, February 2020

Creating a Culture of Youth as Co-Researchers: The Kickoff of a Year-Long STEM Pipeline Program

Farrah Jacquez[1], Lisa Vaughn[2,3,4], Alicia Boards[4], Alice Deters[4], Jody Wells[1] and Kathie Maynard[4]

[1]Department of Psychology, University of Cincinnati, Cincinnati, OH; [2]Department of Pediatrics, University of Cincinnati College of Medicine, Cincinnati, OH; [3]Division of Emergency Medicine, Cincinnati Children's Hospital Medical Center, Cincinnati, OH; and [4]Department of Criminal Justice and Human Services, University of Cincinnati College of Education, Cincinnati, OH

Keywords: Youth Participatory Action Research, Community-Based Participatory Research, STEM Pipeline, STEM Education, STEM Curriculum, High School, Adolescents

Publication Date: February 18, 2020

DOI: https://doi.org/10.15695/jstem/v3i1.02

ABSTRACT: STEM pipeline programs often include research experiences for youth, but fewer focus on youth as shared decision-makers or leaders in research efforts. Youth participatory action research (YPAR) and community-based participatory research (CBPR) orientations suggest that the quality and relevance of research will benefit from youth partnership. Because youth do not traditionally have the opportunity to serve in this type of leadership capacity, STEM pipeline programs that wish to elevate the role of youth in research must create a new culture of co-creation that upends the traditional pedagogical models adolescents experience in high school.We present Research Kickoff as a strategy to engage youth as co-researchers from their very first experience in a year-long STEM pipeline program. We designed activities around a framework consisting of six components: content, process, voice, network, engagement, and culture. Each of the six components of our framework are represented in a series of activities that include participatory research processes, inviting collaboration and valuing diverse expertise, and relationship building. To inform future programs interested in engaging youth as co-researchers, we detail the iterative development of Research Kickoff over two cohorts and describe how it serves to engage youth as change agents from the first touch.

STEM pipeline programs, or educational pathways to guide students into STEM careers, have been in place in the United States since the 1970's, but recent efforts tend to focus more specifically on the "leaky" areas that leaves some students behind (Schultz et al., 2011). Substantial evidence suggests that the period during high school is a decision point where many students begin to opt out of STEM career trajectories (Bøe et al., 2011). The decision not to pursue STEM subjects does not appear to express a disinterest in math and sciences, but rather a belief that these subjects are not relevant to one's own life. For example, the Programme for International Student Assessment (PISA) survey of students in 57 countries found that the overwhelming majority of students appreciated science, but significantly less found science relevant to them personally and only a small minority indicated a desire to pursue a career in science (OECD, 2007). More often than not, STEM education programs emphasize STEM literacy and discipline-specific knowledge acquisition (Kennedy and Odell, 2014; McDonald, 2016), but rarely include the essential components of youth leadership and translation to action. Furthermore, STEM subjects are most often taught using traditional pedagogical formats like lectures and pre-determined exercises, which do not encourage students to become engaged in the material on a personal level (Lyons, 2006).

In order to expand the perceived relevance of science to young people and introduce a pathway into STEM careers to students underrepresented in STEM fields, we developed a pipeline program for high school age youth. *Youth Built Change* aims to increase students' intrinsic motivation to pursue STEM research and highlights the relevance of STEM skills to one's own personal life and community. Specifically, *Youth Built Change* partners with high school juniors to conduct research on drug abuse and addiction in two geographically and socio-demographically different settings that are both dealing with significant drug problems in their communities: rural Appalachia and metropolitan Cincinnati. The underlying premise of our program is that by working with students on research projects that are directly tied to their lives, and by engaging them as shared decision-makers in the research process (co-researchers), they will understand scientific research methods and their relevance to solving re-

al-world problems more deeply and personally. This understanding will facilitate their professional entry into STEM fields by providing them with fundamental skills in research methodologies and techniques, foundational knowledge in science and mathematics, and positive attitudes towards research careers in the biomedical sciences.

CBPR as Foundation of Approach. CBPR is an orientation to scientific inquiry that values shared decision-making and equitable collaboration between community and academic partners (Minkler and Wallerstein, 2011). In the context of STEM pipeline programs, CBPR builds a culture of youth as co-researchers while engaging them in a STEM experience that can improve STEM-related attitudes, self-efficacy, interest, and skills. Engaging youth as researchers through CBPR has been shown to have benefits for the youth, their communities, and the quality of the research (Cheney, 2011; Findholdt et al., 2010; Wang, 2006). When grounded in shared leadership and decision-making, youth engagement in research through CBPR has the potential to have a major impact on youth through the development of practical skills and community awareness, which leads to action for positive change, with improved educational and health outcomes. Youth benefit directly from the increased knowledge about and practice of research skills, the integration of research and action that directly applies to their communities, the practice of critical problem solving, communication skills, teamwork and collaboration which leads to increased social support networks via school, teachers, and community stakeholders and then ultimately to community transformation (Irby et al., 2001; Ozer and Douglas, 2015; Minkler, 2000). In addition, the research process promotes social and emotional development, increases self-efficacy, enhances autonomy, provides opportunities to explore diverse perspectives, and builds community awareness (DeJonckheere et al., 2016; Ozer and Douglas, 2015; Suleiman et al., 2006).

STEM pipeline programs that provide high school students with opportunities to design and implement their own research projects have been shown to have positive impacts on youth. For example, the Interdisciplinary Science and Research program in Nashville facilitates scientist-supervised, hypothesis-driven research projects for high school students and participants get higher ACT and science test scores than peers (Ufnar and Shepherd, 2018). Pipeline programs working more explicitly through a community-based participatory research lens are rarer but have significant evidence of positive outcomes. Most notably, graduates of the Health Sciences and Technology Academy (HSTA), a STEM pipeline program that has been preparing youth in West Virginia for health and technology professions since 1994, attend college and major in STEM more often than their peers (McKendall et al., 2014). HSTA has emphasized community engagement from its inception and many projects focus explicitly on providing CBPR experiences to students (Chester and Dooley, 2011). A major focus of HSTA has been training students as obesity researchers (Bardwell et al., 2009). In the 2011-2012 academic year alone, HSTA students conducted 400 obesity-related projects (Branch et al., 2014). In addition to benefitting participating youth, HSTA's CBPR projects have also demonstrated improved research quality. In one project investigating knee osteoarthritis, high school students exceeded expectations of 100 surveys to collect over 1000 in hard to reach Appalachian communities (Siciliano et al., 2018). As a model, HSTA clearly documents the feasibility and potential impact of STEM pipeline programs that use CBPR to engage high school students to conduct research addressing issues in their local community.

The Current Study. Using the CBPR orientation to research, we are building a STEM pipeline program that engages high school students in research about drug abuse and addiction in their own communities. Our program is funded by the National Institutes of Health through a Science Education Partnership Award, a research funding mechanism to train a diverse workforce that is well-equipped to meet the nation's biomedical, behavioral, and clinical research needs (NIGMS, 2018). Our program engages high school juniors over the course of an academic year to develop their own research questions, to collect and analyze data, and to present results to academic audiences and to stakeholders and policymakers in their own communities. By working with students on research projects that are directly tied to their lives, and by engaging them as shared decision-makers in the research process, we believe that the students will understand scientific research methods and their relevance to solving real-world problems more deeply and personally. This understanding will facilitate their professional entry into STEM fields by providing them with fundamental skills in research methodologies and techniques, foundational knowledge in science and mathematics, and positive attitudes towards research careers in the biomedical sciences.

Although each cohort of student co-researchers participate in the program for an entire year, engaging youth as shared decision-makers and leaders from the very beginning is essential in setting the tone for *Youth Built Change*. Participating in a CBPR project as a co-researcher is markedly different from the day-to-day activities of high school, where a hierarchical teacher/student pedagogy is the norm. To introduce and engage youth in the new dynamic of CBPR research from the very first touch, we designed a two-day Research Kickoff event that set the stage for the students as co-researchers in investigations into drug abuse and addiction in their own communities. The current article outlines a framework to support the development of youth as co-researchers and describes how the elements of this model are carried out during Research Kickoff, the very first contact

with youth. Specifically, we will describe the framework we developed to guide our program, the activities we facilitated to meet the objectives in our framework, and the ways we used evaluation and reflection to collaboratively design the second iteration of Research Kickoff.

PROGRAM DEVELOPMENT

Although considerable and impressive efforts are being made to develop STEM pipelines for underrepresented students, descriptions of these programs do not tend to emphasize the shared leadership and action-based elements that are crucial in CBPR research. To fill this gap, we developed a conceptual framework for a more cohesive approach to supporting the development of youth as co-researchers and instilling a CBPR orientation in all program curriculum and processes. Based on the team's experience, most existing programming focused primarily on the building of content knowledge, less on exposure to research process, and rarely on fostering equity of voice or the intrinsic value created in relationship for being a change maker.

With these gaps in mind, we determined that six components, working in concert, were needed to truly support youth's research identity. This framework equally prioritizes both **content** knowledge and exposure to the research **process.** It creates explicit spaces for diversity of **voice** and shared expertise. Additionally, it calls out the importance of both a peer **network** and **engagement** with academic and local communities. The framework components when taken together are designed to build a **culture** of youth as co-researchers; supporting not the "next generation", but the "now generation" of community change agents. Figure 1 depicts the conceptual framework and Research Kickoff activities that correspond to each component.

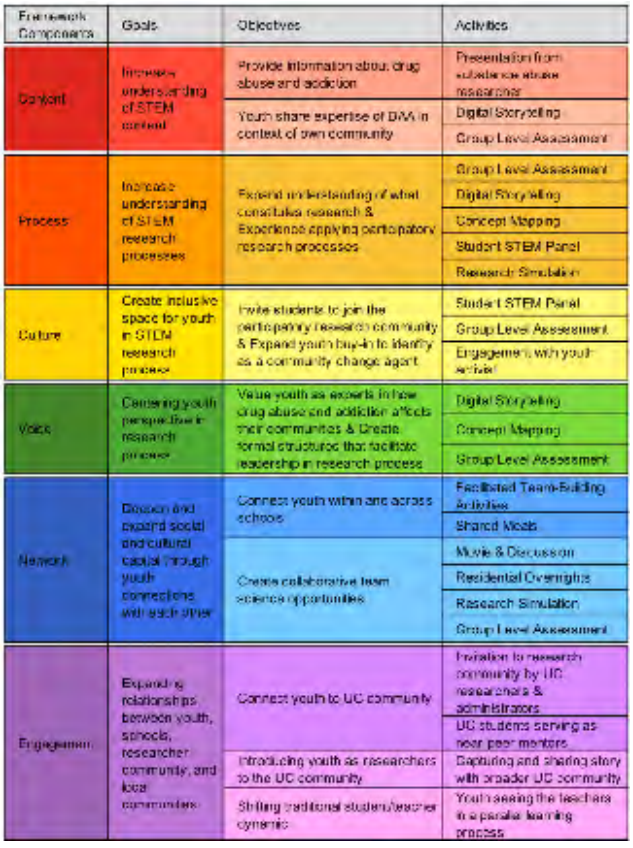

Figure 1. Conceptual Framework Guiding the *Youth Built Change* Program

We used the conceptual framework to ensure the Research Kickoff successfully engaged youth as co-researchers from their first moment participating in *Youth Built Change*. Community voice and shared leadership are hallmarks of the CBPR orientation to research (Minkler and Wallerstein, 2011), but as practitioners we have struggled to understand how to translate these principles into meaningful, sustainable elements of our STEM pipeline program. We present Research Kickoff as a concrete example of the nuts and bolts needed to connect program activities with a conceptual framework that brings CBPR with youth to life.

PARTICIPANTS

Our project engages youth from two high schools: a large public high school inside the Cincinnati metropolitan area and a small public high school about 75 miles east of Cincinnati in rural Appalachia. The 1500-student population of the metropolitan school is ethnically diverse (45% African American, 5% Asian/Pacific Islander, 22% Latinx, 6% Multiracial, 22% White) and about 59% of the student body is considered economically disadvantaged (ODE, 2018b). The rural school serves 354 students who are almost all White (97%) and economically disadvantaged (99.8%; ODE, 2018a). Sophomores in each school were introduced to the program by the research team and invited to apply to participate. Based on school performance and responses to an essay question about motivation to participate, program staff chose 25 students from each school to participate throughout their junior year. Two cohorts of students from these schools have participated in Research Kickoff, the first in May 2018 and the second in August 2019. Table 1 describes demographic characteristics of each cohort.

During Research Kickoff, activities are designed to build knowledge and to solicit youth perspectives about drug abuse and addiction. Many of the youth involved in this project have personal or family experience with addiction, particularly in the rural Appalachian area where opioid abuse is very intense but treatment access is the lowest in the state (Rembert et al., 2017). The entire project team, including two teachers from each school, were trained on mandated reporting procedures in cases where information youth shared revealed that they were unsafe. The principal investigator is a licensed clinical psychologist and all staff were directed to report directly to her if youth became upset while partici-

Table 1. *Youth Built Change Participants by Gender, Race/Ethnicity, and Cohort*

	Gender		
	Female	Male	Total
Cohort 1			
African American	8	3	11
Asian-American/Pacific Islander	2	1	3
Latino	2	0	2
Multiracial	1	1	2
White	21	6	27
Total	**34**	**11**	**45**
Cohort 2			
African American	11	2	13
Asian-American/Pacific Islander	2	1	3
Latino	0	0	0
Multiracial	3	2	5
White	12	12	24
Total	**28**	**17**	**45**

pating. No mandated reporting or individual counseling was needed. The project has been approved by the institutional review board of the University of Cincinnati.

RESEARCH KICKOFF ACTIVITIES

Program activities were primarily facilitated by the authors, who include faculty members in Psychology and Education, an Associate Dean of Education, graduate students in Education, and a Project Manager with a background in Planning. Additional support included college students hired to serve as Ambassadors, accompanying high school students to each activity and staying overnight in their lodging facilities. Additional volunteers were recruited to help with specific activities, including a student in art and design to assist with digital storytelling and a graduate student in education to lead a research facilitation.

As we developed activities to meet the objectives of the six components of our conceptual framework, we found that activities tended to fall into three categories: participatory research processes, invitations to collaborate, and relationship building. We summarize the activities conducted in the first Research Kickoff in Table 2 and describe the activities within these three categories below.

Participatory Research Processes. A variety of participatory research processes were used to expose students to an expanded definition of research and research methods and to engage them in a structured format for participation and sharing of ideas and perspectives. Considering the importance of contextual relevance, buy-in, and developing youth researcher identity, we used four participatory research processes throughout the Research Kickoff: 1) Group Level Assessment; 2) digital storytelling; 3) concept mapping methodology; and 4) research simulation.

Group Level Assessment (GLA). GLA is a qualitative, participatory research method designed for large groups to generate and evaluate information (Vaughn et al., 2011; Vaughn and Lohmueller, 2014). Unlike more traditional qualitative research methods in which participants provide data and then researchers analyze it, GLA participants collaborate to generate data and evaluate it--each participant has the opportunity to have an equal voice in data generation, evaluation, and action planning rather than only valuing dominant voices. We used GLA as an alternative to focus groups because we find they more accurately capture the perspectives and priorities of participants and encourage them to become actively involved in action plans moving forward. The GLA is a 7-step process which has been detailed elsewhere (Graham et al., 2015; Vaughn and Lohmueller, 2014). For Research Kickoff, the GLA was intended to expand youth identity as co-researchers and scientists and elicit ideas about working together in a successful research project. The GLA included prompts relevant to research, science, youth identity, collaboration, future plans, current program, or community context. Example prompts included: "In my experience, the biggest barriers to working together in a group include…;" "The most important BIG issue for kids in my school/community is…;" "In the next 2-3 years, I'm most looking forward to…;" "When I hear the word researcher I think of …;" "In my world, the thing I feel most strongly about changing is…"

Concept Mapping (CM). CM is an integrative, mixed-methods research methodology that uses brainstorming and unstructured sorting combined with the multivariate analytical methods of multidimensional scaling and hierarchical cluster analysis to create a data-driven visual representation of thoughts or ideas of a group (Kane and Trochim, 2007; Trochim and Kane, 2005; Vaughn and McLinden, 2016). Extensive work has demonstrated both the validity and utility of the concept mapping process (Risisky et al., 2008; Rosas and Kane, 2012; Trochim, 2017). During Research Kickoff, we used CM to have youth identify strategies to address addiction in their communities. The CM prompt was, "*I believe that the thing we should be doing about drug abuse and addiction in my community is…*" Youth participated in sorting the ideas and resulting concept maps were generated in real-time and shared with participants at the conclusion of Research Kickoff. The concept maps based on students' perspectives were displayed on a large screen and students participated in a discussion to interpret the results. CM was well-suited as part of Research Kickoff Day because it allowed youth to not only identify contextually relevant strategies for their own communities but to also see patterns and develop a common framework

Table 2. *Research Kickoff Program Activities*

Category	Rationale	Elements
Participatory Research Processes	To expose students to an expanded definition of research and research methods and to engage them in a structured format for participation and sharing of ideas and perspectives	Four Processes: 1) Group Level Assessment (GLA) 2) digital storytelling 3) concept mapping methodology 4) research simulation
Invitations to Collaborate and Valuing Diverse Expertise	To invite youth into the academic community and to expand youth perceptions of researcher, scientist, and expert	Four Activities: 1) Invitation from positions of traditional power 2) Presentation local drug abuse and addiction context 3) Motivational presentation from youth activist 4) Student panel on journey toward STEM
Relationship Building	To build authentic relationships among youth within and between schools and to build relationships between youth and academic leaders at the university with the long term goal of making youth feel comfortable on campus and to develop a sense of belonging in higher education settings	Six Strategies: 1) Facilitated team-building activities 2) Shared meals 3) Movie and discussion 4) Residential overnights 5) Near-peer mentorship 6) Capturing and spreading/Sharing the story

for thinking about addiction across communities (Burke et al., 2005; Vaughn et al., 2017).

Digital Storytelling (DST). DST is a collaborative method in which participants use forms of digital technology to construct visual representations of their own narratives (Gubrium, 2009). DST assumes that youth are capable of sharing stories and that these stories serve as a catalyst to creativity and meaningful dialogue about issues in their own community (Staley, 2017). DST empowers youth by allowing them to use technology as a medium to capture and share the stories of their lived experiences (Staley and Freeman, 2017). Therefore, we used a modified DS method as a way to create a space for youth to explore their lived experiences to develop their knowledge and exposure to substance abuse within their local community. Lambert (2009) explains DS as a way to leverage voices, images, and text to tell a story. Stories were chosen as a way to share variations of stories about themselves and their personal lived experiences (Staley, 2017) around substance abuse to elicit ways in which they can see how their voice and experiences serve as a catalyst to change in this process in becoming community change agents.

Youth were asked to answer the following prompts: "*What are some things that administrators, teachers, and policy makers need to know about drug abuse in your community?"* and "*How has drug abuse in your community defined who you are and shaped your educational experiences*?" After youth took time to reflect and answer the prompts individually, they were divided up into small groups. In these groups, they were given the task to come up with a narrative that addressed some of their responses to the prompts. Groups were assigned randomly and included youth from both schools participating in this process. Each group had about 20 minutes to develop an overarching narrative, then were recorded presenting the story for three minutes. After the group stories were shared, several students volunteered to share their personal lived experiences with substance abuse. These students were granted the space to reflect on how substance abuse has impacted their lives and their individual stories were also recorded.

Research Simulation. To expand youth ideas of what "counts" as research, we designed a research simulation that allowed youth to develop their own identity as researchers. Youth co-researchers were supported through a simulated six-step research process, which included: 1) Developing a research question; 2) Using core research tools (surveys and interviews); 3) Collecting data; 4) Analyzing data; 5) Synthesizing data to produce research findings; and, 5) Planning for action. The research simulation topic was "social media", chosen because students have first-hand experience and therefore had a higher potential to become critically engaged with research question development and interpretation of results.

When introducing the research simulation, the facilitator emphasized that research was more than a scientist in a lab making discoveries, but observations that everyone makes about the world around them. The kinds of questions that people ask about what is happening in their communities are the fuel for research. Youth were coached on how to create research questions that were clear, focused, and complex enough to not be able to be quickly answered. The next step included brief introductions to two core research tools: surveys and interviews. Students then used either surveys or interviews to collect real data about their social media-related research questions from university students located in the student recreation center. Students then conducted a quick data analysis for patterns, themes, and big ideas. The last step of the simulation was a discussion of possible next steps that could move the research to action. Students brainstormed and then shared out with the group on possible ac-

tion plans based on their findings, which allowed students to witness how research findings can assist in developing and implementing data driven results directly back into one's own community.

Inviting Collaboration and Valuing Diverse Expertise. Several activities were designed to invite youth into the academic community and to expand youth perceptions of researcher, scientist, and expert. One strategy to broaden perceptions of "scientist" and "researcher" was to choose facilitators whose personal experiences and demographic characteristics are underrepresented in STEM. Our intention was to provide role models for success who mirrored the attributes of participating youth, including experts who were young, Appalachian, African-American, and/or Latino. A second strategy was to deliberately invite youth to the academic setting not as guests, but as research collaborators. We invited collaboration and shared a value for diverse expertise through four activities.

Invitation from positions of traditional power. During the initial lunch upon arrival, two college Deans welcomed youth to campus and invited them to join the community of researchers on our campus. The faculty members serving as academic leaders of the project also introduced themselves and invited youth to join them as collaborators in a year-long research process.

Presentation of local drug abuse and addiction context. A local researcher described drug abuse trends in our community and linked it the broader addiction research literature. The presentation was especially powerful because the researcher described how her family and childhood experiences influenced her trajectory to earning a doctoral degree and becoming a research scientist. Her story provided a compelling example of how an individual can be motivated by their own experiences to solve community problems through research.

Motivational presentation from youth activist. A local Black Lives Matter activist who led highly publicized efforts to make UC and Cincinnati a more equitable community engaged with participants around youth activism. In a highly interactive, high energy session, the activist presented a vision for youth as drivers of community change. She introduced the concept of research not as a subject in school, but as a tool in an activist's toolbox.

Student panel on journey toward STEM. A doctoral student in clinical psychology moderated a panel discussion with four young people who have been working on diverse forms of STEM research. Panelists included high school and college students serving on a youth suicide prevention council, a recent environmental health graduate who had done activist water research, and a graduate student studying green chemistry to reduce the generation of hazardous substances. Each panelist had sought out STEM research experiences to understand how to address real-world problems, and each were following different paths toward success in their field. The moderator took questions from the high school students and facilitated a discussion about college experiences and STEM trajectories.

Relationship Building. Existing literature on youth as community change researchers has emphasized the importance of socializing and fun into program activities (Nygreen et al., 2006) in order to build a network of support amongst one another. We have found relationship building to be critically important in our previous CBPR research teams (Vaughn et al., 2018), so we intentionally designed activities to build authentic relationships among youth within and between schools. We also created opportunities for youth to build relationships with academic leaders at the university with the long-term goal of making youth feel comfortable on campus and to develop a sense of belonging in high education settings. Six strategies for relationship building are described below.

Facilitated team-building activities. All students from both schools participated in a two-hour session at the campus recreation center designed to build their identity as a collaborative team. Activities were facilitated by trained recreation center employees focused on bringing members of the group closer through exercises using both the body and mind. The session included activities focused heavily on communication and helping teammates feel more comfortable working together as well as activities that gave team members the opportunity to think outside-the-box to achieve team goals.

Shared meals. Sharing meals is an opportunity for youth to discuss concerns, reflect on their day, and share experiences (Neely et al., 2014). Informal conversations can play a significant part in relationship building and when accompanied by food it can serve as a way to bring young people together in a space where they are comfortable sharing ideas, having fun, and having meaningful conversations (Neely et al., 2014). We purposely did not structure activities during most breakfast, lunches, dinner, and designated snack times to allow students to connect more naturally.

Movie and discussion. At the end of the first day, students from both Manchester and Princeton screened the movie Black Panther, which had coincidently been released on DVD just days before. While the screening was somewhat informal, leaving time for students to eat snacks and relax after an action-packed day, the students participated in a discussion facilitated by undergraduate student ambassadors after the movie ended. The discussion centered on how the movie addressed ideas of community improvement and collaboration and prompted them draw parallels between the movie and their own communities.

Residential overnights. Youth from both schools along with teachers and the peer mentors spent the night in an on campus residential hall. They were all located on two floors with two teachers and two peer mentors assigned to each

floor. The majority of the students had not been on a college campus before, so the overnight stay in the residence hall created a unique shared experience. By participating in an overnight stay on a college campus, they were able to picture themselves on campus, engage in informal conversation and interactions with teachers, UC student Ambassadors, and peers from both schools. Staying overnight in the same space allowed for interactions to occur between individuals they may have not had the opportunity to otherwise. Many of the students across schools were able to then connect via social media and/or exchange numbers which fostered continued relationships outside of the Research Kickoff experience.

Near-peer mentorship. Mentorship is a social strategy that engages youth in practices that can benefit them socially, personally, academically, professionally, and emotionally (MacCallum and Beltman, 2003). Peer mentoring allows a "reciprocal relationship" to occur that is beneficial both to the mentor and mentee (Haggard et al., 2011). Four current undergraduate students at the university that were majoring in STEM fields were hired to serve as peer mentors. These students were responsible for staying in the residence hall, sharing their lived experiences as a student and STEM major, assisting in the facilitation of activities, and providing guidance and leadership to the youth during their stay. Students were recruited through the College of Arts and Sciences and participated in a one hour training session to become familiarized with the agenda and understand their role as supporters of youth participation.

Capturing and sharing the story. A representative from UC's College of Arts and Sciences media team attended Research Kickoff Day to take photographs and write an article about the event, which was published in the News and Events section on the University's Arts and Sciences website (Jackson, 2018). The article introduced youth as researchers to the University community. Additionally, we wrote a blog post for the website of The Cincinnati Project, a local initiative designed to expand knowledge of the social dynamics of urban places (Deters, 2018). The Cincinnati Project serves as a collective for local stakeholders interested in community-engaged research, so the blog helped increase awareness of the project among those outside of the University community.

ITERATIVE PROGRAM DEVELOPMENT

Our program uses a collaborative approach to iterative program development to ensure Research Kickoff is successful in meaningfully engaging high school students as drug abuse and addiction researchers. In the summer before Year 2 Research Kickoff, we held a day-long retreat attended by program staff, teachers, and ten students who participated in Cohort 1 of the program (five from each school). Program staff presented participant evaluations of Research Kickoff and the team generated alternative strategies to best capitalize on strengths and mitigate weaknesses. The team also problem-solved issues to address changes in logistics. Year 1 evaluation results are presented, followed by a description of collaboratively adapted Year 2 activities.

Evaluating Research Kickoff - Year 1. Just before leaving Research Kickoff, youth were given a web link to a 5-item Qualtrics survey on their mobile device. Students who did not have a phone were given an iPad with the survey already prompted. The web-based method of evaluation proved very feasible; 100% of participants completed the assessment. Students were asked "In your opinion, how did the Research Kickoff go? Move the slider below from 0 (Not good at all) to 100 (Super awesome)." To rate their own engagement, students were asked "How much would you say YOU got involved in the activities? Move the slider from 0 (I just showed up) to 100 (I was totally into it)." In three open-ended items, students were asked to describe the best thing about the Kickoff, recommendations for the future, and any other information they wanted to share. Open-ended responses were coded by major themes.

Average overall rating of the Research Kickoff was 77.11 (SD=17.08). Average self-report of engagement was 77.47 (SD=19.85). When describing what they liked most about the program, students most often described group activities, meeting new people, and hearing new perspectives from other youth. Participating in research activities and learning new information was also identified as important components. The college campus setting, including dorms and activities around campus, was also valued. When asked for recommendations for the future of the program, the most-cited recommendation mentioned more interactive, fun, engaging activities that required more movement and no lectures. Other factors mentioned included less scheduled time or more breaks and warmer rooms.

Youth also shared their perspectives on Research Kickoff when they participated in focus groups at the end of Year 1. External evaluators conducted five focus groups with members of Cohort 1 for one hour during Dissemination Day, the final event in the program (N=40). Evaluators prompted students on all aspects of their experience and the most salient theme to emerge was Research Kickoff as a strength of their experience in the program. Three factors were identified as most the most valuable aspects of the event. First, students relished the exposure to a college campus. One student said, "*the sleepover was like a once in a lifetime experience really because I've never done anything like this.*" The opportunity to not only spend time on campus but engage with the university community was highly valued. Second, the students felt that interacting the researchers and other members of the project team helped prepare them for their time in the program. In fact, the most commonly cited request was more

time with the university-based project team. Third, students enjoyed time with peers at their school and meeting students from the partner school. Youth so appreciated peer interaction and collaboration they asked to add additional events similar to Research Kickoff throughout the year to facilitate collaboration.

Two major lessons emerged from evaluations and reflections by the project team, teachers, and participating teens. First, youth were most motivated by the opportunity to meaningfully engage with their peers. Although youth knew they were signing up to do research about drug abuse and addiction in their own communities, the part of the program they most enjoyed was interacting with and learning from other youth. We believe this feedback reinforces the critical importance of voice, networking, and engagement in the conceptual framework of our STEM pipeline program. Youth are approaching research from the very beginning as team scientists, placing value on the relationships with other team members and their communities at the forefront of their work. These relational skills are fundamental to team science (Tebes et al., 2014), but are not usually included in research training. Youth feedback has inspired us to "double down" on our conceptual framework and rework Research Kickoff to ensure that voice, networking, and/or engagement is integrated into each program activity. On a related note, the other major theme emphasized in youth evaluations was the desire for less lectures and more fun activities. Despite our efforts to make each activity highly interactive and engaging, youth perceived some of these efforts as "lecturing" that were not interesting enough to keep their attention. We took this feedback, together with the youth's appreciation for interactive, relational activities, and replaced purely instructional sections (e.g., those that include more than 10 minutes of instructor-led speaking) with more small-group activities that required youth to more actively engage in discussions.

Designing Year 2 Research Kickoff. Year 2 Research Kickoff activities were organized around the original conceptual framework described in Figure 1. Most activities remained the same but were revamped. For example, we brought in STEM graduate students to assist in the research simulation to ensure that YBC students had the support they needed to carry out their simulated project. Also, rather than a panel of undergraduate student researchers answering questions, eight graduate student researchers presented posters describing their work in order to expose YBC to dissemination processes by young scientists. Several other activities were replaced in response to student feedback requesting more networking and less lecture. For example, we replaced the movie and facilitated discussion with a more active scavenger hunt activity that allowed students to engage in the campus community. We also added a session introducing youth to the schedule of activities they would be participating in throughout the coming academic year. See Figure 2 for a comparison of the Year 1 and Year 2 schedules.

	Year 1	Year 2
Day 1		
10:00		Welcome & Pre-surveys
11:00	Lunch Presentations: Welcome from Administrators Drug Abuse Presentation Motivational Speaker	Lunch Presentations: Welcome from Administrators Drug Abuse Presentation
12:00		
1:00	Group Level Assessment	Group Level Assessment
2:00		Research Simulation (small groups using different research methods)
3:00	Research Simulation	
4:00		Storytelling: Youth Perspectives of Drug Abuse in their Communities
5:00	Dinner	Dinner
6:00		Campus Scavenger Hunt & Team Building Exercises and Structured Fun Activities at Hotel
7:00	Team Building Exercises at Campus Recreation Center	
8:00		
9:00	Black Panther movie & discussion with pizza & snacks	Facilitated Reflection
10:00		Surprise (Delivery Food)
Day 2		
8:00	Rotation #1 – Storytelling	Preview of the Year to Come (Presenting schedule of activities)
9:00	switch	Analyze Graduate Student Research Presentations
10:00	Rotation #2 - Concept mapping	Rotation #1 – Exit Videos + Surveys Rotation #2 - GLA Themes Rotation #3 - Drug Jeopardy
11:00	Student Panel on Research	
12:00	Closing Remarks & Student Surveys	Closing Remarks & Student Surveys

Figure 2. Schedule of Research Kickoff Activities, Year 1 and Year 2

We made other changes to Research Kickoff to address logistical concerns. First, we realized we needed to change the timing so that the Research Kickoff truly kicked off the research process. Due to restrictions related to the on-campus dorms, we held the Research Kickoff in mid-May 2018 and then did not see the participants again until September. The lag time allowed knowledge and enthusiasm to dissipate. In Year 2, we hosted Research Kickoff in August 2019 just as school started to more seamlessly move into the year-long school-based program. The dorms were also problematic because the setting was not conducive to productive sleep. We realized that we had significantly less engagement on Day 2 of the Research Kickoff because many of the participants got very little sleep while staying in the dorms. In Year 2, lodging was provided in a hotel just across the street from campus. Teachers and UC Ambassadors were also trained to provide a higher level of monitoring during the nighttime hours, balancing the desire for peer interactions with the creation of an environment that is conducive to learning and engagement. Finally, rather than choosing UC Ambassadors based on their experience as a STEM major, we recruited undergraduates with experience facilitating programs for high school youth. We hired six ambassadors instead of four and provided a more rigorous three-session training program to prepare them to help facilitate program activities.

Student evaluations for Year 2 Research Kickoff did not

significantly differ from Year 1. Average student rating of the overall event was 75.26 on the 1-100 scale (SD=16.57). Average student self-report of their engagement in activities was 75.88 (SD=15.57). Students most liked learning interesting information, meeting new people, and being introduced to what they would be doing during their year in the program. When asked for recommendations for future Research Kickoffs, the most-cited request was more free time and ability to go places without supervision. One recurring theme in the evaluations was disappointment in the lack of time at the campus recreation center. Because college classes were in session during the Year 2 Research Kickoff, the Rec Center was not available for outside programming. Participants who had heard about the Rec Center activity in Year 1 were expecting this experience and felt slighted when it was not scheduled. This feedback has been important in our future program development because we have realized the power of peer-to-peer messaging about the program. Although we have put a great deal of thought into how we presented the event to participants, it simply was not as powerful as the information they received from their peers. Next year, we plan to present the agenda for the Research Kickoff before they arrive to facilitate more realistic expectations of the event.

CONCLUSION

In order to successfully guide youth into STEM careers, pipeline programs must do much more than provide STEM content. Youth must see a place for themselves as researchers and feel that their voice is necessary in finding solutions to the problems they observe in their own communities. STEM pipeline programs must be intentional in both content and process to ensure that youth not only get STEM knowledge, but receive it in a way that is relevant to their own lives and has more potential to change their trajectories.

Research Kickoff is an event that positions youth to envision themselves as change agents in their communities in preparation for a year-long STEM pipeline program. Research Kickoff is not a stand-alone event; instead, it is the stepping stone toward youth seeing research as a way to understand and influence their world. We aim to motivate a change in perspective that brings youth from passive recipients of knowledge to providers of essential voices in the fight against drug abuse and addiction in their communities. To motivate paradigm shift, we created a framework consisting of six components: content, process, voice, network, engagement, and culture. We used participatory strategies that gather experiences and expertise that will fuel the research youth engage in throughout the program, invite youth to collaborate with a diverse and inclusive academic community, and build relationships to energize team science. Evaluation feedback and reflection revealed that our recognition of the importance of network, voice, and engagement in our framework was correct, but we needed to further emphasize relationship building and interactive activities. The activities of Research Kickoff, particularly those that intentionally promote the voice of youth in team science, were a successful strategy to set the stage for youth as co-researchers in a year-long STEM pipeline program.

AUTHOR INFORMATION

Corresponding Author

Farrah Jacquez, Ph.D. University of Cincinnati. PO Box 2120376, Cincinnati, OH 45221-0376. (513) 556-5124. Farrah.jacquez@uc.edu

Author Contributions

The manuscript was written through contributions of all authors. All authors have given approval to the final version of the manuscript.

FUNDING SOURCES

Research reported in this publication was supported by a Science Education Partnership Award from the National Institute of General Medical Sciences of the National Institutes of Health under award number R25OD023763-01.

ABBREVIATIONS

AAAS: American Association for the Advancement of Science; CM: Concept Mapping; CPBR: Community-Based Participatory Research; DST: Digital Storytelling; GLA: Group Level Assessment; HSTA: Health Sciences and Technology Academy; PISA: Programme for International Student Assessment; YPAR: Youth Participatory Action Research

REFERENCES

Bardwell, G., Morton, C., Chester, A., Pancoska, P., Buch, S., Cecchetti, A., Vecchio, M., Paulsen, S., Groark, S. and Branch, R. A. (2009). Feasibility of adolescents to conduct community-based participatory research on obesity and diabetes in rural Appalachia. Clinical and Translational Science, 2(5), 340-349. https://doi.org/10.1111/j.1752-8062.2009.00155.x

Bøe, M. V., Henriksen, E. K., Lyons, T., and Schreiner, C. (2011). Participation in science and technology: young people's achievement-related choices in late-modern societies. Studies in Science Education, 47(1), 37-72. https://doi.org/10.1080/03057267.2011.549621

Branch, R. A., Chester, A. L., Hanks, S., Kuhn, S., McMillion, M., Morton-McSwain, C., Paulsen, S., Para, U. K., Cannon, Y. and Groark, S. J. (2014). Obesity management organized by adolescents in rural Appalachia. In Obesity Interventions in Underserved Communities: Evidence and Directions (pp. 205-213). Johns Hopkins University Press, Baltimore (MD).

Burke, J. G., O'Campo, P., Peak, G. L., Gielen, A. C., McDonnell, K. A., and Trochim, W. M. K. (2005). An introduction to concept mapping as a participatory public health research method. Qualitative Health Research, 15(10), 1392-1410. https://doi.org/10.1177/1049732305278876

Cheney, K. E. (2011). Children as ethnographers: Reflections on the importance of participatory research in assessing orphans' needs. Childhood, 0907568210390054. https://doi.org/10.1177/0907568210390054

Chester, A., and Dooley, E. (2011). West Virginia University's Health Sciences and Technology Academy. Journal of Higher Education Outreach and Engagement, 15(3), 87-99.

DeJonckheere, M., Vaughn, L. M., and Bruck, D. (2016). Youth-led participatory action research: A collaborative methodology for health, education and social change. SAGE Research Methods Cases. http://dx.doi.org/10.4135/9781473956032

Deters, A. (2018). High school scientists working in communities. The Cincinnati Project Blog. Retrieved from http://thecincyproject.org/2018/08/20/high-school-student-scientists-working-in-communities/

Findholt, N. E., Michael, Y. L., and Davis, M. M. (2011). Photovoice engages rural youth in childhood obesity prevention. Public Health Nursing, 28(2), 186-192. https://doi.org/10.1111/j.1525-1446.2010.00895.x

Graham, K. E., Schellinger, A. R., and Vaughn, L. M. (2015). Developing strategies for positive change: Transitioning foster youth to adulthood. Children and Youth Services Review, 54, 71-79. https://doi.org/10.1016/j.childyouth.2015.04.014

Gubrium, A. (2009). Digital storytelling: An emergent method for health promotion research and practice. Health Promotion Practice, 10(2), 186–191. https://doi.org/10.1177/1524839909332600

Haggard, D., Dougherty, T., Turban, D., and Wilbanks, J. (2011). Who is a mentor? A review of evolving definitions and implications for research. Journal of Management, 37(1), 280-304. https://doi.org/10.1177/0149206310386227

Irby, M., Ferber, T., and Pittman, K. with Tolman, J., and Yohalem, N. (2001). Youth action: Youth contributing to communities, communities supporting youth. Community and Youth Development Series, Vol. 6. Takoma Park, MD: The Forum for Youth Investment, International Youth Foundation.

Jackson, J. (2018). Urban and rural high school students unite during opioid epidemic community research project. UC College of Arts and Sciences News and Events. Retrieved from https://www.artsci.uc.edu/news/research-stem.html.

Kane, M. and W.M.K. Trochim, Concept mapping for planning and evaluation. 2007: Sage Publications Thousand Oaks, CA.

Kennedy, T. J., and Odell, M. R. L. (2014). Engaging students in STEM education. Science Education International, 25(3), 246-258.

Lambert, J. (2009). Digital storytelling: capturing lives, creating community (3rd ed.). Berkley, CA: Digital Diner Press.

Lyons, T. (2006). Different countries, same science classes: Students' experiences of school science in their own words. International Journal of Science Education, 28(6), 591-613. https://doi.org/10.1080/09500690500339621

MacCallum, J., and Beltman, S. (2003). Bridges and barriers in Australia's youth mentoring programs. In F. Kochan and J. Pascarelli (Eds.), Reconstructing context, community and culture through mentoring: Global perspectives (pp. 73-103). Greenwich, CT: Information Age Publishing.

McDonald, C. V. (2016). STEM Education: A review of the contribution of the disciplines of Science, Technology, Engineering and Mathematics. Science Education International, 27(4), 530-569.

McKendall, S. B., Kasten, M. K., Hanks, M. S., and Chester, A. (2014). The Health Sciences and Technology Academy: An educational pipeline to address health care disparities in West Virginia. Academic Medicine, 89(1), 37. https://doi.org/10.1097/ACM.0000000000000047

Minkler, M. (2000). Health promotion at the dawn of the 21st century: Challenges and dilemmas. In M. Schneider Jammer and D. Stokols (Eds.), Promoting Human Wellness: New Frontiers For Research, Practice And Policy (pp. 349-377). Berkeley, CA: University of California Press.

Minkler, M., and Wallerstein, N. (Eds.). (2011). Community-Based Participatory Research for Health: From Process to Outcomes. John Wiley and Sons.

National Institute of General Medical Sciences (NIGMS) (2018). Science Education Partnership Awards. Retrieved from https://www.nigms.nih.gov/capacity-building/division-for-research-capacity-building/science-education-partnership-awards-(sepa)

Neely, E., Walton, M., and Stephens, C. (2014). Young people's food practices and social relationships. A thematic synthesis. Appetite, 82, 50-60. https://doi.org/10.1016/j.appet.2014.07.005

Nygreen, K., Ah Kwon, S., and Sanchez, P. (2006). Urban youth building community: Social change and participatory research in schools, homes, and community-based organizations. Journal of Community Practice, 14(1-2), 107-123. https://doi.org/10.1300/J125v14n01_07

Ohio Department of Education (ODE). (2018a). Manchester Report Card 2018; https://reportcard.education.ohio.gov/school/detail/000450. Accessed October 23, 2019.

Ohio Department of Education (ODE). (2018b). Princeton Report Card 2018; https://reportcard.education.ohio.gov/school/detail/030759. Accessed October 23, 2019.

Organisation for Economic Cooperation and Development (OECD). (2007). Programme for International Student Assessment (PISA) 2006: Science competencies for tomorrow's world (Vol. 1). Paris: OECD. Retrieved from http://www.oecd.org/edu/school/programmeforinternationalstudentassessment-pisa/pisa2006results.htm

Ozer, E. J., and Douglas, L. (2015). Assessing the key processes of youth-led participatory research psychometric analysis and application of an observational rating scale. Youth and Society, 47(1), 29-50. https://doi.org/10.1177/0044118X12468011

Rembert, M. H., Betz, M. R., Feng, B., and Partridge, M. D. (2017). Taking measure of Ohio's opioid crisis. Columbus, OH: Swank Center of Rural-Urban Policy. Retrieved from https://cpb-us-w2.wpmucdn.com/u.osu.edu/dist/2/14548/files/2017/10/SWANK-Taking-Measure-of-Ohios-Opioid-Crisis-1vtx548.pdf

Risisky, D., Hogan, V. K., Kane, M., Burt, B., Dove, C., and Payton, M. (2008). Concept mapping as a tool to engage a community in health disparity identification. Ethnicity and Disease, 18(1), 77-83.

Rosas, S.R. and Kane, M. (2012). Quality and rigor of the concept mapping methodology: a pooled study analysis. Evaluation and Program Planning, 35(2), 236-245. https://doi.org/10.1016/j.evalprogplan.2011.10.003

Schultz, P. W., Hernandez, P. R., Woodcock, A., Estrada, M., Chance, R. C., Aguilar, M., and Serpe, R. T. (2011). Patching the pipeline: Reducing educational disparities in the sciences through minority training programs. Educational Evaluation and Policy Analysis, 33, 95–114. http://dx.doi.org/10.3102/0162373710392371

Siciliano, P., Hornbeck, B., Hanks, S., Kuhn, S., Zbehlik, A., and Chester, A. L. (2018). Taking a look at the Heath Sciences and Technology Academy (HSTA): Student-research partnership increases survey size, hands-on STEM learning, and research-community connections. Journal of STEM Outreach, 1(1), 1-13.

Staley, B. (2017). Journeying beyond: Digital storytelling with rural youth. The Rural Educator, 38(2), 23-34.

Staley, B., and Freeman, L. (2017). Digital storytelling as student-centered pedagogy: empowering high school students to frame their futures. Research and Practice in Technology Enhanced Learning, 12(1), 1–17. https://doi.org/10.1186/s41039-017-0061-9

Suleiman, A. B., Soleimanpour, S., and London, J. (2006). Youth action for health through youth-led research. Journal of Community Practice, 14(1-2), 125-145. https://doi.org/ 10.1300/J125v14n01_08

Tebes, J. K., Thai, N. D., and Matlin, S. L. (2014). Twenty-first century science as a relational process: From Eureka! to team science and a place for community psychology. American Journal of Community Psychology, 53(3-4), 475-490. https://doi.org/10.1007/s10464-014-9625-7

Trochim, W. M. (2017). Hindsight is 20/20: Reflections on the evolution of concept mapping. Evaluation and Program Planning, 60, 176-185. https://doi.org/10.1016/j.evalprogplan.2016.08.009

Trochim, W.M.K. and Kane, M. (2005). Concept mapping: an introduction to structured conceptualization in health care. International Journal of Qualitative Health Care, 17(3), 187-91.

Ufnar, J. A., and Shepherd, V. L. (2018). Interdisciplinary science and research: A novel program to advance student preparation in STEM. Journal of STEM Outreach, 1(1).

Vaughn, L. M., Jacquez, F. M., and Zhen-Duan, J. (2018). Perspectives of community co-researchers about group dynamics and equitable partnership within a community-academic research team. Health Education and Behavior, 45(5), 682-689. https://doi.org/10.1177/1090198118769374

Vaughn, L. M., Jacquez, F., Zhao, J., and Lang, M. (2011). Partnering with students to explore the health needs of an ethnically diverse, low-resource school: An innovative large group assessment approach. Family and Community Health, 34(1), 72-84. https://doi.org/10.1097/FCH.0b013e3181fded12

Vaughn, L. M., Jones, J. R., Booth, E., and Burke, J. G. (2017). Concept mapping methodology and community-engaged research: a perfect pairing. Evaluation and Program Planning, 60, 229-237. https://doi.org/10.1016/j.evalprogplan.2016.08.013.

Vaughn, L. M., and Lohmueller, M.A. (2014). Calling all stakeholders: Group Level Assessment (GLA) – a qualitative and participatory method for large groups. Evaluation Review: A Journal of Applied Social Research 38(4): 336-335. https://doi.org/10.1177/0193841X14544903

Vaughn, L. and D. McLinden, Concept mapping: Visualizing what the community thinks. In Handbook Of Methodological Approaches To Community-Based Research: Qualitative, Quantitative, And Mixed Methods, Oxford University Press, Oxford, UK, L.A. Jason and D.S. Glenwick, Editors. 2016, Oxford University Press: New York, NY. p. 305-314.

Wang, C. C. (2006). Youth participation in photovoice as a strategy for community change. Journal of Community Practice, 14(1-2), 147-161. https://doi.org/ doi:10.1300/J125v14n01_09