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CREATE Resilience Through Science, Art, and Community Engagement

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Abstract Resilience, specifically community resilience, has a range of definitions but several core elements, including social cohesion and collaboration. Importantly, community-driven goals and approaches tend to be more effective. The CREATE Resilience project centered on co-creating a community vision of resilience, specifically as it relates to natural hazards and climate change by focusing on a positive narrative. By engaging youth, artists, municipal officials and community members in a variety of activities, including surveys, story-gathering and photovoice exhibits, forums, artist-created murals, and ripple effect mapping (REM), the project increased knowledge of weather and climate, risks from local hazards, and strategies for mitigation, while leading the community in thinking about what resilience means. This article describes the project, its use of science, art, and community to co-create a vision of resilience for three communities, the components of engagement and their intent, and the evaluation of impact for participants. As determined through surveys and REM, the CREATE project was effective due to the mixture of art, science and community engagement, which provided a range of opportunities for personal connection and learning related to the science and priorities around hazards and mitigation, helping participants with meaning-making about local hazards and assets, and allowing for a sense of familiarity and interconnectedness. Creating a shared vision of resilience is an effort that engages, connects, and motivates a community around common values and goals, and the approaches implemented through the CREATE project may offer ideas other communities can adopt in efforts to improve resilience.

Plain Language Summary Creating a shared vision of resilience is an effort that engages, connects, and mobilizes a community around common values and goals, and the approaches implemented through the CREATE project may offer ideas other communities can adopt in efforts to improve resilience. This article describes the project, its use of science, art, and community to co-create a vision of resilience for three communities, the components of engagement and their intent, and the evaluation of impact for participants. As determined through surveys and ripple effect mapping, the CREATE project was effective due to the mixture of art, science and community engagement, which provided a range of opportunities for personal connection and learning related to the science and priorities around hazards and mitigation, helping participants with meaning-making about local hazards and assets, and allowing for a sense of familiarity and interconnectedness.

1. Introduction

The concept of community resilience is emerging in the literature with development from integrated socioecological systems and ecosystems, disaster and hazards fields, and community health and development (Berkes & Ross, 2013). There are many definitions of resilience itself—from the capacity of systems to change and adapt to the ability of systems to absorb disturbances and maintain function (Walker et al., 2004), and in health and psychology, resilience can be seen as the ability to recover (Buikstra et al., 2010). While resilience concepts can apply to a diversity of scales and scopes, including individual and earth systems, attention to the community level is important because resilience at the individual, community and household levels are all related. While the approaches to supporting resilience at these different levels may vary (Berkes et al., 2003), a community level focus can result in individual members building capacity, agency, and social learning (Brown & Westaway, 2011; Goldstein, 2008).

Although there is not a common, agreed upon definition of community resilience, there are understood elements that support resilience that are common across the literature, including: local knowledge, community relationships, communication, health, leadership, resources, economic investment, preparedness, and mental outlook (Patel et al., 2017). Community resilience has been described as "community capabilities that buffer it from or

support effective responses to disasters" (Wells et al., 2013, p. 1172). It can also be defined as the "ability to prevent, withstand, and mitigate the stress of a disaster," which often fails to integrate a whole systems model that involves a diversity of community stakeholders (Chandra et al., 2013). In Disasters by Design, Mileti (1999), defines resiliency as the capacity of a locality to "tolerate and overcome damage, diminished productivity, and reduced quality of life from an extreme event without significant outside assistance." Further, Pfefferbaum et al. (2007) define resiliency as "the ability of community members to take meaningful, deliberate, collective actions to remedy the impact of a problem including the ability to interpret the environment, intervene, and move on"(p. 349).

However, the concept of resiliency is not always viewed positively, as articulated by Kaika (2017), where some communities' resistance to being called resilient stems from the lack of focus on the factors that "produce the need to build resilience in the first place." Instead, it is argued, the processes creating the need should be changed. Wilson (2012) emphasizes the need to transform an existing system instead of bouncing back to the status quo, which might not be ideal for some community members.

Some other studies note that the focus for resilience should not be on identifying and addressing deficits, but rather to build on the strengths of the community and its members (Berkes & Ross, 2013; Buikstra et al., 2010; Luthar, 2006). In particular, the strengths that are key to resiliency include social networks, leadership, communication, knowledge, infrastructure, collaborative institutions within the community, and social capital (sense of belonging, people-place connection), among others (Berkes & Ross, 2013). Specifically, research on resilience after natural disasters emphasizes the importance of social cohesion in a community's recovery process (Fonseca et al., 2019). Mileti asserts that sustainable hazard mitigation practices and the social networks that support them are best developed through inclusive decision-making, and that milling—the process of seeking information and reflecting on it with others in social networks—is critical in building resiliency (Mileti, 1999). Others have suggested that building community resilience benefits from an emphasis on action and problem solving (Kulig et al., 2010). Berkes and Ross (2013, p. 11) posit that it "is the way in which communities draw on their strengths in combination, leading to agency and self-organization, which appear to be important aspects of generating community level resilience." Resilience must also be understood in the context of local and pre-existing conditions because "resilience takes on highly localized dimensions" and there is no measure of resilience that exists that can apply for all communities (NASEM, 2019).

The idea of moving toward a new and better future is a key concept in a community's adaptive capacity and ability to deal with change, which relies on being able to build on resources and knowledge within the community to "make a new synthesis, co-producing knowledge" (Armitage et al., 2011; Berkes & Ross, 2013). A focus on community-defined goals and needs is an essential investment to support climate resilience, consider community specific contexts, and prioritize vulnerable populations within the community (Blatchford & Young, 2019; Islam et al., 2020).

Moving community resilience from concept to reality where resilience building activities are identified and tested in actual communities can be seen in community-based approaches like the Los Angeles County Community Disaster Resilience Project (Chandra et al., 2013). This approach emphasized the engagement and interconnection of governmental and community organizations that are necessary for addressing vulnerabilities, mitigation and recovery. Further, Islam et al. (2020) details the development of "Community Resilience Vision Statements" through community engagement for the creation of a shared understanding of flood risk and resilience.

A powerful tool for engaging communities around common issues and goals in support of resilience is the arts, which can improve engagement and support understanding of community values (APA, 2011). Community art is "by, for, and of the community in which it is presented" (NEA, 2018). Community art has many purposes including healing after natural disasters, spreading a message, cooperatively creating meaning, and promoting connection by encouraging community members to gather in public spaces and engage in dialog with each other. It can help communities "create a positive narrative about who they are and what they want their futures to look like" (Blatchford & Young, 2019). Others suggest that art can indirectly affect health, social cohesion, social support, and a sense of belonging (Fancourt, 2017; Fancourt & Finn, 2019), as well as support the creation of a sense of community, and promote inclusion and dialog (Beauregard et al., 2020). Importantly, community art was shown to promote conversation, connection, and communication of messages of hope in post-disaster Nepal, which suffered a devastating earthquake in 2015 (Baumann et al., 2021). The power of art to promote messages of hope and resilience positively affects community health and stability.

CREATE Resilience, a project of the Nurture Nature Center (NNC), a non-profit located in Easton, PA, forged its approach in the concept of co-creating a community vision, specifically around resiliency as it relates to natural hazards and climate change, culminating in a positive narrative illustrated through artist created murals. This article describes the CREATE Resilience project, its use of science, art, and community engagement to co-create a vision of resilience for three communities, the components of engagement and their intent, and the evaluation of impact for the range of participants.

2. Background and Methodology

The CREATE Resilience project was a 4-year (from 2018 to 2022) multi-disciplinary collaboration to engage youth and community to increase knowledge of weather and climate science, the risks from local hazards, and strategies for hazard mitigation. Using a combination of science, art, and community focus, the project resulted in the creation of large murals illustrating the community's vision of resilience. The project was conducted by a small team of NNC staff (four core and three support staff) including an Art Director, Science Director, and Executive Director with community engagement expertise. Three communities—Easton, Wilson, and Bangor, PA—were engaged in the project, all located in the Lehigh Valley region of Pennsylvania. Easton, PA is a small city of roughly 27,000 residents, with another roughly 36,000 living in surrounding suburban municipalities. The area is predominantly urban and suburban residential areas with a central commercial downtown. It is located at the confluence of two major rivers and has a history of major flooding. Wilson, PA is adjacent to the city of Easton and is home to about 16,000 residents. Made up of mostly residential and commercial suburban development, it has some more rural areas to the south. The area is underlain by 200–500-million-year-old limestones, also known as karst, that dissolve as a result of flowing water, sometimes forming sinkholes. Bangor, PA is part of the region known as the Slate Belt due to its industrial history in the 1800s and early 1900s when quarries produced slate. More than 21,000 residents live in the area, the majority of which is rural, residential, and agricultural. Thus, the communities involved span a spectrum of settings (urban to rural) with a similar climate.

The project included a diversity of activities, ranging from storygathering and photovoice exhibits to community forums and mapping exercises to emergency preparedness kit giveaways. All activities focused on engaging the community around resiliency. These activities are described below, with more detail for larger events, including community meetings, interviews, community forums, storygathering, mitigation mixer, high school youth ambassadors, Youth Climate Summits, community guidebooks, films, community mapping, and hazard tours. All of the activities collected data and observations that informed the murals. We explain those activities first before going into detail about the murals in order to provide context for their development. Table 1 provides an overall summary of the project activities and reach.

2.1. Community Meetings

The project started with a focus on the bi-county hazard mitigation plan for Lehigh and Northampton Counties (Pennsylvania). The project kicked off with a community meeting in each of the three focus areas (Easton, Wilson, and Bangor), at which the hazard mitigation plan was presented, and feedback gathered from participants via surveys and written responses on easel boards. These meetings were conducted in partnership with the Northampton County Emergency Management Services (which provided details on the Hazard Mitigation Plan) and the Lehigh Valley Planning Commission (which provided a status report on the Plan's adoption in each community). At each of the community meetings, there was diverse representation of residents and municipal officials, from council persons to mayors and emergency managers, as well as families.

2.2. Needs Assessment Process Surveys and Interviews

As part of the project, two online surveys were developed and administered: one for residents and one for municipal officials, with similar questions for both but different intended audiences. The surveys were intended to gather a sense of what natural hazards were considered priorities, where there might be critical needs, and how prepared communities were for handling natural hazard events—this information served as a baseline for natural hazard understanding and perceptions. Postcards and flyers were designed, and a social media and outreach campaign conducted to solicit responses to the surveys. A total of 377 individuals completed the public residential survey and 25 individuals completed the municipal survey. There was broad representation across all target communities.

Table 1
List of Project Activities, Their Audiences, and Number of Participants

Audience	Project activities	Number reached
Community engagement/Data gathering	Y1 CREATE Public Survey	377
	Y1 Mitigation kick off meetings (3 events, one in each community)	90
	Y1 Storygathering events and interviews (4 events)	43
	Y3 Mural focus groups (3 events, one for each community)	21
Community forums	Y1 CREATE Resilience Forum and Exhibit Opening (held at NNC)	89
	Y2 CREATE Resilience: Building the Vision Forum (virtual)	46
	Y3 CREATE Resilience Mural Reveal and Forum (virtual)	60
Youth	Y1 and Y2 ambassadors	24
	Y1 Hazard Tours (2 events)	19
	Y2 Youth Climate Summit (virtual)	38
Municipal leaders	Y1 Municipal Lehigh Valley Planning Commission Hazard Mitigation Planning meeting	50
	Y1 Interviews and surveys - municipal officials (25 survey responses, 11 group interviews)	46
Educational events (youth, public, community leaders)	Y1 Educational programs (Science on the Sphere presentations and NOAA National Weather Service Weather Forecast Office presentations - 4 events, in-person)	83
	Y2 CREATE Mitigation Mixer Event (in-person, representatives from FEMA, watershed coalition, and conservation district)	47
	Y2 Public Educational Webinars (2 virtual events, one on US Climate Resilience Toolkit and one from American Society of Civil Engineers)	62
	Y2 Public Educational In-Person presentations (2 events, on urban flooding and climate change adaptation)	71
	Y3 Rain barrel virtual workshop and kit pick up	50
	Y3 Emergency Kit Distribution (3 events)	360

Note. Y1 was 2018–2019, Y2 was 2019–2020, and Y3 was 2020–2021. Total number 1,576 (while there are some participants that may be represented in more than one activity, we estimate this would be less than 10% of the total based on contact information collected).

In addition to the surveys, the project team conducted eleven in-depth, in-person group interviews with local officials in the first year of the project to better understand the hazards, challenges and opportunities in each community, and gain a baseline perspective of what was of highest priority for municipal leaders. These interviews also provided insight into the level of preparedness and the capabilities of local officials, fire and police departments, and emergency managers to address natural hazard events.

Later in year four of the project, interview/focus groups were again held with municipal officials to share information collected from the community including priorities and concerns. The participants were asked if they were surprised by any of the findings or if they noticed any gaps in what hazards or assets to include. The sessions helped to inform what content to include in the community guidebooks and as an interim evaluation. Additionally, the team developed and distributed a survey to municipalities to invite their input into the information that should be included in the guidebooks, including inviting partners to submit print materials, community history write-ups, photos and other items that could be used.

2.3. Youth Ambassadors

Two cohorts of high school (9th to 12th grade, 14–18 years old) ambassadors (12 in the first year of the project and 14 in the second year, two of whom were students from the first year who wished to continue with the project and who served as mentors for the new cohort) received education and training and worked to engage with residents to document and exhibit the history of local hazards. They interacted with NOAA scientists (including National Weather Service Weather Forecast Office forecasters presenting on weather and climate information and tools) and regional planners and hazard experts to learn about environmental hazards and strategies for resilience in their own communities. They also helped develop educational materials including hazard cards (https://

nurturenaturecenter.org/wp-content/uploads/2020/09/Hazard-Cards-FINALinks.pdf) which provided details on hazards, their impacts, and possible solutions to distribute to their communities. The youth helped plan and run the area's first Youth Climate Summit which was held virtually for two and a half hours on July 8th and 9 July 2020. All students were asked to complete a visual mapping exercise at the beginning and end of their ambassador year to evaluate how their associations and understanding of extreme weather events changed. These personal mind maps had a focal phrase ("local weather hazards" in Y1 and "hazard mitigation" in Y2) and students were asked to write down anything that came to mind when thinking about the phrase. Additionally, they completed reflection videos at the end of their internship. More details are available in Sickler & Lentzner, 2022.

The first cohort of ambassadors completed a hands-on story gathering workshop that covered best practices and ethical guidelines for gathering stories, and each student was given a recorder and camera to capture the stories and images of interviewees in the community. They were encouraged to interview someone they knew (family or friends or neighbors) and required to attend a community story gathering event. The second cohort of ambassadors researched a specific hazard, associated mitigation strategies, and local case studies, and wrote a report on their findings which were used to create educational "hazard cards" that were disseminated to the communities. They also researched a youth-led climate initiative and presented it during the Youth Climate Summit prior to an open discussion about what ideas the Lehigh Valley youth could look at developing further.

2.4. Educational Events

Over the 4 years of the CREATE project several educational events were held for the community. These included a Mitigation Mixer which gave an introduction to the range of mitigation options for individuals, businesses and communities related to local hazards. The event included a panel of speakers (FEMA/flood insurance, County Conservation District/green infrastructure, Watershed Coalition/restoration projects) followed by open time for participants to meet and talk with experts and local organizations working in the field of hazard mitigation. Other educational events included a webinar series and an in-person presentation on topics related to mitigation. Topics included the U.S. Climate Resilience Toolkit and Climate Explorer, the role of the American Society of Civil Engineers in hazard mitigation, and flash flood susceptibility in the region.

2.5. Community Hazard Tours

Community hazard tours were held in each community during the first year of the project to show participants local areas that had been affected by hazards. Examples of stops on the tour include: the Easton Public Works facility, where the Director of Public Works talked about how the facility had been configured to be ready to evacuate after being flooded in 2004; a streamside area that was affected by intense rain storms causing flash flooding; severe erosion and property damage; and Bushkill Park, an historic amusement venue that was affected by flooding in 2004, 2005, and 2006. In the second year of the project, the COVID-19 pandemic limited in-person engagement and the project team created a virtual resilience tour by compiling interviews, videos, and photos from community leaders to put together an online story map of nine sites that demonstrated successful mitigation projects. These local projects include streambank restoration for flood mitigation, shade tree plantings to mitigate extreme heat, green roofs, and bioswales, among others. The tour, available at https://nurturenaturecenter. org/create-resilience/, was shared with community residents and leaders, project partners, and CREATE youth ambassadors.

2.6. Community Forums

Three community forums were held during the project, one each fall in year one, two and three of the project. The first forum was in-person, the second- and third-year forums were virtual due to pandemic limitations on gathering large groups.

The Year One forum served to culminate the year's look at hazards and was designed to share science and planning information about hazards and climate, share the experiences of hazards in the community through storytelling about local impacts, engage the community in establishing priorities for future learning about mitigation actions, and build a base for a shared vision of resilience (Figure 1). The forum itself was a two-and-a-half-hour event on a Thursday evening with partners, ambassadors, public, and facilitators in attendance. A total of 89

Figure 1. (Left) A local Easton resident stands beside her photo and story about her flooding experience in the community story exhibit. (Right) Forum participants discuss hazard and mitigation priorities during the CREATE Resilience Year One community forum. Photo credit: Lillian Robinson.

people attended the evening and participants who had registered received $40 in compensation for their time. The forum program consisted of dedicated time to view the story exhibit on the walls, followed by a keynote speaker presentation on climate resiliency. Following the presentation, the participants were led through a series of four questions, and facilitators took notes and reported out at the end of the evening. Questions included: What is the hazard you are most concerned about and why?; What mitigation strategy do you feel is most important for your community given the potential climate change future?; What assets does your community already have that can help address the changing nature of hazards?; and What needs does your community have for managing hazards in the changing climate? Participants were asked to complete a brief survey at the end of the program.

The story exhibit was designed using the narratives and information gathered by the student ambassadors from the hazard stories of local residents. The majority of the stories centered on flooding and its related impacts, but stories also addressed extreme heat, winter storms, and invasive species. Forum participants were encouraged to respond via reaction boards, and these responses along with specific survey questions about the exhibit informed the project and helped to bring the communities together in a common understanding of shared impacts (see the results section for more details).

The Year Two community forum (virtual) included a keynote speaker from the local National Weather Service Weather Forecast Office in Philadelphia/Mt. Holly. After the presentation, preliminary results from a community mapping exercise were shown and participants were led through five interactive questions and discussion. The questions were: What resources and assets in your community are contributing to resilience?; What kind of mitigation strategies have you seen in your community that are working?; What other mitigation and resiliency strategies and steps would be helpful? Think of ideas you have seen elsewhere or read about.; Imagine your community in its ideal state of resilience as you envision it. What words describe that community?; What steps would be important for your community and its leaders to take to build resiliency?

A total of 46 individuals participated in the forum and community residents received a $50 gift card for participating in the forum, completing the community mapping exercise, and completing a brief follow-up evaluation after the forum. The community mapping exercise was administered as part of a brief survey prior to participating in the community forum. The poll (available here https://nurturenaturecenter.org/create-resilience-poll/) was meant to help identify important resources that may be used to improve resilience to natural hazards, as well as identify needs and challenges in the community. For the mapping exercise, the Community Remarks platform that was used allowed participants to place pins on a local map and leave a comment about needs or resources.

The Year Three forum was held virtually and revealed the three community murals created as part of the project. Details of the murals are described in the mural section. For the forum, recorded interviews with each artist were shown, followed by a discussion about the murals and resiliency. In addition, following the forum, smaller focus groups were held for each community (two in-person focus groups and one virtual with about 10 people in each community) to discuss each mural based on the Visual Thinking Strategies (VTS) approach and to collect feedback for evaluation (Housen, 2002; Yenawine, 2013). The artists were not present at these sessions to eliminate any impact on feedback. Community participants were encouraged to see the murals in-person—each mural was installed in publicly accessible places in its community such as public markets, high schools, and township buildings. Poster prints of each mural were created and provided to participants in the focus groups and to each partnering artist. A webpage (https://nurturenaturecenter.org/create-murals/) for each mural was developed with additional information and the link to the survey/feedback form.

2.7. Murals

One of the main foci of the CREATE Resilience project was the creation of large murals for each of the three communities (Easton, Bangor, and Wilson) (Figure 2). Three artists, each of whom resided in the communities where they were working, were commissioned to develop the murals based on the information, feedback, and survey results collected in years one and two of the project. The artists participated alongside the other community members in all parts of the process and the murals can be seen as community-informed art because they

Bangor Community Mural by James A. Gloria

Wilson Community Mural by Don Wilson

Easton Community Mural by Jackie Lima

Figure 2. The three community murals illustrated each community's vision of resilience from top (Bangor, PA—artist James Gloria; Wilson, PA—artist Don Wilson; and Easton, PA—artist Jackie Lima). Each mural is a large roughly 15 ft in length piece that is displayed in public spaces within the community.

represent these communities, their priorities and visions, as well as the artists' personal knowledge and experience living in the communities. The artists were Jackie Lima (Easton, PA) a painter of large scale works and professor of art at Fairleigh Dickinson University; Don Wilson (Williams Township, PA—Wilson) a muralist, educator and Master Watershed Steward; and James Gloria (Bangor, PA) a muralist, arts educator, and owner of Totts Gap Arts Center. Each artist worked with NNC to review community input and data and iterate on concepts included in the murals. Artists were compensated for their efforts and materials, and each artist was interviewed about their piece for inclusion in the community forum in year three and on the project website.

2.8. Community Preparedness Event

In the third year of the project, gathering was still limited due to the pandemic so the project team created an educational video about how to prepare an emergency "to-go" kit to be ready for future hazard events. Materials and buckets were purchased, put together and given out free in each of the three communities. Over 300 "to-go" buckets which included shelf stable food, a whistle, flashlight, emergency blankets, hand warmers, and educational materials were distributed across all communities. The supplies in the kits were based on the lists recommended by the U.S. Federal Emergency Management Agency https://www.ready.gov/kit.

2.9. CREATE Science on a Sphere Film and Community Guidebooks

In the fourth year of the project, a short four-minute film was created to provide an overview of the project and encourage other community organizations to get more engaged with their local communities around resiliency. The film was developed for Science on a Sphere® (SOS)—a large, suspended globe exhibit that displays earth and space visualizations and videos spherically. There is a network of over 170 centers around the world with the exhibit with whom the film was shared. The film includes five interviews with local participants in the CREATE project—a municipal official, an emergency management professional, a resident, a youth ambassador, and an artist.

The final community event was not a traditional forum, rather it involved a presentation of all project activities and a summary of the evaluation of project impact, along with a showing of the SOS film and the revealing of a physical exhibit at NNC that showcased several of the outcomes including the ripple effect mapping (further detailed below) and story exhibit. In addition, community guidebooks developed for each of the three communities were disseminated to a range of participants that attended including municipal leaders, emergency management personnel, public, artists, and youth. The community guidebooks were developed from interviews and input from municipal leaders (PDF versions of the guidebooks for Easton (https://nurturenaturecenter.org/wp-content/uploads/2022/10/EASTON-Guidebook_Links.pdf), Wilson (https://nurturenaturecenter.org/wp-content/uploads/2022/10/WILSON-Guidebook_Links.pdf), and Bangor (https://nurturenaturecenter.org/wp-content/uploads/2022/10/BANGOR-Guidebook_Links.pdf)).

2.10. Evaluation

Learning outcomes for the CREATE Resilience project included individual knowledge gains (youth ambassadors and attendees), resiliency actions, and improved community-level resilience in the long term. Evaluation questions included:
To what extent, and in what ways, does involvement in CREATE Resilience impact participating youth?
To what extent do education events and forums successfully activate community members' learning?
In what ways do participants continue to take preparedness actions or get involved in resiliency activities?
In what ways (and through what pathways) does CREATE Resilience contribute to improving resilience within each of the communities?

The evaluation, which spanned 4 years and included formative and summative elements, used multiple methods to inform the project's decision-making and gather evidence of the ways in which the project achieved its goals. Given the nature of the outcomes, which allowed latitude for community members' personal meaning making and priorities to guide the direction of learning, evaluation methods emphasized qualitative approaches and incorporated embedded measures of learning within events. Evaluation methods included: youth personal meaning maps, youth video journals, post-event engagement surveys, during-event embedded activities, mural discussion

groups, follow-up surveys in the final year of the program and, importantly for a comprehensive look at effects, Ripple Effect Mapping, which is explained and detailed further below. (See the project evaluation report for a full detail of all methods and findings; Sickler & Lentzner, 2022).

2.11. Evaluation Methodology: Ripple Effect Mapping

In this paper, we focus on the evaluation to answer our highest-level, summative evaluation question: In what ways, and through what pathways, does CREATE Resilience contribute to improving resilience within the communities? To address this question, the evaluation adapted Ripple Effect Mapping (REM) methodology (Chazdon et al., 2017) to discover the naturally unfolding, community-wide impacts that resulted from the project. REM is a participatory evaluation approach, grounded in the field of Appreciative Inquiry (Coghlan et al., 2003), and is designed to be a generative process, built to uncover, and document the variety of pathways of impact that an initial program or investment contributed to creating. In application, the method engages stakeholders in a process of appreciative inquiry, reflection and radiant thinking, and visual mapping to document the ways they have observed a complex program contribute to community change. It is similar to other emergent, qualitative, non-indicator-based strategies in evaluation of complex programs, including Most Significant Change methodology (Dart & Davies, 2003; Wilder & Walpole, 2008), Outcome Harvesting (Wilson-Grau, 2019), or the Citizen Science Impact StoryTelling Approach (Wehn, et al., 2021). What this method does well is to document ways a project has demonstrably made a difference in a community, particularly when it would be difficult to predict or quantify the outcomes in advance. The outcomes that emerge in an REM evaluation are not hypothetical or hoped-for, they are those that participants and stakeholders observed occurring and could articulate how the project activities contributed to (although likely not the only factor involved) the outcomes identified. It should be noted that this method does not seek to prove or disprove a hypothesis, nor does it seek to measure or quantify the frequency with which a particular impact occurred (or did not occur) for those who engaged with the program; those conclusions would require different methodologies.

In this project, the evaluation team conducted a facilitated REM session with the main project team, followed by a series of one-on-one interviews with key stakeholders in the winter of Year 4 after the murals and guidebooks had been completed and shared with the communities the previous fall. This adaptation of the REM methodology, which relied more heavily on one-on-one interviews than a single group session with internal team members and external stakeholders, was in response to limitations of the COVID-19 pandemic, which continued to present difficulties in gathering groups of people (physically or virtually) at the time of the evaluation, and was in line with strategies used by other REM evaluation efforts during this period (Nobles et al., 2022). The REM facilitation followed a three-step process to: capture the range of impacts observed (using paired, appreciative inquiry interviews), collectively identify themes to group related ideas, and articulate the pathways that link the project to the extended impacts and changes that the participants observed. This was done using a sticky wall of impacts and connections. Throughout the process, participants were asked to critically reflect on the pathways through which the project activities contributed to the described impacts; if an impact was shared where the participants could not form a reasonable chain of how the program had contributed to its occurrence, it was removed from the mapping.

Following this process, the notes and recordings from the group and individual REM sessions were analyzed through a process of coding, theming, and sequencing. While we initially tried to apply the Community Capitals Framework (Emery & Flora, 2006) to the data, as has been done in several prior community development REM evaluations, we found that this framework conflated many of the inherent groupings that had emerged in the participatory processes. Instead, we used an inductive coding process, developing overarching themes that aligned with the patterns and clusters that participants had defined during the sessions. The ultimate coding framework included seven major groupings of the highest-level impacts of the program which became the "spokes" of the final ripple map. Within those spokes there were multiple sub-codes that represented impacts; these codes sought to cluster and group multiple observations from individual stakeholders into a repeatedly expressed theme of impact from the project. Finally, the sub-codes were organized into a temporal hierarchy to depict the progression from immediate to further-reaching impacts and were depicted in a visual map (shown in the results below). It is worth noting that this was not the only summative evaluation method used to help this project gauge success; a follow-up survey of program participants from the past 3 years was also undertaken to measure and report on pre-defined indicators and measures of success anticipated by the project.

3. Results

Results and data are presented in two parts: (a) Community Engagement & Response focuses on several of the community centered activities and how they were received by participants including analysis of survey responses to post-event mini surveys and forum discussions, along with an online follow-up survey to all those that had participated in a CREATE event; and (b) Evaluation of Community-Level Impacts with an emphasis on the ripple effect mapping as a final assessment of the project's impact extending beyond the immediate impacts of activities and events.

3.1. Community Engagement & Response

Overall, those that participated in the CREATE programs ($n = 211$ completed post-event surveys) reported high levels of interest and engagement and enjoyment with the formats and ways of engaging in post-event surveys. 70% of attendees stated they were interested to learn more about the topic and that the ideas presented were relevant, and 87% of attendees agreed that they understood the topics better than before events with a greater understanding of local resilience plans and resources. Importantly, responses related to definitions of resilience suggest participation in the CREATE project may have contributed to long-term changes. For instance, survey responses ($n = 211$) immediately after events described resilience as reaction and response to challenges, while a survey in the last phase of the project ($n = 68$) long (more than a year) after they participated in events led to descriptions of resilience as being flexible and adapting to new situations.

The most lasting takeaway message for participants about the project was about hazard and disaster preparedness for households and communities—prompting thinking about the importance of, and ways to, prepare for future events, along with ways to help with community preparedness and planning. 84% of respondents reported continued attention to news and discussion of community hazards after being involved with the programs. Further, 93% of respondents indicated they shared information about the project and resilience information with others. The communities identified new perspectives, acquired new knowledge, and gained awareness of new resources through their participation. Reflections reveal feelings that the communities were more resilient, connected, and informed as a result of the CREATE project: "*It has really helped in resiliency for the entire community*" and "*It has impacted my community in contributions and facilitating connections.*" Some responses also highlighted some challenges participants perceived: "*Becoming aware of resiliency related issues makes me also aware of how difficult it might be to motivate local council and supervisors to act*" and "*I'm thinking more now about negative impacts of development along the river, how important preservation of marshlands is*".

Community meetings were seen as beneficial in introducing the CREATE project to the local community, forging a strong partnership with the Northampton County Emergency Management Services, and educating residents about the Hazard Mitigation Plan. One participant felt the project would "*increase the knowledge of understanding of those who live in these communities and have a tremendous value on hopefully all aspects of Emergency Management*" and hoped to 1 day expand the program to a neighboring county.

Public surveys for residents and municipal officials were intended to serve as a baseline perspective of natural hazard understanding and perceptions and were conducted in the first year of the project. Survey respondents were asked to rank each hazard listed in the hazard mitigation plan from 1 to 14. The average priority ranking of hazards varied slightly by community, but overall respondents ranked winter storms and flooding as highest priority (Figure 3, top left). Sinkholes, radon, lightning and extreme temperatures were also priorities with the more rural community of Bangor consistently ranking hazards lower priorities than the other two communities. More than half of all Easton and Bangor residents felt their community was somewhat prepared to handle a natural hazard event, while a higher percentage of Wilson respondents felt the community was prepared to very prepared (Figure 3, top right). Similarly, Wilson residents were more likely to feel prepared and knowledgeable about natural hazards, with at least a third in each community reporting they were prepared and less than a quarter not feeling prepared (Figure 3, bottom right). Actions residents would take in the case of an evacuation order, show that more than 40% of Easton and Bangor residents would evacuate (Figure 3, bottom left). All three communities felt that education and communication were key to improving preparedness in their community and mentioned these more frequently than other responses.

Respondents were also asked about resiliency and what that would look like to them. Many did not know, but a few did respond with thoughtful insights. One person stated: "*I envision a community that is well-informed*
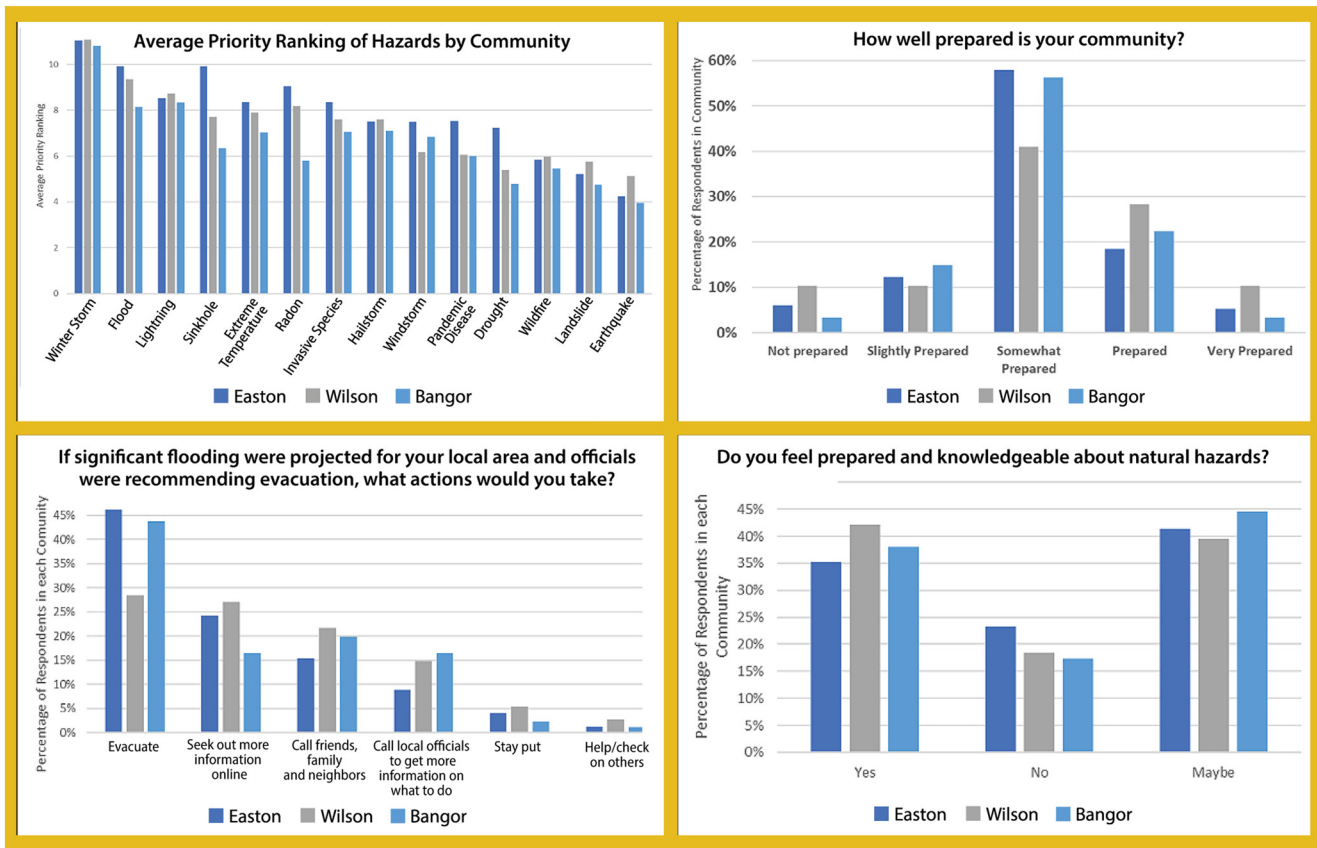
Figure 3. Sampling of results from the public survey for the three communities in focus (Top left) Respondent's ranking of priority for hazards affecting their community; (Top right) Preparedness perceptions for each community; (Bottom left) Anticipated actions in an evacuation situation by community; (Bottom right) Percentage of residents that feel prepared and knowledgeable about natural hazards.

about where to go in case of emergency and/or evacuation where food and shelter are supplied for all residents at a moment's notice." and another reported resiliency was *"Ensuring that all residents are given adequate and appropriate concern and care in the event of emergencies".*

Student ambassadors reported that they really valued their experiences with the project. During meetings and events, the students were inquisitive and growing in both knowledge and professionalism. One student attended his local township meeting to speak about the CREATE project and reported the meeting went "absolutely amazing" and the supervisors were very appreciative of the presentation. The hazard tours stood out to the student ambassadors as one of the most memorable activities they completed with the CREATE project—seeing and hearing firsthand about hazards made a significant impact. The Youth Climate Summit was reported by many students to be a positive experience with several showing high interest in pursuing more opportunities related to climate action in the future. Several ambassadors participated in the year end community forums and community mapping exercise even though they were no longer formally part of the ambassador program and not required to attend.

The student ambassadors reported a better understanding of their local environment, hazards, and impacts on communities as a main takeaway of the program and most of the youth associated community resilience with the idea of collaboration. Importantly, the youth expressed intent to continue being engaged in their community either through volunteering or creating specific plans to start environmental clubs.

The mitigation mixer educational event drew out audiences that do not usually visit NNC and traveled quite a distance to be there, including college students, residents who haven't previously engaged, elected and volunteer officials from smaller municipalities often hard to reach, high school students and others. One survey respondent was inspired by what they learned and connected it to what they could do at home: *"I really want to turn my*
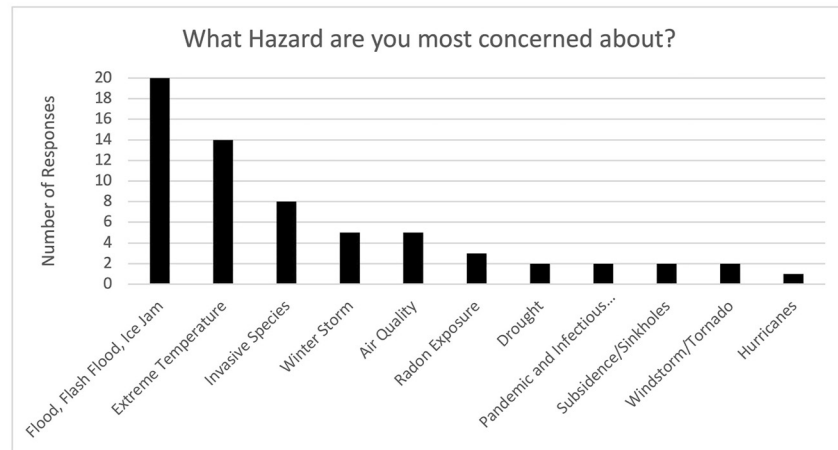
Figure 4. Responses from forum participants about their top hazard concerns in their community.

family's yard into a meadow" and another said they were so grateful to know all these people were working so hard to get good things done, it gave her hope.

In the **first year forum**, flooding was the number one hazard identified, followed by extreme temperatures and invasive species (Figure 4). Planning was seen as the main way to get people to act together for the benefit of the community and to encourage planning ahead of time. Some participants also noted that they wanted to see more action from the government and the City. Many participants commented on the robust community, strong support system, and communication that exists in the area. Whether through the Farmer's market, neighborhood associations, student clubs, Nurture Nature Center, or social media, residents felt connected and able to find support. Importantly, the participants saw past flooding experience as an asset because it made the community more aware of the hazard and willing to be a part of the conversation about mitigation strategies. Getting residents more familiar with hazards and preparedness actions at a young age was recommended, along with seeking out more money to fund mitigation and education initiatives. Fixing the combined sewer/stormwater systems, planting more trees, and having more restrictive building codes were mentioned as actions the community should pursue. In addition to the forum discussion, a **Community Stories exhibit** led to a majority of attendees feeling a connection with the hazards and community—provoking emotional and motivational responses most.

The **year two forum** resulted in a digital community map with over 200 locations identified and commented on (Figure 5). Areas of concern included those prone to flooding and unsafe intersections and sidewalks. The forum discussion noted current assets for resiliency and the need for increased education and collaborative community efforts.

The **year three forum** that revealed the murals was highly rated with attendees feeling they were able to contribute ideas about how the community could be more resilient during the discussion. Further, in the survey following the forum, half of the respondents felt the most meaningful part of the mural was how the artist had depicted their community, with a majority seeing the murals as personally meaningful. Separate mural discussion sessions using an adaptation of the Visual Thinking Strategies approach led to the identification of key themes including the strong sense of place created by the murals (familiarity and interconnectedness), features of resiliency (especially as a future vision), and local assets. Participants saw the murals as a positive reflection of their home and delighted at discovering new elements within the murals.

3.2. Evaluation of Community-Level Impacts

The result of the **ripple effect mapping** evaluation process revealed seven overarching impact pathways through which the CREATE project, over its 4 years, spurred ripples of extended impact throughout the community (Figure 6). Notably, the results of this process emphasized that the various audiences of the project—youth ambassadors, community leaders, community residents, artists—did not experience their impacts in isolation; but
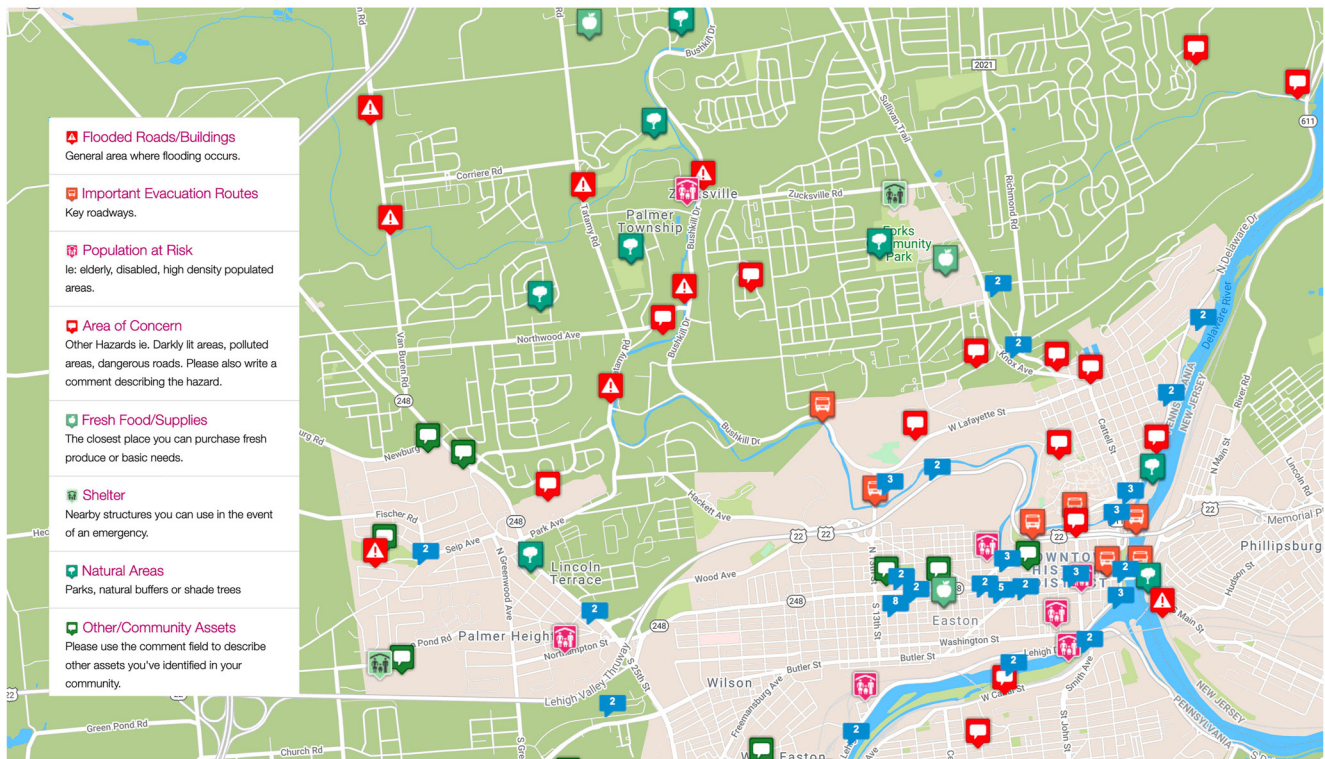
Figure 5. Example of the digital community mapping platform and results.

as they intersected through the programming, they impacted one another in a variety of ways. The final pathways of impact included:

Art as community reflection and connector

Development of future leaders

Empowerment of community members

Creation of lasting resiliency resources

Building of relationships that enabled doing more together

Change to local communities

Spreading impact beyond the region

We focus on a few but not all of the pathways here (each pathway is described in a supplemental report, Sickler & Lentzner, 2022).

3.2.1. Art as Community Reflection and Connector

The initiation of the mural process set in motion a series of interactions that informed the creation of the artwork—three murals that would ultimately work to build connections and spur dialog among the artists, residents, and other community stakeholders. The first-level change reported was with the commissioned artists themselves, who came to understand and engage with their communities and the concept of resiliency through new eyes. Expanding the knowledge of the artist about the topic and having them closely engaged in order to understand residents' thoughts and ideas, led to the next level of change: the artists' representation of the vision of resiliency. Independent evaluation found various lines of evidence of the ways in which the murals were positively received in the communities, ranging from building a sense of pride in community resiliency efforts to recognizing the need for change. From that achievement, there were a variety of reports that emerged in the mapping process of how individuals and institutions in the community were making more space to use artwork as a way to communicate and connect, including the existing murals.

3.2.2. Developed & Propelled Future Leaders

This theme was an example of a set of ripple effects that began around one element of the project but extended into other reaches of the community. The first levels of impact occurred for the youth who participated as ambassadors. They gained knowledge about the issues, but also came to understand their own communities and
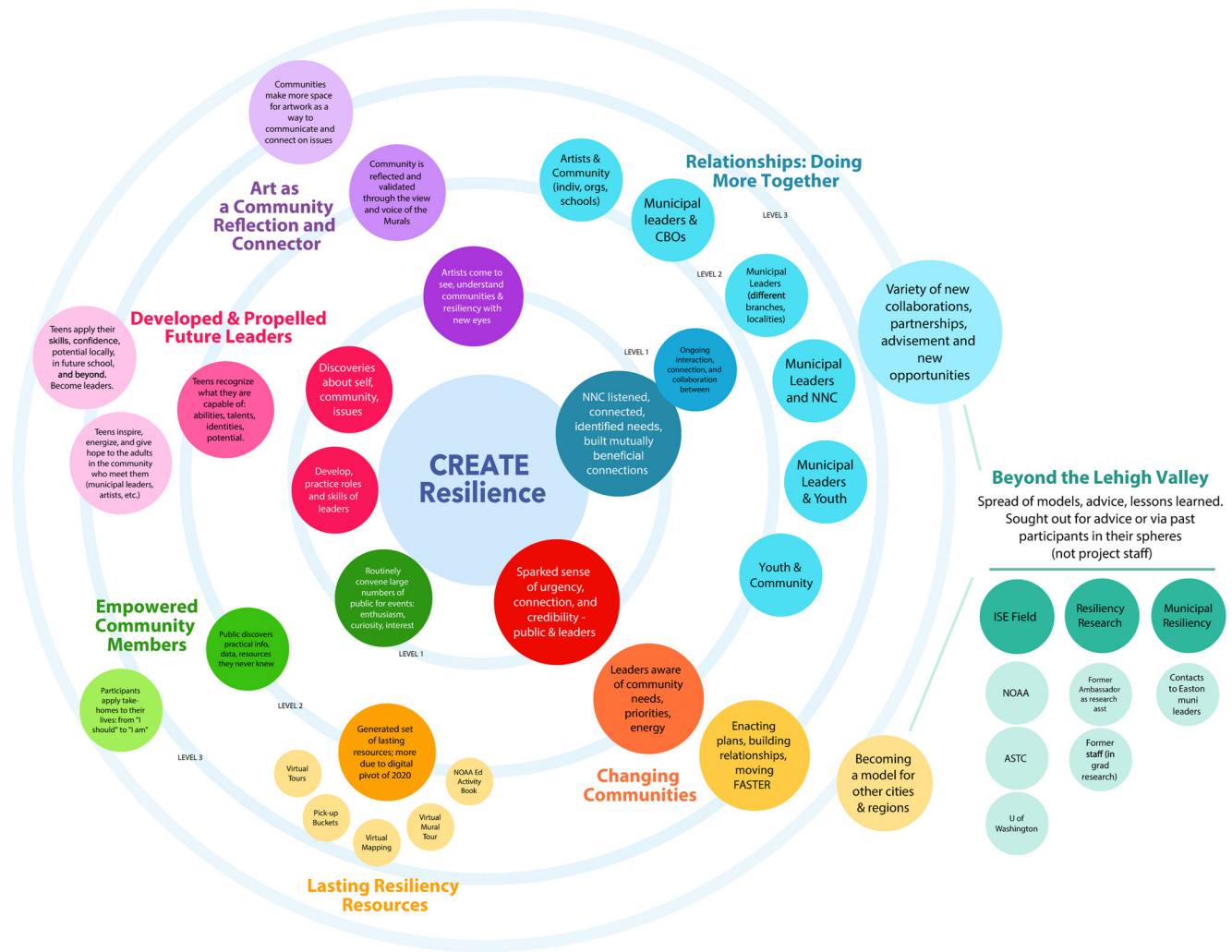
Figure 6. The resulting Ripple Effect Map from the CREATE Resilience project evaluation of impacts.

themselves more deeply—specifically, their interests, concerns, and capacities as leaders. At the same time, the youth developed skills and had opportunities to act as leaders through research, story gathering, and outreach. In doing all of this, the youth came to recognize their contributions and built confidence in their skills and abilities, leading them to take further steps into their communities as leaders. Their development as leaders created impact on the community leaders with whom they interacted, for instance, through presenting to their local township at a public meeting—those local officials reported that the interaction prompted them (the adults) to feel more energized, hopeful, and inspired about the potential for achieving resiliency goals. As time continued, teens continued to apply the skills, confidence, and sense of potential in further study and leadership roles. For example, several youth were inspired by their participation in the CREATE project to pursue fields of study in college related to hazards, resilience, and community. Many of the youth continued to stay engaged with the NNC long after their internship ended, including one that is now a docent at the Center, and one that went on to a nearby graduate program with an environmental policy degree in order to continue working on these issues in his local community.

3.2.3. Relationships: Doing More Together

The catalyst for this impact was the totality of events, engagements, and interactions that NNC fostered (described above). Throughout and across this wide range of engagement and activities with different stakeholders, NNC was consistently seen as a careful listener and partner, in particular, that they were focused on finding and building mutually beneficial connections between stakeholders. From this connection-building, a variety of new collaborations and partnerships were established benefiting these stakeholders in the long-term. Several municipalities

struggled to find the right resources and opportunities to help with their local concerns and needs, but through the CREATE project found a space for learning and discovering partners and needed resources.

4. Discussion

The CREATE Resilience project centered community in co-creating a vision of resilience through a diverse range of engagement activities, education and outreach. As the evaluation demonstrated, the CREATE project was effective, in part, due to the mixture of art, science and community engagement, which provided a range of opportunities for personal connection and learning related to the science and priorities around hazards and mitigation. The approach helped participants with meaning-making about local hazards and assets and allowed for a sense of familiarity and interconnectedness. Together, these elements increased the openness and receptivity of participants to learning and considering hazards, how they are changing, and how communities can take action to prepare. While the project team anticipated the multi-disciplinary approach would have resonance with the communities, the level and depth of impact and engagement was more than expected and the longer timeframe of the REM evaluation provided surprising insights into how the project activities' ripples extended beyond the immediate actions and responses following events. For example, the findings that youth involved in the project made educational decisions influenced by their participation in the project was a positive and surprising outcome, as was learning how interactions with the enthusiasm and commitment of youth ultimately impacted community leaders' sense of hope and energy. Other studies that have used REM to evaluate community programs have similarly found the process most effective for revealing unexpected outcomes, relationships, and interactions within a complex system (Nobles et al., 2022; Taylor et al., 2020).

Further, the focus on community resilience visions is not new, but approaches vary, and documentation of process and impact are limited. In Bangladesh, Concern Worldwide and the Zurich Flood Resilience Alliance worked with several communities to develop "Community Resilience Vision Statements" as part of a broader application of their Flood Resilience Measurement for Communities which involves collecting data about 44 indicators of resilience sources. The vision statements were based on a shared understanding of flood risk and the flood resilience the participants wanted to see for their communities in 5 years. Community Resilience Action Plans were also prepared as part of the process (Islam et al., 2020). In the Oakland City neighborhood of Atlanta, Georgia, a local arts organizer facilitated community engagement to develop a local Climate Resiliency Plan building on momentum from a community-engaged art project (a mural in the local transit station). Sparking discussion with questions such as "What makes this community distinct and what about your community should never be lost?", the project built shared identity and helped empower residents to co-create solutions (Blatchford & Young, 2019).

4.1. Limitations

This work focused on three small communities in Pennsylvania and the results may not be applicable to other locations or sizes of communities. The project did not systematically track individual participation across all project activities so some participants may be counted in more than one activity for the quantification of total number reached. However, based on email addresses/contact information that was collected the project team estimates this double counting as under 10% of the total.

The project spanned the time of the COVID pandemic with the first year and a half of activities able to be in-person and the rest virtual, with a few masked in-person events at the end of the 4 years. This shift in format had an impact on engagement as community participation was continued in the virtual space. Future explorations to understand how similar efforts could be carried out in larger communities should be conducted with a diversity of populations and locations. Additionally, investigating a range of community engagement activities and the relative value of different types (such as in-person vs. virtual), which this study was not able to determine due to the unplanned pandemic, would be beneficial.

5. Conclusion

With the CREATE Resilience project, community members were engaged and interested at events, increased their understanding of the topics, and felt a personal connection to the project. As reported in post-event surveys, many came away more aware of hazards and resiliency, and in the follow-up survey conducted in Year 4 of 3 years

of event attendees ($n = 68$), 99% reported they took at least one relevant action after their participation, including seeking more information, adding an emergency kit to their house to be better prepared, and sharing information with others. Youth involved in the project increased their understanding of local hazards and mitigation strategies and were empowered to take action in their communities, while gaining skills. Engaging youth and connecting them to their local community had mutually reinforcing benefits, from growing skills, confidence, and motivation in students to providing energy, hope, and capacity to the local community. Local municipal officials often pay significant attention when youth attend council meetings to voice their community concerns. The project found that these municipal leaders are not just resources within the communities but active target audiences for community education efforts as well. As found in the REM, municipal partners had unique needs and priorities and benefitted from expanded education and connection opportunities.

Additionally, reflections in the REM, and in the community-centered focus groups around the murals, it was found the process of creating murals, and the end products themselves, left a lasting impact, showing a vision of resiliency for each community. The murals created an authentic sense of place, making the idea of resilience relatable and the concept of interconnectedness apparent. The artists themselves became more connected with the communities they sought to represent. In addition, the project highlighted the NNC as an important community resource—a source of objective, trusted information, a convener of community members for important local issues, a connector and builder of relationships who listens to needs, and a critical part of the community creating long-lasting ripples of impact.

Importantly, the CREATE project kept the community at the center of efforts, listening and providing avenues for responsive action. Critical to the successful involvement of the community was the decision to position the risk of hazards and the threat of changing climate impacts in a positive, forward-thinking light. Community resilience as the focus led to hope, a focus on assets, and the determination to strive for a better future where the community itself is thriving through its interconnected resources and members. Creating a shared vision of resilience is an effort that engages, connects, and mobilizes a community around common values and goals, and the approaches implemented through the CREATE Resilience project, described here, may offer ideas and methods other communities can adopt in an effort to improve their resiliency.

Conflict of Interest

The authors declare no conflicts of interest relevant to this study.

Data Availability Statement

The data collected from the community used for the findings in the study are described in detail in Sickler & Lentzner, 2022, which is included as Supporting Information S1. This report and underlying data is available at Open Science (OSF) at https://osf.io/ud7ab/, DOI: https://doi.org/10.17605/OSF.IO/UD7AB.

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