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ABSTRACT

Through Youth Advocacy for Resilience to Disasters (YARDs), we offer a case study of a middle-school science, technology, engineering, art, and mathematics (STEAM) programme to engage youth in disaster resilience planning through mapmaking and advocacy. From 2021 to 2023, we designed and implemented a 14-session curriculum that empowers middle-school youth (ages 11–14) to advocate for infrastructural improvements that can benefit their communities by learning about disaster resilience from the perspective of environmental justice and equity. Youth explore virtual mapmaking and data visualisation to understand the assets and vulnerabilities in their communities related to disasters. Finally, they develop an action plan and present their plan to local civic and government leaders to advocate for change. This curriculum was piloted as an after-school programme in the fall of 2022 and twice as a summer camp in 2022 and 2023. Results from student surveys, field note observations, and focus groups show that there was increased self-efficacy among the participants for advocacy behaviours related to natural disasters and an increase in their understanding of and feelings of importance of the programme topics. This article can help inform others working with youth on successes and challenges with programme development around disaster resilience.

Dans le cadre du programme Youth Advocacy for Resilience to Disasters (YARDs - Plaidoyer par les jeunes en vue de la résilience face aux catastrophes), nous proposons une étude de cas sur un programme de sciences, technologies, ingénierie, art et mathématiques (acronyme anglais : STEAM) destiné à faire participer les jeunes à la planification de la résilience face aux catastrophes grâce à l'élaboration de cartes et à des activités de plaidoyer. De 2021 à 2023, nous avons conçu et mis en œuvre un programme d'enseignement en 14 sessions qui permet aux collégiens (âgés de 11 à 14 ans) de plaider en faveur d'améliorations infrastructurelles pouvant bénéficier à leurs communautés respectives en étudiant la résilience aux catastrophes du point de vue de la justice environnementale et de l'équité. Les jeunes explorent la cartographie virtuelle et la visualisation de données afin de comprendre les atouts et les vulnérabilités de leurs communautés face aux catastrophes. Enfin, ils élaborent un plan d'action qu'ils présentent aux responsables civiques

KEYWORDS

Disaster resilience; climate change; youth; advocacy; mapping

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et gouvernementaux locaux afin de plaider en faveur de changements. Ce programme d'enseignement a été testé en tant que programme extrascolaire à l'automne 2022 et deux fois sous forme de camp d'été en 2022 et 2023. Les résultats des enquêtes auprès des élèves, des observations de notes de terrain et des groupes de réflexion montrent que les participants ont renforcé leur auto-efficacité en ce qui concerne les comportements de plaidoyer liés aux catastrophes naturelles, ainsi que leur compréhension des sujets abordés dans le programme et l'importance qu'ils accordent à ces sujets.

Centrándonos en la Incidencia Juvenil para la Resiliencia ante las Catástrofes (YARD en inglés), ofrecemos un estudio de caso enfocado en un programa de ciencia, tecnología, ingeniería, arte y matemáticas (STEAM en inglés) promovido en una escuela media. Su objetivo se orienta a involucrar a los jóvenes en la planificación de la resiliencia ante desastres mediante la incidencia y la elaboración de mapas. Entre 2021 y 2023 diseñamos e implementamos un plan de estudios de 14 sesiones que empodera a los jóvenes de la escuela media (de 11 a 14 años) para que aboguen por mejoras de infraestructura que beneficien a sus comunidades. Los jóvenes aprenden sobre la resiliencia ante desastres desde la perspectiva de la justicia ambiental y la equidad; además, investigan sobre la creación de mapas virtuales y la visualización de datos que permitan comprender los activos y las vulnerabilidades de sus comunidades en relación con las catástrofes. Por último, elaboran un plan de acción y lo presentan a los dirigentes cívicos y gubernamentales locales para promover el cambio. Este plan de estudios se puso a prueba como programa extraescolar en el otoño de 2022 y dos veces en campamentos de verano en 2022 y 2023. Los resultados obtenidos en encuestas aplicadas a los estudiantes, en observaciones sobre el terreno y en grupos focales permitieron constatar que aumentó la autoeficacia de los participantes en sus comportamientos de incidencia relacionados con los desastres naturales y su comprensión y percepción de la importancia de los temas del programa.

Introduction

There is mounting evidence that frontline coastal communities are under increased threat from intersecting disasters (Van Aalst 2006; Yasuhara et al. 2011). Globally, extreme weather events, such as hurricanes, heatwaves, and flooding, are projected to rise in frequency and severity due to climate change (Fourth National Climate Assessment 2018). Further, industries operating in coastal ports pollute the air and soil of nearby neighbourhoods, and the negative health effects caused by industrial pollution can be exacerbated or redistributed by hurricanes and flooding (Horney et al. 2018). The COVID-19 pandemic created another acute public health threat, exacerbated by widespread economic hardship, particularly burdening low-income and marginalised communities (Heyd 2021). The effects of these compounded disasters can include loss of life, economic and material damage, physical and mental health effects, changes in labour markets, cultural shifts, and disruptions to education (Tierney 2017). We (the authors) assert that natural disasters are not simply acts of nature. The societal impacts of disasters are also a result of social and infrastructural histories, which have created

acute vulnerabilities for a subset of people and places, especially for historically marginalised communities of colour in the Southeastern US (Bullard 2008) and the global South (Ngcamu 2023).

Black feminist radical planners recognise that these disasters are not *social vulnerabilities* but rather an amplification of environmental inequalities embedded within our built environment because of systemic oppression of communities of colour, poor people, and women (Jacobs 2019). Following Jacobs, we emphasise that advocacy efforts should focus on addressing these structural and historical inequities to ensure equitable disaster preparedness, response, and recovery. Effective advocacy must involve a diverse range of voices and perspectives; thus, we must integrate all of the members of environmental justice communities and community knowledge into disaster planning and education. While there is increasing research on disaster resilience, there is less research on programmes to help improve disaster resilience, especially for the youth.

Through Youth Advocacy for Resilience to Disasters (YARDs), we seek to engage youth aged 11–14 in disaster resilience planning, mapmaking, and advocacy through a cross-curricular science, technology, engineering, art, and mathematics (STEAM) programme. The purpose of YARDs is to equip youth living in frontline communities to become leaders in climate justice and disaster resilience. YARDs seeks to inspire and empower these young people to pursue educational, career, and civic opportunities so that their visions of thriving communities can be brought into reality. We wanted them to think beyond their schools and classrooms by having them create action plans for their communities around disaster resilience and having them present those plans to local leaders.

Why do we focus on the youth? Young people are routinely overlooked in disaster recovery efforts and urban planning (Jacobs 2019). Additionally, disaster-related trauma can have devastating effects on their psychological and psychosocial development, particularly in cases where dislocation uproots family and social networks or when there is school or academic disruption (Hyde et al. 2021; Peek et al. 2017). We designed a youth programme because families are often busy with other activities, including care work and employment; however, young people can act as a gateway to busy families. Finally, past research has shown that engaging young people in advocacy can enhance disaster resilience (Peek et al. 2016).

This research project began in Savannah, Georgia through a partnership between the Georgia Institute of Technology, Savannah State University, the Harambee House, the City of Savannah's Office of Sustainability, Savannah and Chatham County Public School System, and the University of Minnesota. Addressing complex issues like climate change and disaster resilience requires a transdisciplinary perspective. Our research team represents a variety of disciplines including sociology, digital media studies, public policy and affairs, urban planning, and civil engineering, and includes leaders from the Harambee House, an environmental justice organisation in Savannah, Georgia. After two years of partnering, we applied to a planning grant in 2020 with the National Science Foundation's Civic Innovation Challenge's Disaster Resilience track, aiming to develop community-identified issues and solutions through community–university partnerships. We

originally decided to study how residents in Savannah's west side understand disaster and climate resilience from their own perspective. Through conversations with the Harambee House about the challenges of community engagement during the COVID-19 pandemic, we pivoted to developing a youth programme because youth are a sizeable and vulnerable part of communities on Savannah's west side, and the research team and the Harambee House had expertise working with youth through the Youth Engagement and Action for Health (YEAH!) programme[1] and the Black Youth Leadership Development Institute (BYLDI),[2] respectively. We discuss YEAH! and BYLDI in greater detail later in the paper.

In this paper, we have two primary goals: to share knowledge on how this programme was developed and to present findings from the evaluation of the pilot programmes. First, we describe the development of the curriculum, including the literature that inspired YARDs and the process of creating the structure and content of the curriculum. We hope that this not only illuminates the intellectual and curriculum development background of YARDs, but also provides a case study for others developing similar programmes. Second, we end the paper with an evaluation of the three pilot programmes of YARDs addressing the following research questions: (1) How does YARDs affect youth self-efficacy around advocacy for resilience to disasters? and (2) How can mapmaking help youth understand their communities and disaster resilience better? The YARDs pilots were conducted in Savannah, Georgia, a coastal city in Southeastern US. The study uses pre- and post-programme survey data with youth who participated in the pilot programmes in 2022 and 2023. Additionally, it includes insights from focus group interviews conducted with the young people who participated in the programme and the teachers who co-led the pilot programmes. This evaluation is not intended to prove the success of YARDs; however, it should be seen more as a multi-pronged approach to understand the strengths, weaknesses, and limitations that YARDs offers when working with youth on improving disaster resilience. While our pilots were conducted in Savannah and Chatham County, we aim to expand YARDs to other parts of the Southeastern US and eventually other nations, including those within the global South like South Africa.

Imagining YARDs: a transdisciplinary approach

As mentioned, issues of disasters, resilience, and climate change connect to a wide range of disciplines reflected in the composition of our research team; thus, we used various concepts and theoretical perspectives from different disciplines to imagine the YARDs curriculum.

Environmental and climate justice

One major inspiration for YARDs comes from environmental justice literature, with roots in 'environmental racism' scholarship pioneered by sociologist Robert Bullard (Bullard 2005) and others, often focusing on the Southeastern US. Bullard contends that '[c]ommunities consisting primarily of people of colour continue to bear a disproportionate burden of this nation's air, water, and waste problems' (Bullard 1993, 23).

Environmental justice can be seen as the response to environmental racism. According to Bullard, '[e]nvironmental justice embraces the principle that all people and communities are entitled to equal protection of environmental, energy, health, employment, education, housing, transportation, and civil rights laws and regulation' (Bullard 2021, 244). While Bullard is often credited with coining the term 'environmental racism', the environmental justice movement has linkages to the US Civil Rights Movement with Martin Luther King Jr.'s and other activists' efforts in the 1968 Memphis Sanitation Workers' Strike[3] and the case of *Bean v Southwestern Waste Management Corporation* and the Formation of the Northeast Community Action Group (NECAG) in Houston where a group of middle-class, suburban African American homeowners fought a landfill from being built near a public school in their neighbourhood[4] (Environmental Protection Agency 2024).

More recently, the environmental justice movement has connected with climate change movements leading to the concept of climate justice. Many climate justice influences come from the global South (Schlosberg and Collins 2014) and have roots in the Bali Principles of Climate Justice (CorpWatch 2002). Within the US, organisations like the Climate Justice Alliance work to interlink strategies and communities around climate justice issues (Climate Justice Alliance 2024). The climate justice movement notes that the effects of climate change are not equally shared across different social groups and geographies, and many people living in the global South face disproportionate negative social and economic effects of rising sea levels and climate-induced hazards/disasters. The climate justice movement also acknowledges that the global North and large corporations have profited by polluting the environment and extracting natural resources, which have largely contributed to climate change. Thus, it is necessary to consider the links between industry, pollution, climate change, and the effects of disasters on people, which disproportionately affect marginalised groups and people living in the global South. In YARDs, we discuss the perspectives of environmental and climate justice, especially concerning disaster resilience. Additionally, YARDs is rooted in the legacy of the environmental justice movement and seeks to engage youth and communities who are most affected by climate change as part of decision-making and planning processes.

Disaster resilience and vulnerabilities

The YARDs programme has also been heavily informed by the literature from disaster studies and interdisciplinary work on resilience. Disaster resilience is often framed as the characteristics that help social systems or individuals absorb, respond to, and adapt after disaster events (Cutter et al. 2008), 'bouncing back' to a 'stable state' that existed prior to the disaster (Paton et al. 2001). While traditional resilience perspectives imply returning to the status quo, 'bounce forward' resilience (Kresge Foundation 2015) promotes 'just resilience', or strategies and policies 'to offer an alternative political orientation that fundamentally addresses the conditions that necessitate resilient individuals, communities, and societies' (Davoudi et al. 2018, 6) that promote equity, inclusion, and justice.

Increasingly, research shows that people living in low-income neighbourhoods and people of colour often experience higher risks of vulnerability to climate-induced disasters (Balbus 2009; Roberts 2021), especially concerning flooding and hurricanes (Aranda et al. 2023; Kim 2015). The vulnerabilities can be linked to oppressive classist and racist systems that ensure poor communities and communities of colour have less political and economic capital. For example, diminished political representation, low wages, limited resources, and geography (polluting industries are often located near marginalised communities), all attributed to historical oppression, perpetrate a cycle of poverty in marginalised communities that exacerbates social vulnerability (Bullard 2008).

Youth are often more vulnerable to disasters than adults (Peek 2008) and experience disproportionately adverse effects related to mental, physical, and nutritional health, access to education, economic revenues, and safety (Hyde, Li, and Maltbie 2021). Despite these vulnerabilities, youth are not powerless. Young people can foster greater community resilience by acting as change agents and have been critical to social movements (Earl 2017), including in the US civil rights movement, in particular sit-ins (Klimke 2010), the Anti-Vietnam War protests (Overstreet 2019), the Black Lives Matter movement (Earl 2017), and South Africa's Youth Climate Action Plan (Vogel 2022). Thus, educating and empowering the youth early in environmental justice and disaster resilience can support better preparedness and community resilience. Thus, in the YARDs programme, we discuss how youth have been important in social movements in the sessions on youth engagement.

Black feminist urban planning perspectives and climate resilience

Current practices in climate resilience planning often fail to consider youths' perspectives as critical when addressing the climate crisis. Jacobs (2019) critiques the traditional focus on social vulnerability within disaster research because it fails to address institutional racism, classism, and sexism exposed by disasters. Additionally, such research falls short in its ability to build community empowerment and systemic change partly due to its inability to centre community knowledge and confront intersectional oppressions. Black feminism addresses the intersections of race, class, and gender while highlighting the importance of local knowledge and storytelling above extractive technocratic data that dehumanise and further marginalise communities (McKittrick 2020). This aligns with the principles of radical planning, which advocates for participatory and inclusive planning processes that empower all community members; particularly, those who are excluded due to their race, gender, and class. Following Jacobs' (2019) framework, disaster resilience planning must incorporate youth perspectives, specifically from those who are often most affected by climate policies but least consulted, leveraging the unique insights and lived experiences of youth and ensuring that planning is not done for the community but with the community.

Youth-led advocacy (noted as youth advocacy for brevity going forward) has been shown to support positive psychosocial, emotional, and developmental outcomes (Linnenbrink and Pintrinch 2002). For youth of colour, advocacy helps them to actively

address inequalities that affect their lives, and it helps develop agency, self-efficacy, and optimism for change (Whitehead 2009). Self-efficacy is an important factor shaping disaster preparedness, which is vital for community disaster resilience (Adams et al. 2019). Self-efficacy affects disaster preparedness because individuals are more likely to prepare for disasters if they believe that disaster preparation actions can have meaningful outcomes (Levac et al. 2012). Disaster preparedness collective efficacy improves resilience because trust that preparedness and infrastructure interventions can mitigate disasters leads to (1) increased perceptions of the risks of disasters and (2) belief that their actions will mitigate the negative effects of disaster events and stimulate a speedier recovery (Babcicky and Seebauer 2020). Previous research on youth advocacy that focused on tobacco control found that such advocacy led to attitudinal and behavioural changes among the youth and improvements in their self-efficacy and collective efficacy related to tobacco usage (Holden et al. 2004; Ribisl et al. 2004). Researchers, including Botchwey and OConnell on our research team, have previously used youth advocacy for healthy eating and physical activity promotion through Youth Engagement and Action for Health (YEAH!) (Botchwey et al. 2020; Linton et al. 2014; Millstein et al. 2016). YEAH! positively affected self- and collective-efficacy for youth participants and led to real change in policy, systems, and the built environment. For YARDs, we anticipate that youth advocacy will (1) help enact wider social change and awareness of disaster resilience and its relationship to infrastructure and (2) improve self and collective efficacy around disaster preparedness and infrastructure interventions, in turn improving disaster resilience (Peek et al. 2016). Thus, the YARDs programme has important psychosocial implications that can improve disaster preparedness and resilience at the individual, family, and community levels.

Another major inspiration for the YARDs programme was the BYLDI, developed by the Harambee House through Dr. Mildred 'Mama Bahati' McClain, a veteran teacher and internationally renowned environmental justice leader (also co-principal investigator and team member for the YARDs programme), and Mr. Clarence T. Martin, a public servant and civil rights leader from Atlanta, Georgia (The Harambee House 2024). The BYLDI was founded in 1988 to train young African Americans to serve as leaders and change agents in their neighbourhoods, schools, churches, and youth groups. The BYLDI empowers Black Youth between the ages of 12 and 19 who are primarily in communities in the Southeastern region of the US that have been impacted environmentally by climate change. Through BYLDI, the programme can increase public awareness and knowledge of youth regarding environmental justice issues while providing them with the skills necessary to make informed decisions and take responsible action, creating leaders for the future.

Civil infrastructure solutions to increase resilience to disasters

Beyond social factors, infrastructure systems, including elements of the natural and built environments, are important in shaping community resilience (Choi et al. 2019; Johansen et al. 2017; McAllister 2016). Community flooding risks stem from flood hazard exposure and rising sea levels depending on proximity to the coast (Emrich and Cutter 2011). For

heatwaves, the south-east coastal US has moderately high temperature thresholds and mortality risk when compared with the rest of the world (Li et al. 2015). In the US, marginalised communities have faced historical under-investment in infrastructure, leading to more severe negative impacts from flooding events and longer recovery times (Shonkoff et al. 2011). These effects are coupled with other risk factors, such as poorer air quality (American Lung Association 2001), which can exacerbate the negative effects of disasters.

When considering infrastructure solutions for resilience to flooding, leaders and decision-makers can consider different infrastructure types, including grey, green, or both (Shafique and Kim 2017; Wang et al. 2023). Grey infrastructure, like storm drains and levees, are traditional hard-scaped solutions typically designed for a primary purpose: to limit the effects of storms and flooding. Green infrastructure is a nature-based solution designed to reduce flood risk and provide additional benefits, like reducing urban heat island effects (Leal Filho et al. 2021). Green infrastructure solutions, including bioretention ponds and oyster reefs, limit or slow down the effects of storms or flooding. Solutions incorporating both types of infrastructure include multiple elements, such as a bioswale that connects to a grey stormwater system.

Green infrastructure has multiple benefits for disaster risk mitigation (Demuzere et al. 2014), which makes it a priority for YARDs. When considering green infrastructure, one should consider the multiple potential benefits and placement of the proposed site, especially in relation to flooding (Reckner and Tien 2023). Following prior work and to provide examples of the multi-functional benefits of infrastructure solutions, Reckner et al. (2024) divided potential green infrastructure benefits for an area into four main categories. Disaster Risk benefits relate to the potential disasters themselves and reducing risk to critical assets. Basic Survival benefits support the survival of humans including shelter, clean air, clean water, and healthy food. Ecosystem benefits help preserve plant and animal habitats. Sociocultural benefits aid the social and cultural characteristics and activities. Given this literature, we include lessons on green and grey infrastructure solutions to disasters in YARDs, and we encourage participants to consider both in the creation of their action plans and disaster resilience solutions.

Digital civics and participatory mapping

Digital civics, an emerging research area that blends digital media and planning, seeks to create data-driven public tools and services, which encourages active participation in the co-production of knowledge for local governance (Gurstein 2011; Olivier and Wright 2015). Digital civics illuminates challenges in the application of these digital media and inclusive urban planning approaches to resilience in the face of disasters (Gabrys et al. 2016; Sitinjak 2018), as well as in making data accessible to marginalised communities (Asad et al. 2017; Costanza-Chock 2020). Digital civics approaches are often most effective through cross-sector and community partnerships (Chen et al. 2013; Lu et al. 2018).

Existing research shows that visualisation tools can help youth understand the effects of disasters, the value of resilience, and how infrastructural improvements can support or improve existing community resilience strategies (McAllister et al. 2019). Generally, visualisation tools that support disaster-related decision-making are aimed at individual adult decision-makers. YARDs introduces an open-source data visualisation tool, Map Spot, which is both accessible to youth and explicitly collaborative. Map Spot was developed out of the broader Map Room Project (Loukissas 2019; Loukissas et al. 2018) in collaboration with data artist Jer Thorp, who created the first Map Room in St. Louis in 2017, together with the Office of Creative Research and COCA (Aviles 2020). Map Spot was developed by Yanni Loukissas to be a portable version of the original project. Map Spot contains three basic elements: (1) software using Node, MapBox, and Open Street Maps for storing and retrieving preloaded data layers; (2) a short-throw digital projector mounted on a TV display stand; (3) a drawing surface where the projection can become a guide for group mapmaking activities using physical media, such as paper, pens, markers, and collage materials. Map Spot is intended to work when participants are enabled to use the spatial organisation of the map to draw together their lived experiences with existent spatial data to illustrate claims about the places they live.

Creating YARDs

Building upon the literature described in the previous section, our research team developed the YARDs curriculum through an iterative process. YARDs is a 14-session curriculum that empowers youth to identify environmental concerns in their communities while also creating opportunities to advocate for community change and healthy, more resilient neighbourhoods. Each session is between 60 and 90 minutes with discretion left to the teacher or facilitator. Three pilots for the YARDs programme were conducted: one in the summer of 2022, one between October and December 2022, and one in the summer of 2023.

For the summer and fall of 2022 programmes, we did online trainings with the teachers, going over three or four sessions at a time. While the teachers initially felt confident with the material, the research team and teachers agreed that more hands-on training done in person or in a hybrid format would be more effective. For the summer of 2023, more intensive hybrid training was conducted, which was paired with the teacher's previous experience running the programme.

The YARDs curriculum includes the following modules and sections (see Table 1):

- Module 1 provides a broad introduction to the YARDs programme and civics lessons connecting participants to leadership and governance structures. Session 1 introduces participants to the concepts of disasters, resilience, community, and environmental justice, helping them to imagine thriving communities. Session 2 provides an overview of civics fundamentals, especially politics and power at the local, state, and federal/national levels. Session 3 involves the policy game,[5] where

Table 1: YARDs curriculum design and sessions

Module	Session	Description
1	1	Introduction to YARDs
	2	Civics 101
	3	Civics 101 Review & Power/Policy Games
2	4	Map Spot, Part 1 – Stories Discussion of Vulnerability and Resilience
	5	Map Spot, Part 2 – Learning the Map Spot Tool and Turning Stories into Data
	6	Map Spot, Part 3 – Mapping the Place – Guest Speaker
3	7	Infrastructure Solutions Green vs Grey and Floodplain Demo
	8	Prepare Action Plan
	9	Package Action Plan
	10	Practice Makes Perfect
	11	Homework – Talk with Your Family
	12	Action Day (Family Emergency Preparedness Plans and Kits)
	13	Presentation of Action Plans to Advocate for Community Change
	14	Reflection (on Presentations, Thank You Notes and Decision Maker Follow-up)
	15	Celebration and Next Steps

youth begin to imagine an action plan that would help their community be more resilient to disasters.

- Module 2, including Sessions 4, 5, and 6, includes activities around Map Spot. Through several prompts, the participants are invited to draw their own experiences of the city, as well as explore data on community assets and vulnerability. The broader goal of Map Spot is to encourage grassroots engagement with civic data and help the communities mobilise around issues important to them. Thus, Map Spot acts as a bridge between the 'official' data and the lived experiences of youth.
- Module 3 introduces the concepts of green and grey infrastructure in Sessions 7 and 8. Through a flood simulator, participants receive a presentation on green and grey infrastructure and how they work. This allows participants to learn the importance of impervious surfaces while having an opportunity to build infrastructure to protect a floodplain. Participants then use MapSpot to select a site for an infrastructure project they will use to design their action plans. MapSpot allows the participants to analyse open lots, often targeting Federal Emergency Management Agency (FEMA) property lots[6] (lots bought by FEMA due to persistent flooding) or park spaces. In Sessions 9–14, participants begin to develop an action plan that they ultimately present to local leaders. In Session 12, participants develop a family disaster preparedness action plan.

Data and methods

This section includes the methodology followed for the assessment and evaluation of the YARDs intervention.

As mentioned above, in 2022 and 2023, we implemented pilots of the YARDs programme. In the summer (July) of 2022, 12 youth participated in a five-day summer camp. Between October and December 2022, 25 middle-school youth participated in the after-school YARDS programme, meeting twice a week at a Title I school,[7] in the Savannah and Chatham County Public School System. Finally, eight youth going into the 8th grade

took part in the summer (July) 2023 five-day programme as a summer camp. Overall, we reached around 45 youth with the three pilots, of whom 22 participated in the evaluations.

The study design focused on assessing the effectiveness of the YARDs curriculum through a comprehensive evaluation approach. We used both formative and summative evaluations, utilising surveys administered before and after the programme, along with focus group interviews with the youth and the teachers at the programme's conclusion. The pre- and post-programme student surveys measure changes in attitudes, along with focus group discussions with youth and teachers to gather qualitative insights into programme implementation and effectiveness.

Recruitment method

For the summer of 2022 and 2023, youth were recruited through Georgia Tech's Center for Education Integrating Science, Mathematics and Computing (CEISMC) youth summer camp. For the fall of 2022, youth were recruited through the support of the principal and teachers at the school participating in the programme, as well as through a demonstration of YARDs to youth, including Map Spot. We made the programme free to increase access for those with lower incomes and to increase socioeconomic diversity of potential participants. We also incentivised participation in the summer 2022 summer camp and fall 2022 after-school programme with US$50 gift cards to provide financial compensation given that the youth were helping us refine the curriculum. Written parental consent and written assent were obtained from all the participants and their respective guardians.

We recruited teachers/facilitators through the GA Tech's CEISMC Georgia Intern-Fellowships for Teachers (GIFT) programme for the summer of 2022, which included an application and interview process among teachers. For the fall of 2022, we recruited teachers by first working through the Savannah and Chatham County Public School System. The superintendent referred us to a principal and school, and then the principal recruited three middle-school teachers. For the summer of 2023, we recruited one of the teachers from the fall of 2022. All four teachers identified as Black or African American, and three were women.

Measures

The pre- and post-surveys were modified from surveys created by Millstein et al. (2016) to evaluate participants' perceptions of psychosocial factors and their understanding of knowledge and skills relevant to the summer programme topics. Additional items were developed to assess participants' comprehension of infrastructure. This process aimed to facilitate the adaptation of the existing survey to the new curriculum. All items and the constructs are modified from previous measures and validated for this study.

The survey focused on several items:

1. Perceptions of psychosocial factors:
    - Self-efficacy for disaster resilience/environmental justice and advocacy behaviour.

- Sociopolitical control (active participation and optimism for change).
- Advocacy outcome efficacy.

2. Perceptions of knowledge and skills:
   - Participatory competence and decision-making.
   - Peer support for resilience behaviours.
   - Advocacy history.

Additionally, youth identified disasters facing their community, their enjoyment of advocacy, and perceived importance of course topics. Advocacy involves efforts to build support for, recommend, and argue in favour of a cause or policy (Carlisle 2000). Constructs such as outcome expectancies, perceived self-efficacy (Bandura 1977), and sense of community can influence advocacy perceptions, skills, and behaviours, including public participation and vocalising one's beliefs to decision-makers. Hence, these measures were adapted to be used in this study. The pre-survey also contained demographic items, while the post-survey included open-ended items to gather feedback on youth satisfaction with programme activities and suggestions for improvement.

Data collection and analysis

All the participants in the YARDS programme were invited to complete a pre-survey on the first day of the programme and a post-survey on the final day. A total of 22 participants across all implementations responded to the surveys. Only the participants who had consented to the study and had parental permission were invited to take the survey; however, some participants did not participate in the pre- or post-survey if they were absent on the days that the surveys were administered. Quantitative survey data were analysed using descriptive statistics, including means, frequencies, and standard deviations (SD). The Wilcoxon signed-ranks test was used for analysis due to the small sample size. The analysis was conducted using SPSS version 29. When multiple items were previously validated and used to form a construct, responses to each item within the construct were averaged to assess youth overall perceptions of the construct. We acknowledge that the three pilots were conducted in different settings and circumstances, which may introduce some confounding variables. However, since the descriptive survey data patterns for each pilot are similar, we have chosen to present the data in aggregated form.

Additionally, hour-long interviews were conducted with the four participating teachers at the end of the programme. Further, we did a total of six focus group interviews with the youth participants, or two focus groups for each of the three pilots. Finally, the research team took field notes during observations throughout the process. For the field notes, focus groups for youth participants, and interviews with teachers, we did thematic coding (without software) based on some of our research questions and inductive coding based on emerging themes developed in the analytical process.

Results

Participants

Combining the demographics of the 22 youth across all three implementations of the programme, the participants were primarily African American or Black youth. Pilot 1 participants ranged in age from 11 to 14 years old. Sixty per cent were in 6th grade, and 60 per cent identified as girls. The majority of participants identified their racial and ethnic background as African American. Pilot 2 participants were between 12 and 14 years old, mostly in 9th grade, and included 60 per cent girls. They self-reported as being Black/African American, Multiracial (including Hispanic/Latino), or Asian/Asian American. Pilot 3 participants were aged between 12 and 14 years old, mostly in 8th grade, and included an equal split between girls and boys. Fifty per cent of them identified as Black/African American, with the rest identifying as Multiracial or Native American/American Indian.

Research question 1: How does YARDs affect youth self-efficacy around advocacy for resilience to disasters?

A set of ten items was used to assess participants' self-efficacy for advocacy behaviours related to disaster resilience and environmental justice (for the items, see Table 2). In Table 3, we present the results from the pre- and post-surveys. Across all measured areas, there was a positive increase from pre-survey to post-survey. Specifically, there was a statistically significant increase in participants' self-efficacy for advocacy behaviours related to disaster resilience and environmental justice and advocacy outcome efficacy.

Table 2: Items for self-efficacy for disaster resilience/environmental justice and advocacy behaviour

1. I am sure that I can tell my friends how infrastructure problems could impact the neighbourhood.
2. I am sure that I can tell my friends how to prepare for natural disasters.
3. I am sure that I can tell my friends how to advocate for disaster resilience.
4. I can talk about what types of natural disasters might affect my neighbourhood.
5. I am confident that I can work to make my school or community more prepared for natural disasters.
6. I am sure I can identify which areas in my community are at most risk for flooding.
7. I can talk about how building better infrastructure could lead to less flooding in my neighbourhood.
8. I can help my community to find disaster emergency housing after a disaster happens.
9. I know what location I would want a new grocery store in my neighbourhood.
10. I know where different types of infrastructure, such as hospitals and grocery stores, are located in my neighbourhood.

Table 3: Results from pre- and post-surveys of youth participants

Item	Pre-survey		Post-survey		Difference (post − pre)
	Mean	SD	Mean	SD	
Self-efficacy for disaster resilience/environmental jjustice and advocacy behaviour	3.23	0.52	3.83	0.62	+0.60**
Sociopolitical control: active participation	3.00	0.82	3.02	0.61	+0.02
Sociopolitical control: optimism for change	3.38	0.73	3.61	0.76	+0.23
Advocacy outcome efficacy	3.78	0.56	4.14	0.70	+0.32**
Participatory competence and decision-making	3.77	0.57	4.02	0.69	+0.25
Enjoyment of advocacy	3.68	0.89	3.86	0.63	+0.18

$n = 22$; $^{**}p < 0.01$.

The results indicated a statistically significant increase in self-efficacy for advocacy on the post-survey compared to the pre-survey ($Z = 3.36$, $p < 0.01$). On average, youth agreement with the self-efficacy construct increased by almost three-quarters of a point from the pre-survey (mean = 3.23, SD = 0.52) as compared to the post-survey (mean = 3.83, SD = 0.62). This suggests that participants developed their efficacy for advocacy behaviours specifically related to understanding, preparing for, and responding to natural disasters. These findings suggest increases in certain aspects of advocacy efficacy, although participants' average agreement with efficacy items overall remained neutral.

Additionally, data from the focus group interviews support the impression that self-efficacy related to disaster resilience and preparedness among youth increased. One participant said that they learned that advocacy meant to '[t]ake action and fight for what you believe' and 'allows people to be aware of your problem' (focus group interview, Savannah, 22 July 2022). Another participant said: 'Proper infrastructure can decrease flooding, getting help [for communities] easier, and help people be more prepared.' In Pilot 2, one participant gave a passionate address about the lack of investments and opportunities in their presentation about their community to state senator staffers, local government leaders, and youth families. She said, 'How can y'all sit in your offices and not do anything to address this [in reference to climate justice and disasters]? People are suffering in our communities and in the streets. Y'all have to do something' (student, Savannah and Chatham County Public School System, 30 November 2022). By going through the YARDs programme and developing these action plans, participants were able to use knowledge from the programme, their lived experiences, and family experiences to make powerful critiques of historical and current oppressive systems, which aligns well with Black feminist planning perspectives (Jacobs 2019).

Additionally, there was a statistically significant change with the overall construct for advocacy outcome efficacy (four items) from pre-survey to post-survey ($Z = 2.07$, $p < 0.01$). Notably, on the post-survey, participants agreed, on average, with all statements assessing their perceptions of their advocacy outcome efficacy, suggesting that participants perceived stronger feelings of efficacy related to using the YARDS project to make a positive difference in their school or community. One student said that the YARDs programme helped them feel 'inspire[d] to advocate for yourself and your community' (focus group interview, Savannah, 21 July 2023). Another participant said that they learned, 'if you are more prepared then there will not be as much damage so you can recover better, which makes you resilient' (focus group interview, Savannah, 22 July 2022).

Participants also reported improvements in their knowledge and skills related to youth advocacy. There were increases in youth assertiveness, competence, and decision-making, particularly in discussing programme topics with others. This is supported by responses to the multiple-choice questions that asked about how frequently students have conversations with people about the topics that they learned. The results showed that students reported increased conversations with close friends, peers, family members, and local leaders about natural disasters and environmental justice, suggesting that the participants were actively sharing camp learning and topics with others during the programme.

The improved self-efficacy is noteworthy because of its role in Social Cognitive Theory (Millstein et al. 2016) and its strong association with behavioural outcomes. Based on Social Cognitive Theory, it was expected that high or increasing self-efficacy for advocacy behaviours would result in youth advocacy behaviour change. These pre–post changes suggest that YARDs had several intended effects on participating youth. While we did not follow up with the participants after the programme, we do have evidence that the programme inspired action. One young person in Pilot 2 went so far as to identify the owner of the FEMA lot of their proposed action plan, and then drafted a letter requesting that the owner consider the participant's plan to turn the park into a green space with trees to (1) reduce flooding and heat and improve air quality and (2) create a play space for kids in the community due to the large youth population. This unanticipated act of ambition surprised the research team and teachers alike, showing the empowering elements of advocacy programmes for youth (Jacobs 2019).

In interviews, teachers also identified several benefits for participants, including academic growth and community engagement. Participants developed public-speaking skills, which many had not previously mastered. YARDs also empowered participants to take ownership of projects and step out of their comfort zones, enabling them to make positive contributions to themselves and their communities. Teachers were excited to witness their students' growth in advocacy throughout YARDs.

Overall, we find modest evidence that youth participating in YARDs had greater disaster resilience/environmental justice and advocacy self-efficacy and behaviour after the programme than prior to entering it.

Research question 2: How can mapmaking help youth understand their communities and disaster resilience better?

We draw upon student focus groups and field note observations to understand the research question related to the importance of mapping. When we ran the Map Spot session with the after-school programme, the sessions started from a place of confusion for many participants. These young people did not have experience working with maps or thinking about their city geospatially. We prompted the participants to think about what they know of the city, what their experiences have been, and how they could share it on the map. The participants felt they had limited experience and familiarity with the city. At first, we commonly heard 'we are just kids, we don't know enough'. Thus, they focused primarily on using data, such as the under-18 population, distribution of parks in neighbourhoods, which were more relevant to them. We also introduced them to flood-risk data, which helped them put disaster vulnerability in dialogue with the impact on youth and their resources. Despite the participants initially feeling unsure, they were able to make an argument using data and maps as evidence by the end of the session, which illustrates the potential for maps to be used as a tool for engaging youth in civic conversations and is supported by organisations like the USAID (2024).

Additionally, the focus groups and field notes provided more evidence that mapping was an important aspect of the programme. One young person argued, 'Cool to see more

about different areas of Savannah, rather than the areas of our school and houses, we don't look too much at but seeing the data was cool' (focus group interview, Savannah, 22 July 2022). Mapping '[g]ave me a wider perspective of where I live'. On the Pilot 3 presentation day, one grandmother told us that her grandson realised that his grandfather was from the same neighbourhood where he was proposing his action plan, which set up a conversation about how different things were on the west side of the city and the suburb where the grandson lived. Without mapping, this connection might not have happened. These connections for the youth between family and local history are important for inspiring social change (Lamarca 2010).

Prior to the pilots, we had expected that the youth would focus on the flooding and sea-level rise data layers; however, we found that many of them were not as concerned about flooding, particularly because many had not experienced a major flood in their recent memory. Instead, they tended to focus more on the air-quality data and health data like cancer rates, lead paint levels in buildings, and other health issues in their communities. Without prompt, the participants realised the correlations between the demographic data like racial/ethnic composition, poverty rates, disaster risks like flooding and heat, and health effects of industrial pollution. Another group expressed concerns about why there were no hospitals and limited doctors' offices on their side of the city, which prompted them to include a resilience hub with medical services in their plan. This group pointed out that there were limited jobs with decent pay in their community and wanted their resilience hub to include jobs for residents. In a conversation with one parent in this group, a mother agreed with her child's concerns and was proud to hear about their action plan. Thus, youth focused on flooding, air quality, and heat in their action plans, as well as social issues in their communities. The Harambee House confirmed that adult residents were also more concerned about pollution, cancer, air quality, access to medical care, and decent jobs over flooding. As Jacobs (2019) notes, centring local knowledge is so important in planning efforts, especially for those in marginalised communities, because the so-called 'experts' (aka our research team) often lack an understanding of communities' real priorities and needs. Local knowledge and amplifying voices of the youth can help these efforts be more effective and increases buy-in from residents.

Overall, this evidence suggests that the interaction with maps and data improves young people's understanding of their community and disaster resilience.

Conclusion

As the effects of climate-induced disasters are felt by more people across the globe, educating the youth, planning for thriving communities, and inspiring action will be important. As we try to develop a more-inclusive and thriving society, all communities should be represented and empowered, and public discourse should be more balanced across the populations impacted. We argue that involving the youth can lead to this as a reality and that the YARDs programme is one of many potential ways to begin those conversations, create new educational opportunities, and imagine more equitable and resilient futures.

Overall, we found that youth advocacy programmes like YARDs can increase self-efficacy generally (Millstein et al. 2016), especially around disaster resilience (Jacobs 2019; Peek et al. 2016). Thus, it is not enough for the youth to simply learn about climate change or disaster resilience academically, but it is more important that this education is linked to advocacy and action plans. Programmes like YARDs have the potential to not only give voices to the youth, but also to inspire local leaders to provide new and innovative solutions to disaster resilience. The belief that one's efforts can lead to real results is important as we address climate change. Despite the youth being vulnerable to disasters (Hyde, Li, and Maltbie 2021), they can be important voices for change despite often being left out of climate and urban plans (Jacobs 2019).

We also found that mapping can be an important way for the youth to understand data, which supports past research (McAllister et al. 2019). Mapping and exploring data about their communities not only helped young people better understand where they live, but also helped them better understand themselves and their relationships with family members. It helped them see the relationships between geography, disaster risks, and social vulnerability, and it informed their action plans. Indeed, we asked that the solutions that they provided reference to a data layer from Map Spot, which strengthened the justifications of their proposed solutions.

Through the initial pilot programmes, we have a better understanding of some of the successes and what worked well. First, we successfully created a cross-curricular STEAM programme where participants saw the connections among the key concepts and themes of curriculum material in different sessions, which were then implemented into the designs of their action plans. Second, the youth in YARDs created meaningful designs for social and physical infrastructure that could be implemented if local government funding and support were available. Third, many participants said that YARDs was fun; two young people participated twice, which we saw as a positive indicator of programme effectiveness, given past research showing the importance of fun in learning for children and youth (Buckingham 2013).

Despite the successes, we faced some shortcomings. First, it has been challenging to get aspects of the youth action plans implemented even though local leaders and government officials were excited about these action plans. These leaders tend to cite a lack of funding as a barrier. It is likely that working more closely with local governments or organisations that have parks and/or community centres would yield more success. Second, teachers often saw themselves as experts in only one 'discipline' or subject and felt less confident in the cross-curricular design of YARDs. Third, while we reached more than 40 young people, only 22 participants completed both the pre- and post-programme surveys. This limits the statistical power and generalisability of the findings. Finally, while we had adult facilitators lead the programme in each of the three pilots, professors and graduate students assisted to various degrees in leading class activities and discussions. In the first pilot, since we had newly designed the curriculum, both the teacher and research team had limited knowledge on how things would go. Therefore, the research team played a major role in running the first summer camp. In the second pilot, we sought to take a more hands-off approach; however, due to teachers being sick or called

by their principal to run other after-school activities, we sometimes needed to step in to run sessions. In the third pilot in the summer of 2023, one teacher was able to take on a major role in leading all of the sessions, in part due to her having had experience as a facilitator in one of the earlier pilots.

Looking forward, we aim to write additional papers based on the qualitative data from the pilots. In the summer of 2024, we worked with two teachers to further refine the curriculum, including redesigning it for an inland context and developing a shorter version of the programme intended for sixth graders. We plan to pilot YARDs in a major inland city in the Southeastern US like Atlanta by 2025 and revised YARDs as a two-day programme in Cape Town, South Africa, in August and September 2024. We see potential for YARDs to have benefits for youth, teachers, and communities throughout the US and globe by emphasising the local context in the curriculum.

After the writing of the paper began, the city of Savannah experienced tragic flooding as a result of Hurricane/Tropical Storm Debby in August 2024. Savannah received at least 25 cm of rain in just a few days, and thousands of residents experienced power outages (Fox 5 Atlanta Digital 2024). Schools were closed as the academic year just began, and some families and neighbourhoods were isolated due to the rising waters. While many participants of the YARDs programme had not experienced a major flood in their recent memory, Debby and other future storms fuelled by the climate crisis are likely to linger on their minds, shaping their life opportunities and trajectories. As Jacobs (2019) notes, we know that we cannot get through this climate crisis without involving the youth and other voices that are often marginalised from across the globe. The growing climate crises are urgent, and we must act for their future.

Notes

1. See https://yeah.gatech.edu/.
2. See https://harambeehouse.my.canva.site/relaunch-harambee-house-ej (under construction at the time of article submission).
3. The Memphis Sanitation Workers' Strike occurred in 1968, and the major focus was on the health and working conditions of sanitation workers, including men who worked on garbage trucks who lost their lives on the job. Martin Luther King Jr. attended this strike as part of the Poor People's Campaign in the US. Ultimately, he was shot and assassinated in Memphis on this trip. For more information about the Memphis Sanitation Workers' Strike, see https://kinginstitute.stanford.edu/memphis-sanitation-workers-strike.
4. For more information about the *Bean v Southwestern Waste Management Corporation* case and its ties to the environmental justice movement, see https://www.aaas.org/membership/member-spotlight/welcome-front-lines-environmental-justice-robert-bullard.
5. The policy game is an activity where students identify a social issue in their community, identify a potential policy solution, and then decide who they would need to reach out to to advocate for this policy. This helps them practise designing their action plan ahead of the later sessions.
6. For more information about FEMA lots and the buyout process for flood-prone areas in the US, see https://www.pewtrusts.org/en/research-and-analysis/reports/2022/04/property-buyouts-can-be-an-effective-solution-for-flood-prone-communities.

7. A Title I school is a school which receives federal funding to help students from low-income families achieve high academic standards in the US. In these schools, there is a higher proportion of youth on free or reduced lunches.

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