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Prefiguring Sustainability through Participatory Action Research Experiences for Undergraduates: Reflections and Recommendations for Student Development

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Abstract: *PAR-based UREs* are undergraduate research experiences (UREs)—built into university-community partnerships—that apply principles of participatory action research (PAR) towards addressing community-defined challenges. In this paper, we advance PAR-based UREs as an action-oriented framework through which higher education institutions can simultaneously enact and advance the United Nations sustainable development agenda, while cultivating student development. We draw upon interdisciplinary scholarship on sustainable development and PAR, as well as empirical findings from a pilot program, to accomplish dual goals. First, through the lens of six Sustainable Development Goal (SDG) clusters, we explore the synergies between undergraduate PAR engagement and sustainable development, explaining how PAR-based UREs can prefigure and facilitate SDG achievement by promoting cross-sector collaboration and supporting diverse stakeholder engagement through community-driven research and action. Second, within each SDG cluster, we offer complementary reflections and recommendations around the design and implementation of PAR-based UREs towards advancing students’ skills and abilities as: (1) Community Collaborators (and Learners); (2) Community-Engaged Researchers; (3) (Interdisciplinary) Scholars; (4) Agents of Change; (5) (Sustainable) Co-Innovators; and (6) Institutional Representatives. Finally, we discuss the critical role of higher education institutions in minimizing structural barriers to PAR-based URE implementation, given their prefigurative and practical potential for both SDG achievement and student development.

Keywords: community partnership; higher education; participatory action research; prefigurative politics; sustainability; undergraduate

1. Introduction

In 2015, the United Nations (UN) General Assembly unanimously adopted a resolution outlining 17 Sustainable Development Goals (SDGs), which together set an ambitious, fifteen-year agenda to mobilize countries around the globe to promote human flourishing, while “protecting the planet” [1,2]. Encompassing social, environmental, and economic dimensions, the SDGs envision a world that is “free from hunger, injustice and absolute poverty”, offers “universal education, health and employment”, and fosters “inclusive economic growth, based on transparency, dignity and equity” [3] (p. 1)—all within fixed and finite planetary boundaries—by 2030 [4,5]. Given the breadth of the issues addressed

by the SDGs, combined with its urgent timeframe, there exists a critical need for concrete, actionable ways to realize the vision of this transformative agenda.

In this manuscript, we emphasize the role of higher education institutions (HEIs) in simultaneously prefiguring sustainability—or modeling its conditions in the present—while facilitating SDG achievement and key forms of student development through community-engaged research practices [6,7]. Not only are HEIs hubs for innovation, creativity, and collaboration towards addressing the world's most pressing challenges, they are embedded within communities whose diverse histories, geographies, and members offer infinite opportunities for partnership, research, and action towards improving the well-being of people and planet [8]. Scholars across disciplines agree that achieving the SDGs will require moving beyond 'business as usual' (i.e., routine) procedures, and they emphasize the transformative potential of strategic partnerships across sectors [9,10]. Indeed, prioritizing partnerships is itself written into the SDGs as the final and only goal dedicated entirely to means of SDG implementation [1]. Energized by this bridge-building momentum, this paper examines the prefigurative and practical dimensions of PAR-based UREs, which are undergraduate research experiences (UREs)—built into university-community partnerships—that apply the principles of participatory action research (PAR) towards addressing community-defined challenges. In particular, we explore PAR-based UREs as a vehicle for SDG implementation through HEIs and offer recommendations for student development based on our own past findings related to the PAR-based URE framework [11].

Participatory action research is a collaborative approach to research, education, and action [12] that brings researchers and participants together to identify, examine, and address problems in community settings [13]. PAR challenges traditional hierarchies between researchers and participants by engaging participants as full collaborators in all aspects of the process—from defining the scope and design of the research to implementing solutions [14,15]. As such, PAR emphasizes democratic engagement, full-cycle collaboration, and social justice [16]. The goal of PAR is to “mobilize everyday people for change” through collaborative research and action [16] (p. 172).

The omnibus term “undergraduate research experiences” refers to varied high-impact models that engage students in authentic research with the goal of enhancing learning. Most UREs also aim to: (1) Assimilate students into science, technology, engineering and mathematics (STEM) cultures; (2) increase and diversify participation in STEM fields; and (3) enhance interdisciplinary knowledge and practice [17]. URE models range from year-long apprenticeships to summer internships and more recently have come to include course-based authentic research [17]. Traditionally, most UREs have been laboratory- or field-based, with a focus primarily on STEM topics; others have included interdisciplinary research that bridges STEM and the social sciences. Although the particulars of URE programs and their impacts may vary, extensive evidence suggests that UREs often serve to strengthen student outcomes such as knowledge and skills acquisition [18,19], communication abilities [20–22], and persistence in STEM [18,23,24]. As such, UREs are an established and highly-regarded mechanism for supporting the development of undergraduate students in STEM fields. However, programmatic UREs remain far less established in interdisciplinary contexts and among community-engaged researchers.

In this paper, we describe the integration of these frameworks (i.e., PAR and UREs) through the concept and practice PAR-based UREs, which apply PAR methods in collaboration with communities, while deliberately and meaningfully involving undergraduate students in authentic research. We argue that PAR-based UREs hold great promise as an action-oriented framework for enacting and advancing the SDG agenda by promoting cross-sector collaboration, developing interdisciplinary scholars and engaged citizens, and supporting diverse stakeholder engagement through community-driven research and action.

In the sections that follow, we explore PAR-based UREs through the lens of prefiguration. Specifically, we describe how PAR-based UREs may advance the role of HEIs in contributing to the SDG agenda through prefigurative research practices. Prefiguration is a term increasingly prevalent

in social movements scholarship that refers to imagining and enacting alternative modes of being and interacting in the world that reflect—and, in so doing, bring into being—the desired social transformations of a group [6]. Prefigurative action is guided by the principle of ‘means-ends consistency,’ which emphasizes that the ultimate goals of a group must fundamentally shape the methods it employs (e.g., peace through nonviolence). Prefiguration further refers to exemplifying change in the ‘here and now,’ towards gradually building a “new world in the shell of the old” [25] (p. 108). As such, prefigurative research methodologies seek to collaboratively facilitate the design and implementation of viable alternatives to the unjust and unsustainable status quo [6] through ongoing research practices “concerned with the enacting of hope and desire in the present moment, rather than with the establishment of ideal future blueprints” [7] (p. 38). Just as the SDG agenda is aspirational—or future-oriented—yet demands action in the present, so too is the nature of prefiguration in PAR. Through non-hierarchical research relationships and democratic engagement, PAR simultaneously envisions and enacts counter-hegemonic modes of inquiry and community-driven action that blur the boundaries between process and goal [26]. Put simply, prefiguring sustainability through PAR-based UREs means instantiating a sustainable future now.

This is the third and final paper in a series exploring the concept, theory, and practice of PAR-based UREs. The first was an empirical research article, introducing the PAR-based URE approach and exploring its transformative impact on students and communities [11]. The second was a theoretical article reviewing ‘typical’ PAR and URE approaches, exploring the synergies and opportunities of their integration, and advocating a coordinated approach to accommodate their divergent dimensions [27] (under review). Having laid the groundwork for the present discussion, here we discuss the prefigurative and practical dimensions of PAR-based UREs in the context of the SDG agenda. Additionally, drawing on analyses of a PAR-based URE pilot program (described below), we offer a related set of reflections and recommendations for HEIs around the design and implementation of PAR-based UREs for key student development outcomes. In this, we respond to Newman’s call for broader examination and exchange of “applicable lessons learned and models of service learning pedagogy” [28] (p. 18) in the area of student education and engagement in sustainability.

2. Pilot PAR-Based URE Study

The first published manuscript in this series was an empirical study [11] exploring students’ experiences (i.e., perceived impacts) of a PAR-based URE pilot program that was developed as a voluntary second-year experience augmenting a traditional STEM lab-based URE. In this section, we briefly describe the pilot program (i.e., design, implementation, impacts) in order to provide adequate context for our subsequent discussion situating PAR-based UREs within the context of the SDG agenda. A more in-depth description and discussion of these aspects can be found in the first published manuscript in this series [11].

2.1. PAR-Based URE Program

The pilot PAR-based URE program took place over a nine-week summer period in 2012 with two historically marginalized, indigenous Southern Louisiana communities. Students were selected based on their prior participation in the lab-based URE associated with this pilot program, as well as an expressed interest in community-based research. During the PAR-based URE, two female, African American undergraduate students—one with a background in Meteorology and the other in Sociology and Anthropology—lived, socialized, and worked in these communities as they collaborated with community members on designing and implementing action-oriented research projects identified by the community as important (e.g., the creation of a land loss awareness mobile phone application).

The two communities were identified through an existing partnership between a community-based social scientist in the region and a climate scientist in the Mountain West U.S., as both communities were experiencing dramatic geomorphologic changes due to industrialization and urbanization that were then (as today) devastating the land-based livelihoods of local indigenous

populations [29]. Members of these communities expressed a desire to enhance their own ability to advocate for state and local services by conducting research. The PAR-based URE developed organically around this identified need, as well as existing relationships between the community members and the local social scientist, the social scientist and the climate scientist, and the climate scientist and a qualitative research methodologist. All these partners served as mentors to the two undergraduate students throughout the nine-week PAR-based URE, although each had a unique role as content expert or community liaison, and sometimes both.

With support from their mentors, students spent the first two weeks of the program in the communities: (1) Establishing relationships with key community members (who held traditional ecological knowledge of the region); (2) meeting with local scientists (who held Western science knowledge on the climate change-fueled land loss experienced in the region); and (3) studying PAR methodology. The level of dedication to the program required for, and displayed by, the students during this time cannot be overstated; they spent a great deal of time traveling within the communities, participating in social events (e.g., community members' family dinners), learning about the communities' histories and cultures, and getting to know more about different community members as individuals. During the third week of the program, after students had begun to build relationships and establish trust within each community, research questions and approaches were co-developed by the community members and the students. The remaining weeks of the PAR-based URE were spent collaboratively conducting the planned research.

2.2. Study Methods

To examine the impacts of the PAR-based URE, our data collection and analysis methods closely followed the interpretive phenomenological analysis process, which seeks to explore a phenomenon both ideographically, as well as collectively [30]. We conducted three (i.e., prior to, immediately following, and six months after the experience) in-depth, semi-structured interviews with each of the two students. The specific focus of each interview varied based on its timing, but each explored the perceptions and experiences of the students in relation to their academic, professional, and personal development. General interview questions within these categories were predetermined, but the interview process was kept flexible and open to further follow-up and exploration of previously unidentified avenues of discussion. For example, students were asked, "How have you used what you've learned from the [URE]?" but because each student answered this question differently, follow-up questions and specific interview topics were unique to each interviewee, while remaining tied to the program.

Each author read and reread the interview transcripts, making notes about interesting or significant statements and discourse structure. From these notes, we developed inductive first-order labels and then second-order categories capturing patterns we each observed in the data. After analyzing the interviews individually, all authors met to compare our independent interpretations with the intent of establishing a stable set of emergent themes. We then engaged in an iterative process with the two undergraduate students, during which they reviewed our written interpretations for accuracy and provided clarity. In response, and in conversation with the students, we reconciled areas where our interpretations and the students' perceptions diverged. Once emergent themes were agreed upon, we identified connections between themes as well as convergences and divergences in the participants' experiences. We draw upon these analyses as we describe PAR-based UREs in relation to the UN sustainable development agenda.

3. Sustainable Development Goals and PAR-Based UREs

Given the immense—and some would say contradictory—mission of sustainable development, definitions of the term are inevitably varied and contested [31,32]. However, an often quoted definition of sustainable development has its origins in the Brundtland Report, also known as "Our Common Future", which describes sustainable development as that which "meets the needs of the present generation without compromising the ability of future generations to meet their own needs" [33]

(p. 8). The 17 SDGs are therefore a patchwork of interdependent, variously overlapping—and frequently controversial—aims that together offer a future-oriented vision of human and environmental flourishing intended to inform present priorities and paths forward [4,34]. Ultimately, the SDG agenda is meant to mobilize global action towards “building an inclusive, sustainable and resilient future for people and planet” [2].

As written, the SDGs and associated targets provide greater detail in terms of *content* (i.e., the “what” of sustainable development) compared to *methods* of goal attainment (i.e., the “how” of sustainable development) [9]. In response to the need for developing pathways to SDG achievement, “The World in 2050” (TWI2050) [35]—a global research initiative launched by the International Institute for Applied Systems Analysis (IIASA), the Sustainable Development Solutions Network (SDSN), and the Stockholm Resilience Center (SRC)—brought together scientists, policymakers, analysts, and multi-sector organizations to identify means of SDG implementation. To aid in the identification of pathways to transformational change, and recognizing the interlinkages and interdependence across goals, collaborators classified and arranged the SDGs into various thematic groupings [35].

In the below sections, we describe how PAR-based UREs may simultaneously advance the role of HEIs in contributing to SDG achievement and student development. Although at first glance PAR-based UREs may appear to align most objectively with SDG Target 4.7 (i.e., education for sustainable development), this paper describes the broad implications of PAR-based UREs for all 17 SDGs, which are, in turn, buttressed by 169 individual targets. To streamline our discussion, we apply one of the frameworks proposed by TWI2050, which organized the 17 SDGs into six thematic clusters: (1) Basic Human Needs, (2) Universal Values, (3) Earth Preconditions, (4) Sustainable Resource Use, (5) Social and Economic Development, and (6) Governance and Partnerships [35]. We agree with TWI2050 that the SDGs are “universal, holistic and inter-dependent, thereby indivisible” [36]. As such, the six clusters are in no way meant to divide SDGs into competing categories, as progress within one SDG inevitably advances others, within and across clusters. Further, the order of the SDG clusters as presented in this paper does not imply priority or precedence but was determined to be most conducive to introducing PAR-based UREs, their prefigurative potential, and key practical considerations in a logical and meaningful way. Below, these six clusters, along with findings from our previous empirical study [11], frame our discussion of PAR-based UREs in relationship to the SDG agenda. Additionally, within each SDG cluster, we offer complementary reflections and recommendations around the design and implementation of PAR-based UREs relative to important dimensions of undergraduate student development. In particular, we focus on the capacity of PAR-based UREs to advance students’ skills and abilities as: (1) Community Collaborators (and Learners); (2) Community-Engaged Researchers; (3) (Interdisciplinary) Scholars; (4) Agents of Change; (5) (Sustainable) Co-Innovators; and (6) Institutional Representatives.

3.1. Basic Human Needs

Robust and productive societies are created and maintained by healthy individuals whose basic biological needs are met. The first cluster, “Basic Human Needs”, includes three SDGs [3]. First, *No Poverty* is a commitment to end poverty in “all its forms everywhere” (SDG 1) [1]. The aims and scope of this goal go beyond a singular conceptualization of poverty as a lack of income to broadly include hunger, malnutrition, access to education and basic services, discrimination, and opportunities to participate in decision-making. The closely-related *Zero Hunger* (SDG 2) aims to advance food security, improved nutrition, and sustainable agriculture [1]. The third and final SDG in this cluster, *Good Health and Well-Being* (SDG 3), is focused on promoting health and well-being for all people by eradicating diseases and addressing sanitation and health issues around the globe [1].

3.1.1. Basic Human Needs and PAR-Based UREs

As an innovative avenue towards advancing the SDG agenda, PAR-based UREs combine two approaches—PAR and UREs—already practiced within HEIs, but which are rarely combined.

Whereas PAR is grounded in critical and constructivist paradigms, and most often involves collaboration between university faculty and community partners [37–39], UREs are most often oriented towards providing STEM undergraduates with traditional, campus-based (e.g., basic, laboratory) research experiences where positivist approaches dominate [40]. By integrating these approaches through PAR-based UREs, undergraduates within and beyond STEM are able to gain valuable experience with critical, community-engaged research under the mentorship of faculty, while contributing to the improvement of communities [11]. Moreover, PAR-based UREs have the potential to confer similar benefits as more typical UREs (e.g., increased student engagement, expanded understandings of disciplinary knowledge and practice, integration into cultures of research).

A foundational organizing principle of PAR-based UREs is the notion that those who will be most affected by a research project should be involved throughout the process—not just as participants (i.e., data units), but as collaborators who are “experts in their own lives” and who may substantially contribute to the scope and design of the research [41] (p. 390). As such, PAR-based UREs bring HEIs (e.g., university faculty; undergraduate students) and community partners (e.g., organizations; residents) together through prefigurative research that: (1) Employs methods—for data collection, dissemination, and action—that are community-driven; and (2) aims to address community-defined challenges in the present, rather than merely identifying avenues for future community improvement [11]. With problem identification, priorities, and process emerging through university-community collaboration, PAR-based UREs serve to address immediate issues that are most important to community members (e.g., basic necessities). The PAR literature documents numerous examples of universities and communities coming together to advance goals related to the “Basic Human Needs” SDG cluster, including poverty, hunger, health, and well-being [42–45].

3.1.2. Reflections and Recommendations for Student Development: Student as Collaborator and Learner

In the PAR-based URE pilot program described earlier, undergraduates facilitated the PAR process with majority-Indigenous Southern Louisiana communities experiencing saltwater intrusion and land loss due to climate change, as well as environmental degradation and pollution caused by the oil and gas industry. Through relationship-building and collaborative decision-making with key community members, their projects came to focus on: (1) Plant species of cultural and medicinal significance that are vulnerable to environmental degradation; and (2) the place attachment, risk perceptions, and adaptation preferences of Indigenous residents. As both projects centered on ecological threats to community members’ livelihoods, health, and well-being, these student-facilitated PAR initiatives were relevant to communities’ “Basic Human Needs”.

A key strength of this PAR-based URE pilot was its capacity to address community-defined challenges through university-community collaboration, while simultaneously developing the community-engaged research capacities of undergraduates through authentic research and multidisciplinary mentorship [11]. In brief, students, as well as communities, were beneficiaries of the process. This occurred despite the seemingly divergent nature of PAR and UREs, in which the former is primarily a community-centered approach, and the latter is a primarily student-centered approach. However, a closer look at PAR process illuminates its potential to confer multifaceted benefits. According to Fals-Borda and Rahman, PAR is “not only as a means of creating knowledge; it is simultaneously a tool for the education and development of consciousness as well as mobilization for action” [46] (pp. 121–122). In PAR, they continue:

... both researcher and researched recognize that despite their otherness they seek the mutual goal of advancing knowledge in search of greater justice. They interact, collaborate, discuss, reflect and report in collectivities on an equal footing, each one offering in the relationship what [they] know best. ... It is in this space of a truly participatory activity that the actual meeting of diverse scientific traditions takes place, resulting in an enriched

overall knowledge, which in addition is more effective in the struggle for justice and the achievement of social progress and peace. [46] (p. 152)

The PAR process is characterized by multiple cycles of research, reflection, and action through which all participants—students, researchers, and community partners alike—are likely to benefit through learning and transformation [46,47]. As such, in our view, the positive outcomes of PAR-based UREs are not a finite resource that require zero-sum calculations regarding “who benefits?” Rather, PAR maintains a focus on the questions “knowledge for what?” and “knowledge for whom?” towards the collective empowerment of marginalized groups [46] (p. 152). In order to uphold these potentialities of PAR, and to support students’ development as *community collaborators and learners*, we recommend flexibly integrating student participation into the community-driven process. This means that students’ roles will evolve and change in accordance with the PAR process, rather than adhere to a strict or pre-determined definition of what students’ URE participation will entail. With communities setting the agenda for meeting their own needs through PAR-based UREs, HEIs can play an important role in prefiguring sustainability, while promoting the SDG-oriented civic engagement of undergraduates. Figure 1 illustrates the relationships between PAR-based UREs, the SDG framework, and student development outcomes.

3.2. Universal Values

A second cluster of SDGs centers on “Universal Values” for fundamental human rights that provide a foundation for a peaceful, prosperous, and sustainable future [3]. *Quality Education* (SDG 4) is the achievement of universal educational goals for all people, across the lifespan [1]. *Gender Equality* (SDG 5) includes universal provisions for “equal access to education, services, decent work” as well as “equal representation in political and economic decision-making processes” [1]. Finally, *Reduced Inequalities* (SDG 10) is broad to include the reduction of inequality both within, and also across all countries across the world [1].

3.2.1. Universal Values and PAR-Based UREs

PAR initiatives, though diverse, are united by a shared set of values around the conduct and purposes of research. Central principles of PAR include broad inclusivity, democratic process, and reflexive practice. Respectively, in PAR practice, these value orientations translate into goals of diverse research participation, equal distribution of power and decision-making ability, and learning and transformation for all involved [13,46]. Together these process-oriented goals provide the basis for strengthening community agency and empowerment, where agency is defined as “the capacity of individuals to act independently to make their own free choices” [48] (p. 322), and empowerment refers to “the process by which people gain control over their lives, democratic participation in the life of their community . . . , and a critical understanding of their environment” [49] (p. 570). Towards these ends, PAR collaborations often involve work with marginalized groups, such as women, racialized and ethnic minorities, young people, and refugee and immigrant populations [14]. Ultimately, the PAR process is oriented towards improving quality of life and advancing the “collective situation” of community partners through collaborative research and action [7,15] (p. 10).

In these ways, through embodied practice, PAR-based UREs prefigure the aims of SDGs related to “Universal Values”. For example, the educational dimension of PAR-based UREs aspires to engage and transform undergraduate students as well as community members from diverse walks of life and across the lifespan (SDG 4), while the non-hierarchical dimension of PAR practice is explicitly directed at reducing inequalities, both through the practice of collaborative research and by achieving equity and human flourishing within communities as the ultimate goal (SDG 5; SDG 10). In the PAR literature, there are numerous examples of collaborative research partnerships—bringing HEIs and communities together—focused on improving quality education [50], promoting gender equality [51–53], and reducing inequalities more generally [54–56].

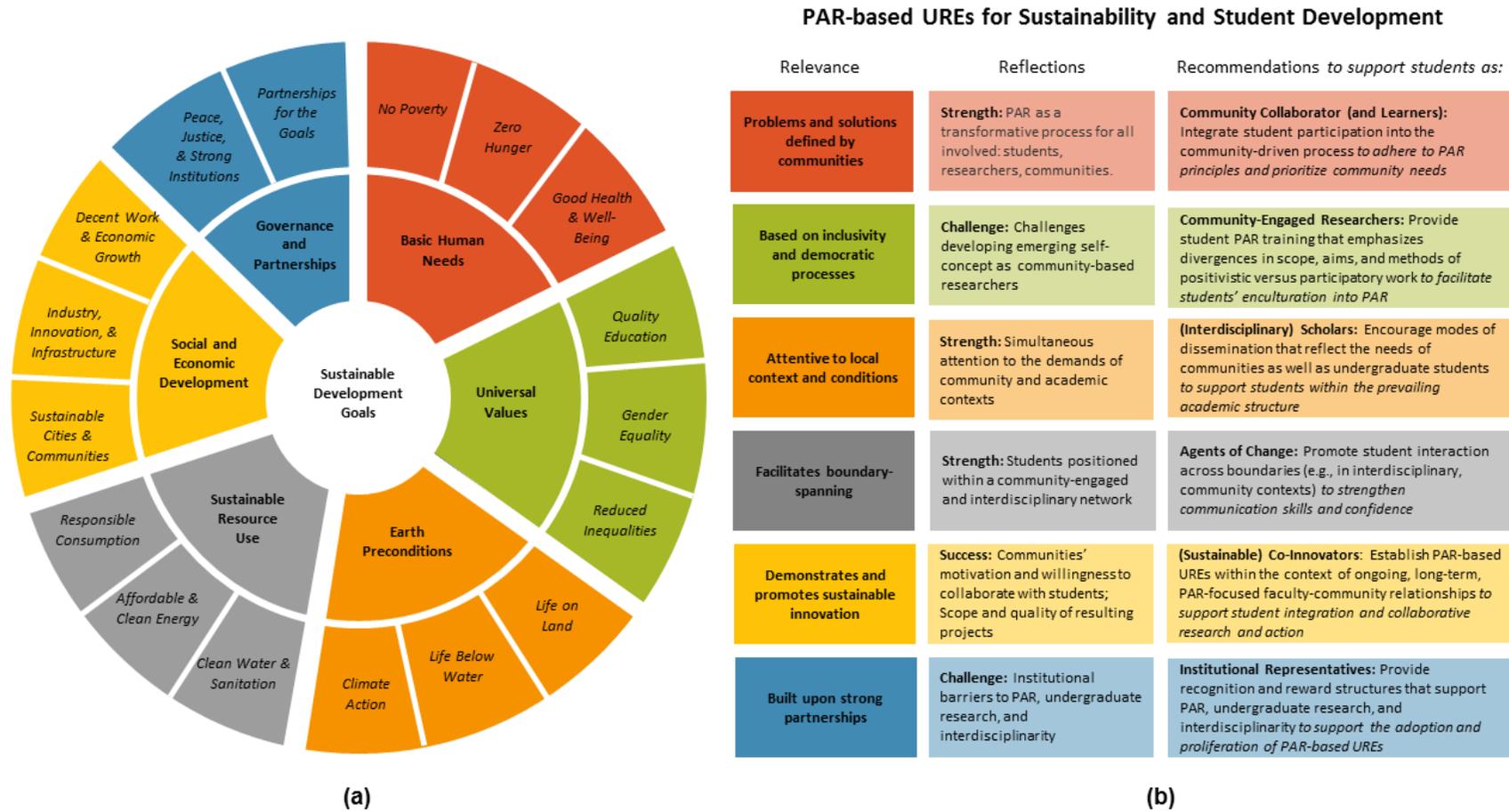


Figure 1. This figure illustrates how PAR-based UREs serve to advance sustainability and student development. (a) The left-hand portion of the figure depicts six clusters [36] that encompass the 17 UN Sustainable Development Goals (SDGs) [1]. (b) Using corresponding colors, the right-hand portion of the figure illustrates the relevance of PAR-based UREs for addressing the SDGs, and includes both reflections as well as recommendations for the design and implementation of PAR-based UREs.

3.2.2. Reflections and Recommendations for Student Development: Student as Community-Engaged Researcher

During the summer prior to their participation in the PAR-based URE pilot, undergraduate students completed a more typical lab-based URE in which the procedures, methods, and modes of inquiry were situated squarely, and solely, within the realm of atmospheric science. Like in most STEM UREs, the research questions addressed by students were predominantly faculty-driven and pre-determined. In the second-year PAR-based URE, all aspects of the projects were guided by and co-constructed with community members, with limited, if any, direct input by faculty. Through this experience, undergraduate students developed understandings of how to establish and maintain relationships between researchers and communities. In particular, undergraduates' conceptualizations of the process of effective science communication shifted away from that of unidirectionally conveying and communicating scientific ideas to laypersons, and toward a bidirectional, discourse-oriented approach. Importantly, students' perceptions of the role of community members moved from the periphery—where they are being spoken to by scientists as 'consumers' of completed research—to a central location wherein community members have a voice in the co-creation of all aspects of a research project. By partnering with majority-Indigenous communities, and constructing non-hierarchical research relationships to collaboratively address community-defined challenges, these student-facilitated PAR initiatives served to advance SDGs related to "Universal Human Values".

Despite their expressed commitments to the fundamental tenets of PAR, the undergraduates who participated in the PAR-based URE pilot described challenges switching their research mindset, or methodological orientation, from science-focused to community-engaged. They were cognizant of the fundamental shifts required and, during post-URE interviews, reflected on their own successes and struggles reconciling their former research training with their emerging self-concept as community-based researchers. Breaking out of the traditional hierarchical structure of STEM research, in which researchers are accustomed to being in total control, was uncomfortable and perhaps even unsettling. The emergent nature of PAR, as not pre-planned but community-driven, combined with its reliance on relationship- and trust-building with community members, required a patience and persistence students had not anticipated prior to beginning their work. Compared to STEM research, and to (post-)positivist research more generally, PAR is unique in its emergent and evolving nature, as well as its deliberate and democratic inclusion of community members throughout the process. Students within and beyond STEM who have been previously enculturated into positivistic epistemological and methodological paradigms will likely face similar challenges in PAR-based UREs due to the fundamental perspective-shift that it necessitates. Therefore, in order to support students' development as community-engaged researchers, we recommend that students receive PAR training prior to their participation in PAR-based UREs. This training should specifically call out divergences in the scope, aims, and methods of positivist versus participatory research, and emphasize that PAR is simultaneously a "process of 'unlearning' as well as new learning" [35] (p. 138). By deliberately involving undergraduates in community-engaged research with marginalized groups to collectively act for their own empowerment, HEIs may simultaneously reaffirm their civic missions, while prefiguring the "Universal Values" that define a sustainable future.

3.3. Earth Preconditions

The "Earth Preconditions" cluster highlights the role of a stable biosphere and climate system for a sustainable future [3]. "Preconditions" refers to the need for steady functioning of Earth systems as "a prerequisite for a thriving global society" [57] (p. 305). The *Climate Action* (SDG 13) goal describes the need for urgent action to combat climate change and its impacts, as climate change is impacting individuals and communities, as well as disrupting economies, in every country around the globe [1]. Conservation, management, and sustainability of *Life Below Water* (SDG 14; i.e., oceans, seas, marine resources) is essential to maintaining a sustainable biosphere, as is protecting *Life on Land* (SDG 15) by

managing deforestation and desertification, as well as reversing or interrupting land degradation and biodiversity loss [1].

3.3.1. Earth Preconditions and PAR-Based UREs

Climate change has been characterized as a global problem with local solutions. That is, although climate change is a geographically diffuse and complex phenomenon, its immediate consequences are localized—or experienced in unique ways by specific communities at different times and in different places [58,59]. For example, communities often face wildly different climatological threats (e.g., extreme weather events) based on the geophysical features of their environments, and strengthening community resilience requires attention to psychosocial, political, and infrastructural realities of individual localities. As a result, local-level (e.g., city, county) initiatives have emerged in recent years as critical to climate change mitigation, adaptation, and disaster risk reduction (SDG 13) [60]—initiatives that have inevitably translated into protections for life below water and above land (SDG 14; SDG 15).

What makes localized programs especially effective in protecting the biosphere, specifically, are the same features that position PAR as a promising strategy to address a diverse range of community problems, within and beyond the scope of environmental degradation. Compared to (inter)national policies and programs, smaller-scale initiatives are relatively less encumbered by multi-level considerations in processes of development, approval, and implementation. Moreover, local partnerships create conditions conducive to fostering awareness around specific features of local environments that can facilitate success, such as local opportunities, resources, and barriers [8,61]. Such considerations often translate into policies and programs with place-based, social and cultural relevance to specific communities, where top-down models are often inadequate. PAR-based UREs—as local, bottom-up, grassroots initiatives—seek to integrate multiple perspectives through diverse stakeholder engagement, and in so doing, generate plans and products meaningful to the lived realities of community members. PAR has been applied, across a variety of geographic contexts, to address wide ranging environmental issues, including climate change adaptation in Canada (SDG 13) [62], estuary management in South Africa (SDG 14) [63], and Central American agroecology (SDG 15) [64].

3.3.2. Reflections and Recommendations for Student Development: Student as (Interdisciplinary) Scholar

Projects in the PAR-based URE pilot were directly relevant to the “Earth Preconditions” SDG cluster. Specifically, student-facilitated PAR initiatives centered on problems arising from climate change, including land loss due to saltwater intrusion and land subsidence. As is typical in PAR, the ‘products’ of students’ PAR collaborations went beyond traditional academic dissemination modes (e.g., journal articles) to include non-traditional products. For example, one student’s PAR-based URE experience culminated in a mobile phone application to promote land-loss awareness among community members. The app simultaneously served as a data collection strategy and educational platform that compiled and featured oral histories, video testimony, historical and current photographs, and geographic data. This research product was not merely information to be consumed at one point in time or on one occasion by the community; rather, it was designed for regular and ongoing use—and development—by the community over time beyond the summer URE period.

Researchers conducting PAR are tasked with regularly considering and negotiating the needs of a broad range of community partners and stakeholders to facilitate processes of research and action. Further, as academics, they face additional pressure to disseminate and advance knowledge through conventional disciplinary channels [65]. A key success of the PAR-based URE pilot was its simultaneous attention to the demands of community and academic contexts. Specifically, students were positioned to contribute to the improvement of communities through collaborative research and action, while they were simultaneously being supported in ways that may allow them to succeed within the prevailing academic structure. In PAR collaborations, a range of dissemination modes is commonly employed. These can include community events (e.g., workshops, training

seminars), political organizing and action (e.g., campaign materials), arts-based approaches (i.e., art exhibitions, performances), or the production and distribution of online or print resources (e.g., websites, newsletters) [66]. Yet these non-traditional research products may not be perceived as valuable ‘academic currency’—or, alternatively, the development of highly regarded academic skills—within the rigid, disciplinary institutional norms and expectations that define research productivity in today’s academic institutions. Therefore, in order to more appropriately support students as (interdisciplinary) scholars, we recommend providing students with opportunities and recognition for dissemination that include both traditional academic (i.e., journal article, conference presentation) and perhaps non-traditional dissemination modes that result from the PAR process (e.g., creative educational products). In these ways, PAR-based UREs may serve as a mechanism through which HEIs cultivate (interdisciplinary) sustainability scholars, advance SDG attainment, and prefigure ideal university-community relations by ‘giving back’ to their communities—applying their skills and resources in the service of local residents.

3.4. Sustainable Resource Use

The fourth SDG cluster encompasses avenues for “Sustainable Resource Use” [3]. The implications of access to *Clean Water and Sanitation* (SDG 6) are far-reaching, and enhancements to infrastructure will ensure an adequate supply of water, sanitation, and hygiene for all [1]. *Affordable and Clean Energy* (Goal 7) is perhaps the cornerstone upon which addressing many other SDGs depends [1]. Energy systems that supply reliable, sustainable energy will be transformative as they support all sectors and help address inequalities such as those in food production, jobs, education, infrastructure, and health. *Ensuring Responsible Production and Consumption* (SDG 12) includes both sustainable management as well as efficient use of natural resources that will increase quality of life [1]. Accomplishing this will result in a better quality of life for all with the focus on efficient resource and energy use, the development of a sustainable infrastructure, and increased access to basic services and decent jobs.

3.4.1. Sustainable Resource Use and PAR-Based UREs

Central to controversies around defining, characterizing, and acting towards sustainable development is the ‘wicked’ nature of sustainability challenges, which require new modes of inquiry and action due to their increasing level of complexity [67]. Advancing sustainability requires consideration of the interconnected—and sometimes contradictory—nature of solutions across multiple systems and scales, including the geographic, political, social, environmental, and economic dimensions of sustainable transformation [57,68,69]. Like many SDGs, the specific goals related to “Sustainable Resource Use” demand collaboration across boundaries of campus, discipline, and nation.

PAR-based UREs practice these forms of ‘boundary-spanning’ on multiple levels. First, through university-community partnerships, undergraduate students are encouraged to traverse the boundaries of the university campus and to work in collaboration with communities for their own improvement and empowerment. Further, PAR-based UREs apply a multidisciplinary mentor model, providing undergraduates with exposure to diverse research traditions (e.g., epistemologies and methodologies), within and beyond their major or specialty. With experience working across disciplines and in partnership with communities, PAR-based UREs have the capacity to develop students who are able to comprehend, communicate about, and address complex socio-scientific issues—or societal dilemmas with ties to science that, like wicked problems, are “typically contentious in nature, can be considered from a variety of perspectives, do not possess simple conclusions, and frequently involve morality and ethics” [70] (p. 5). For example, though not organized as UREs, previous studies have documented PAR initiatives around all SDGs in this cluster, including clean water [71], sanitation and hygiene [72,73], clean energy [74], and responsible production and consumption [75,76]. Through SDG-oriented PAR-based UREs, participating students may develop the capabilities to speak

across boundaries—with scientists, researchers, community partners, and the public—in ways that, at present, hinder integrated action on complex sustainability challenges.

3.4.2. Reflections and Recommendations for Student Development: Student as Agent of Change

In the PAR-based URE pilot, undergraduate students completed projects that integrated traditional ecological knowledge with Western science. For example, one project incorporated local knowledge as it simultaneously drew from ethnobotany, atmospheric science, geography, environmental science, and social science. This project centered on vulnerable plant species with cultural and medicinal value to community members and faith healers. The aims were to identify and record data using geospatial information systems (GIS) technology, to understand and document the importance and location of these plants used by the region's Native American tribes, and also explore potential solutions that would enable the sustainable production of the vulnerable plant species. In light of the diverse content areas and methods integrated during this PAR collaboration, and considering the specific sustainability-oriented issues addressed, the PAR-based URE pilot was especially relevant to the "Sustainable Resource Use" SDG cluster.

Notable outcomes of this PAR-based URE, as documented during interviews with student participants, included undergraduates' transformed views of how knowledge is generated, as well as their deeper understanding of and respect for traditional ecological knowledge [11]. Students also gained an appreciation for the challenges and rewards of community-engaged research, an expanded understanding of the social dimensions of their work, and came to realize the empowering impacts of community engagement—not only for community partners, but for themselves. For example, undergraduate students developed a sense of agency to transform *their own science networks* by discussing the value of interdisciplinary research with their peers and mentors, and by continuing to engage with communities in their future work.

A key strength of this PAR-based URE was its positioning of students as 'boundary-spanners' as they facilitated the PAR process with community members. During the pilot, students were tasked with developing relationships with community members, learning about the history of the region and the problems perceived by community members, and co-constructing projects to address local environmental problems. This required full-time investment by the students throughout the duration of the program, as well as the support of a constellation of academic mentors from multiple disciplines who provided advice on their specific PAR initiatives. These included mentors in STEM, social science, and qualitative methodology. Further, they were each assigned a community liaison who provided mentorship and guidance as they integrated themselves into the communities. As a result, student participants in the PAR-based URE became part of a community-engaged and interdisciplinary network, which fostered their growth as civically-engaged scholars committed to the improvement of communities. Throughout the program, they regularly communicated across cultural (e.g., with community members) as well as disciplinary (e.g., social and physical science) boundaries. By the end of the program, students had gained confidence in their communication abilities as well as their potential to be agents of change. Given these positive outcomes related to student empowerment, we recommend that in any PAR-based URE, students should be encouraged and supported in speaking and collaborating across boundaries, especially by communicating their work in a variety of academic contexts, and in community settings. By supporting students as agents of change through PAR-based UREs, HEIs simultaneously demonstrate their commitment to addressing global sustainability challenges of the present and future, while prefiguring sustainability through community-engaged research that enables action in the 'here and now'.

3.5. Social and Economic Development

According to the SDG framework, "Social and Economic Development" [3] are key features necessary to ensure global peace and security. The SDG *Decent Work and Economic Growth* (SDG 8) centers on inclusive and sustainable growth towards ensuring equitable opportunities

for employment and decent work [1]. In addition to eradicating slave and child labor, economic productivity and prosperity are encouraged through the promotion of development-oriented policies. The implications of sustainable *Industry, Innovation, and Infrastructure* (SDG 9) are far-reaching. Adequate infrastructure is central to the success of many SDGs, as is sustainability-oriented innovation around industrialization [1]. Finally, *Sustainable Cities and Communities* (SDG 11) are emphasized in this cluster, as cities are hubs for “ideas, commerce, culture, science, productivity, social development, and more” [1]. Inclusive, safe, and resilient cities and communities are framed, within this cluster, as paving a path toward further social and economic advancements.

3.5.1. Social (and Economic) Development and PAR-Based UREs

Of the many controversies surrounding the SDGs, debates around their inclusion of economic growth have been most contentious [77]. In light of the present-day existence of extreme poverty coupled with income and wealth inequality (i.e., threats to human flourishing), as well as overexploitation of resources due to a culture of extraction (i.e., threats to ecological sustainability), many see unfettered economic growth as a clear and immediate threat to promoting human development within planetary boundaries [4,9,57]. In critiquing the ‘3P model’ (i.e., people, planet, profit)—the framework that undergirds the SDGs, and which is known by a handful of other names (e.g., three pillar model; triple bottom line; tripartite model)—many have argued that economic growth, as measured by GDP, should not be among the key SDG priorities [4,9,57,77]. Apart from doing away with economic goals entirely, many have argued that at the very least, the well-being of people and planet should come before profit. We agree with Holden et al. that “sustainable development constitutes a set of constraints on human activities, including economic activities” [4] (p. 3). As such, in this section, we constrain our discussion of the potentialities of PAR-based UREs to two themes: (1) Sustainable innovation; and (2) sustainable cities and communities. Within these themes, we discuss how PAR-based UREs may build capacity within aspects of each SDG in the cluster, without losing sight of economically-driven threats to the wider ecology of the planet.

PAR-based UREs advance sustainable innovation as well as the sustainability of cities and communities. We view sustainable innovation (SDG 9) as the creation of new methods, ideas, or products that embody or advance human flourishing and planetary well-being. Relatedly, a key premise for building sustainable cities and communities (SDG 11) is that “... human settlements can be incubators for innovation and ingenuity and key drivers of sustainable development” [2]. Sustainable innovation is a concept that describes both process and outcome of PAR-based UREs. In terms of process, providing opportunities for undergraduates to engage with local residents for collaborative, community-driven, SDG-oriented research and action through PAR-based UREs *already* challenges the status quo—specifically of entrenched academic modes of insular, disciplinary research that is often disengaged from communities. Additionally, as discussed, the outcomes of the PAR process—as community-defined—often fall outside the typical range of recognized and rewarded scholarly products (e.g., journal articles), but rather tend to encompass innovative modes of dissemination and action that are more likely to reach and to resonate with community members. This is because, in PAR, ownership of the process, knowledge generated, outcomes, and actions lies with community members, which can strengthen the adoption and sustainability of community-driven initiatives, making them ultimately more successful [78,79]. PAR has been applied in a number of contexts related to sustainable innovation as well as sustainable cities and communities. For example, by facilitating youth-led climate action in diverse yet neighboring communities [80], through research emphasizing the implications of unreliable transportation systems on negative birth outcomes in communities in Nigeria [81] and Uganda [82], and by bringing together representatives from various sectors to address sustainable household waste management challenges in Brazil [83].

3.5.2. Reflections and Recommendations for Student Development: Student as (Sustainable) Co-Innovator

Our empirical investigation of the impacts of the PAR-based URE pilot documented only students' views of the process, leaving our understanding of its impacts on community members incomplete. However, during interviews, students articulated a common perception that the collaborative process strengthened community members' sense of agency to address environmental problems through their own ability to conduct research and to engage in self-advocacy. Further, students commented upon the potential of PAR-based UREs, through processes of collaborative research and action, to strengthen communities' capacity for self-determination [11]. In brief, in the eyes of student PAR facilitators, the process was empowering to community members in that it created the conditions under which they could gain further control over their own affairs [49]. Both by representing a new type of program that engages undergraduates in community-based research based on PAR principles, and through the creation of novel community-designed resources (e.g., a mobile app) focused on environmental threats, this PAR-based URE served to advance SDGs related to "Sustainable Innovation" and "Sustainable Cities and Communities".

Key strengths of the PAR-based URE were the motivation and willingness of community members to work collaboratively with the undergraduates, and the scope and quality of the resulting projects—especially given the relatively short duration of the program (i.e., 10 weeks). However, these features of the pilot were only possible due to strong connections established prior to the URE between community residents and the community-engaged faculty who provided mentorship to students during the program. These longstanding relationships provided a strong foundation of trust, which allowed for students' seamless integration into the process. As discussed in greater detail previously [11], given the significant bi-directional investment involved in relationship-building—upon which the success of any PAR initiative rests—PAR-based UREs should more often be designed to augment existing, long-term, PAR-focused faculty-community relationships, rather than to establish one-off, short-term, or URE-focused faculty-community relationships. Correspondingly, in order to support students' development as (sustainable) co-innovators through PAR-based UREs, we recommend the scope and specific nature of students' contributions always and completely serve the current and evolving needs of the collaborative relationship. As such, PAR-based UREs, as HEI-supported student opportunities, prefigure or demonstrate sustainable innovation within cities and communities, just as they promote sustainable innovation by serving as vehicles of transformative community-led change.

3.6. Governance and Partnerships

The sixth and final SDG cluster encompasses "Governance and Partnership" goals [3]. *Peace, Justice, and Strong Institutions* (SDG 16) advocates for equitable global standards for justice, a commitment to peace, and a responsibility to address inequalities by way of effective, accountable, and inclusive institutions across all contexts [1]. Aims within this goal are expansive, ranging from strengthening national institutions, to the reduction of corruption and organized crime, the provision of legal identity for all, and also the abolition of abuse, exploitation, and trafficking of children. *Partnerships for the Goals* (SDG 17) is the sole SDG entirely devoted to means of implementation, with its emphasis on domestic and global partnerships focused on finance, technology, capacity building, and policy [1].

3.6.1. Governance, Partnerships, and PAR-Based UREs

It is with respect to the "Governance and Partnerships" SDG cluster that the specific dynamics (and capacities) of PAR-based UREs truly resonate. Not only do PAR-based UREs hold the potential of paving a path toward peace and justice by advancing the previously discussed SDG clusters (i.e., Basic Human Needs, Universal Values, Earth Preconditions, Sustainable Resource Use, and Social and Economic Development) through the community-driven scope of projects undertaken, these

collaborations typify the sort of university-community partnership that may genuinely strengthen ties between HEIs and the communities within which they reside (SDG 16) [1]. Moreover, the very mechanism through which these processes may occur—partnership—forms the basis of SDG 17 and PAR-based UREs [1,11]. In short, through partnerships between students, communities, universities, and the public, PAR-based UREs may simultaneously advance the SDG agenda with respect to both content (SDGs 1–16) and means of implementation (SDG 17) [1].

PAR-based UREs employ methods falling under the broader umbrella of action research, which has been described by Reason and Bradbury [84] as cited by Gayá and Brydon-Miller [7] (pp. 37–38) as that which takes place “in participation with others” towards:

... the pursuit of practical solutions to issues of pressing concern to people, and more generally the flourishing of individual persons and their communities ... [and towards] a more equitable and sustainable relationship with the wider ecology of the planet of which we are an intrinsic part. [84] (pp. 1–2)

As such, the general philosophy of action research shares fundamental commitments with the SDG agenda [2], as well as to the very definition of “sustainable development” proposed by Griggs et al. to accommodate the era in which we now find ourselves, the anthropocene: Sustainable development, to them, is that which “meets the needs of the present while safeguarding Earth’s life-support system, on which the welfare of current and future generations depends” [57] (p. 306). By involving undergraduates in PAR-based UREs, HEIs may contribute not only to cultivating the ‘next generation’ of community-engaged, justice-bound, and sustainability-oriented citizens and scholars; they may expedite the enactment—the realization—of these aspirational ideals now. This present-oriented, lived embodiment of ‘future’ goals is the essence of prefiguring social and ecological sustainability through PAR-based UREs.

3.6.2. Reflections and Recommendations for Student Development: Student as Institutional Representative

During the PAR-based URE, the undergraduate student facilitators served as institutional representatives. In their work with community members, they became the face of academia, their universities, and given the nature of the URE, science. As young people collaborating with community members, as students pooling their knowledge with local expertise, and as researchers at the nexus of social and physical science, undergraduates in the PAR-based URE were able to interface, communicate, learn, and disseminate knowledge across boundaries. A key success of the PAR-based URE was its capacity to build and bolster bridges through research and action, whether that meant strengthening connections among community groups, between students and communities, across disciplinary boundaries, or between universities and the public. During the pilot, all of these critical connections—within and between actors and institutions—were forged or reinforced in some way. As such, the PAR-based URE pilot, to a degree perhaps outperforming all other clusters, served to advance SDGs related to “Governance and Partnerships”.

Despite these capacities, PAR-based UREs face numerous institutional barriers. Related to the nature of PAR, for example, the perspectives of community members continue to be devalued in many academic science circles [85,86], and the prolonged duration of engagement typical of PAR is perceived as a threat to academic career prospects given a culture of hyperproductivity at many research universities [87]. Moreover, PAR-based UREs face structural challenges related to their specific characteristics. For example, many universities lack faculty incentives for facilitating undergraduate research [88–90]. Finally, PAR-based UREs such as the pilot we describe, which spanned physical and social science, may face challenges due to their interdisciplinary nature (e.g., related to disparate methods, languages, publishing outlets; [91,92]). We authors emphasize that these barriers to PAR-based UREs lie not in the specific capacities and configurations of the programs themselves, but in the rigid cultures and modes of academic research within which they operate. With these prohibitive

factors in mind, we bring our attention to the critical role of HEIs in supporting the adoption and proliferation of PAR-based UREs. In place of a specific recommendation, we offer an appeal—one grounded in the potential of PAR-based UREs to simultaneously contribute to sustainable development as well as student development: By facilitating the implementation of PAR-based UREs, HEIs are in the position to usher in a new era of undergraduate training—one in which students become institutional representatives contributing to the advancement of peace and justice through strong ties between universities and their surrounding communities, while prefiguring sustainability through accessible and robust community-driven research and action.

4. Conclusions

The unanimous adoption of the SDGs by the UN General Assembly has been heralded as a major global achievement. However, the substantive impact of countries' universal agreement around this set of ambitious goals will ring hollow without concrete support and concerted action on the part of institutions and governments around the world [9]. In our view, HEIs have a critical role to play in the success of the SDGs. As centers for innovation and exchange, HEIs are uniquely well-positioned to offer infrastructure, personnel, and recognition to galvanize collaborative research and action towards global sustainability and human development.

PAR-based UREs represent a promising pathway towards realizing the vision of the SDGs. Beyond fostering relationships between students, communities, researchers, and the public, due to their flexibility and scalability, PAR-based UREs offer a mechanism for the proliferation of community-driven, action-oriented research to simultaneously address sustainability challenges and promote well-being in local contexts. In these ways, PAR-based UREs offer a prefigurative pathway to bring much-needed transformation to communities in the 'here and now,' rather than in the abstract or distant future. Moreover, PAR-based UREs have the potential to advance students' capabilities as community-engaged collaborators, learners, and researchers; interdisciplinary, boundary-spanning scholars and innovators; and empowered agents of change representing and transforming HEIs and their disciplines as they interface with local communities.

In this paper, we have merely sketched the contours of the symbiotic relationship between PAR-based UREs and SDG achievement. The role of HEIs in supporting their combined success is a matter of procedural and cultural transformation. Procedurally, HEIs must—on the front end—establish alternative proposal-review (e.g., funding, institutional review board) mechanisms that comprehend and embrace the emergent and evolving nature of PAR, and—on the back end—devise reward systems (e.g., tenure and promotion) that recognize the value of undergraduate research and the development of non-traditional academic products resulting from PAR (e.g., community, policy impact). Culturally, HEIs must continue along a growing trend of incentivizing bridge-building beyond the boundaries of discipline and university campus, first by prioritizing interdisciplinary collaboration, and relatedly, by reestablishing firm roots within their surrounding communities through partnerships and prefigurative practice.

The SDGs envision a world of human flourishing within planetary boundaries [1,93]. Their achievement now requires alternative modes of research and action to address critical social and environmental problems [7,65]. Prefigurative methodologies, such as PAR, bring these seemingly soaring ambitions 'down to earth' by emphasizing individual and collective transformation in the present—change that is firmly rooted in the embodied practice of collaborative inquiry and action. Through PAR-based UREs, HEIs will continue to represent a global force for positive change—though not hidden behind paywalls or in ivory towers, but on the ground, in lock step with communities in need.

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