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# COLLABORATIVE TRANSDISCIPLINARY RESEARCH IN A SMALL INSTITUTION: CHALLENGES AND OPPORTUNITIES

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## ABSTRACT

Aim/Purpose: In this paper, we discuss how a Transdisciplinary (TD) and a Community Based Participatory Research (CBPR) initiative was conceptualized, developed, implemented, and sustained at a small academic institution with limited research infrastructure, emphasizing the role of capacity building.

Background: Most examples of the implementation of TD research come from large-scale initiatives in research-intensive institutions or centers with multiple resources to establish collaborations among experts from different disciplines. However less is known about the implementation of TD and CBPR initiatives in small academic settings.

Methodology: This paper includes a discussion of the challenges and lessons learned of this process in a teaching-intensive Hispanic Serving Institution (HSI), which included a research component as part of the institutional priorities when it transitioned to a 4-year college in 2001.

Contribution: We hope that our experience helps other researchers in similar institutions to engage in this type of research.

Findings: In this case, a collaborative TD and CBPR initiative was successfully implemented despite limited resources for capacity building and research infrastructure, as well as diversity among researchers and community members.

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|---|---|
| Recommendation for Researchers | To sustain institutional collaborative capacity in this type of institution, authors recommend continuous capacity building efforts and the development of modules and/or courses to provide formal TD training for junior faculty while encouraging researchers to interact and collaborate. In addition, the importance of the role of the community liaison is highlighted. |
| Impact on Society | Successful TD and CBPR initiatives may have a positive impact on the reduction or elimination of health disparities which involve complex phenomena that requires a broad view from different perspectives. |
| Future Research | Even though capacity building can facilitate the implementation of TD and CBPR, many challenges arise as an inherent result of community engagement and the integration of different disciplines. Thus, the need of continuous reflection to acknowledge them becomes critical for advancing TD and CBPR efforts. |
| Keywords | transdisciplinary research, community based participatory research, capacity building, Hispanic Serving Institution |

## INTRODUCTION

Health disparities problems involve multiple factors that should be analyzed and evaluated from theoretical frameworks and research models that allow a broad view of these complex phenomena. Transdisciplinary (TD) research offers this opportunity through the integration of different disciplines for the creation of a common conceptual framework to tackle a problem (Rosenfield, 1992). Using a TD approach, investigators from different scientific disciplines, expertise and cultures interact to co-produce knowledge (Abrahams, 2006). Meanwhile, Community Based Participatory Research (CBPR) is a collaborative approach that begins with a research topic of importance to the community and combines knowledge with action, in order to achieve social change to improve health outcomes and eliminate health disparities (W.K. Kellogg Foundation Community Health Scholars Program, 2001). Therefore "*TD, community-based, interactive, or participatory research approaches are often suggested as appropriate means to meet both the requirements posed by real-world problems as well as the goals of sustainability"* (Lang et. al, 2012).

The implementation of both TD and CBPR approaches requires a continuous capacity building effort. ESSENCE on Health Research (2014) defines research capacity building as any attempt to increase the ability of individuals and institutions to undertake high-quality research and to engage with the wider community of stakeholders. Most examples of the development and implementation of TD and CBPR initiatives come from large-scale programs led by research-intensive institutions or centers with multiple resources to establish collaborations among experts from different disciplines (Cooper et. al. 2013; Emmons, Viswanath & Colditz, 2008; Stokols, Hall, Taylor & Moser, 2008). However less is known about the process of establishing TD and CBPR initiatives in small academic settings. Therefore, in this paper we outline how a TD and a CBPR research initiative was conceptualized, developed, implemented, and sustained at a small academic institution with limited research infrastructure.

## CASE STUDY: UNE'S TD RESEARCH EFFORTS

Universidad del Este (UNE) is a Hispanic Serving Institution (HSI) located in Puerto Rico, whose primary focus is teaching. However, in 2001 a research component was incorporated in UNE's mission and included as a priority in the institutional strategic development plan, initially as a way to enhance science education and provide research experiences to undergraduate students. The transition to a teaching-research institution required the implementation of holistic and sustainable strategies that could have a university-wide impact. Therefore, based on the definition of TD research, our institution embraced the use of this approach as a strategy to maximize the use of academic and financial resources.

The aims of UNE's TD Research Efforts were to:

1. Strengthen UNE's research infrastructure.
2. Promote TD research endeavors among its faculty, students and academic units.
3. Develop CBPR initiatives that focus on health disparities affecting in UNE's surrounding communities.

To accomplish these aims, research capacity building was considered a priority to develop the necessary infrastructure to conduct research in health disparities using TD and CBPR approaches.

## CONCEPTUALIZATION OF A TD AND CBPR RESEARCH AGENDA

In 2008, our university was awarded a Research Infrastructure for Minority Institutions (RIMI) grant from the National Institutes of Minority Health and Health Disparities (NIMHD) to enhance research capacity in health disparity areas (P20MD003355). The overall goal of the NIMHD-RIMI grant was to enhance UNE's research capacity in health disparity research at the basic science, preventive health, sociobehavioral, and educational level, as well as to increase student pursuit of advanced studies in these areas. This presupposed at minimum a multidisciplinary approach to tackle a problem of interest, as it involved the participation of faculty and students from different academic units (i.e., Science & Technology, Health, Social Sciences, and Education). The health disparities of interest were asthma and violence at elementary school settings in Puerto Rico. These were selected based on their prevalence in Puerto Rican population, and because they provided a wide context for collaboration among diverse disciplines. To address these issues, the VIAS Health Disparity Network was created with the goal of promoting TD and CBPR approaches for the prevention of violence and asthma in UNE's surrounding communities (Lugo, Báez, Medina, & Santiago, 2011).

During the conceptualization phase of VIAS Health Disparity Network, careful attention was given to the *Transdisciplinary research design principles* (see Table 1) to assemble the violence and asthma research teams. However, since the inclusion of the community in the research process requires a paradigm shift that not only replaces the community's position in research but also re-conceptualizes the role of the researcher, the *CBPR guiding principles* described by Israel and others (Israel, Schulz, Parker, & Becker 1998, Israel et al., 2008) (see Table 2) were incorporated as well in the conceptual framework of our TD research initiative.

**Table 1. Transdisciplinary research design principles** (Lang et. al, 2012)

| Principle | Description |
|---|---|
| *Phase A: Design principles for collaborative problem framing and building a collaborative research team* | |
| Build a collaborative research team | Identify researchers, collaborators and stakeholders with expertise in the research problem, and facilitate explicit team-building processes. |
| Create joint understanding and definition of the sustainability problem to be addressed | Define the sustainability problem and make sure all team members are involved in that process. |
| Collaboratively define the boundary/research object, research objectives as well as specific research questions, and success criteria | Formulate an overall research object in which all the partners agree on common success criteria. |

| Principle | Description |
|---|---|
| Design a methodological framework for collaborative knowledge production and integration | The research team must agree upon a jointly developed methodological framework that defines how the research target will be pursued in the next phase and what settings will be employed. |
| *Phase B: Design principles for co-creation of solution -oriented and transferable knowledge through collaborative research* | |
| Assign and support appropriate roles for practitioners and researchers | In each research effort, the tasks, roles and responsibilities of the scientists and practitioners, must be clearly defined in a transparent process. |
| Apply and adjust integrative research methods and transdisciplinary settings for knowledge generation and integration | The research team employs a methodological framework to generate solutions to the research problem, as well as develop suitable settings for inter- and transdisciplinary cooperation and knowledge integration. |
| *Phase C: Design principles for (re-)integrating and applying the created knowledge* | |
| Realize two-dimensional integration | Review the research outcomes and evaluate if its implementation served to solve or mitigate the problem addressed. |
| Generate targeted product for both parties | The research products, such as publications, must be appropriate to both researchers and partners so they can use that information for real-world problem-solving, scientific progress and/or innovation. |
| Evaluate scientific and societal impact | Evaluate the project at different stages after completion. |
| *General Design Principles cutting across the three phases* | |
| Facilitate continuous formative evaluation | Formative evaluation must involve experts related to the topical field and transdisciplinary research. This process should allow to review the progress and reshape the subsequent project steps and phases, if necessary. |
| Mitigate conflict constellations | The researchers and practitioners must prepare and anticipate conflict at the outset, as well as adapted agreements should accompany the transdisciplinary research process over the entire course of the project. |
| Enhance capabilities for and interest in participation | Pay adequate attention to the material and intellectual capabilities that are required for effective and sustained participation in the project over time. |

**Table 2. CBPR guiding principles (Israel et al., 1998; Israel et al., 2008)**

| Principle | Description |
|---|---|
| Recognizes community as a unit of identity. | Communities can be geographic, neighborhoods or groups that do not share these characteristics, but have a common sense of identity that involves a sense of emotional connection and identification with others. |
| Builds on strengths and resources within the community | Considers, includes and works with the skills and resources of the people involved, the networks that the community has to support its self-management process, and the social structures that contribute to the ability of community members to work together. |
| Facilitates collaborative, equitable partnerships in all phases of the research. | The norms of partnerships include mutual respect; recognition of the knowledge, expertise, and resource capacities of the participants in the process; and open communication. |
| Promotes co-learning and capacity building among all partners. | The co-learning process facilitates the reciprocal transfer of knowledge, skills, and capacity. |
| Integrates and achieves a balance between research and action for the mutual benefit of all partners. | Seeks to create a balance between the generation of scientific research and application of knowledge resulting from it in favor of community efforts that lead to social change. |
| Involves a long-term process and commitment. | The relationships and commitment of all partners involved go beyond the culmination of a specific project or funding period since the problems faced by the communities are not limited by the time established by a project or funding agencies. |
| Involves systems development through a cyclical and iterative process. | The cyclical and iterative process should include partnership development, community assessment, problem definition, determination of action, and mechanisms for sustainability among others. |
| Emphasizes local relevance of public health problems and ecological perspectives that recognize and attend to the multiple determinants of health and disease. | It emphasizes an ecological approach that involves individuals, the immediate context in which they live, and the broader context in which they are embedded. |
| Disseminates findings and knowledge gained to all partners and involves all partners in the dissemination process. | The data obtained from the research must be: interpreted and discussed by all parties involved, presented to the community in a clear and respectful language and in ways that will be useful for the community, and disseminated among and beyond the partnership itself. |

## DEVELOPMENT OF TD AND CBPR RESEARCH INFRASTRUCTURE

A core aspect of the development of a TD & CBPR research initiative is to promote capacity building among researchers and community partners, as well as enhance the collaborative readiness among them. According to ESSENCE (2016) framework for research capacity strengthening, capacity building goes beyond training, involves shifts in power, elicits systematic changes, and is influenced by cultural aspects, among other factors (see Table 3). In UNE's case, the NIMHD-RIMI grant contributed to direct on-going capacity-building efforts towards the development of the administrative, human, and physical infrastructure needed to promote a TD research institutional culture, a critical feature for the success of this type of initiative. During the five years of the grant, significant institutional and administrative changes were implemented, many of which remain, to continue supporting capacity building efforts. Administrative changes included the creation of the Associate Vice Chancellor's Office of Research, an Institutional Program for the Advancement of Research (PIFI, Spanish acronym), and a Transdisciplinary Research Institute (TRI). The Associate Vice Chancellor's Office of Research was tasked with the promotion, coordination, administration, and dissemination of research activities and projects through a TD approach. PIFI provides seed money for pilot projects (up to 15K) to gather preliminary data and submit competitive research proposals for external funding. The TRI functions as a research support unit that collaborates in the coordination of activities related to: faculty development, curricular assessment of research skills, development of research projects, and research compliance. In addition, full-time research positions (currently seven) were created to allow faculty to spend all their time and effort on research endeavors. Moreover, physical infrastructure dedicated to research was increased to include 1,000 sq. ft. of office space for the TD Research Institute (including workstations with specialized software for qualitative and quantitative research and access to scientific databases), as well as 1,000 sq. ft. of laboratory space with specialized equipment in the School of Science and Technology.

**Table 3. Research capacity building principles (ESSENCE on Health Research, 2014, 2016)**

| Principle | Description |
|---|---|
| Network, collaborate, communicate, and share experiences | Involves collaboration between many stakeholders, ability to communicate effectively, as well as finding out about and becoming part of a network of research activity. |
| Understand the local context and accurately evaluate existing research capacity | Promote and facilitate the production of research relevant to the society by engaging community representatives that can assert the most pressing priorities to be addressed to ensure equity. Perform needs assessment of current and planned research capacity for monitoring and evaluation efforts. Support guidance, tools and training in evaluation and enable stakeholders to conduct independent evaluations. |
| Ensure local ownership and secure active support | Engage research leaders in academic, private and public sectors to identify gaps in research capacity and consider local priorities, in order to formulate research development strategies. Involve stakeholders in the design, implementation and evaluation phases of research initiatives. |

| Principle | Description |
|---|---|
| Build in monitoring, evaluation and learning from the start | Incorporate an agreed framework to evaluate and monitor capacity building efforts before they are implemented. Include quantitative and qualitative indicators of success that can be used for comparative analysis. Provide periods for "reflection on action" to respond to changing circumstances throughout the process. |
| Establish robust research governance and support structures, and promote effective leadership | Strengthen structures and systems that enable high-level decision. Facilitate customary research work such as ethics reviews, grant management and budget. Relationship between components can be used to design more sustainable capacity building strategies by harmonizing efforts and ensure complementarity. Support research training in essential leadership and management skills to establish and maintain effective relations within research teams and with other stakeholders. |
| Embed strong support, supervision and mentorship structures | Foster tailored, flexible regular support from knowledgeable and passionate supervisors and mentors to produce high-quality, timely and relevant research. Promote training to develop mentoring skills at all levels to ensure early career researchers become effective mentors and thus help drive sustainability. |
| Think long-term, be flexible and plan for continuity | Develop a long-term systemic approach that impacts multiple levels, (individual and institutional) to reach a critical self-sustaining mass of research capacity. Place strong emphasis on developing fundraising and policy engagement skills to encourage long-term sustainable support for high-quality research. |

Furthermore, the VIAS Health Disparity Network invited local, national, and international experts in TD, CBPR and other research related areas to provide workshops and guidance to UNE's faculty and community partners, as well as to serve on the VIAS External Advisory Board. Among them were: (a) a Senior Fellow in the Robert Wood Johnson Foundation Center for Health Policy and Professor of Early Childhood Multicultural Education at the University of New Mexico, (b) the Co-Director of the Resilience Research Centre and Adjunct Professor at the School of Social Work, Dalhousie University, Canada, (c) the Professor and Director of the Research, Evaluation, Measurement, and Statistics program at Texas Tech University (TTU), (d) an Associate Professor in Psychology (Affiliated with Latino and Latin American Studies) at the University of California, Santa Cruz, (e) a Professor of School of Public Health, University of Michigan, (f) an Assistant Professor of Department of Health Promotion, Education & Behavior, University of South Carolina, (g) Professors of School of Social and Human Sciences and School of Science and Technology, Universidad del Este, (h) the Associate Vice Chancellor's Office of Research, Universidad del Este, (i) the Director of Transdisciplinary Institute of Social Action Research and Associate Professor of University of Puerto Rico, Humacao Campus, (j) the Director, Office of Research Integrity at University of Kentucky, (k) an Associate Professor and Associate Director, Center for Community Health, Institute for Public Health and Medicine, Northwestern Feinberg School of Medicine, (l) the Director of the Department of Pediatrics, (m) an Associate Director for Community Engaged Research, Professor and Head of the Department of Community, and Behavioral Health and Director of Prevention Re-

search Center for Rural Health, University of Iowa, and (n) the Professor of the Department of Pediatrics, University of Puerto Rico, Medical Sciences Campus, among others. The capacity-building activities were coordinated by the TRI, and were attended by faculty, administrators, students, researchers, as well as community stakeholders (see Table 4).

**Table 4. Capacity-building activities and workshops**

| Category | Activities/Workshops | Audience |
|---|---|---|
| TD & CBPR | CBPR: Rationale, benefits, and challenges<br>Setting the stage: The why, what, and how of interdisciplinary/transdisciplinary inquiry<br>Open dialogue about TD research<br>School violence prevention and CBPR: Strengths and challenges of community-university relations<br>Challenges of school community engagement to prevent youth violence | Faculty |
| | Introduction to CBPR | Faculty & students |
| | CBPR & Health Disparities Summer Activities<br>Engaging youth in participatory action research | Community |
| Health disparity issues | School needs assessment on violence and asthma<br>Fundamentals of school violence<br>Psychological aspects of school violence | Teachers |
| | Laws regarding self-administration of asthma rescue medications in schools<br>Psychological Services Guide | Community |
| | Asthma as a multifactor illness: Research and service opportunities Particulate matter and asthma: Physiological, biochemical, and molecular mechanisms | Faculty |
| | Environmental factors & asthma<br>Asthma management in children & adults | Faculty<br>& community |
| Research development & methods | Grant writing and external resources | Faculty |
| | Statistical Analysis: Theoretical Aspects<br>Quantitative methods & SPSS<br>Application of multivariate statistical models in the behavioral and social sciences<br>Qualitative methods & In-Vivo<br>Understanding the obscure and taken-for-granted: The use of visual methods<br>Photovoice<br>Strategies for Youth Violence Prevention | Faculty & students |

| Category | Activities/Workshops | Audience |
|---|---|---|
| Ethics | Responsible conduct of research | Faculty & students |
| | Responsible conduct of research & CBPR | Community |
| | Ethics in CBPR | IRB members |
| | Ethics in mentorship | Faculty & students |
| Mentorship | Monthly mentoring training series (Introduction to mentoring, Individual development plan, etc.)<br>VIAS-RIMI Mentoring Guide | Faculty & students |
| | Writing effective letters of recommendation | Faculty |

Hall et al. (2008) considered three categories in the evaluation of collaborative-readiness in TD research teams: the contextual-environmental conditions (e.g., institutional support, physical proximity of investigators), intrapersonal characteristics (e.g., research orientation, leadership, among others), and interpersonal factors (e.g., group size, diversity of disciplines represented, previous history of collaboration). In our case, the capacity-building activities helped address these factors by bringing researchers and community stakeholders together in a series of face-to-face meetings within an enabling environment that fostered collegiality and cultivated seeds for collaboration. As stated in Medina, Fernández, Cruz, Jordán and Trenche (2016), these meetings "…helped create a productive environment in which all ideas were listened to and were integrated…" and fostered trust and respect among partners. In addition, it provided a common ground in which a shared language was developed, and teams were assembled to define the research questions and study design, as illustrated by the configuration of the VIAS Health Disparity Network.

## IMPLEMENTATION OF TD AND CBPR RESEARCH INITIATIVE

The VIAS Health Disparity Network consisted of two distinct TD teams, one for Asthma Prevention and the other for Violence Prevention. Both teams had committees at each participating elementary school, whose members were researchers and undergraduate students from different disciplines and community stakeholders, which included parents, teachers, students, social workers, administrative staff, and other members of the community (see Table 5).

**Table 5. VIAS Health Disparity Network teams**

| TD Team | Disciplines represented | | |
|---|---|---|---|
| | Researchers | Undergraduate students | Community members |
| Asthma prevention | Medicine<br>Public Health<br>Demography<br>Environmental Toxicology<br>Academic/Research Psychology | Biology<br>Biotechnology<br>Microbiology<br>Nursing<br>Social Work | Teachers<br>Counselor<br>Social workers<br>Librarian<br>Parents<br>Students<br>Administrative Assistant<br>School directors<br>Leaders of community organizations<br>Government officials |
| Violence prevention | Clinical/Community Psychology<br>School Psychology<br>Academic/Research Psychology | Criminal Justice<br>Education<br>Psychology<br>Social Work | |

For effective communication among team members, face-to-face meetings at regular intervals (i.e., biweekly) were held to discuss the progress and challenges in the research activities, as well as ideas for new projects. A liaison was appointed to maintain an open line of communication between the community and the researchers. In addition, community engagement activities were frequently held to raise awareness of health disparity issues and to promote familiarity and social cohesiveness among team members and community stakeholders through both formal and informal settings (see Table 6).

**Table 6. Community Engagement Activities**

| Category | Activities |
|---|---|
| Awareness | World Asthma Day<br>"No smoking" week<br>Art Contests<br>Health Fairs<br>Movie Forums |
| Outreach | Mothers' SPA day<br>School Open House<br>Annual Turkey Run<br>Christmas Lighting<br>Field day<br>Reading Week |
| Service | Reforestation of school areas<br>Vegetable garden<br>Workshops for students, teachers, school staff<br>Environmental health student club<br>Fundraising for school activities |

An example of one the projects that stemmed from these teams and committees was the development, validation, and implementation of a school violence observation instrument designed to gather information about the characteristics and behavioral patterns of school violence at each school community (Medina et al., 2016; Medina Santiago, Cruz Rivera, Trenche Rodríguez & Báez Ávila, 2017). In this study the principal investigator worked collaboratively with the school communities and VIAS' research team during the whole research process. Moreover, faculty and undergraduate students from diverse disciplines were involved in data collection and had also input in the modifications made to the observation instrument and procedure. In addition, they contributed in data analysis and interpretation. This TD and CBPR effort helped develop a better instrument tailored to the needs of the community and contributed to a better understanding of the phenomenon being researched.

In CBPR efforts, the dissemination of findings should be provided on an ongoing basis, using multiple strategies, so results can be used to guide the development of interventions and policy change (Israel et.al, 2008). In this case, the results were discussed with community members and disseminated to the communities at large (e.g., school personnel and parents) through oral and written reports. Furthermore, action plans were developed at each school community to prevent and reduce school violence based on the results of the study. For instance, changes in school organization (e.g., lunch schedules, supervision duties) were implemented and parents were invited to participate in school activities as classroom assistants, lunch monitors, etc. In addition, dissemination of findings extended beyond the partnership itself, involving a community member (a school social worker) as co-author of publications and co-presenter at conferences and workshops.

Regarding this process of dissemination of results, CBPR recognizes the importance of the discussion and interpretation of the data obtained from the research by all parties involved. However, this information should be presented to the community in a clear and respectful language, and in ways which will be useful for decision-making and for developing action plans that will benefit the community (Balcazar, 2003). Thus, multiple strategies of dissemination were used to communicate the results on an ongoing basis to different audiences (see Table 7).

**Table 7. Dissemination strategies**

| Strategy | Audience |
|---|---|
| VIAS biannual newsletter<br>Brochures<br>Teachers meeting<br>Parents-teacher meetings<br>Study Reports (Biannual) | School community members (students, parents, school personnel) |
| Faculty meetings<br>Brown-bag series: "Almorzando y conversando"<br>Seminar series: "Jornadas para la discussion de investigaciones y productos de labor creativa"<br>Institutional magazine: Medina, N.G., & Méndez, L.B. (2016, May). Se investiga la relación entre la contaminación atmosférica y las condiciones respiratorias en niños. UNEVISION, 14, 17. Retrieved from: http://www.suagm.edu/une/publicaciones/unevision/unevision_2016_mayo | Institutional personnel (administrators, faculty, staff, students) |
| Documentary:<br>López Román, F. A. (Producer & director). (2011). La investigación acción participativa y la violencia escolar [Documentary]. Colección Jesús T. Piñero (LB 1028.25.P9 148 2011). Universidad del Este, Carolina, PR. Excerpt retrieved from: https://vimeo.com/23142488/description<br>Interviews:<br>Méndez, L.B., & Medina, N.G. (2016, December 8) Efectos de contaminantes atmosféricos en la salud respiratoria y cognición de niños puertorriqueños (Proyecto ECO-RED). Interview by L. Gómez. In Utopística [Web-based broadcast]. Retrieved from: https://www.youtube.com/watch?v=XwD845VaBDU<br>Lugo, E., Medina, N.G., & Santiago, C. (2013, October 6) Prevention of School Violence through research work of Violence Prevention Component of VIAS-RIMI. Interview by J. Rodríguez-Cancel. In UNEVISION [Television broadcast]. San Juan, PR: Sistema TV WMTJ<br>Méndez, L.B., & Medina, N.G. (2016, July 2). Proyecto ECO-RED. Interview by M. Carrasquillo. In Ruta U: Revista Pitirre [Television broadcast]. San Juan, PR: Sistema TV WMTJ<br>Medina, N.G. (2014, April). Effects of school violence in academic achievement. Interview by David Reyes. In Noticias 24/7 [Television broadcast]. Ciudad, PR: Channel 6 WIPR<br>Medina, N.G. (2010, June 6). School Violence and Bullying. Interview In Comunidad Ley y Orden [Radio broadcast]. Ciudad, PR: Radio Vida 90.5 FM | Community-at-large |

## SUSTAINABILITY OF TD AND CBPR RESEARCH EFFORTS

Sustainability is a core concept in TD, CBPR, and capacity-building principles. Therefore, early and continuous capacity building efforts are necessary to sustain TD and CBPR research efforts and collaborations. According to Hacker and colleagues (2012), "capacity building can be seen as both a determinant of sustainability and an outcome of it. Some have even referred to this as capacity sustainability" (p.2). Referring to the conceptual model for the evaluation of collaborative initiatives described by Hall et al. (2008), the capacity building activities during the development and implementation of our TD initiative, not only enhanced the collaborative readiness of the teams, but also their collaborative capacity which in turn translated into sustainable collaborative products.

For instance, the enabling institutional environment for cross-disciplinary collaborations, the development of research skills through capacity-building activities, and the convergence of investigators through formal and informal settings contributed to the submission in 2013 of a grant to the Environmental Protection Agency (EPA), aimed to determine the impact of urban environmental stressors in student health and achievement by means of a CBPR and TD approach. For this grant submission, the research team was composed of investigators from both TD teams of the VIAS Health Disparity Network working together towards a common goal. Even though the grant was not awarded, it received favorable comments from reviewers, but more importantly it set up the stage for future TD collaborations in UNE. Thus, in 2015, two of the researchers involved in the submission of the EPA grant were awarded an Academic Research Enhancement Award (AREA-R15) from NIMHD (R15MD010201). The purpose of this research mechanism is to stimulate research in educational institutions that have not been major recipients of NIH support, and is intended to support small-scale research projects (National Institutes of Health [NIH], n.d.). As a small institution, being a recipient of this grant is an encouraging and positive outcome of fostering TD collaborations, since it has been the first of its kind to be awarded to UNE and it had provided continuity to the collaboration with the surrounding school communities.

In addition, one of the guiding principles of CBPR is that it involves systems development through cyclical and iterative processes, including those for developing partnerships and establishing mechanisms of sustainability (Israel et al. 1998). This is also true for TD and capacity building research efforts. Hall and colleagues (2012), proposed a four-phase model of TD team-based research in which a cyclical progression occur through the phases (i.e. development, conceptualization, implementation, and translation) as well as recursive and iterative movements among them during the life cycle of a TD initiative. These movements may lead to new research directions and changes in the TD team. Indeed, the evolution of the TD team is a key process in the translation phase in which the development of new collaborations that provide additional expertise can aid in moving the TD research findings from one level of analysis to another and/or across the discovery–development–delivery continuum (Hall et al. 2012). In our case, the VIAS Health Disparity Network evolved into Project ECO-RED. The main goal of this project is to examine the relationships between exposure to traffic-related air pollution and the risk of developing respiratory and neurocognitive impairments in Puerto Rican children. The new research direction in our TD initiative required the addition of an epidemiologist and a respiratory therapist to the previous research team of the environmental toxicologist, school psychologist, and academic research psychologist that participated in the VIAS teams.

## CHALLENGES AND LESSONS LEARNED

Although we have been able to successfully implement and sustain a collaborative TD and CBPR research initiative we still face challenges (see Table 8) that have been reported in the literature on these topics (Kessel & Rosenfield, 2008; Stokols, Misra, Moser, Hall & Taylor, 2008; Vogel et al., 2014). For instance, there are institutional barriers, such as emphasis on academic-teaching tasks for faculty that does not have a research appointment. In our institution, most faculty are part-time and

mostly hired for teaching. In addition, of the 154 full-time faculty members only 54.5% have a doctoral degree. These factors limit opportunities for collaboration within the institution. However, it has encouraged us to develop collaborations and partnerships with other institutions and organizations, which have enhanced our TD and CBPR research team.

**Table 8. CBPR, TD and capacity building principles and challenges of sustainability**

| Principles | Challenges | Response to the challenges |
|---|---|---|
| *CBPR*<br>Recognizes community as a unit of identity<br>Facilitates collaborative, equitable partnerships in all phases of the research<br>Integrates and achieves a balance between research and action for the mutual benefit of all partners<br>*TD*<br>Collaborative problem framing and building a collaborative research team (Phase A)<br>Co-creation of solution-oriented and transferable knowledge through collaborative research (Phase B)<br>Mitigate conflict constellations<br>*Capacity Building*<br>Network, collaborate, communicate and share experiences<br>Ensure local ownership and secure active support | Diversity in values and attitudes, as well as differences in terminology, methods and techniques among researchers across different disciplines and community members<br><br>Requires more time<br><br>Requires more faculty participation | Collaborations and partnerships with other institutions and organizations, which have enhanced our TD and CBPR research team<br><br>Recruitment of a liaison to promote effective communication between researchers and community |
| *CBPR*<br>Builds on strengths and resources within the community<br>Involves a long-term process and commitment<br>*Capacity Building*<br>Understand the local context and accurately evaluate existing research capacity | Small institution with a primary focus on teaching<br><br>Limited resources and opportunities for the development of areas designated for research activities.<br><br>Lack of a critical mass of investigators to be able to successfully compete for major grants for construction, instrumentation, research centers, etc. (Most faculty is part-time and only 54% of faculty members have doctoral degree) | Investigators shared resources towards a same goal<br><br>Need to identify other types of funding sources for investigators to have access to facilities, instrumentation, collaborations, career development, and research trainings (i.e. – PR-INBRE, UNE)<br><br>Strengthening the capacity building component<br><br>Peer mentoring |

| Principles | Challenges | Response to the challenges |
|---|---|---|
| *CBPR*<br>Promotes co-learning and capacity building among all partners<br>*TD*<br>Enhance capabilities for and interest in participation<br>*Capacity Building*<br>Establish robust research governance and support structures, and promote effective leadership | Difficulty to maintain activities aimed at capacity building when the funding period ends for programs that contribute to develop research infrastructure | Training of junior faculty<br>Peer mentoring<br>Develop modules and/or courses to provide formal TD training |
| *CBPR*<br>Involves systems development through a cyclical and iterative process<br>*TD*<br>Facilitate continuous formative evaluation<br>*Capacity Building*<br>Build in monitoring, evaluation and learning from the start | Limited human resources<br>Lack of critical mass of investigators to compete for major grants | Institutional seed funds<br>Collaboration between faculty with common research interests<br>TD team-based research |
| *CBPR*<br>Disseminates findings and knowledge gained to all partners and involves all partners in the dissemination process<br>*TD*<br>(Re-)integrating and applying the created knowledge (Phase C) | Lack of experience in research work that involves community members as partners in the research process<br>Institutional processes unrelated to this type of work | Institutional support to train researchers and community partners<br>External collaborators with expertise in IRB process, writing of scientific articles, and presentations in professional forums, etc. |

The implementation of a research approach particularly focused on TD proved to be cost-effective to our institution as the investigators shared resources towards a same goal. However, as the research teams and projects keep expanding in disciplines and scope there is a need for additional research infrastructure and continuous capacity-building efforts to support the changing demands of the TD research. This element has been more difficult to sustain since, as a small institution with a primary focus on teaching, there are limited resources and opportunities for the development of areas designated for research activities. Also in contrast with research-intensive institutions, UNE receives less than 530,000 USD a year in research grants and thus limited indirect costs. In addition, our institution does not have a critical mass of investigators to be able to successfully compete for major grants for construction, instrumentation, research centers, etc. This has created the need to identify other types of funding sources. For instance, UNE is one of the primarily undergraduate institutions served by the Puerto Rico IDeA Network for Biomedical Research Excellence (PR-INBRE, P20GM103475-14), which are funded by the National Institute of General Medical Sciences of the National Institutes of Health. Through PR-INBRE, UNE investigators have access to core instrumentation facilities, opportunities for collaboration with an island-wide network of researchers, ca-

reer-development workshops, and research training. Furthermore, PR-INBRE has provided funds for alteration and renovation of laboratory spaces, research instrumentation, and pilot projects.

During the initial phases of the implementation of the TD and CBPR research initiative, a considerable time and effort was devoted to capacity-building activities focused on TD and CBPR training. This proved to be effective in stimulating collaborations among investigators and the community. Unfortunately, after the initial funding from the NIMHD-RIMI grant, these capacity-building activities have scaled-down, which has limited the participation of additional faculty in the TD research projects. We emphasize the need for training junior faculty since traditionally most investigators have not been involved in TD research and thus many lack the skills and dispositions to engage successfully in TD collaborative efforts. While others have focused on TD training for graduate students and postdoctoral fellows, as those described by Nash et al. (2003) and James, Gehlert, Bowen and Colditz. (2015), as a small academic institution without doctoral programs, this may not be feasible. Thus, to sustain the institutional collaborative capacity, more emphasis should be made in developing modules and/or courses to provide formal TD training to faculty while encouraging researchers to interact and collaborate (Nash, 2008).

Diversity in values and attitudes, as well as differences in terminology, methods and techniques among researchers across different disciplines and community members are known barriers for TD and CBPR (Vogel et al., 2014). Thus, to promote effective communication between the researchers and the community, a liaison was appointed to facilitate the flow of information. Initially, the functions of the liaison were mainly structural tasks such as coordination and information exchange. However, throughout the tenure of VIAS Health Disparity Network, it became clear that the liaison was more than just an intermediary between parties, but a key player for the successful implementation of TD and CBPR initiative. Gray (2008) states that brokers who function as representatives and liaisons are the most crucial in large TD teams as they are the only links connecting diverse groups. In our case, the liaison not only provided linkage, but also assumed a role of leadership due to the unique position of centrality within the TD teams. Thus, the liaison provides support to the principal investigators by facilitating team-based processes, maintaining frequent communication, and serving as translator to maintain a clear message and build trust among team members. As such, the liaison must be skilled in group processes, conflict resolution, and interpersonal communication. Since the role of the liaison takes a considerable amount of time and effort, in our TD and CBPR initiatives, an academic research psychologist has been exclusively tasked with this endeavor.

## CONCLUSION

This article focuses on CBPR and TD approaches to the study of health disparities, paying attention to the capacity building component as an important part of the process of achieving TD knowledge generation. As illustrated in Figure 1, capacity building shares core aspects with CBPR and TD efforts such as building and developing collaborations, supporting and sustaining research efforts, as well as evaluating and monitoring the research process.

Capacity building sessions encouraged the convergence of researchers from different disciplines towards the same goals, providing a common ground to develop new ideas and projects to address health disparities in our communities. This became an opportunity to maximize limited research resources in our institution by expanding the scientific network of the researchers, increasing collaborations, and enhancing the translation of potential solutions to address the needs of community stakeholders. Even though capacity building can facilitate the implementation of TD and CBPR research, many challenges arise as an inherent result of community engagement and the integration of different disciplines. Thus, the need of continuous reflection to acknowledge them, becomes critical for advancing TD and CBPR research efforts.


**Figure 1. Core concepts shared by TD, CBPR, and capacity building efforts**

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