Developing Professional Skills in STEM Graduate Education through Community Challenge Projects using Design Thinking Tools

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Abstract

Twenty-first century STEM graduate training challenges educators to develop innovative approaches that transcend disciplines and prepare STEM students for a broad range of career choices. A novel training model was designed for a cohort of newly admitted PhD students that aligns critical professional skills training with experiential learning pedagogy. The training model includes two components, an immersive Summer Leadership Academy, followed by a fall Challenge Course that incorporates community-based design thinking and service learning. This paper describes the challenge course objectives and goals. As part of the Challenge Course, students worked in multidisciplinary teams with community partners on a community challenge project. The challenge course also provided training in the use of design thinking methodology for project development. After completion of the Challenge Course, student reflections from their final reports indicated that students did develop knowledge and skills in community engagement, collaboration, interdisciplinary mindsets, and STEM scholar leadership.

Keywords: Community, Graduate Training Models, Engagement, Design Thinking, Interdisciplinary

Introduction

Twenty-first century scientists and engineers must possess skills that enable them to reach beyond the laboratory, across disciplines, and into communities to identify issues and develop solutions that increase both resilience and sustainability. To prepare this new kind of leader, graduate training must embrace innovative approaches that inculcate critical professional skills that transcend disciplines and prepare STEM students for a diverse range of career choices [1-3]. With land/sea grant mission in mind, the University of Georgia Graduate School partnered with several academic and public service and outreach units to develop a novel interdisciplinary model for STEM doctoral education (see Figure 1). This novel strategy aligns professional skills training with experiential learning pedagogy adapted from training models in the health professions [4-6]. A major focus of this model is the alignment of graduate STEM education with community engagement[7] and interdisciplinary teamwork[8-9]. This paper presents a brief description of the training model and preliminary findings from a Challenge Course that students worked on projects involving community partners.

Graduate STEM Training Model

This pilot training program, known as Graduate Scholars Leadership, Engagement and Development (GS LEAD), is funded from the National Science Foundation. The goals of GS LEAD are to combine transferable skills training with reflective experiential learning opportunities, so that students develop both foundational and applied knowledge, and demonstrate competency in the following areas: (1) awareness of self, (2) community engagement/public citizenship, (3) disciplinary knowledge, (4) strategic problem solving, (5) effective communication skills and (6) interpersonal collaboration/multiculturalism. Since the program is targeted towards fundamentally transforming the education of doctoral students in STEM and STEM-related disciplines, the inclusion of diverse students from across campus to form multidisciplinary teams is a critical component of this program. The innovative model (see Figure 1) piloted through the GS LEAD program challenges the traditional disciplinary-focused graduate education paradigm by positioning critical professional skills development at the forefront of doctoral training and incorporating both personal and group reflection into experiential opportunities. In addition, the training model combines challenge-based learning[10] with competency-based learning[11].

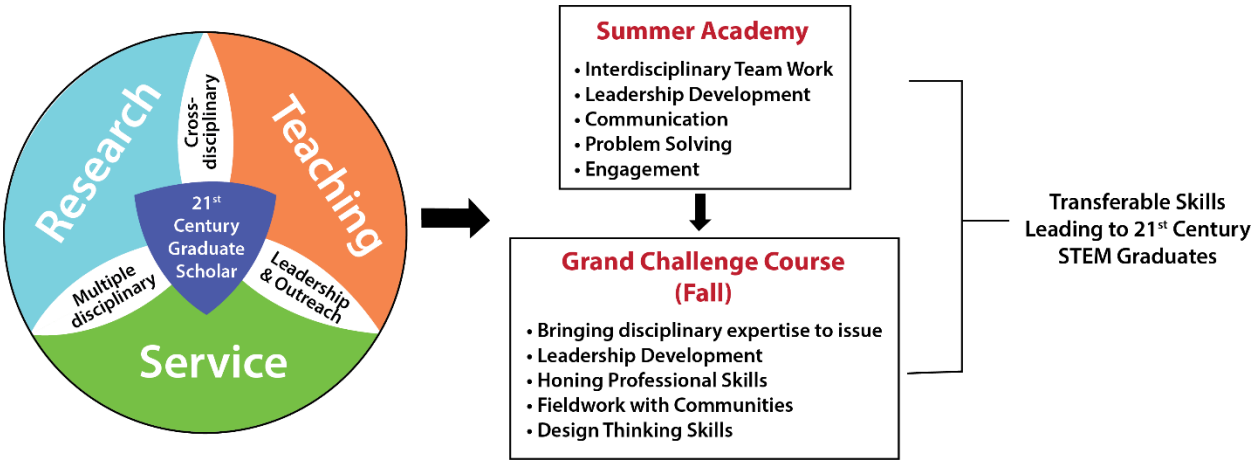

Figure 1. Graduate Education Training model (left) and course structure (right)

Summer Leadership Academy

The GS LEAD Summer Leadership Academy was an immersive six to eight-week program designed for students to build foundational knowledge, hone transferable skills, and develop competency in key areas. The program was student-centered and included a mix of faculty-facilitated and student-led discussions/exercises, workshops, personal reflections, expert panels, and field trips. An interdisciplinary team of faculty and staff from the UGA Fanning Institute for Leadership Development, and the UGA Colleges of Education, Engineering, Journalism & Mass Communication and Veterinary Medicine facilitated the summer academy. During the academy the students also began to build relationships with potential community partners. Following completion of the summer program, the students advanced to a graduate level Challenges Course for the following semester. The Challenge Course was designed for students to internalize the

processes and practices learned in the Summer Leadership Academy by putting these skills into action[12-13].

Challenge Course

In the Challenge Course, students, work in multidisciplinary teams with community partners to (i) understand the challenges faced by communities in solving local issues; (ii) learn best practices in community engagement; and (iii) develop a community challenge project to be completed by the end of the semester. The Challenge Course also provided training in the use of design thinking methodology for project development. During a typical week, students would meet in a class setting for two hours to participate in design thinking training process in an active learning set-up. Student teams are formed based on their interest and the interaction with community partners during the summer leadership academy course. Once students understand the design thinking process, teams work on their projects during the class as well as outside of class doing field work on their projects with their community partners. Each of the student teams had their design reviews, once at the problem definition stage, and the other at conceptual design and evaluation step receiving feedback from faculty and the stakeholders. At the end of the semester, student teams were expected to deliver final prototypes of their community projects. The final prototypes were presented to a group of university and community stakeholders, and the presentations included strategies for product/model implementation. After completion of the challenge course, students provided reflections from their experiences to gauge the impact of their community involvement.

Student Participants and Community Projects

The pilot program has the capacity for up to 15 participants per year. Potential participants were selected through an application process from various disciplines at UGA. The student participants comprised a diverse, multidisciplinary and international group from Arts and Sciences, Engineering, Education, Ecology, Public Health, and Public and International Affairs; as well as the Interdisciplinary Toxicology Program and the Integrative Conservation Program. All students were enrolled in the Challenge Course in their first semester as students in these various PhD programs.

Student projects grew out of their collaborative interests after exposure to different community needs during the Summer Leadership Academy. Each cohort split into three groups of four or five students and engaged with a different set of community partners for the Challenge Course project that reflected that year's theme or scope. During the first year, the Summer Leadership Academy focused on food as a unifying theme for interdisciplinary problems solving. Field trips for this inaugural cohort took students to a variety of communities outside of the surrounding university community to explore food access and community engagement. Accordingly, students identified projects within two of the communities they visited and used their interdisciplinary strengths to deliver prototypes as varied as the following: a Community Garden Guide for a new Community Center; a Project-Based Learning Plan to improve access, literacy, and connection to healthy food within a public school farm-to-classroom program; and a Community-empowered needs assessment plan for areas with urban food deserts.

The second year of GS LEAD did not define a theme during the Summer Leadership Academy but instead identified local homelessness as the theme for the fall Challenge Course. In these projects, students partnered with three different local nonprofit groups to address the challenge of

local homelessness by focusing on empathy, access, and awareness. The deliverables ranged from a communication and storytelling event at a local homeless meal sharing ministry, to a volunteer management and resource development plan for a nonprofit that serves women experiencing homelessness, to a collaboration with the local United Way outreach to connect people experiencing homelessness to resources. The third cohort developed their project ideas from the interests that emerged during the Summer Leadership Academy around developing stronger connections with the University community. This current cohort developed projects around natural conservation and recreation, academic communication to non-academic audiences, and civic engagement partnerships between graduate and undergraduate groups.

Student Reflections and Outcomes

All three cohort groups of GS LEAD students indicated in final reflections that the experience of putting their collaborative leadership and interdisciplinary problem-solving into action in a community-engaged setting provided them with invaluable professional experience to develop themselves as STEM scholar-leaders. End-of-course student reflections recognized the importance of engaging the community partner in the project problem identification, and continually working to build trust with their community partners by listening and being responsive to their needs. One student commented the following: “The experiential component of the program strengthened my ability to identify project objectives in partnership with a stakeholder, collaborate with talented peers from a range of disciplines, and to find a way to develop an effective project despite limitations of time and resources.” Another student commented: “The Challenge Course project and GS LEAD experience as a whole has helped me think more expansively about my responsibility to my community as a scholar.”

The impact of professional scholar leadership development from the first cohort can be seen in a variety of ways. Firstly, two members of cohort one served as community partners to support project development in cohorts two and three. These students from the first cohort were engaged in leadership positions within the university and a local nonprofit and from these positions were able to serve as university/community collaborators for the subsequent cohorts. Secondly, another member of cohort one used the connections made in the Challenge Course with the public school system to leverage additional scholarly projects, including her dissertation project. Thirdly, one of the Challenge Course projects from cohort supported the acquisition of a regional grant to support the development of the Community Center.

Members of cohort three show promise as scholar leaders by extending their engagement with their project and working to sustain the community partnership. Two of the projects groups from this most recent cohort have plans to extend their engagement with their community partners and to continue the projects into the next semester. One of the groups has submitted multiple grant applications, including to the University’s Office of Sustainability, to host an environmental and arts awareness event to be held in the semester following their Challenge Course. All member of this group have voluntarily agreed to continue their involvement in the project. The other group has designed a science communication podcast for non-science audiences that they plan to implement in the following semester and work toward a sustainability plan with their community partner groups. The full impact of their community involvement as a result of their participation in the GS LEAD program is yet to be seen.

Summary and Concluding Remarks

The training model presented in this paper is unique in its focus to bridge STEM education, with interdisciplinary attitudes and community engagement. It is our hope that this pilot program will provide an effective framework to equip STEM graduate students with the skills necessary to be productive, engaged scholars, and encourage graduate educators to engage students from across disciplines to work together on complex issues of importance to the public.

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