

REFLECTIONS ON AN APPLIED INTERDISCIPLINARY ONE HEALTH SCHOLARS PROGRAM



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Abstract

One Health promotes the idea that the health and wellbeing of all life are inextricably linked to each other and the environment. An interdisciplinary approach is necessary to understand, prevent and treat diseases and health factors across humans, animals, microbes, and plants that share the same influential environment. Yet, universities are siloed, divided by colleges, majors, and schools. New models of education are needed to train the next generation of students and faculty to collaborate across disciplines and find solutions to multifaceted health issues. Utilizing a SWOT (strengths, weaknesses, opportunities, threats) evaluation, we reflect upon two years of an applied interdisciplinary One Health Scholars program in which faculty and students from public health, medicine, veterinary sciences, and landscape architecture collaborated on research the first year, and in the classroom the second year. This manuscript offers calls for action for faculty and institutions interested in facilitating similar integrated applied training programs in their institutions.

Keywords: One Health, applied training, interdisciplinary, program evaluation, SWOT analysis

One Health

In recent years, global pandemics, food insecurity, mass species loss, and poverty-linked diseases have threatened local to global health systems (Sidikou et al., 2022). With an increasingly endangered planet and its inhabitants, the “One Health” framework was introduced, folding ecosystem health into the existing One Medicine concept that advocates for combining human and veterinary medicine (Destoumieux-Garzón et al., 2018). Because of the complexity of One Health issues, finding actionable solutions requires transdisciplinary collaboration and an exchange of ideas across knowledge and practice realms (Sidikou et al., 2022). The One Health Commission and the Centers for Disease Control and Prevention acknowledge numerous potentials for change: “One Health is a collaborative, multisectoral, and transdisciplinary approach—working at local, regional, national and global levels—to achieve optimal health (and well-being) outcomes recognizing the interconnections between people, animals, plants and their shared environment” (One Health Commission, 2023a). Despite an emphasis on collaboration and applied outcomes, universities are siloed – divided by colleges, majors, and schools – with little intentional design

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to stimulate interdisciplinary interactions, and a dearth of real-life applications to prepare students to function in expanding fields. New education models are needed to train the next generation of students and faculty alike to collaborate across disciplines and innovate solutions, thus effectively enacting the “change through collaboration” defined in One Health.

One Health Training

The Center for Disease Control and Prevention notes that more than 60% of known infectious diseases in humans can be spread by animals, and this number is growing with new emerging infectious diseases having worldwide impacts such as COVID-19 and Zika fever (Center for Disease Control and Prevention, 2024). This, paired with the daunting challenge to feed a growing global human population amidst increasing threats to food safety and security and rapidly depleting ecosystems, has increased interest in One Health training. However, One Health initiatives are still often embedded within veterinary and medical education programs and predominantly utilize didactic coursework (Centers for Disease Control and Prevention, 2021; Gargano et al., 2013). There currently is no accrediting body to set standards for core competencies, resulting in varied educational outcomes and focuses under the large umbrella of “One Health” (Sidikou et al., 2022; Togami et al., 2018). These programs deliver interdisciplinary exposure, however, many lack the cross-disciplinary exchange needed to address the complexities of real-world communities, environments, and situations. To address these challenges, applied training programs that incorporate a wide range of disciplines are necessary (Villanueva-Cabezas et al, 2022; Destoumieux-Garzón et al., 2018; Sidikou et al., 2022; Singh et al., 2015). Furthermore, experts suggest incorporating One Health concepts earlier, in undergraduate and graduate programs, to gain interdisciplinary experiences, and in lower-commitment certificate and training programs, to increase exposure and dedication to One Health throughout various sectors (Stroud et al., 2016).

This paper reflects upon a two-year pilot applied interdisciplinary One Health Scholars Program at Pennsylvania State University in which undergraduate, masters, PhD and professional students from public health, medicine, veterinary sciences, and landscape architecture collaborated with faculty from three colleges and two campuses. The first year, Scholars worked with faculty on a One Health research mapping project, and the second year Scholars collaborated with a class that designed One Health solutions for an underserved community. The overall objective was to pilot a new model of education for trainees to learn about One Health applications through interdisciplinary interactions and dialogue, and therefore train a new generation of cross-disciplinary problem solvers. Secondary objectives include fostering interdisciplinary collaboration amongst faculty of departments who do not typically interact, and providing services to the public and communities where the applied projects took place.

Year 1 Approach and Outcomes

The Collaborative Applied Project

The first year of the pilot One Health Scholars Program centered on an applied mapping project (Figure 1). Scholars and faculty collaborated to create a state-wide mapping database of environmental factors that might impact perinatal health (the health of babies and mothers before, during, and after birth) for humans and animals. The team initially cast a wide exploratory “net” to facilitate One Health dialogue (Table 1). The shared task of talking through the data opened the door for students and faculty to discuss their disciplinary perspectives and ask questions of others in the cohort, organically learning about One Health through application. Conversations about the maps suggested several human-environment perinatal health risks (e.g. minority groups, preterm birth, air quality and forested areas), and, after analyzing preliminary patterns, eventually focused discussions on a challenging multifactorial health frame involving the full human-animal-environment One Health trifecta (land use and lead in soil for environment, deer and deer hunting prevalence for animal, and perinatal health factors for human). This inquiry and the training process revealed significant missing data, differences in disciplinary norms about how data is collected, and, related, inherent challenges to communicating around multiscale boundaries of data (examples of boundary types for data we investigated: households, farms, counties, zip codes, wildlife management areas). The numerous complex associations warrant further study (a forthcoming manuscript may detail pilot data conclusions).

The Training Process

Four One Health Scholars and four faculty met once per month over two semesters. In the first semester, monthly meetings focused on learning each other’s disciplinary vocabulary and data methodologies, and defining perinatal health through each disciplinary lens. The second semester focused on creating and analyzing the map. Trainees also met biweekly with faculty from that Scholar’s discipline to support reflection and application to their degree and future career. Lastly, the team met twice with the university-wide One Health Group (22 faculty across two campuses) to gain feedback on the project and provide further interdisciplinary exposure. Because of the COVID-19 pandemic and team members in different locations, meetings were remote synchronous through Zoom.

Year 2 Approach and Outcomes

The Collaborative Applied Project

The second pilot year investigated One Health collaboration in the classroom, and at the global scale. Three Scholars joined a landscape architecture design activism studio course with eight landscape architecture undergraduate and graduate students working with an underserved community in Iquitos, Peru, and provided disciplinary consultation to their design ideas. Students created infographics representing One Health issues in the community, built human-scale prototypes of solutions

Table 1

Data initially collected for perinatal mapping project in Year 1 of the pilot One Health program.

Data Category	Examples of Data Collected in Category (by county)
Demographics	Race, Income, Gender, Education Level etc.
Land Cover	Forest, Wetland, Rural/Urban Classification etc.
Human Perinatal Health	Preterm, Perinatal, Neo/Postneonatal, Infant, and Maternal Mortality Rate, Low Birth Weight, Cesarean Delivery Rates etc.
Healthcare Access	Health Insurance, Proximity to Hospital or Birth Center etc.
Recorded Animal Populations	Fish, Deer etc.
Environmental Quality	Air, Water, and Soil contamination, Proximity to Mining etc.

to identified issues, and designed community-scale environmental solutions to improve quality of life for humans and animals in the community (see Figure 2 for an example design outcome). The course included a study abroad to Iquitos to meet with community members and conduct community workshops, and the outcome was a book of design ideas presented to the community, and future funders, to implement ideas (Andrews et al., 2023).

The Training Process

One Health Scholars joined the semester-long class for one hour a week, spending half the time with One Health guest lecturers and the other half providing disciplinary input on students’ design ideas. Additionally, the three Scholars and three faculty Co-PIs met for beginning orientations and end-of-program reflections, trainees met regularly with faculty from their discipline, and the team met with the university-wide One Health Group to present the book. Interactions were in-person, however one Scholar, at a different campus/city attended remotely through Zoom the majority of the semester. As with the first year, the act of working together towards a common goal (this time designing on-the-ground solutions to specific One Health issues a community faced) provided the flexible structure needed to learn about each other’s disciplines and One Health in application.

2016; Soares et al., 2018). Participants were asked five open ended questions. Survey questions inquired about the program’s strengths, the program’s weaknesses, how the program increased trainees’ current academic opportunities or future One Health career opportunities beyond the Scholars program, and perceived external barriers or threats to future continuation of the program. Because of the small number of participants, every response was included in the SWOT analysis. The fifth question asked the Scholars to share any additional thoughts on the program that were not yet addressed in the prior four questions, and responses that could be categorized as a strength, weakness, opportunity or threat were included in the SWOT analysis. Scholars and faculty discussed themes to group the responses, results were compiled and arranged into a SWOT diagram (Figure 3), and Scholars had an opportunity to review results. The four faculty Co-PIs also took a SWOT survey with similar five open ended questions to reflect upon their experiences leading the program (Figure 4). Faculty too were asked about strengths and weaknesses of the program, but also what opportunities the Scholars provided to themselves as faculty in their career track, and what external threats may become a barrier to the continuation of the program. Lastly faculty also had an open-ended question asking if they have anything else noteworthy for this manuscript.

Methods

Program Reflection

To analytically reflect upon the pilot One Health Scholars program, the seven participating trainees took an anonymous online survey designed as a SWOT (strengths, weaknesses, opportunities, threats) analysis. SWOT analysis is considered an efficient tool for internally evaluating programs (Ghazinoory, Abdi & Azadegan, 2011; Sharath Kumar & Praveena, 2023) and has been effective in evaluating in-development trainee programs across disciplines (D’Angelica, Doyle & Cleary, 2022; Bódi & Gotea,

Results

All seven trainees completed the Scholars survey. Six were female, one was male; three identified as white, four identified as a person of color or mixed race; two were advanced undergraduate students, three were masters students, one a PhD student, and one a medical resident. Scholars academically represented all three parts of the human-animal-environment trifecta (public health, global health, women’s health, landscape architecture, and veterinary and wildlife sciences). Generally, trainees observed Program strengths to be learning the other parts of the One Health definition, working with professionals, faculty and community members from different backgrounds,

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and creating an environment of open communication and teamwork. Weaknesses included difficulties in addressing each One Health discipline equally, time management and scheduling difficulties, and limited sharing during discussions that came from a lack of common knowledge. Trainees noted the Program opened opportunities to advance their academic and professional careers in One Health by acquiring new skillsets and articulating cross-disciplinary terminologies. Almost all Scholars noted the inclusion of the One Health Scholars program on their resume opened conversations in job interviews and applications to graduate school, medical school, and veterinary school. External barriers were a slow progression of One Health in practice, hardships in balancing academic priorities with real-world timelines in applied projects, and resistance to participation from key departments.

All four faculty completed the Faculty survey. Two were male, two were female; three identified as white, one identified as a person of color; all four were junior faculty representing three different colleges and two different campuses. As with the Scholars, faculty represented all three parts of the human-animal-environment One Health trifecta (obstetrics and gynecology medicine, veterinary and wildlife sciences, and landscape architecture and ecology). Overall, faculty reported the interdisciplinary nature of the Program was its greatest strength; a unique opportunity for structured collaboration between students and faculty across disciplines. Faculty described benefits to their own interdisciplinary interactions, noting the rarity that such interdisciplinary meetings happen passively (without such a program). Faculty overwhelmingly noted institutional framework weaknesses; while interdisciplinary education is largely applauded, it is often considered “above and beyond” – with little time, money, and professional incentive for most faculty and students. In addition, despite the program funded by an internal “seed grant,” navigating logistics between departments, such as pay structures or collaboration software, proved a significant barrier to delivering program goals. Faculty recognized external opportunities as building their professional network that expanded other research opportunities. They reported external threats to continuing this program as junior faculty fatigue, lack of institutional infrastructure, incentives or support for students and faculty to participate, and challenges in equally prioritizing disciplines in the One Health definition.

Reflections and Calls for Action

The two years of the One Health Scholars Program piloted applied interdisciplinary multi-level One Health training in both research and the classroom. Both faculty and trainees noted personal and professional growth not just in learning One Health concepts, but also in interdisciplinary collaboration and complex problem solving. While this paper reflects a pilot program with a small cohort, hurdles and opportunities trainees and faculty encountered across the two years led to several calls to action, that build upon prior calls in the literature (see Introduction: One Health Training):

1. A call for educational institutions to address logistical barriers and promote cross-disciplinary and applied training.

Traditional education from kindergarten through college and professional degrees in the U.S. does not prepare students for holistic thinking (Orr, 2004). Rather, as a student progresses, they are encouraged (or required) to narrow their knowledge scope until firm expertise in a discipline. In most cases, this process equips the student to be effective in their specific field, but does little to help them address systemic environmental and social problems they encounter in their professional careers. In response, Orr (2004) notes:

... learning sometimes occurs most thoroughly when diverse people possessing different kinds of knowledge pool what they know and join in a common effort to accomplish something that needs to be done. When they do, they discover ways to communicate that disciplinary education alone cannot produce (p. 98).

Further, Orr advocates that interdisciplinary knowledge happens best when students work across disciplines to solve problems that include local communities and real stakeholders as constituents in the process. One Health requires these levels of cross-disciplinary and applied training. We call for institutions to address logistical barriers (e.g. tight degree requirements that do not allow for elective courses or courses outside your degree program, collaboration software, funding and pay structures, tenure process support etc.), and provide incentives for faculty and students to benefit from such cross-disciplinary and applied training programs. Like efforts to increase writing skills by reinforcing “writing across the curriculum” rather than in a single course, incorporating One Health concepts and interdisciplinary collaboration skills through a lengthy hands-on project with mentored reflection may increase skills comprehension and retention.

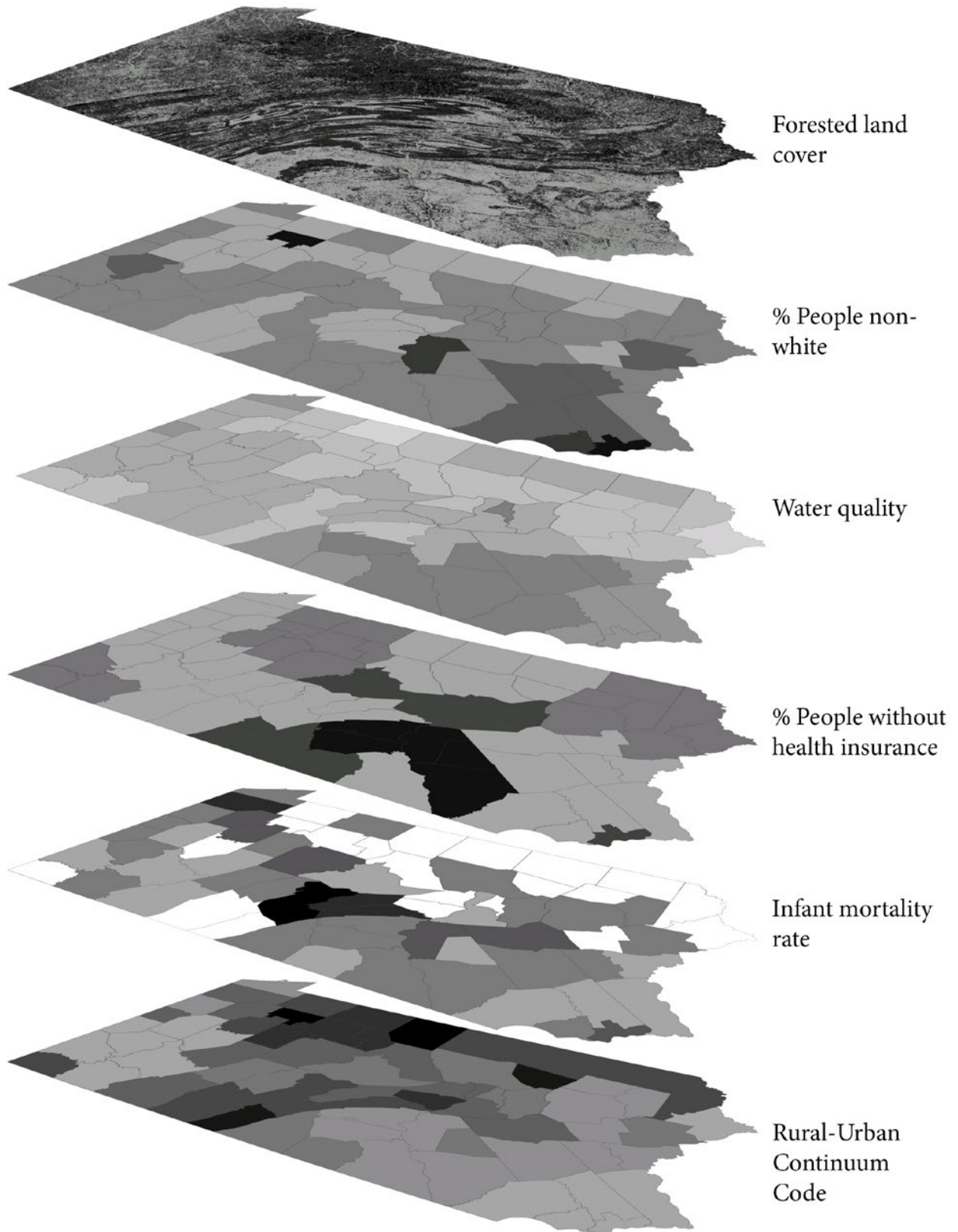
2. A call for One Health training and collaborative research to meaningfully and equitably include the full One Health definition.

One Health acknowledges the interconnected health of humans, animals and plants nested within a shared environment. Yet, it is challenging to represent all parts of One Health equally and with mutual disciplinary respect and credit for each other’s critical roles. We call for multi-departmental training and degree programs that include faculty and students representing each component of the One Health definition, and with equally shared responsibility and governance across departments/colleges (e.g., multiple Co-PIs in health sciences, public health, veterinary sciences, agriculture, plant sciences, and environmental departments etc.). One Health research collaborations should mutually and respectfully define disciplinary scopes appropriate to the project. If logistically limiting, we encourage the disciplinary home for One Health efforts to reside in the most pro-collaboration department respective to each institution. For example, where an institution has a robust Comparative Medicine (animal-human disease comparison) program,

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Figure 1

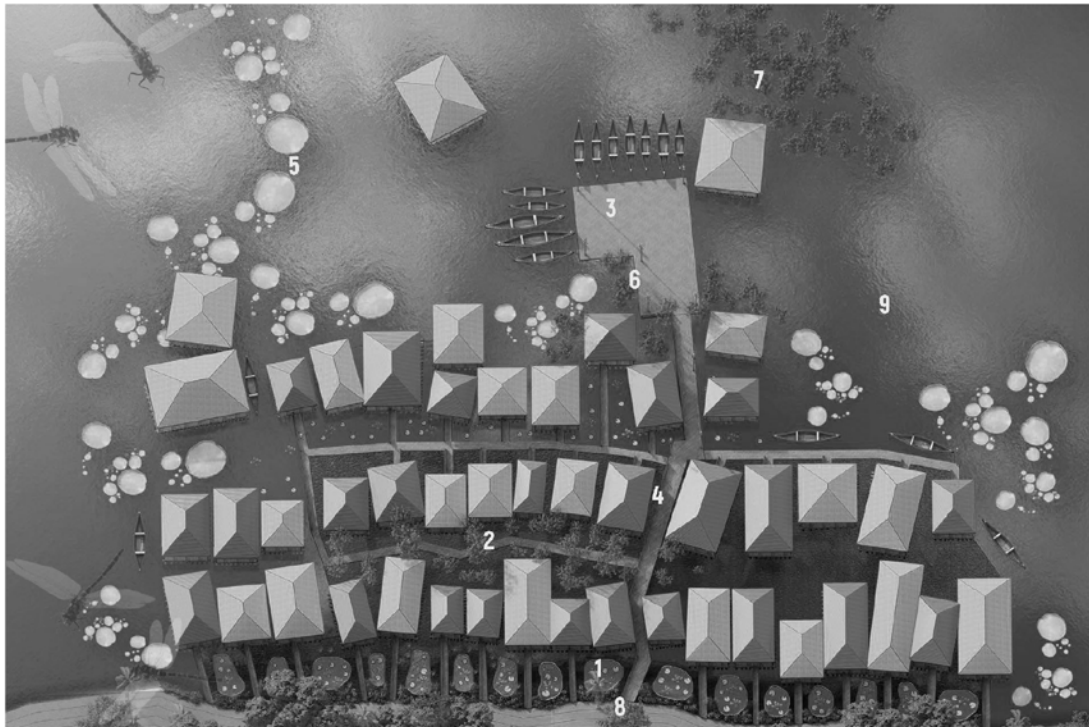
Sample of spatial data that facilitated One Health discussion in Year 1 of the pilot One Health program, illustrated as standard deviations from the mean (areas in white illustrate missing data). The team investigated numerous types of spatialized demographic, environmental, animal and human health data to discover patterns and learn about each others' disciplines



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Figure 2

Sample image of a design outcome that addressed One Health in an informal community in Peru. This student explored creating and enhancing eight types of greenspaces in the community to promote habitat for mosquito eaters to address mosquito-borne diseases, malnutrition and food insecurity, mental health, injuries, and biodiversity issues. Graphics credit: Keith Faminiano



ONE HEALTH ISSUES

PROPOSED SPACES

- 1 Dragonfly Pond ●●●●
- 1 Edible Garden (Dry Season)
- 2 Camu camu walk ●●●●
- 3 Floating bamboo pier
- 3 Social Space (Dry Season)
- 4 Bamboo walkway (with rails) ●
- 5 Lily pad corridor ●●●
- 6 Batboxes area ●

EXISTING SPACES

- 7 Camu camu thicket ●●●
- 8 Hillside ●●●●
- 9 Soccer field/play area (in Dry Season)

LANDSCAPE FUNCTION

- Habitat ● Conduit ● Barrier
- Source ● Sink ● Filter

Mosquito-borne Diseases Malnutrition Depression Injuries Food Insecurity Biodiversity Issues

Space	Mosquito-borne Diseases	Malnutrition	Depression	Injuries	Food Insecurity	Biodiversity Issues
1 Dragonfly Pond	████████					████████
1 Edible Garden		████████			████████	
2 Camu camu walk		████████			████████	████████
3 Floating bamboo pier			████████		████████	
3 Social Space			████████			
4 Bamboo walkway				████████		
5 Lily pad corridor	████████					████████
6 Batboxes area	████████					████████

Space	Mosquito-borne Diseases	Malnutrition	Depression	Injuries	Food Insecurity	Biodiversity Issues
7 Camu camu thicket		████████			████████	████████
8 Hillside					████████	████████
9 Soccer field/play area				████████		

DESIGN INVENTORY

330 sqm.	300 m	9	16	300+
Floating bamboo pier	Rope railings	Batboxes	Dragonfly ponds	Lily pads

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Figure 3

SWOT evaluation of the One Health Scholars Program pilot from Scholar's feedback.

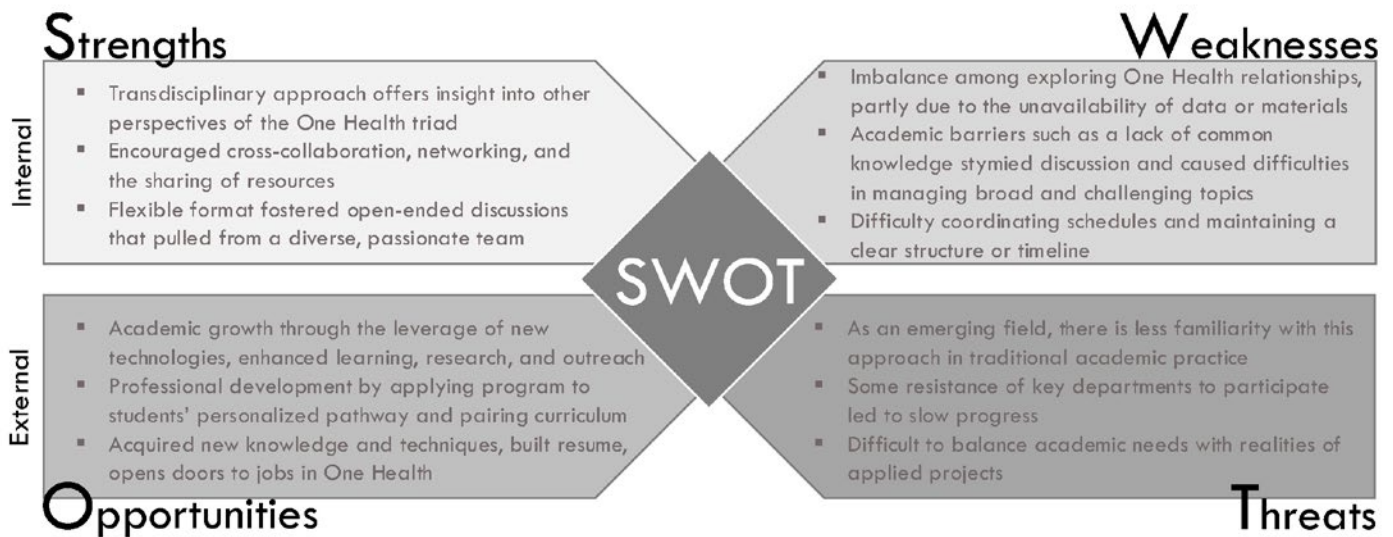
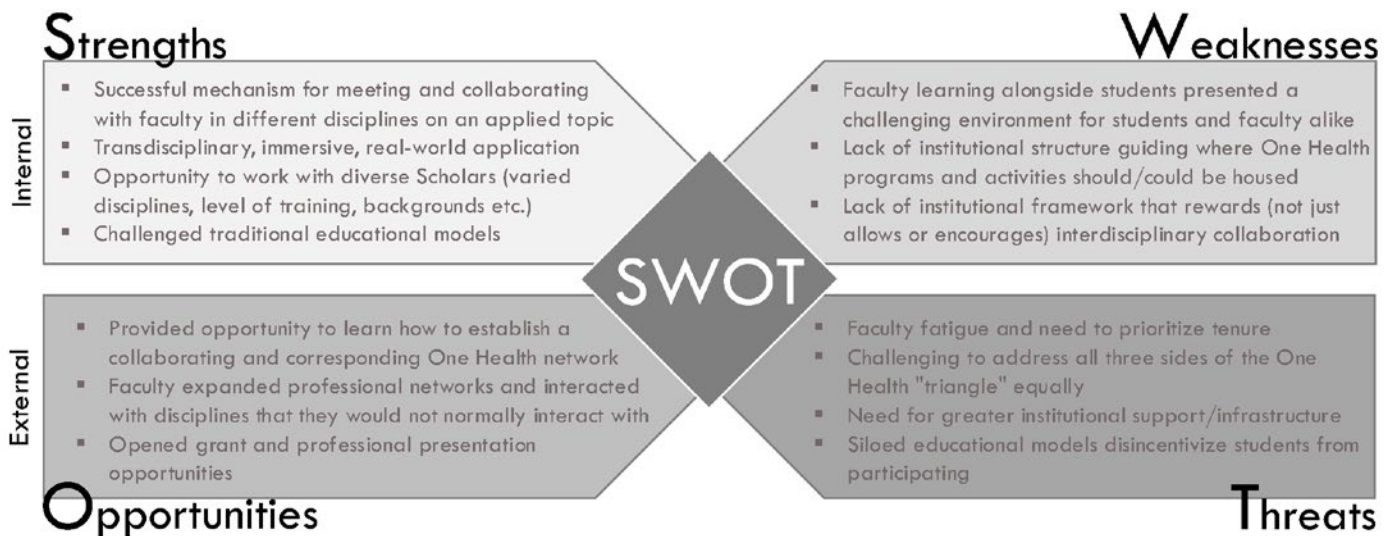


Figure 4

SWOT evaluation of the One Health Scholars Program pilot from faculty feedback.



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One Health efforts could be housed here and support joint departmental appointments or protected time for non-Comparative Medicine faculty to effectively engage in One Health activities. In other instances, it may seem logical for the “environment” part of One Health to house efforts. The environment is often a natural focal point for interdisciplinary education, encompassing all the biotic and abiotic material of the world, from mountains to microbes, and is layered with social values and natural and constructed ecological systems that instigate One Health issues (Allison, 2004).

3. A call for undergraduate, degree discovery and multi-level One Health training programs.

There are currently few undergraduate One Health degree programs; 11 as of 2023 compared to 51 graduate/professional programs (One Health Commission, 2023b). Aligning with other experts (Stroud et al., 2016), we call for institutions to provide Bachelor degree options and low-risk opportunities for early One Health discovery such as minor, certificate, or scholars training programs. Exposure upon beginning higher education may help the next generation of professionals address the complex and pressing One Health issues down the road. Even if students do not go into direct One Health fields, being exposed to interconnected health concepts and cross-disciplinary learning is a benefit to most fields (Jasani, 2018). In addition, there are numerous benefits to multi-level learning programs (i.e. interactions between undergraduates, masters, PhD and professional training) including vertical peer learning, degree exposure, knowledge exchange and development of a supportive network (Morrison et al., 2014). Existing programs should consider designing flexibility into degree requirements to expand enrollment diversity (e.g. a One Health Minor could also be a graduate specialization and open and achievable for students outside the health and veterinary sciences).

As One Health matures and develops standards for core competencies and/or an accrediting body, these calls for action may provide guidance for interested faculty and institutions.

Summary

With rising threats to our local to global health systems and an increased understanding of the interconnectedness of humans, animals, plants and the environment, new education models are needed to train the next generation of students and faculty to collaborate across disciplines and innovate solutions. This paper reflects upon a two-year pilot applied interdisciplinary One Health Scholars Program in which faculty and trainees across departments and campuses collaborated on research and within the classroom. The team conducted a SWOT analysis to reflect upon the pilot program. Overall, the program delivered a unique training opportunity for both Scholars and faculty to learn across disciplines and in a shared and applied way while providing career development opportunities. The program was challenged with several obstacles including institutional, scheduling and knowledge challenges to engaging in meaningful and discipline-equitable dialogue

and collaboration. We hope institutions, including our own, continue to explore ongoing One Health Scholars programs as a viable applied interdisciplinary training model. We offer calls for action for faculty and institutions interested in facilitating similar integrated applied training programs in their institutions: 1) to address logistical barriers and promote cross-disciplinary and applied training in academia, 2) for One Health efforts to meaningfully and equitably include the full One Health definition, and 3) to offer undergraduate, degree discovery and multi-level One Health exposure.

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