

Level-up: Expand Undergraduate Research Capacity (and Serve Faculty) through Vertically Integrated Projects

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Abstract—The Level-up workshop will challenge exclusive and exclusionary models for undergraduate research experiences, and it will give participants tools to expand undergraduate research to serve all students. The model and associated tools are adaptable, and they have been implemented in 44 colleges and universities of varying sizes, settings and missions in 12 countries.

Keywords—*leadership, multidisciplinary, transdisciplinary project based learning, team based learning, undergraduate, higher education, Vertically Integrated Projects, VIP*

I. GOALS

The goal of the Level-up workshop is to:

- Challenge exclusive and exclusionary models for traditional undergraduate research experiences.
- Familiarize participants with the Vertically Integrated Projects (VIP) model, which can scale to serve all students and benefits faculty and students.
- Give participants the tools needed to establish large-scale, long-term undergraduate research programs with the VIP model.

A. Alignment with FIE Values

The proposed workshop challenges established practices in undergraduate research, which aligns with the second FIE value

of innovation, new approaches, and challenging established practices [1].

The workshop is also strongly aligned with the first FIE value, “Collaborative, supportive, and inclusive community: encouraging mentorship and professional growth, promoting global discourse and collaboration, and appreciating multidisciplinary approaches” [1, Para. 3] The VIP model involves multidisciplinary student teams, relies on peer-mentorship, and supports student professional growth. At the faculty and administrator level, the VIP Consortium is a peer-network of VIP directors built on peer-to-peer learning that enables international collaborations. The workshop facilitators demonstrate this dedication to peer-to-peer learning, with facilitators from 8 institutions in 5 countries.

II. WORKSHOP CONTENT

A. Topic

Conventional undergraduate research cannot serve all students. It is typically reserved for students of higher academic rank (such as 4th year students) and students with high grade point averages [2]. The limited number of opportunities serve only a fraction of students [3], resulting in competition and selective screening. In a series of surveys with approximately 11,100 respondents, Russell, Hancock, and McCullough found that students who participated in undergraduate research were typically juniors and seniors with high grade point averages.

While many programs target historically underserved populations [4], this has not changed inequity in participation rates [5].

The workshop will present an alternative to conventional undergraduate research designed to serve all students, VIP. The session will include key findings (access and equity, student learning gains, scalability), will provide participants with the tools needed to establish pilot and full-scale programs, and will connect participants with the 44-institution VIP Consortium.

B. Interaction

Workshop participants bring a wealth of knowledge and expertise to the learning environment, and they seek information/solutions they can immediately apply (Merriam, Caffarella, & Baumgartner, 2006). To leverage these things, the workshop will involve active discussion, reflection, and development of personalized action-plans.

To situate the session within the contexts in which participants work, attendees will share the ways in which undergraduate research operates at their institutions. After learning about aspects of VIP Program implementation, participants will identify obstacles and resources specific to their institutions. Importantly, attendees will get input from others who have established programs in a variety of settings, which will be of use as participants develop personal action plans.

C. Content

1) Agenda

The 2 ½ hour workshop will involve two blocks of lecture, broken up by three participatory activities (Table 1). Two activities will be small group discussions, and one will involve rotation through stations in the room, with different discussion prompts and facilitators at each station.

TABLE I. WORKSHOP AGENDA AND ACTIVITY FORMATS

Agenda Item/Topic	Format	Minutes
Welcome and introductions	Speak from seat	10-15
Environment for undergraduate research at participants' institutions	Small groups	12
Overview of the VIP model and the wider context of undergraduate research	Presentation	25
Opportunities: - Undergraduate research programs - Courses: create or repurpose - Faculty already working with students - Idea for own VIP team	Rotate through stations	16
Break		10
VIP program mechanics	Presentation	20
Variations in implementations	Mini-presentations	25
Obstacles, allies, & low-hanging fruit	Small groups	12
Wrap-up	Question & Answer	10

2) Take-aways

After participating in the workshop, attendees will:

- Understand aspects of the VIP model that make it cost effective, scalable and sustainable.

- Have a framework and tools to implement large-scale long-term project-based undergraduate research courses at their institutions.
- Have identified obstacles, allies, and opportunities for success.
- Have access to resources that support implementation (processes, course descriptions, effective practices, etc.).
- Know VIP Directors from institutions of varying sizes and mission, who can provide guidance.

III. AUDIENCE

The workshop would be of interest to faculty who mentor undergraduate researchers, department chairs, deans, and undergraduate research program coordinators. We have multiple facilitators and are flexible on the size of the audience.

IV. FEES

No fees are associated with the workshop. Per FIE, workshop registration is required.

V. QUALIFICATIONS

The workshop will be facilitated by VIP Directors from 7 institutions, which are presented in alphabetical order by institution.

A. Neveen Shlayan, The Cooper Union

Neeven Shlayan is Associate Professor of Electrical Engineering and VIP Program Director at The Cooper Union (CU), a comprehensive institution located in New York, New York in the United States.

The CU is unique within the Consortium because it has a unionized faculty. The CU established their VIP program in 2019, and Shlayan can share insights from a new program's perspective and as a program with unionized faculty (a novel context).

B. Ed Coyle and Julie Sonnenberg-Klein, Georgia Institute of Technology

Ed Coyle developed the VIP model in 2001 at Purdue University, leads the VIP Program at Georgia Tech, and is Chairman of the VIP Consortium Board of Directors. Coyle also co-developed the Engineering Projects in Community Service program at Purdue University, for which he and his colleagues received the Gordon Prize for Innovation in Engineering and Technology Education.

Georgia Tech has the largest VIP Program across the consortium, with over 80 VIP teams, 100 instructors, 1,500 students each semester, and serving 25% of Atlanta campus undergraduates by the time they graduate.

Julie Sonnenberg-Klein is Assistant Director of the Georgia Tech VIP Program. She handles VIP program policy and assessment at Georgia Tech, and she advises early-stage VIP programs. Sonnenberg-Klein holds a Master's degree in Education, and is a doctoral candidate at Georgia State University in Education Policy Studies.

C. Nichole Ramirez, Purdue University

Nichole Ramirez is Assistant Director of the VIP Program at Purdue University. She handles VIP program assessment and student professional development, and she holds a PhD in Engineering Education.

The VIP model originated at Purdue, making it the longest-running program in the Consortium. In Purdue's VIP Program, students participate in supplemental professional development including VIP-provided and campus-provided programming, which is a unique attribute within the Consortium.

D. Han-Chieh Chao, National Dong Hwa University

Han-Chieh (Josh) Chao is President of National Dong Hwa University (NDHU). In addition to overseeing the establishment of a VIP Program at NDHU, he also oversaw the establishment of the VIP Program at National Ilan University while president there.

NDHU is unique, in that the three of its programs employ the VIP model: the π -Project Based Learning program (the original proof-of-concept program for the model); the Break/Redefine/Imagine/Catalysis/Kindle (BRICK) program; and the traditionally-branded VIP Program [6]. While the programs draw on varied funding sources and operate individually, they operate well in parallel.

E. Jack Bringardner, New York University

Jack Bringardner is Assistant Dean for Academic and Curricular Affairs at New York University, and VIP Site Director. He is campus representative to the American Society for Engineering Education, and an Executive Board Member of ASEE's First-Year Programs Division.

The NYU VIP Program was established in 2016, and in the last 6 years, it has grown from 4 teams and 25 students to 34 teams and 500 students. With their active involvement in ABET accreditation preparation on their campus, the NYU VIP program has set an example for other VIP Programs in the Consortium.

F. Talis Junha and Brigita Dalecka, Riga Technical University

Talis Junha is the Vice-Rector (Vice President) for Research, a Professor of Water Engineering and Technology, and VIP Program Director at Riga Technical University (RTU) in Riga, Latvia. Since 2018, Junha has led the wastewater VIP team which is developing an EcoMachine, a concept that involves wastewater post-treatment and aquaculture production.

RTU was the first institution to establish a VIP Program in continental Europe. Their program stands out within the Consortium in three notable ways: it offers scholarships to their VIP students, it has joint teams with another university (Riga Stradins University), and their VIP teams involve high school students.

Brigita Dalecka holds a PhD in Biotechnology and is a senior researcher at RTU Water Research and Environmental Biotechnology Laboratory. Along with scientific activities, Brigita has been a member of the RTU Science and Innovation team, coordinating the activity of the Vertically Integrated Project and the EIT RawMaterials Baltic Hub. Brigita has also

been actively involved in activities related to public education and information increasing the awareness of the impact of science on society.

G. Lelanie Smith, University of Pretoria

Lelanie Smith is the VIP Program Coordinator, Head of Community Engagement projects, and Project Lead for Integrated Curriculum Activities in Engineering, Built Environment and IT at the University of Pretoria (UP) in Pretoria, South Africa.

The UP VIP Program is the first established in Africa. Engineering Curricula in South Africa are prescriptive and fixed, so the VIP model was adapted to operate as a co-curricular program. Instead of counting VIP as an elective (which was not an option), VIP is offered as a voluntary program or through the use of containment modules that facilitate project based learning. This is a novel adaptation of the VIP model, which is of particular interest to institutions with highly prescriptive programs of study.

H. Stephen Marshall, University of Strathclyde

Stephen Marshall is a Professor in Electronic and Electrical Engineering, Director of the Hyperspectral Imaging (HSI) Centre, and Academic Director for the VIP Program at the University of Strathclyde in Glasgow, Scotland. Steve led the establishment of the VIP Program at the University of Strathclyde, and he is mentoring emerging VIP Programs in Europe and North Africa.

The Strathclyde VIP program is built around the UN Sustainable Development Goals (UNSDGs). The program won the 2019 UK and Ireland Green Gown Award in Student Engagement for "innovative and inspiring sustainability work taking place in universities and colleges to create a brighter future for their students" [7].

ACKNOWLEDGMENT

The workshop facilitators represent their own institutions, but they come together through the VIP Consortium which was established to support & promote the success of VIP Programs around the world. The non-profit seeks to help institutions start and sustain successful VIP programs that accelerate the pace of innovation, boost graduation rates, reduce inequities in undergraduate experiential learning, and better prepare students to participate in and lead tomorrow's collaborative, cross functional workforce.

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