4-VA AT UVA

2018-2021

Innovation and Collaboration

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Based on recommendations from the Governor's Higher Education Commission and the Governor's Commission on Economic Development & Job Creation, 4-VA was created in 2010 to leverage the strengths of Virginia's public institutions to improve higher education across the Commonwealth. At its inception, the 4-VA consortium included the University of Virginia, George Mason University, James Madison University, and Virginia Tech, and has since expanded to include Old Dominion University, Virginia Commonwealth University, the Virginia Military Institute, and William & Mary.

As a collective, 4-VA has contributed to collaborative research, course redesign efforts, and improving access to higher education across the Commonwealth. At the University of Virginia, the 4-VA program has made significant investments in these areas, with special focus on expanding research collaborations across the Commonwealth and introducing innovative technologies to enhance teaching and learning. In this report, which provides a summary of 4-VA at UVA activity between 2018-2021, you will learn more about 4-VA at UVA grants that:

- Created networks around the Commonwealth to support K-12 students' and teachers' mental health and well-being;
- Supported a collaborative effort with faculty, students, and dinning services personnel at five institutions to provide instruction to a rising generation of food system leaders on local and sustainable food economies;
- Facilitated the redesign of introductory courses in STEM fields;
- Advanced the development of real-time sensing approaches and cloud infrastructure for flooding applications in urban environments that have the power to obtain high-resolution flood warnings and mitigate flooding impacts;
- Supported pilots to enhance technology-engaged teaching and learning; and
- Enabled student participation in research and the resulting eleven undergraduate projects, one master's thesis, eight doctoral dissertations, and seven poster presentations.

Representing only a sample of 4-VA's impact, the achievements highlighted here and on the pages that follow are powerful indicators that innovation and collaboration are fundamental to 4-VA's success. 4-VA at UVA is committed to continuing to support projects that leverage the strengths of member institutions for advancements in knowledge and improvements in higher education across the Commonwealth.

Deep thanks are owed to our partners in state government and at other 4-VA participant institutions for enabling the work of 4-VA at UVA. I am also grateful to Brie Gertler, vice provost for academic affairs, and other colleagues in the Provost's Office at UVA, Jared Grigg, 4-VA at UVA Deputy Campus Coordinator, and faculty across the University for supporting and engaging in this collective endeavor.

CHAPTER I

COLLABORATIVE RESEARCH GRANTS

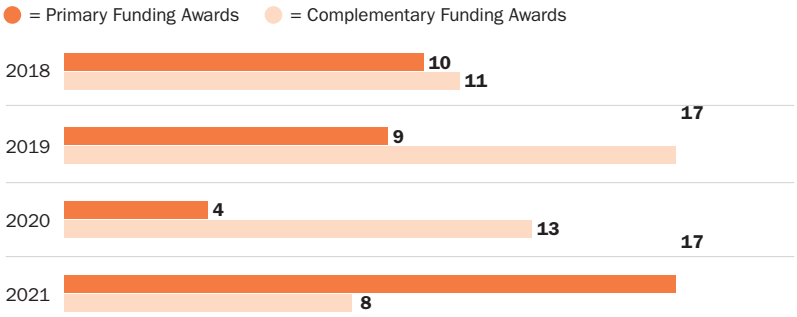
4-VA collaborative research grants encourage and strengthen research partnerships across Virginia's institutions, enabling faculty teams to test ideas in pursuit of subsequent external funding opportunities.

BROADLY REPRESENTATIVE

One of the four 4-VA initiatives, Collaborative Research Grants are intended to bolster research competitiveness within the Commonwealth by providing funding for faculty teams to engage in pilot research that could be used as a springboard for subsequent external funding. With access to funding via a Collaborative Research Grant, faculty teams can build evidence to show that their projects will make valuable, impactful contributions to their fields, thereby increasing their chances of winning larger external grants. The collaborative nature of these grants leverages faculty expertise and resources at participating 4-VA institutions to increase competitiveness and capacity.

There are two funding mechanisms in the 4-VA at UVA Collaborative Research Grants program: primary funding is awarded to a UVA faculty member who is the lead Principal Investigator (PI) on a project and complementary funding is awarded to a UVA faculty member who is a Co-PI on a project funded by another 4-VA institution. Between 2018-2021, the 4-VA at UVA Collaborative Research Grants program supported projects involving 89 UVA faculty members, representing academic departments across the University and collaborations with six other 4-VA institutions.

FUNDING AWARDS 2018-21



$25,271 Average Primary Funding Award

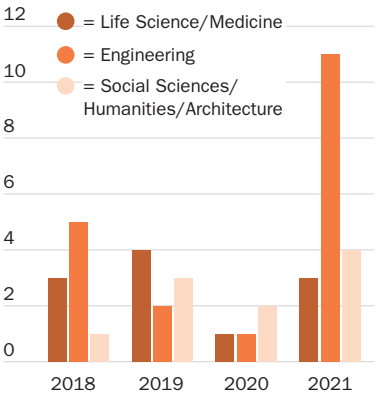
$1,008,808 Total Primary Funding

$614,815 Total Complementary Funding

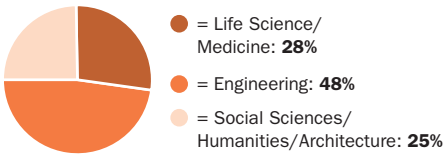
Disciplines Represented in Primary Funding Awards

Receipt of 4-VA at UVA Collaborative Research Grant primary funding is broadly representative of faculty from across the University.

DISCIPLINE CATEGORY BY YEAR



DISCIPLINE CATEGORY 2018-21



NUMBER OF CRG AWARDS BY SCHOOL

School of Architecture: **4**

College and Graduate School of Arts and Sciences: **10**

School of Education and Human Development: **3**

School of Engineering and Applied Science: **19**

School of Medicine: **4**

COLLABORATION

4 -VA at UVA Collaborative Research Grants promote scholarship across the Commonwealth.

PRIMARY FUNDING AWARD COLLABORATIONS BY INSTITUTION

George Mason University: **4**

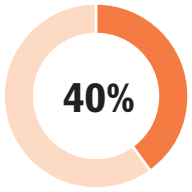
James Madison University: **8**

Old Dominion University: **6**

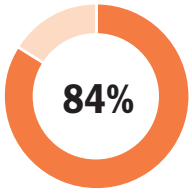
VCU: **11**

Virginia Tech: **21**

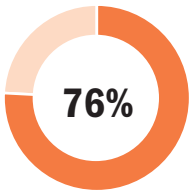
FROM A SAMPLE OF 25 CRG STUDIES:



Studies that involved multiple UVA faculty members



Indicated that their non-UVA Co-PI was a new professional connection with whom they had not previously worked



Respondents that reported that their CRG study led to subsequent studies with their 4-VA collaborators

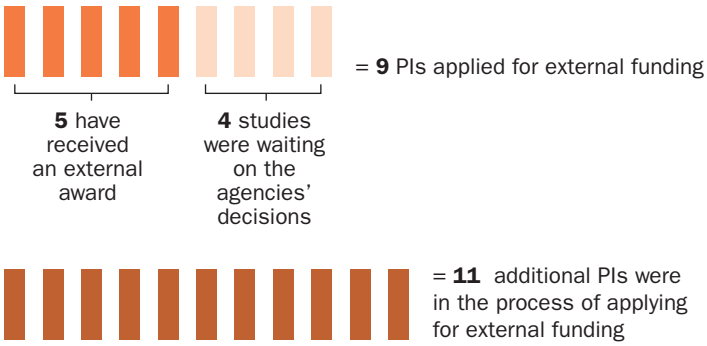
IMPACT

With access to funding via a Collaborative Research Grant, teams can build evidence to show that their projects will make valuable, impactful contributions to their fields, thereby increasing their chances of winning larger external grants.

To better understand the impact of the Collaborative Research Grants program, 4-VA at UVA surveyed the forty faculty members who received primary funding between 2018-2021[1].

[1]Twenty-five faculty responded to the survey, representing a 61% response rate.

FUNDING OUTCOMES



CRG-supported projects have been awarded funding by the National Science Foundation, the Department of Education, and the Department of Energy, with external awards ranging from $10,000 to $8 million. These data underscore that the 4-VA Collaborative Research Grants program is an effective tool for leveraging strengths and resources across the Commonwealth.

Research Dissemination

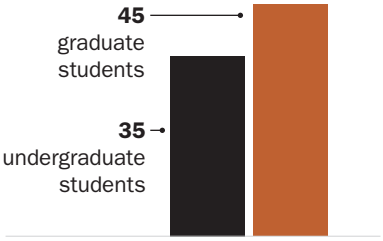
Collaborative Research Grant recipients were asked to report their successes in disseminating the findings from the studies supported by 4-VA at UVA, specifically whether UVA PIs pursued journal publications and conference presentations.

Of respondents, seven studies (29%) resulted in articles published in 14 different peer reviewed academic journals (see page 25 for a full list of references). An additional ten UVA CRG PIs are in the process of submitting articles for review.

Of respondents, sixteen UVA PIs have been invited to present the findings of their studies at twenty-eight different professional conferences. Furthermore, one study's findings (see page 12) has led to in UVA hosting the 7th International Conference on Advanced Nanoparticle Generation and Excitation by Lasers in Liquids (ANGEL) in 2024.

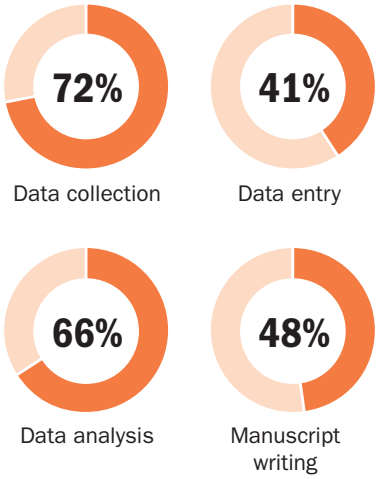
Student Engagement

Student engagement is an important element of the Collaborative Research Grant program, and UVA faculty CRG recipients have demonstrated an excellent record of involving students



STUDENT CONTRIBUTIONS

Students are supporting:



Respondents also reported that students are themselves pursuing academic and professional investigations because of their participation in 4-VA at UVA CRG funded studies. Respondents reported that eleven undergraduate projects, one master's thesis, eight doctoral dissertations, and seven poster presentations have been supported in part by a 4-VA at UVA CRG.

Improving Student Outcomes through Data-Driven Practices among School Counselors

2018 4-VA AT UVA COLLABORATIVE RESEARCH GRANT RECIPIENT

Dr. Julia Taylor,
UVA Associate Professor, Human Services

When it comes to combating the mental health challenges facing American students, two elements of an effective strategy are communication and coordination. With the support of a 4-VA Collaborative Research Grant (CRG), Professor Julia Taylor addressed the problem of comprehensive mental health training for educators across the Commonwealth. Partnering with Dr. Emily Goodman-Scott (ODU), Elizabeth Parker (Williamsburg-James City Public Schools), Dr. Donna Dockery (VCU), and Dr. Tameka Grimes (Virginia Tech), Taylor led a cohort program designed to teach data-driven practices to school counselors. The findings from this team's research illustrate the spirit and power of the 4-VA coalition through broad social impact and pooled expertise.

Prior to receiving this funding, Taylor and Dockery saw a need for centralized training and consultation programs to address inconsistencies among school counseling practices. In response, the two hosted monthly workshops at VCU where practitioners were provided "didacts and skill teaching, professional development conversations, and mentorship." This program, informally titled, AdVAntage, was able to continue statewide through the initial funding provided by 4-VA at UVA. In 2019, the success of AdVAntage became a platform for receiving a $2.5 million grant from the U.S. Department of Education to form the Virginia Partnership for School Mental Health (VPSMH). Taylor and Dr. Michael Lyons (UVA) co-direct the VPSMH, alongside Joseph Wharff (Virginia Department of Education).

The VPSMH consists of professional development for school mental health providers via learning modules and telementoring. The telementoring model, called Project ECHO, involves school mental health professionals attending monthly sessions to consult and collaborate about real-world challenges. Taylor characterized this model as a hub-and-spoke approach to disseminating evidence-based practices that allows researchers to stay connected to educators' needs and vice versa, forming a "bidirectional pathway for us to stay current on what happens in the field and where practitioners can get data-informed interventions."

When asked how the CRG program impacted her ability to develop her research, Dr. Taylor responded "The partnerships that were developed during the 4-VA grant were instrumental to facilitating a highly successful research-to-practice partnership [VPSMH]" that extends across the Commonwealth. Additionally, Taylor credits the initial 4-VA award with leading to other important research outcomes, such as conference presentations, journal articles, and a recent $6 million grant from the U.S. Department of Education to continue their training and outreach work.

Taylor further credits the CRG program with promoting networking between academics and a coalition of contacts in school districts, saying "[The schools] give us the support we need and we give them the resources to improve their student outcomes." Through this large-scale, front-line approach to school mental health training and research, the team's impact was far greater than individual effort could have hoped.

Taylor also highlighted the involvement of new universities partners in the VPSMH, such as Longwood University and Virginia State University, as examples of how a program started through 4-VA can be adapted and expanded. She further identified a desire to develop a professional training pipeline for graduate students completing a degree program in school mental health to obtain employment in partnership school divisions.

Looking to the future, Dr. Taylor has a range of goals for the VPSMH that focus on growth at the local, university, and state-wide levels. Taylor's goal at the state level is simple: to continue scaling VPSMH outreach efforts and reach more K-12 schools and districts. Taylor sees this process as involving three major components: recruitment of graduate students, retention of current school mental health professionals, and building capacity through professional development. After all, strengthening and expanding VPSMH programming allows the team to pursue an aspirational goal: "To more intentionally meet the needs of the community."

High Energy Density Lithium-Ion Battery Cathodes via Freeze Casting High Voltage Spinel Materials

2018 4-VA AT UVA COLLABORATIVE RESEARCH GRANT RECIPIENT

Dr. Gary Koenig, UVA Associate Professor, Chemical Engineering

Dr. Gary Koenig received a Collaborative Research Grant in 2018 to explore how to optimize efficiency and effectiveness of energy storage in batteries. In his study, Koenig partnered with Dr. Dipankar Ghosh at ODU to combine their expertise in material processing (Koenig) and fabrication (Ghosh) to develop higher quality battery designs.

The key to understanding Koenig's project lies in the fundamentals of battery construction and performance. According to Koenig, a battery's slow-charging process is the result of limitations in battery materials and internal processes, "In some cases, the step that makes a battery slow to charge is ions moving through the battery electrode." Koenig and his team worked to "characterize the process and use design and engineering strategies to overcome [the slow transfer of ions across the electrode]." With funding from 4-VA at UVA, the research team investigated how to "change the way you make battery electrodes."

In broad terms, Koenig's team sought to understand the interaction between the mechanical and electrochemical properties within their energy storage system. This approach represented a novel concept of battery development; integration of the two properties from the earliest stages of battery design is not common. By looking at the intersection of mechanical stability and electrochemical performance, Koenig and his team identified more efficient electrode fabrication strategies. This novel framework is important, as electrodes are a major bottleneck when it comes to charging batteries.

To develop a more efficient electrode, the team explored using multifunctional freeze-cast electrodes. In general terms, freeze-casting is an emerging fabrication technique that uses ice crystals to develop a template for component replication. In the Koenig study, researchers used porous ceramic base materials and successfully processed them to form channels for higher-performing batteries.

Using the CRG as a springboard, Koenig and Ghosh submitted a grant proposal to the National Science Foundation and received an initial award of $500,000. They have since completed that grant and await decisions on additional funding related to freeze cast materials research. According to Koenig, the next step is to "push materials to test electrode stability in batteries" and "to broaden the processing techniques of the latest and greatest battery electrode materials to test their mechanical stability." Looking forward, Koenig believes this research could "increase the reliability of cycling battery loads over time." In other words, better batteries are in our future.

Beyond advancements in the lab, Koenig's CRG has had positive effects on the Commonwealth's academic community. Resulting from this project, ODU developed a Research Experience for Teachers for grades K-12 to increase teachers' exposure to cutting-edge advances in scientific disciplines. Additionally, the researchers delivered a seminar on their findings at ODU.

When asked about the impact the 4-VA CRG had on his research, Koenig spoke highly of the collaborative nature of the grant, "When you have a program that forces you to look up what other people are doing, that really broadens your reach." Koenig is optimistic about how his expanded professional network will drive innovation not just in battery development, but in battery application too (e.g., health-based wearables). As Dr. Koenig's team continues to pursue outside funding for their work, the 4-VA CRG program remains the bedrock necessary to ask and answer those first, groundbreaking questions.

Advanced Rechargeable Zinc-Air Batteries via Catalyst Construction and Electrode Optimization

2020 4-VA AT UVA COLLABORATIVE RESEARCH GRANT RECIPIENT

Dr. Sen Zhang, UVA Associate Professor, Chemistry

More than most, Dr. Sen Zhang understands the urgent need to develop new technologies that promote clean energy. For his 4-VA at UVA CRG project, Zhang partnered with researchers at Virginia Commonwealth University and Virginia Tech to develop efficient and cost-effective materials to enable the construction of next-generation rechargeable Zn-air batteries (RZABs).

Broadly speaking, Zhang and his colleagues aimed to construct RZABs as an energy storage solution. Zhang emphasized the importance of energy storage technology, stating "It will be used to store and distribute the renewable but intermittent energy for a more stable and convenient energy flux." Compared to established lithium-ion batteries, RZABs have advantages in terms of prospects for lower cost, higher energy density, and more environmentally friendly materials and electrolytes. To produce advanced RZABs, Zhang developed the catalysts that use earth abundant elements (iron, nickel, and titanium) to enable the critical chemical reactions at cathode of RZABs: oxygen reduction reaction (ORR) and oxygen evolution reaction (OER). Zhang's research represents an advancement in energy storage as well as in the materials necessary to scaled implementation of this technology.

When discussing the collaborative relationship between UVA, VCU, and VT, Zhang endorsed the 4-VA CRG program as a mechanism for identifying new research partners. According to Zhang, the various faculty members involved in the project were professionally familiar to one another but had never explored working together; the collaborative nature of 4-VA funding provided the motivation to formalize working relationships.

Zhang's work on clean energy has extended beyond the laboratory. Since receiving their 4-VA CRG, the research team founded a statewide organization called the Virginia Clean Energy and Catalysis Club (https://uva.theopenscholar.com/2021virginia-cleanenergycatalysis/). Zhang described the club as an opportunity for clean-energy focused researchers in VA to come together to discuss future research directions and collaborations. The club hosted a virtual summit in 2021 and convened their first in-person summit in 2022, partially funded by 4-VA grants from UVA and Virginia Tech, with additional financial support from VCU. Membership is open to faculty and students, further underscoring the team's commitment to mentoring students.

Finally, the 4-VA at UVA CRG provided a springboard for significant external funding. Zhang noted that the CRG funding was responsible for supporting the preliminary data collection that was leveraged to secure one National Science Foundation collaborative project along with California Institute of Technology and one Department of Energy project.

Advancing Sustainability Goals Through the Virginia Food System Leadership Institute

2019 4-VA AT UVA COLLABORATIVE RESEARCH GRANT RECIPIENT

Tanya Denckla Cobb,
Director, Institute for Engagement + Negotiation And Lecturer

When speaking with Tanya Denckla Cobb, it is easy to see why the Virginia Food System Leadership Institute (VFSLI) has grown from an idea into a successful, multi-university initiative. Alongside 4-VA faculty partners at GMU, JMU, and VT, Cobb is an advocate for social justice and equity through intentionally designed food systems. Using 4-VA at UVA CRG funding, the VSFLI leaders developed an experiential program that teaches students about the complex interplay between agriculture, history, public health, race, and socioeconomics.

The goal of VFSLI is to "create a class that brings together students and faculty from multiple Virginia universities to tackle systemic challenges in food systems," which Cobb described as "cover[ing] every aspect of what is needed to bring food to our plates. It ranges from seed to production, harvesting, distribution, packing, and preparation." The faculty diversity across universities and disciplines brings "different expertise, skills, and perspectives in seeking ways we can be change agents." From this shared passion for change, the VFSLI was born.

The VFSLI is deeply rooted in 4-VA, receiving an initial grant in 2012 at GMU. As the coalition grew, the course evolved to meet different challenges. For instance, it was originally a three-week summer residency at the Smithsonian Conservation Biology Institute. However, during the pandemic, it transitioned to its current structure, a virtual model with student field projects. Cobb described how the course is evolving again with a spring 2024 section.

For the first two weeks, students, alongside community members, will attend daily meetings led by a multi-university team of faculty. During these meetings, students will develop a faculty-mentored group project that will be the focus of the third week. Cobb cited an example as "speaking with farmers of color about their challenges and barriers, bringing university-level knowledge and resources to bear on these problems." The students will conclude the course with a class presentation.

Discussing the scope of VFSLI, Cobb highlighted that it is designed specifically to understand and improve food systems in Virginia. To illustrate VFSLI's collaborative impact, Cobb pointed to VSU and VCU recently joining the program. Furthermore, students from outside the participant institutions are enrolling in the course. Finally, the work of VFSLI has impacted community partners; one group is now looking at how racism and sexism impact agriculture, while another is exploring indigenous peoples' food traditions.

Cobb credits 4-VA at UVA as a critical component of VFSLI success, "This class could not have happened without 4-VA funding. We could not have established our network without 4-VA support." The ability for students from diverse fields to pool their knowledge under faculty guidance allows VFSLI to "cultivate the seeds of education for emerging leaders who understand the big picture across various fields."

Thanks to the work of VFSLI faculty, those seeds are bearing fruit. As Cobb reported, UVA is one of two universities nationwide offering price support to bring locally and regionally sourced food from BIPOC farms to campus in partnership with Aramark, increasing BIPOC farmer participation from 9% to 37% over three months. Through the VFSLI, lessons learned in the classroom are being applied in ways that are changing the world one bite at a time.

Generation of Nanoparticles with Controlled Size and Composition by Pulsed Laser Ablation in Liquids

2021 4-VA AT UVA COLLABORATIVE RESEARCH GRANT RECIPIENT

Dr. Leonid Zhigilei,
UVA Professor, Materials Science

Across the 4-VA consortium, one of the major goals is promoting collaborations between universities that lead to larger impacts in the Commonwealth and beyond. Of note is the 4-VA at UVA Collaborative Research Grant (CRG)-supported research of Dr. Leonid Zhigilei and VCU's Dr. Katharine Tibbetts, and the international attention their research has brought to Virginia.

Broadly speaking, Zhigilei's project focused on the formation of metal nanoparticles using a laser beam directed at a metal target immersed in a liquid environment. When the laser pulse passes through the transparent liquid and strikes the target, the metal heats up, explodes, and produces nanoparticles. Due to the highly nonequilibrium conditions created by the rapid laser energy deposition, the nanoparticles have unusual structure and feature a very high density of crystal defects. Through his research, Zhigilei realized that when nanocrystals have many defects in their structure, these abnormalities can increase the catalytic activity of the nanoparticles "by an order of magnitude."

Zhigilei's and Tibbet's research represents a truly collaborative process whereby Zhigilei creates computer models that predict the most promising conditions of laser-materials interactions for experimental exploration in Tibbetts' lab. According to Zhigilei, "In all of our computational projects, we try to have experimental collaborators. There is a clear advantage of co-designing simulations and experiments to maximize opportunities for model verification and direct testing the computational predictions in the lab." Zhigilei credited the CRG as providing the impetus to reach out to Tibbett's.

The partnership has proven fruitful on an international scale, with the duo presenting their 4-VA CRG research at conferences in Germany and Japan. Of note, their work will bring the 7th International Conference on Advanced Nanoparticle Generation and Excitation by Lasers in Liquids (ANGEL) to Charlottesville from May 26-31, 2024. Zhigilei highlighted that UVA will be the first United States host of the conference, joining previous host cities that include Engelberg, Switzerland; Taormina, Italy; Matsuyama-shi, Japan; Essen, Germany; Lyon, France; and Hefei, China. Zhigilei and Tibbetts will serve as co-chairs of this international gathering of scientists. Additionally, the researchers have submitted a proposal to the U.S. Department of Energy for a three-year grant and are currently awaiting a decision.

When asked about the impact of the 4-VA at UVA CRG program on his research, Zhigilei stated "Without [the funding] we would not have been able to generate the initial results. It would also be more difficult to apply for Department of Energy funding" without an established research program. Additionally, Zhigilei discussed how this collaborative project allowed a VCU graduate student to gain access to the modeling and advanced material characterization technology available at UVA.

The CRG program is designed to encourage new research collaborations across Virginia, and the successes of Zhigilei and Tibbetts illustrate how local collaboration can rapidly expand to have an international impact. Zhigilei's research serves as a foundation for nanoparticle and laser research while also increasing UVA's reputation in the international Material Science and Engineering community.

Real-time Sensing of Flooding within Urban Environments

2021 4-VA AT UVA COLLABORATIVE RESEARCH GRANT RECIPIENT

Dr. Jonathan Goodall,
UVA Professor, Civil and Environmental Engineering

One benefit of technological advancements is the ability to provide decision-makers with real-time information. With support from 4-VA at UVA, Dr. Jonathan Goodall (UVA) and Dr. Navid Tahvildari (Old Dominion University) set out to better understand how real-time sensors could be used to manage community flood alerts, pushing the boundaries on how cities understand, predict, and react to flooding.

Generally, the Internet of Things (IoT) consists of networks of data-inputs to better understand and regulate processes. Most people encounter the internet of things in the form of smart cars, home automation, and wearable technology. In Goodall's work, this network takes the form of custom-designed sensors that monitor "real-time water levels and how they might impact residents within a city or community." Goodall stressed how important this technology is, saying "high resolution, widely deployed [water level] sensor networks are not something that exist in cities." A 4-VA Collaborative Research Grant supported the advancement of this technology.

Designing the flood warning technology, the team recognized early that powering the sensors would be a challenge. Overcoming the energy-related challenges meant focusing on "low power solutions that can run off a normal battery for years." Reviewing the available communication systems, the researchers decided to work with a LoRaWAN network architecture due to its low energy footprint and powerful connectivity. In this system, the sensors are connected to a long-range, low-power, low frequency communication network that transmits data over a large network and does not conflict with other wireless channels.

Currently, the researchers are in the development and testing phase of their concept. Goodall reported that they have approximately ten sensors primarily located in the Charlottesville area with additional sensors in Norfolk. This approach allows the team to test the software locally with an eye to scalability.

Beyond the proof-of-concept phase, Goodall sees one goal as "large scale deployment that can help people know how to avoid flood events." The focus on coastal communities is important because tidal flooding can flood streets without warning. Ideally, Goodall sees the development and deployment of this technology as a joint effort between academia, government, and the private sector.

Discussing the impact of 4-VA on his study, Goodall characterized his partnership with Tahvildari as one of complementary expertise, "[Professor Tahvildari] is an ocean modeler and I understand flooding on land masses…the 4-VA program really encourages people to see how other people's work intersects with their own." Goodall stressed how CRG awards "allow us to figure things out and then seek external funding and support." The researchers continue to pursue external funding opportunities.

Finally, Goodall's work allowed students to engage with cutting-edge research, with his 4-VA-supported study incorporated into a UVA fourth-year capstone class. Six multi-disciplinary UVA engineering students installed and maintained a LoRaWAN gateway on Rice Hall in the UVA School of Engineering and placed sensors in a local creek. Their work was accepted to the Systems and Information Engineering Design Symposium, an Institute of Electrical and Electronics Engineers conference.

Expanding access to evidence-based youth behavioral health prevention programs through community/academic partnerships in rural schools

2019 4-VA AT UVA COLLABORATIVE RESEARCH GRANT RECIPIENT

Dr. Amanda Nguyen, UVA Research Assistant Professor, Human Services Department

When researching dynamic mental health challenges, flexibility is a critical component for success. UVA's Dr. Amanda Nguyen demonstrated this when pivoting the focus of her CRG project as the result of the COVID-19 pandemic. Initially proposed as an evidence-based mental health program for rural schools, the pandemic led Nguyen and team to adapt a proposed in vivo intervention into a responsive and timely mixed-methods research project.

Nguyen, partnering with Dr. Catherine Bradshaw (UVA) and Dr. Kathy Hosig (Virginia Tech), originally proposed adapting a behavioral health program to be delivered in rural Virginia schools with a goal of improving school mental health resources. However, when schools were shuttered during the pandemic, these plans were no longer feasible. With assistance from the 4-VA at UVA program, Nguyen refocused her team's efforts to helping schools better understand and manage educators' mental health challenges.

According to Nguyen the new direction for the project focused on understanding rural schools' abilities to "maintain mental health support, identify emerging needs, and make new connections." Partnering with the Coalition of Small and Rural Schools of Virginia and the National Center for Rural School Mental Health, Nguyen sought to document the experiences of teachers and other school staff as they juggled the challenges of remote learning, expanded responsibilities, and general concern for their students' development.

Nguyen found that the compassion teachers had for their students was both a strength and a liability. As a strength, teachers regularly went beyond their traditional roles to increase student engagement (although Nguyen notes that student connectedness was negatively impacted overall by remote learning). Conversely, high levels of teacher compassion were associated with increased emotional burdens and professional stress resulting from the pandemic.

The study findings also suggested ways rural communities were uniquely positioned to help educators respond to the challenge of remote, synchronous learning. For instance, a local church partnered with a school to open wireless internet spots for students who did not have access at home. This finding underscores the often-unspoken challenges faced by rural families as they work to engage in a rapidly transforming digital educational landscape.

When discussing the opportunities accessed through the 4-VA at UVA CRG program, Nguyen stressed how access to funding allowed her to easily adapt to the pandemic. Second, the collaborative element of the program established a relationship with Dr. Hosig, who had an

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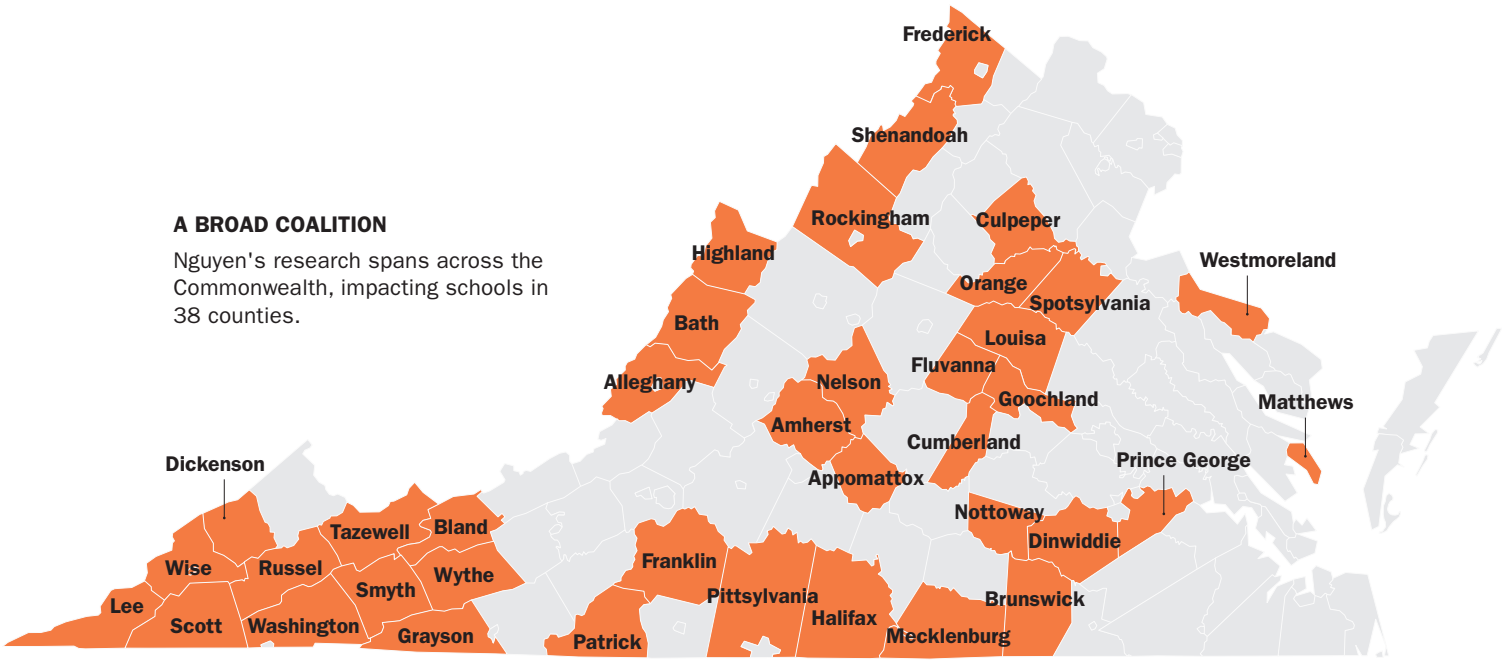


FREE VECTOR MAPS
GRAPHIC PROVIDED BY THE PI

Continued from page 14

extensive network of contacts in rural school systems. Finally, the CRG program enhanced graduate student Jieun Sung's professional development by positioning her to supervise and mentor an undergraduate research assistant.

Looking to the future, Nguyen sees two areas for additional study. The first is maintaining the network developed during the CRG study and continuing to monitor behavioral health outcomes post-pandemic. A second opportunity is to study post-pandemic teacher mental health, burnout, and stress so that interventions can be developed and implemented to proactively protect educators.

Ultimately, Dr. Nguyen's adaptability and partnership with 4-VA at UVA allowed her to dynamically respond to a systemic challenge in support of rural Virginia educators. Through her research, she was able to develop policy recommendations for the Coalition of Small and Rural Schools of Virginia on how to support educators and staff during large-scale interruptions of services. Thanks to her work, rural schools may see increased support from a broad coalition of allies.

Prototyping A Housing Justice Atlas for Virginia

2021 4-VA AT UVA COLLABORATIVE RESEARCH GRANT RECIPIENT

Dr. Barbara Brown Wilson, UVA Associate Professor, Urban + Environmental Planning

Dr. Michele Claibourn, UVA Assistant Professor, Public Policy

In 2021, Dr. Barbara Brown Wilson and Dr. Michele Claibourn partnered with VCU's Dr. Kathryn Howell and Dr. Ben Teresa to bring "richer data to bear on the ongoing policy advocacy for housing affordability and stability." Their study is rooted in concerns about eviction rates in Virginia communities, a trend that Claibourn identified as "a pressing and urgent problem within our community partners." The award supported two related projects: forming a community advisory board of stakeholders from various renters' rights organizations and publishing the Virginia Evictors Catalog.

Claibourn described the advisory board as a collection of tenants' rights organizations, legal aid agencies, and other community groups who engage with evicted renters and underscored the fact that members of the advisory board work both on the front lines as well as behind the scenes through policy advocacy. Through the partnerships formed via the advisory board, the research team gained a better understanding of the challenges faced by evicted Virginians.

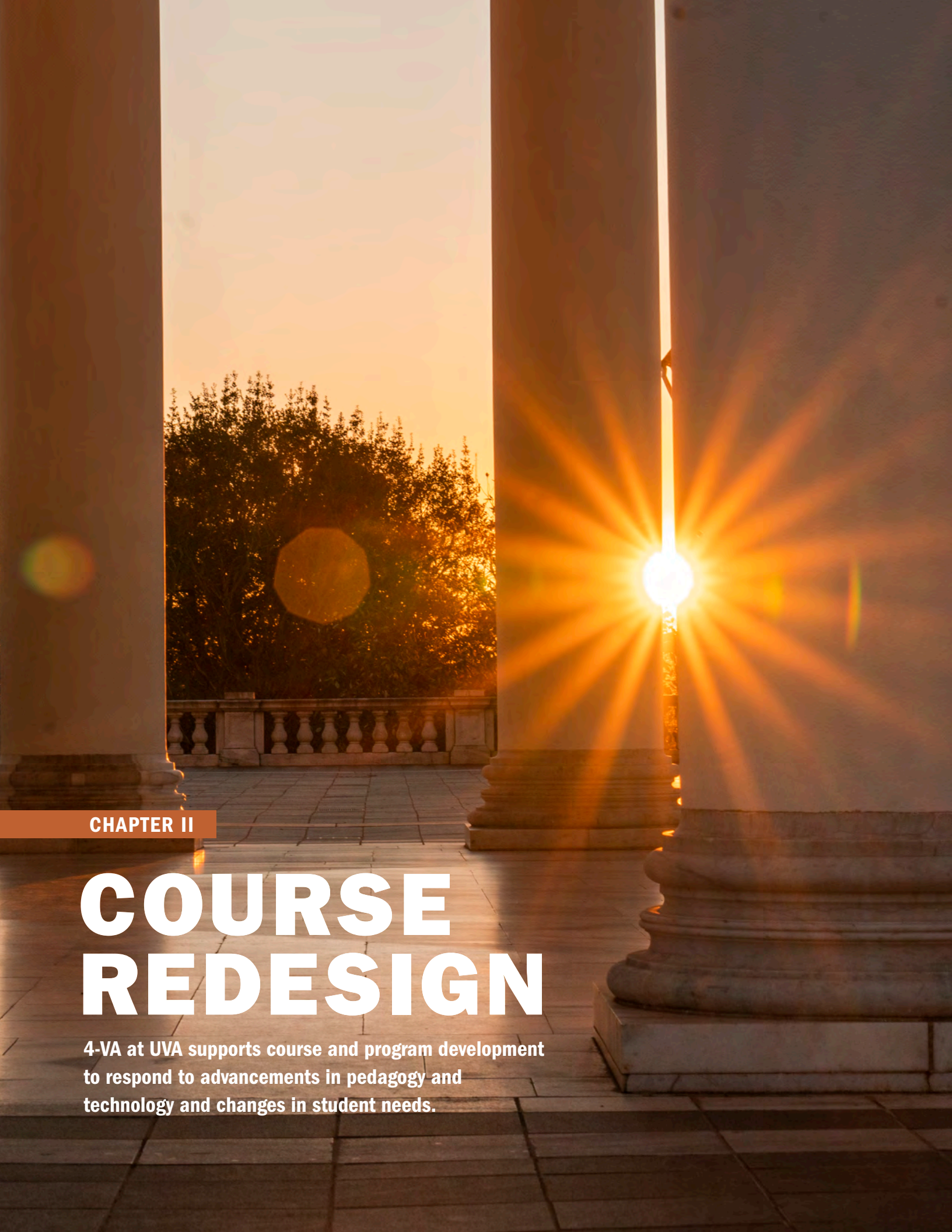
With access to extensive public records and support from 4-VA at UVA, the researchers crafted and launched the Virginia Evictors Catalog in 2022 (tinyurl.com/2p8nspvd). According to Claibourn, the catalog's purpose is to empower renters to better understand publicly available data on landlords, "We know that people with more power [landlords] use the [court's] eviction records. This system makes it easy to see who is filing evictions." While the project is currently focused on the Charlottesville and Richmond areas, the researchers are eager to form partnerships across the Commonwealth.

In developing the Virginia Evictors Catalog, the team began with the work of VCU's RVA Evictions Lab (Howell and Teresa) to provide quarterly reports of Richmond area evictions based on court records initially scraped by a civic technology volunteer. The UVA Equity Center team (Claibourn and Wilson) brought computational and statistical expertise to expand the use of the data statewide, further uncovering the trends and policy recommendations within the data. While developing the Catalog, the team established a partnership with Legal Services Corporation to provide nearly real-time data acquisition and sharing.

The members of the research team have ongoing conversations with new partners to present their data and methods, what Claibourn called "the Roadshow." The team's community engagement is starting to pay dividends; Claibourn reported that agencies in Hampton Roads have initiated conversations about how they can participate in the project. Additionally, the Virginia Poverty Law Center is forming an internal data group to explore eviction policies. As their network grows, Claibourn hopes to expand the Evictors Catalog to include information about the ownership structures behind LLCs and corporations.

When asked how the 4-VA at UVA CRG impacted the research, Claibourn was unequivocal in stating 4-VA funds "helped us launch something really powerful that continues to grow and evolve." The success of this CRG project is also evident in the classroom, where Claibourn uses the CRG study to supplement graduate-level lectures with experiential learning. For instance, she reported two graduate student teams are tackling a question about predatory attorney fees in leasing documents. Additionally, as a foundation for future research, UVA PhD Plus students are in the early stages of organizing data that connects housing types to ownership structures.

As the program continues to grow, UVA is positioned to be a significant force in challenging housing inequities across the country.



CHAPTER II

COURSE REDESIGN

4-VA at UVA supports course and program development to respond to advancements in pedagogy and technology and changes in student needs.

A SURVEY OF CALCULUS (I & II) AND CALCULUS (I & II)

2018 COURSE REDESIGN GRANT AWARDEE

Recognizing a need to redesign introductory calculus courses to improve student outcomes, UVA's Mathematics Department charged a committee, chaired by professor C. Grommoll, to design new curricula that would bolster student engagement, retention, and achievement. Following their initial assessment, the committee determined the courses should be redesigned using an empirically grounded pedagogical approach. To support the redesign of several introductory calculus courses, the Mathematics Department received a $100,000 4-VA at UVA course redesign grant.

Examining the introductory calculus curricula, the committee determined that the department's historical approach to teaching calculus was grounded in communicating knowledge without deep engagement in the thinking patterns and language of mathematics. As a result of the historical attitude towards introductory math instruction, students were completing courses but were not deeply engaging with the information. Therefore, according to Dr. Jim Rolf, the commitment was made to invest more time and experience in improving student learning experiences in introductory calculus courses given the critical importance of mathematics in other STEM disciplines.

In the search for a new calculus pedagogy, the committee discovered an approach that was developed and tested at the University of Michigan (https://dept.math.lsa.umich.edu/courses/sg/). Using the evidence-based tenets of the Michigan model, the department customized the novel teaching system for UVA's Introduction to Calculus course sequences:
1.) Ground courses in curiosity, critical thinking, collaboration, student retention, and positive educational experiences.
2.) Use a flipped classroom model where time is spent working on assignments following brief periods of didactics.
3.) Emphasize group work both in and out of the classroom.
4.) Emphasize problem comprehension and real-world applicability.
5.) Increase class time and instructor engagement, complemented by a 25% decrease in class sizes and associated increase in sections offered.
6.) Increase expectations for outside classroom engagement through complementary support services (e.g. Undergraduate learning assistants and tutoring resources).
7.) Increased training and support for graduate and post-doctoral instructors, who experience cyclical turnover.

As the course redesign progressed, the changes were adapted to accommodate budgetary and resource limitations. For instance, the Calculus for STEM major courses saw a decrease in class size, while the non-STEM courses remained at existing enrollment capacity (conversations about reducing these class sizes are ongoing). Another deviation from the initial plan included keeping the non-STEM course at three hours rather than increasing it to four hours. Additionally, the course redesign has resulted in seven new teaching-focused faculty members. Finally, the course redesign initiative also resulted in an expansion of the Math Tutoring Center in Clemons Library.

The four courses were fully redesigned by the Spring 2022 semester, and initial results are promising. For instance, the percentage of students withdrawing or receiving a D or F grade decreased by 5% over three years. Additionally, according to standardized assessment data, students in the new curricula demonstrated an 11% improvement on the Calculus Concept Inventory. Finally, on departmental exams, students in the new course structure are performing between 6% and 38% better than students in the historical model.

Students are noticing the benefit of the new classroom structure, with increases in course ratings, perceived learning, and instructor ratings. Surveyed student comments include "I really enjoyed the flipped classroom. The videos allowed us to learn at our own pace before coming into the classroom" and "I learned a lot of new material in ways that were easier to understand and implement." As the department continues to collect data, the improvements in student outcomes, combined with the faculty's commitment to closing achievement gaps for students from diverse backgrounds, illustrate UVA's commitment to excellence in education.

Author's Note: *Success has many authors; the following individuals contributed to the Calculus Redesign: Dr. Craig Huneke, Dr. Paul Bourdon, Dr. Gail Hunger, Dr. Jim Rolf, Dr. Daniel James, and Dr. Matt Demers*

INTRODUCTORY COLLEGE CHEMISTRY I AND II

2018 COURSE REDESIGN GRANT AWARDEE

Undergraduate students often find themselves faced with three options for satisfying science curricular requirements: chemistry, biology, or physics. At the University of Virginia, Chemistry 1410 (Introductory College Chemistry I) and 1420 (Introductory College Chemistry II) are the first experiences most students have with chemistry, independent of their major, and the courses serve approximately 1450 and 800 students, respectively, each year. To maximize the impact of these courses, Dr. Linda Columbus, supported by a $27,500 4-VA at UVA Course Redesign grant, partnered with UVA instructional designer Gail Hunger to transform the way students first interact with chemistry and the sciences.

"How we understand and talk about chemistry has changed, but the way we teach it has not."

Dr. Linda Columbus,
Professor Of Chemistry And Molecular Physiology And Biological Physics

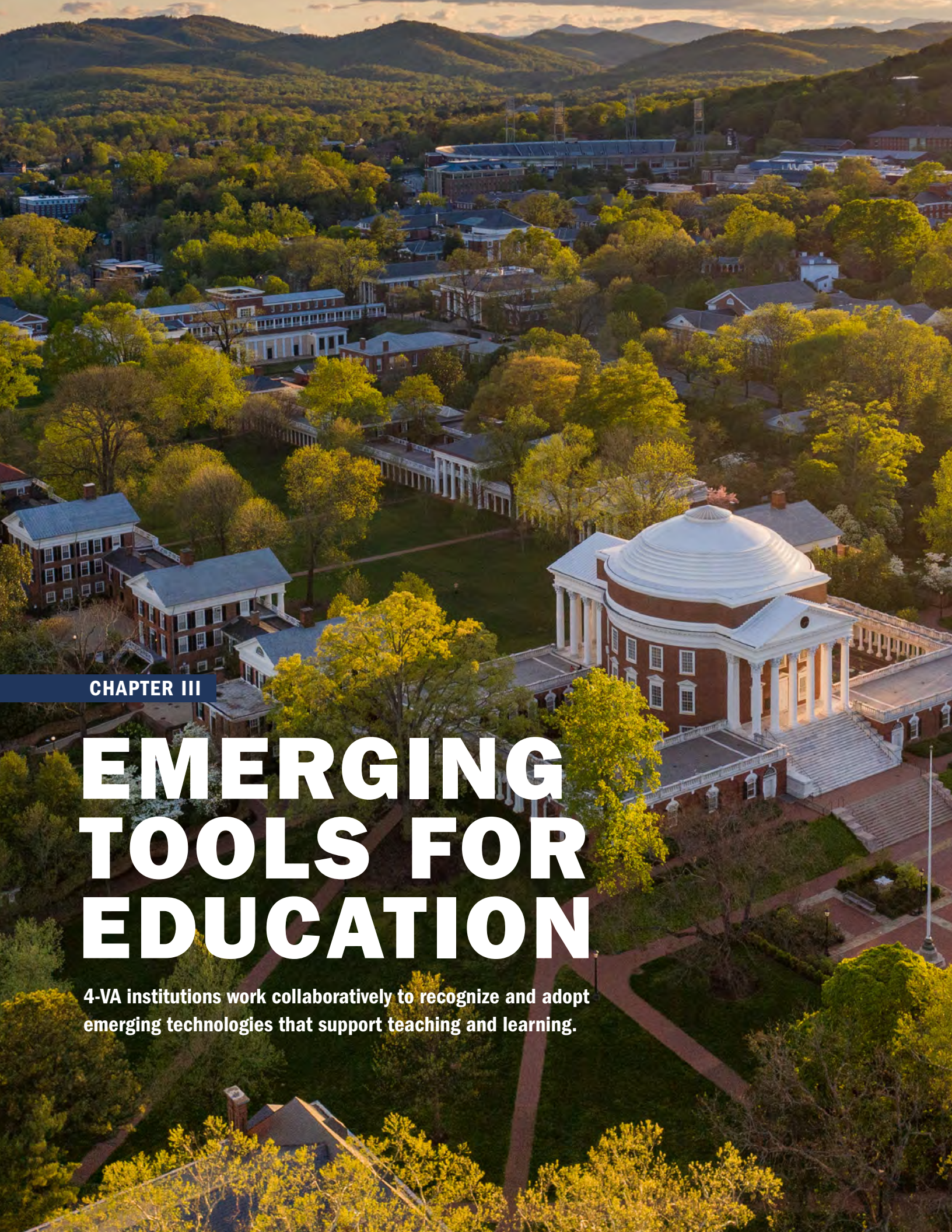
To begin the redesign process, Columbus and Hunger undertook a comprehensive assessment of the introduction to chemistry curriculum, student outcomes, and UVA support resources (e.g., tutoring, labs, Chemistry Resource Center). Using surveys and focus groups to collect student and faculty input, the team found that chemistry at UVA was a stale classroom experience marked by lectures and homework. In describing their findings, Columbus observed "How we understand and talk about chemistry has changed, but the way we teach it has not."

To challenge the outdated pedagogy, the team spent a year crafting a new approach to teaching introduction to chemistry that blended traditional instruction with enhanced activity. This evidence-based concept is known as a "flipped classroom," where instructional time is divided between classroom teaching and hands-on problem solving. In the case of Introductory College Chemistry I and II, Columbus and Hunger established a new curricular structure divided between a weekly traditional lecture and a separate group-centric experiential period called an "Expo." Tackling chemistry instruction from this perspective, Columbus and Hunger's approach allows for "more in-depth learning with integrated concepts rather than a checklist of facts." This novel approach provides students an opportunity to engage with material beyond reading, passive lectures, and answering multiple choice questions. Instead, students read, write, draw and verbalize their understanding in a smaller classroom setting.

Launched in 2018, the new class structure has proven successful, with four instructors using the new curriculum. Perhaps most uniquely, the structure is flexible and can be adapted to accommodate an individual instructor's teaching style and expertise. Columbus offers resources to instructors that help them understand how to structure their courses to connect lectures and Expos, as well as what topics to cover in the first and second semester to provide a seamless experience for instructors and students.

Columbus and Hunger's course structure benefits students in two major ways. First, it allows instructors to be actively engaged in students' curiosity and discovery processes. Second, focused attention and instruction increases access to the life sciences for students from diverse backgrounds. Both benefits equip students with a grounding in the scientific approach that can benefit them in their own fields of study. Broadly speaking, students are responding well to the new course structure, as evidenced by an increase in student retention from the first to second course in the two-course sequence. Furthermore, students are performing better on assessments.

Through creative thinking and a passion for student success, Columbus and Hunger continue supporting academic excellence, curiosity, and discovery.



CHAPTER III

EMERGING TOOLS FOR EDUCATION

4-VA institutions work collaboratively to recognize and adopt emerging technologies that support teaching and learning.

THE EVOLUTION OF LEARNING TECH

The University of Virginia's Center for Teaching Excellence (CTE) is a unit dedicated to "enhancing teaching and learning" and "fostering teaching innovation at all levels and in all academic disciplines." As part of this mission, the center innovates ways for faculty to have access to cutting-edge educational software and platforms. Through funding from the 4-VA at UVA initiative, the CTE initially licensed an off-the-shelf software to identify emerging educational technologies, used the tool to learn more about the specific needs of the university, and then developed a new, tailor-made portal that efficiently connects UVA educators to a diverse catalog of educational software. Through the creativity and expertise of the CTE, UVA recently launched Learning Tech, a central online repository for all the educational technology software UVA offers.

Learning Tech online database: /learningtech.virginia.edu

Email: learningtech@virginia.edu

Twitter: @learningtechuva

Development of the Learning Tech website began in 2020 when the CTE purchased a three-year license for LearnPlatform. At the time, the CTE oversaw two different types of platforms for educational technologies: UVA Collab (a learning management system for UVA-specific software) and a vast collection of third-party applications. The LearnPlatform offered a way to organize those third-party programs. According to Dr. Michael Palmer, Barbara Fried Director of the CTE and UVA professor, the LearnPlatform "aggregates all of the learning tech out in the world, around 8,000 programs. You can look at different tools and make informed decisions based on data, advantages, and disadvantages." Adopting the LearnPlatform allowed UVA administrators and faculty access to a robust network of vetted programs to help facilitate learning and achievement.

According to Palmer, over the course of the initial license, "we used LearnPlatform to make sure our third-party ecosystem was robust" in terms of giving faculty options to modernize and digitize their learning environments. As the three-year license neared completion, the CTE team determined the amount of information available on LearnPlatform exceeded the needs of the university. In order to provide a more tailored database of software, the staff developed the Learning Tech website and launched it in 2022.

Learning Tech (https://learningtech.virginia.edu/) is a self-contained, UVA-specific ecosystem that hosts the university's third-party software catalog. Learning Tech is a truly novel online database in terms of its functions; the homepage touts itself as "Your gateway to UVA's digital toolkit." More specifically, faculty and staff can access all third-party applications that UVA licenses, along with software summaries, operating system compatibility, introductory videos, contacts, support links, and reviews submitted by UVA community members. The reviews include narrative submissions as well as 5-point ratings for "Ease of Setup," "Ease of Use," "Features and Options," Pedagogical Impact," and "Accessibility." Furthermore, each program is categorized with 1-2 primary purposes (e.g., Assessment and Evaluation, Collaboration and Communication, Content Management). This comprehensive information is presented in easily accessed webpages for each program.

The nature of the Learning Tech database continues to evolve as well. Palmer highlighted how the website has a form for faculty to recommend new technologies. Once requests are submitted, faculty can then upvote suggestions to encourage purchase of licenses. Another recent feature includes categorizing

Continued on page 22

GRAPHIC PROVIDED BY THE CTE

Continued from page 21

applications for specific schools and departments. This feature means that faculty do not have to sift through every program to differentiate the all-university programs from the ones that apply to their specific discipline. These new features help facilitate a collaborative environment where faculty can promote new resources in service of student-focused outcomes like achievement, collaboration, and technology engagement.

When discussing the Learning Tech website, Palmer was quick to credit 4-VA at UVA as a significant element of the program's conceptualization and development, "What we learned from the LearnPlatform allowed us to develop Learning Tech. The 4-VA money was applied to LearnPlatform and directly shaped the structure of Learning Tech." Additionally, the initial 4-VA investment funded a full-time support position for a year and half. That position proved critical to supporting Learning Tech and is now a full-time, university funded position (with the original officeholder being responsible for the subsequent launch of Canvas at UVA).

Palmer and the CTE team created a database that is unique in the Commonwealth because of its "strong pedagogical component and the ability for faculty to make requests and have them endorsed by others." Though the Learning Tech website is unique to UVA, it provides an example for other universities about how technology can be organized, managed, and applied in the service of modern, technology-engaged classrooms. Summarizing the evolution of LearnPlatform into Learning Tech, Palmer said "We are getting better at using the data that comes out of the tools, increasing our ability to understand what a digital ecosystem needs."

EXPLORE...
more than two dozen licensed tools, with access information, video introductions, support options, and other helpful resources.

DISCOVER...
how colleagues are using tools in their teaching and research, with course trailers, faculty spotlights, archived workshops, and more.

REVIEW...
tools and share your experiences with others, with categorical ratings including Ease of Use, Features and Options, and Pedagogical Impact.

REQUEST...
additional tools for your courses, or for institutional use, through a simple, transparent process.

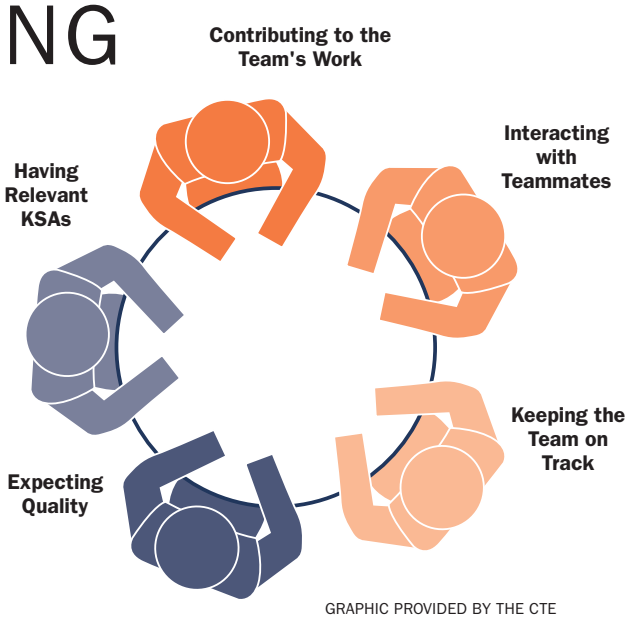
REVOLUTIONIZING GROUP WORK

Within the UVA Learning Tech catalog, one program stands out for its ability to automate a regular and sometimes challenging classroom process: forming groups of students for class work. Students are likely familiar with how this typically goes, either they rush to form groups with peers they want to work with or groups are assigned by the instructor. Often, groups can struggle because membership lacks diversity in knowledge, skills, and experiences, schedule conflicts prevent outside of class meetings, or members do not have mechanisms to resolve conflict. To help improve group dynamics, 4-VA at UVA sponsored the Comprehensive Assessment of Team Member Effectiveness (CATME) educational technology tool administered by UVA's Center for Teaching Excellence (CTE).

CATME, a software suite developed at Purdue University, is specifically designed to help improve group formation, function, and assessment in higher education classrooms. Dr. Michael Palmer, Barbara Fried Director of the Center for Teaching Excellence at UVA, described CATME as "a tool that allows instructors to create student groups based on whatever criteria they set up," such as sociodemographic, gender, class schedule, or GPA. To start, the instructor develops a survey instrument based on variables of interest and distributes it to students in the class. The variables can be weighted so the formed groups are more similar or dissimilar on certain criteria.

However, the usefulness of CATME does not end with group formation. Palmer highlighted the fact that CATME "allows for self-assessment and peer assessment of group performance and contributions." The CATME evaluation module uses a 1-5 ratings scale (with 5 being the best score) on five broad dimensions. *See chart above.*

This approach to assessment allows students to provide more nuanced, confidential feedback to their instructor about each group member's role and contributions to a project. Each member of the group is then provided with an average peer-assessed rating on each dimension.



GRAPHIC PROVIDED BY THE CTE

Additionally, the program has been designed to highlight unique feedback patterns to identify overconfident, underconfident, manipulative, conflict-oriented, and cliquish members of a group. This additional layer of feedback provides faculty with insight that can be used to mentor students in a more targeted way.

CATME has been in use at UVA since 2018, with the annual licensing fees supported by 4-VA at UVA. Palmer estimates that roughly 4,000-6,000 students engage with CATME across the University in roughly seventy-five courses. When asked how CATME has grown at UVA, Palmer reported that increasing the user population has proven challenging for two reasons: the licensing cost is correlated with the number of users and supporting faculty as they learn how to use CATME requires significant personnel resources. Nevertheless, Palmer reported that once faculty begin using the program, they tend to incorporate it into their courses year after year.

Broadly speaking, CATME is a program that has positive impacts on both faculty and students. Faculty are supported in making data-driven decisions about student groups, while students receive feedback from their peers specific to their performance on a range of domains. As Palmer summarized the deployment of CATME at UVA, it "saves an instructor an enormous amount of time and creates better groups."

For faculty interested in learning more about **CATME**, they can find it on the UVA Learning Tech website or by visiting ***https://learningtech.virginia.edu/tools/catme***.

Looking Ahead

Momentum continues to build for 4-VA at UVA. The following two 4-VA at UVA Collaborative Research Grant-supported studies are underway. We offer here a brief overview of their work, but be sure to check out next year's 4-VA at UVA report for comprehensive narratives on these projects and many others!

RESOURCE USE AT A CRITICAL LIFE STAGE: POLLEN COLLECTION BY QUEEN BUMBLEBEES

Dr. David Carr

Dr. Carr, in partnership with Dr. Haw Chuan Lim at George Mason University, is studying bumblebee queen resource gathering. Specifically, Carr's team formed a coalition of volunteers across the Commonwealth to collect live bumblebee queens and take samples of hive nectar and pollen. The DNA of the samples were tested at GMU and analyzed to determine from which flowers and plants the nutrient rich resources had been collected. Carr reported that environmentalists generally do not know exactly what plant life is critical to seasonal bumblebee hive development, and his team hopes to fill this knowledge gap to support survival of the endangered bumblebee. The results of Carr's field research have the potential to improve habitat preservation and cultivation, increasing bumblebee population density and overall health in Virginia and around the world.

NANOCRYSTAL-IONIC LIQUID SUPERSTRUCTURES FOR CAPTURE AND CONVERSION OF CO2 TO VALUE-ADDED CHEMICALS

Dr. Huiyuan Zhu

Dr. Zhu's participation in the 4-VA CRG program illustrates the power of professional networking and collaboration. Zhu's initial engagement with 4-VA was in 2020 as an Assistant Professor in Virginia Tech's Chemical Engineering Department, where her 4-VA at Virginia Tech award supported the study of clean energy and environmentally sustainable catalysis. Through the collaborative aspect of the CRG program, her Virginia Tech work on CO2 capture and conversion technology was complemented by Dr. Sen Zhang's research at UVA. That collaboration motivated Zhu to move her lab to UVA in the fall of 2022, where she is now an Assistant Professor of Chemistry. While her data collection is ongoing, Zhu's engagement with 4-VA is a clear example of how intra-university collaboration can dramatically impact researchers in a variety of ways. Welcome to the University of Virginia, Dr. Zhu!

To better understand the impact of the Collaborative Research Grants program, 4-VA at UVA surveyed the forty faculty members who received primary funding awards between 2018-2021. Of the 25 respondents, seven studies resulted in articles published in the following 13 different academic journals.

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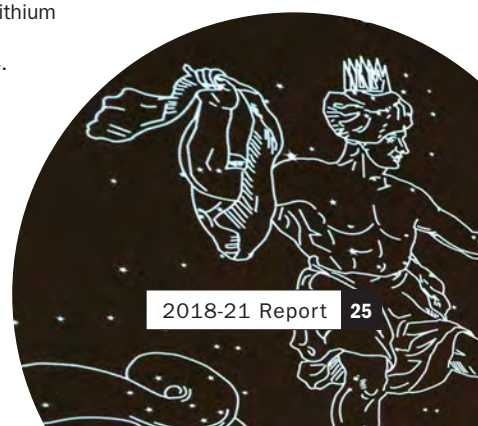

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