VCU College of Engineering
Tech-Talent Pathways
Expanding Access to Technology Careers

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Executive Summary

A coalition of educators from all levels, non-profit and private sector leaders, and government agency representatives participated in a year-long GoVA planning program to better understand available resources, non-conventional activities and initiatives that impact "technical education pathways" that operate in Region 4. This program was initiated by the VCU College of Engineering; an organization that interfaces with K-12 academics as well as hundreds of private and public sector organizations that are in continual need of highly-skilled talent.

The project team developed a work plan and commenced research prior to the massive disruption created by the Covid-19 pandemic. While the pandemic forced almost all activity to take place in a virtual environment, the consequences of the pandemic provided sharper visibility of the disparities that impact high-value education processes across the Region. Like many similar reports and papers that have recently been published at state and national levels, we present Regional research that also highlights gaps in resources that have direct correlation to local demographics, income and exposure to opportunity. Regional information and summaries of community-oriented discussions are presented in order to stimulate future dialog that may close these gaps and expand technical education pathways. We endeavored to make sure this report reflects Regional activity and the thoughts of hundreds of participants who, in their own ways, are united in efforts to build equitable education opportunities. This report captures their voices as we identify the issues that impact individual schools, educators, students and our communities.

There are reasons to be optimistic due to solid progress in expanding Tech-ed Pathways across the Region. Organizations such as CodeVA, Achievable Dream Academy, Partnership for the Future, MAXX Potential. and many others are growing and creating valued relationships with public school systems. Even though total enrollment and participation in advanced placement courses have remained at the same level over the past 3 years, we are encouraged by recent progress in establishing special programs such as technical centers, STEM academies and other initiatives that bring awareness, build confidence and create pathways for more young people. However, many of these programs and centers are not easily accessible to a large number of students for reasons that are well-studied, such as transportation and housing. While there is progress, this work group believes we have only just started on a long journey. The journey is more complicated since the highly innovative digital workplace continues to change rapidly. The educational pathways need to instill a sense of individual and systemic continual learning in addition to the acquisition of ever-changing specific skills.

The Pandemic was a call to action across all education programs, and it impacted this particular project. The rapid, large-scale movement to remote learning had numerous negative consequences and highlighted the large disparities related to broadband access (both urban and rural) and issues related to safe, productive remote learning locations. Across the Region and State, there was an explosion of impactful online educational content and new learning

modalities. It was also made clear that additional, and different, support resources were required to assist in the transition to online learning, and new communication structures were needed to provide support and encouragement. These new capabilities will be useful in the post-pandemic environment, but there is also a need to provide additional learning resources in the individual circumstances where technology or safe shelter does not exist.

Over the past two years as this project was conceptualized and executed, some of the most valuable activities were regular community discussions with individuals engaged in educational processes and who share a common passion; but they had never met each other and were largely not aware of resources available across the Region. It was amazing to experience the energy and commitment across a broad landscape of activity, and it is clear that additional diverse discussion groups and informal networking would be a plus. The tech business community has extensive, ad-hoc meet-ups and workgroups coupled with educational seminars and forums. We will need to bring these efforts together for sustainable Regional tech-pathway success.

In the concluding sections of this report we provide a set of recommendations that center around expanding conversations across the Region. Providing improved access to Tech-education Pathways is not simply a matter of money, and in many respects the expansion of the pathways should not fall on the shoulders of our established education institutions. Rather, we believe it is a broad community responsibility. There must be more engagement from the private sector, we need to find ways to overcome income-related barriers, and we should examine novel techniques to insert critical resources where most needed. We must create more awareness of opportunity at the family/community level, and ensure there are viable initiatives to create more access. We also ask for continued commitment from the institutions that are currently driving effective change across the Regional educational ecosystem; particularly from ChamberRVA, Virginia Commonwealth University and the non-profit organizations mentioned in this report. We thank the Commonwealth, Dominion Energy and GoVA for the opportunity to create an important Regional dialog.

As you proceed with this report, bear in mind that a critical underlying success factor leading to education opportunity is intangible; creating trusted engagement with our children. There must be individuals at all levels and in all walks of life who want to engage with young people, build relationships and who themselves have the knowledge and judgment to provide context and access.

Final Report

Objective

The Richmond Region is an attractive location for hundreds of "digital economy" companies fueled by the skills and talents of thousands of well-educated individuals who have access to high value education. However across RVA, as in many urban centers across the United States, there is a massive gap whereby lower income and under-represented populations (urban and rural) have difficulty accessing even the basic technical education that could lead to life-changing career opportunities.

An innovative, highly successful tech-education platform exists at the VCU College of Engineering that interfaces with K-12 public schools, the VCU School of Education and the business community. However, its reach is limited and much more needs to be done to create the exposure and educational outcomes that create systemic change. We know it is possible, but we must harness a broad group of community leaders to align efforts across the Region and expand education equity. It is well documented that high value technical education transforms individuals, families, communities and the Country, and it is one of the best ways for any individual to jump up the economic ladder and have a myriad of career opportunities.

Alongside numerous partners throughout the Greater Richmond area and the Virginia Gateway Region, VCU's College of Engineering created a comprehensive plan to better align the region's existing tech talent educational programs and help expand Region 4's tech talent pipeline to address needs now and in the future.

1. Catalogue and map Region 4's existing tech talent workforce activities,
2. Identify specific opportunities to improve alignment and close gaps,
3. Develop proposals for expanded partnerships between industry, the region's school systems, community colleges and universities,
4. Create strategies to facilitate innovation across the Tech Talent Pipeline.

Method

Overview of the Process, Participants and Purpose

We developed a multi-phase plan to conduct research and develop the final deliverables of the project.

- Phase 1 Research regional demographics and education
- Phase 2 Research regional tech education programing and training organizations
- Phase 3 Business and community engagement

Our project team included VCU College of Engineering faculty and staff and was led by Todd B. Waldo, Hugh Helen LLC Founder and Touri Goode, Project Coordinator and Researcher. In addition to our project team, a workgroup was created to help develop the final opportunities and recommendations.

Work Group

The work group included volunteer business and community leaders, subject-matter matter experts, and government staff. We had commitments from work group members across these areas:

- Community Organizations / Nonprofits

- Business Organizations / Associations

- Government

- Corporate / Business

- Education - K12

- Education - Higher Ed

- VCU Government Relations, Development and Alumni Relations

The work group's purpose was to help ensure a process that was technically sound, enjoys broad public and expert support, and results in the creation of a sustainability strategy that could guide community, business, education and local government efforts. The working group assisted the project team in identifying best practices, developing and prioritizing recommended actions, identifying financial needs and resources, and proposing plans and partnerships to ensure effective implementation and monitoring over time.

Responsibilities included

1. Playing an active role by attending monthly team meetings and other small group meetings that will be scheduled from January 2021 to May 2021.

2. Assisting the project team by gathering input from the community to help identify opportunities and develop recommendations.

3. Lending subject-matter expertise and experience as well as inside knowledge of community, nonprofit and industry priorities and needs.

4. Assisting in prioritizing recommendations with consideration for goals around job creation, social justice impact, etc.

5. Becoming an ambassador to promote community engagement and support the project

Business and Community Engagement

VCU College of Engineering joined forces with education and business leaders to develop recommendations to address tech education disparities. There were two virtual community events that invited students, parents and industry professionals to receive their feedback on these recommendations. Hearing from the community was a very important part of the process. A survey was developed and we invited the community to:

1. Rank the recommendations in order of importance and;

2. To provide us with any additional recommendations that are helpful for eliminating disparities and creating stronger linkages

The results from the feedback we received from the community is presented below in the Key Findings section.

Key Findings

Technology jobs are booming in Central Virginia. According to the [1]Virginia Employment Commission, in July 2020 there were over 76,000 job openings in the computer and mathematical fields, and 12,428 job openings in architecture and engineering. Virtually all these jobs are high-value, high-skill positions. Based on expansion announcements and economic forecasts, job openings in these fields will continue to increase. It is believed that 8 of every 10 middle skill jobs will require medium to high levels of digital proficiency. Central VA must attract

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[1] Virginia Employment Commission; EMSI. (2020). *A significant mismatch between the desired and available occupational skills in the market*. Virginia Employment Commission. https://www.vec.virginia.gov/

and grow this workforce to become a major tech hub for large scale users of everyday digital technologies.

[2]Since 2016, the Federal Reserve has held national level discussions, conferences and publications about workforce development. They have collaborated with various authors to publish a book titled "Investing in America's Workforce: Improving Outcomes for Workers and Employers." More specifically, it included a brief about digital education and skills development, discussing the increased need for workers with robust digital skills for 21st century jobs.

The research process for the Tech Talent Pathways Initiative was divided into three phases. Phase 1 was focused on demographics and education in the Central Virginia region. Phase 2 was focused on K12 education and community organizations. Phase 3 was focused on workforce development and community reaction to the recommendations that were formed from the research and workgroup members. Major gaps were identified, such as inequities in education, limited awareness of technology, and a shortage of technology trained teachers.

Phase 1

By looking at demographics in the Richmond metro area it will allow for an overall picture of what the region looks like, involving race, gender, income, poverty, enrollment, and graduation trends. We wanted to identify and analyze the population and education data ranging from K12 to higher ed. In addition to graduation and employment statistics, some connections can be made between the quality of education to employment. After looking further into the data, factors such as gender and economic circumstances contribute to the tech talent gap.

The economic environment has an impact on student learning. In order to analyze the level of interest in technology related activities and identify the "tech education deserts" it is valuable to understand the economic environment of the student. This can be determined by examining school conditions along with the students' economic struggles. [3]The data revealed that the poverty rates are particularly high in the school districts of Emporia (30%), Petersburg (38%) and Richmond (33%). Economic struggles, food insecurity, and lack of essential resources can affect a student's learning climate. By looking at the economic/financial landscape conclusions can be made to determine student success.

[4]Also, according to the Greater Washington Partnership there are currently 17,000 unfilled digital technology jobs. African American, Hispanic and Latinx are significantly underrepresented in the

[2] Federal Reserve Bank. *Investing in America's Workforce*. Richmond Fed. Retrieved May, 2021, from https://www.richmondfed.org/community_development/resources/invest_in_americas_workforce

[3] US Census Bureau, 2018 Poverty Estimates for School Districts. https://www.census.gov/data-tools/demo/saipe/#/?map_geoSelector=aa_c

[4] Greater Washington Partnership. (2020). *The Capital Region Faces a Huge Tech Talent Shortage*. Greater Washington Partnership. https://greaterwashingtonpartnership.com/skills-and-talent/

digital tech workforce. The lack of diversity greatly affects the tech talent workforce. [5]The U.S. Census Bureau provided the statistics of how many women and men work in tech fields. There is a significant gap and this plays a large part in tech education disparities. The number of women in tech fields are significantly smaller when compared to men. 70% of men work in computer, mathematical, engineering and science occupations compared to 25% of women.

The table below displays the number of people employed in tech and tech adjacent fields in 2019. In order to address the surplus of tech openings, the employment number of about 23,000 should be increased. This can be done through educating a new workforce and reskilling the current workforce.

[6]Table 1. Occupation and Wages, 2019

Occupation	Employed	Unemployed	Average Wage	Experienced Wage
Management	35,468	457	$133,400	$162,600
Business and Financial Operations	45,956	897	$76,700	$91,200
Computer and Mathematical	23,300	356	$89,400	$107,00
Architecture and Engineering	9,365	139	$84,200	$99,100

Educational attainment is a large, if not the largest, contributor to the socioeconomic gap. Specifically in Virginia, race and poverty has influenced the lack of equal access to education. [7]A report was conducted by VCU and Penn State researchers to explore more in depth the inequities in opportunity for minority students to access Advanced Placement classes. The access of AP classes are lower in schools that have majority Black and Latinx students. School segregation by race and economic status indicate unique reasons why minority students lack opportunities to take higher level education courses. Some of the relevant key findings are:

- Black students that are economically disadvantaged have unequal access to AP courses
- White rural students also have unequal access to AP courses when compared to urban and suburban students

There is intersectionality between race, poverty, and educational inequity. However, school segregation still plays a significant role in why higher level courses are not equally accessible.

[5] U.S. Census Bureau, 2019 American Community Survey 1-Year Estimates. https://data.census.gov/cedsci/

[6] Chmura Economics & Analytics, JobsEQ; Occupational employment is of 2019 Q3, wage data as of 2018. Posted by Greater Richmond Partnership.
https://www.grpva.com/wp-content/uploads/2020/11/GRP_Occupational-Employment-Wages.pdf?hsCtaTracking=cf4ff9ab-cfb2-47d5-99f9-03f0075e918e%7C819013ba-9b7b-4a18-8e17-8e2b977d2a12

[7] Brian, M. (2021, April 28). VCU, Penn State researchers shed light on racial, economic segregation in Virginia schools. *VCU News*.
https://news.vcu.edu/article/VCU_Penn_State_researchers_shed_light_on_racial_economic_segregation?utm_source=VCUNewsNewsletter&amp%3Butm_medium=email&amp%3Butm_campaign=VCUNewsNewsletter&amp%3Butm_content=https%3A%2F%2Fnews.vcu.edu%2Farticle%2FVCU_Penn_State_researchers_shed_light_on_racial_economic_segregation

Closing gaps in K12 education can only lead to increased access to educational opportunities for all. [8]The Commonwealth of Virginia is starting to address educational inequity. The state was awarded a grant by the Lumina Foundation to help address the educational attainment gap among students of color, with the goal to increase it by 5 percentage points.

Phase 2

Phase 2 focused on K12 education and community organizations. There is a wide array of activities within the region that have not been identified and catalogued. Identifying specific opportunities is vital for improving alignment, closing gaps, and addressing employer needs in the future. Making students in K12 aware of these organizations can assist with enhancing their technical skills throughout their middle school and high school years – thus, giving them the opportunity to pursue technology as a career option.

Surveys were distributed to twenty-four organizations and four virtual interviews were conducted asking more in-depth questions related to their activities, demographics, serving capacity, and support needs. Below is some of the information that was provided during the conversations:

- The lack of consistent student attendance
- More industry partnerships for networking and development of additional programming for students
- The need for more awareness and education about technology-oriented careers, and their potential to improve quality of life

After completing conversations with community organizations, interviews were conducted with K12 teachers and administrators. The school districts that participated in the interviews were: Henrico, Chesterfield, Petersburg, Chester, Hopewell, Goochland, and Hanover. Based on these conversations there was a general consensus that technology education is vital. However, there are specific issues that must be addressed in order to integrate technology effectively within the curriculum. Listed below are two areas that were identified as needing the most support:

- Creating more awareness of career opportunities and the associated pathways, primarily using more industry partnerships and individual engagement. Specifically, the existing programs that facilitate mentorships and internships for students are seen as effective.
- Opportunities for teachers to be retrained in technology and the methods continually build learning skills. Training can enhance opportunities for integration of computer science and technology within the curriculum. This is critical for the advancement of students' technical skills throughout middle school and high school.

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[8] Office of the Governor. (2019, November 13). *Virginia Receives $500,000 Lumina Foundation Grant to Help Close Gaps in Educational Attainment.* Commonwealth of Virginia. https://www.governor.virginia.gov/newsroom/all-releases/2019/november/headline-849305-en.html

There are resources that school districts can use in order to facilitate their educators' development. CodeVA is a nonprofit that partners with schools to provide computer science training to teachers as well as student programs in coding and robotics. At no cost to public school districts, CodeVA can provide the necessary training to teachers. Data has shown that student exposure as early as kindergarten can facilitate interest and enhance technical skills throughout their middle school and high school years. Integrating computer science and technology within the curriculum can make that possible, which can then guide students on the pathway to a digital technology career. [9]According to the VDOE's High School Computer Science Profile, 70% of high schools in Central VA offer computer science courses with only 3% of students enrolled. For further breakdown of the numbers, only 1,904 students are enrolled in CS courses. To address the workforce demand the enrollment numbers in CS need to double.

In addition to CS, there should be digital skills and soft skills integrated into the curriculum. Project based learning along with incorporation of real world examples can enhance student skills. There are additional free resources that can be used to teach these skills. [10]For example, Syracuse, NY offers their students the option to obtain digital badges through IBM's free Open P-Tech program. Students are allowed to work at their own pace and learn to build a chatbot, blockchains essentials, and python coding. These badges can be included on their resumes for potential jobs in tech. This program also exposes high school students to technology that they will be using in the workplace. Educators can also use this program to equip themselves with the expertise to teach technology. They can also obtain badges and promote their life-long learning.

[11]Also, the Governor of Virginia has proposed to invest $1 million dollars to increase pathways for students to become STEM teachers. The Uteach program will be implemented by Norfolk State and Virginia State. This gives college students opportunities to pursue their STEM major while obtaining a teaching certification. Extra time and money will not have to be required. This proposal can help address the limited number of technology trained teachers.

Providing examples within the classroom can inspire these students to believe that they have the ability and skills to pursue a career in tech. Exposure through mentorships or internships can provide confidence as well. Lack of equity in education can play a role in low enrollment. [12]The Richmond Times Dispatch reported that the African American Superintendent's Advisory Council, found that 12% of Virginia's gifted enrolled students were Black, during the 2018-2019 school

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[9] Virginia Department of Education. *Virginia's High School Computer Science Profile*. Virginia Department of Education. https://www.doe.virginia.gov/instruction/computer-science/virginia-cs-dashboard.shtml

[10] We are Teachers. (2020, August 11). *Future Jobs Require Emerging Skills. High School Curriculums Need to Reflect That*. We are Teachers. https://www.weareteachers.com/teach-emerging-technology/

[11] Office of the Governor. (2020, February 10). *Virginia Works to Grow, Diversify STEM Educator Pipeline*. Commonwealth of Virginia. https://www.governor.virginia.gov/newsroom/all-releases/2020/february/headline-851715-en.html

[12] Hunter, K. (2021, March 19). Va. education superintendent's African American Advisory council releases recommendations for Black student equity. *Richmond Times Dispatch*. https://richmond.com/news/state-and-regional/va-education-superintendents-african-american-advisory-council-releases-recommendations-for-black-student-equity/article_627de9e9-71dc-579f-814f-37add3ad3560.html

year. 22% of students in the Virginia public school system are Black. However, there is a 26% disparity between Black and white students enrolled in AP and dual enrollment courses.

There is a current and local internship experience that can assist and enhance students technical and professional skills. [13]MAXX Potential has developed a technology internship program for students to participate. It's a new virtual work-based learning opportunity. Even though more needs to be done regarding internship placements; specifically, making them more equitable. This virtual opportunity is an important step in addressing the shortage of tech internships and providing students realistic work based experiences.

"Interns receive verifiable experience that they can add to their resumés including coaching on how and where to add it. Most importantly, this one-of-a-kind experience will give them a better feel for the multitude of professional job opportunities and pathways available in the technology industry."- MAXX Potential

The student will serve as an intern for MAXX Power and will work with a team from different departments. The work experiences that students can take part in are: cybersecurity, data analytics, or software development. Currently, there are three sessions that will be held during Summer 2021.

Phase 3

VCU College of Engineering conducted two virtual community events that invited students, parents and industry professionals to offer their feedback on recommendations that were developed in collaboration with workgroup members. We also invited the community to complete a survey ranking the recommendations that were the most helpful and impactful. Also, there was a request to add any other recommendations that were missed. Below are the results of the survey:

Training and Professional Development
(ranking 1-3 in order of most important)

1. Train educators in computer science and add salary incentives when they become technology education teachers

2. Provide and encourage professional development opportunities for educators

3. Encourage internship and externship opportunities for educators

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[13] MAXX Potential. (n.d.). *MAXX Power Internship Experience*. MAXX Potential. https://maxxexperience.com/

Student Connections through Coursework, Community Organizations and Industry to Enhance Technical Skills
(ranking 1-4 in order of most effective)

1. Identify early learning opportunities for students to creatively apply engineering skills, problem solving, collaboration, and critical thinking.

2. Focus on year to year growth on students' technical skills as they progress through their K-12 STEM curriculum.

3. Connect students with community organizations that are advancing tech education within the community in order to increase awareness, hands-on learning opportunities, participation, and competency level.

4. Create a region-by-region virtual clearinghouse for internships, externships, and experiential learning opportunities for K-12 students.

Additional Comments/Recommendations

- Incentivize non-STEM educators to gain and apply tech skills to their own professional development and to their course curricula.
- Require teachers to work in the tech industry to give them real world experience outside of academia.
- Teachers should explore the newest and upcoming trends to introduce in the classroom.
- Encourage teacher mentorship and allow new teachers to observe new concepts in a classroom so they teach them to their students.
- Make sure to find the connections between computer science and core content.
- Focus more on the unplugged skills

Aligning Education and Labor Market Outcomes
(ranking 1-4 in order of most important)

1. Increase and improve transparency of learning outcomes that lead to further education and employment through high-quality credentials beyond high school

2. Encourage experiential learning opportunities

3. Identify ways to connect to the goals, strategies and actions related to Pathways to Opportunity: The Virginia Plan for Higher Education

4. Make connections with Virginia Economic Development Partnership Authority's future Office of Education and Labor Market Alignment

Affordable Pathways
(ranking 1-7 in order of most effective)

1. Support dual enrollment and other education acceleration program initiatives in order to expand students opportunities for advancement in higher education

2. Promote multiple pathways for career development and look to use stackable education and credentials

3. Increase investment in college students who want to become teachers, helping them gain a technology education endorsement with their teacher's license

4. Current working technology professionals can pursue certifications and continuing education opportunities

5. Promote models of success in underrepresented groups to encourage K-12 students to pursue tech careers

6. Look at regional, state and national best practices including evaluation of current platforms and tools used in Virginia's Pre-K-20 for career exploration and alignment

7. Launch an active communication and marketing campaign on trade professions

Additional Comments/Recommendations

- Consider the fact that workers who most stand to gain from after-hours training in tech skills often have significant time constraints and child-care needs. Try to make as many opportunities as possible available remotely, with real-time coaching from a mentor when needed. Also consider offering free, high-quality kids recreation activities at any on-site training facilities.

- Certificates, OJT, and credential options outside of degree programs

- Models such as VCU's da Vinci certs/courses/degree take real-world, authentic challenges and generate STEM solutions via cross-functional teams (mirroring real-world creative team generated solutions), models

Internships and Early Career Programs

(ranking 1-4 in order of most important)

1. Investment in mentorship opportunities from business and industry organizations providing employees that work in engineering, computer engineering, and digital tech fields the time, flexibility and opportunity to serve as mentors

2. Provide equitable and meaningful internship opportunities for high school students

3. Increase support for entry level rotational programs that helps college graduates transition to early career

4. Provide career switcher incentives to join key fields

Training and Talent Management

(ranking 1-3 in order of most important)

1. Align employer's needs with job training and education competencies including gap analysis

2. Development and delivery of training programs with public and private partners defining employer needs and scaling solutions throughout the Richmond Region

3. Implementation of a framework/methodology and community engagement such as the U.S. Chamber of Commerce Foundation's Talent Pipeline Management

Additional Comments/Recommendations

- Make sure the internships are paid

- Localities and the Commonwealth must expand broadband access (and promote effective use) in the underserved urban and rural communities

> - Design impactful internship opportunities to enhance the skill set of the student. Accommodate students and parents that have challenging schedules and transportation. Also, determine how to broaden these experiences so that more students can take part in these opportunities.

Communication Strategies for Students
(ranking 1-5 in order of most important)

1. Help develop one of the STEM Network/Hubs for the Richmond region, following a recommendation in the September 2020 Virginia STEM Education Commission Final Report

2. Develop strategy and resources to increase the awareness of engineering careers and elevate the experiences of professionals that could reach deeper into marginalized communities

3. Develop a strategy to present engineering, computer science, and technology ensuring a broader base for STEM literacy

4. Identify tools to communicate with parents, students, educators, and businesses about tech talent pathways and careers

5. Identify stakeholders in order to develop communication strategies

In addition, engagement with the regional business community helped affirm the opportunities and recommendations developed by our workgroup.

In particular, business leaders identified the need to emphasize mentorship and support for early career rotational programs. They also highlighted the importance of learning and developing both soft and technical skills to support for interns to support a variety of roles

Support for college graduates' smooth transition from the classroom to work was also a critical need.

Opportunities and Recommendations

These are opportunities and recommendations for expanding partnerships between industry, the region's school systems, community colleges and universities that help facilitate increased access and innovation across the Tech Talent Pipeline. This is based on the opportunities to improve alignment and close gaps from researching the area's existing tech talent workforce activities.

We have four areas of focus:

- K-12 Technology Education Support
- Higher Education Alignment with Community and Businesses
- Workforce Development
- Communication and Information Sharing

These areas overlap and integrate with each other with the intention of creating a comprehensive framework to expand Tech Education Pathways and improve opportunity equity for under-represented communities.

K-12 Technology Education Support

Training and Professional Development for Current K-12 Teachers

There is a critical shortage of tech-ed teachers. Train current faculty as opposed to adding new faculty. Encourage non - CTE/STEM teachers to become certified in these areas by allowing endorsement opportunities in computer science. CodeVA offers free training for teachers who want to pursue a CS endorsement and those that want to integrate computer science into their curriculum. Utilizing CodeVA as a resource will help remove the cost burden to train public school teachers. Schools should also look to add incentives for people that want to become technology education teachers including salary incentives. School districts should work with the Virginia Department of Education around licensure requirements to allow science-endorsed teachers to teach computer science classes.

Provide and encourage professional development opportunities for teachers. Increase engagement with CodeVA, the state-funded CS teacher professional development program. CodeVA, the state-funded CS teacher professional development program, is based in the Richmond region. Closer, and more intentional collaboration between school leaders and CodeVA's teacher professional development programs could have a major impact on the rate of local adoption of the

K-8 integrated computer science standards. This is key to broadening diversity among girls and minority students who pursue computer science/cybersecurity and STEM high school classes, and then STEM+C higher education and career pathways.

Encourage internships and externship opportunities for educators. Together with the private sector and established education programs, provide summer teacher internships or teacher in-residence opportunities. Encourage externships and/or seminars for teachers to develop their expertise in up-to-date software, languages, and technology. Provide technology centered professional development opportunities for students who want to become teachers oriented around teachers for tomorrow.

Student Connections through Coursework, Community Organizations and Industry to Enhance Technical Skills

Identify early learning opportunities for students to creatively apply engineering skills, problem solving, collaboration, and critical thinking. Support existing maker and lab spaces that are within libraries, museums or non-profit organizations. In order to facilitate participation in these spaces, there should be a number of student engagement techniques involved. Encourage and support professional development for faculty and educators, which will help provide them with the techniques to better use these lab spaces. VCU engineering can also provide their expertise for better understanding of these spaces to students and educators. One example is the proposed Data Science & Computing Center, a tech sandbox from a partnership with VCU Engineering and Bank of America that would provide hands-on learning for Richmond region students.

Connect students with community organizations that are advancing tech education within the community in order to increase awareness, hands-on learning opportunities, participation, and competency level. Support elementary and middle school students in STEM-H/STEAM. Identify successful summer and school year opportunities (i.e. after school programs); *make sure every elementary school and middle school has access and resources, not just the centers and academies.* Summer STEM programs can link to successful, existing "Summer camps" that have established administrative structure and community awareness. Should also look to expand childrens' STEM+C programs in PreK-5 and include STEM+C days in individual schools or across districts.

Focus on year to year growth on students' technical skills as they progress through their K-12 STEM curriculum. Connect individual coursework presented to students across course years and consider badging or other recognition for achievement, create a sense of continual learning of new skills. Sufficiently fund technology equipment and teacher training in high schools that support STEM exposure, learning and competencies. Develop and implement systematized review processes to make classes more functional and relevant and integrate computer science and technical skills within the course curriculum. Effectively integrating computer science would give a better opportunity to

address the 76,000 job openings in computer programming (Virginia Employment Commission, 2020). Classroom integration is vital to ensure that all youth have exposure and experiences in Tech/STEM. Without integration, students are left to self-select these opportunities, which prevents some youth from seeing themselves as Tech/STEM capable and competent. Through effective integration, all youth receive these quality experiences that may help them identify their own pathway.

Create a region-by-region virtual clearinghouse for internships, externships, and experiential learning opportunities for K-12 students. This can be done through Chamber RVA with the incorporation of teacher development opportunities. As well as, MAXX Potential's work-based simulation tool can be used to help identify internship and externship opportunities. These opportunities can expose students to meaningful and relevant experiences after their initial exposure through the simulation tool.

Higher Education Alignment with Community and Business

Training, Professional Development and Resources for future K-12 teachers

Increase investment in college students who want to become teachers, helping them gain a technology education endorsement with their teacher's license. Universities should strengthen partnerships and promote conversations between Schools of Education, Engineering and private sector partners to increase the supply of STEM teachers, make sure there is a basic understanding of innovation, the rate of change, and where there are opportunities to acquire additional skills. Enhance professional development and related stipends for current teachers to receive technology education endorsements as part of their professional development or technical professional licensure. Scale or pilot endorsement programs across the Commonwealth at various institutions. For example, VCU Engineering has partnered with their School of Education, providing an opportunity to prospective teachers to obtain a computer science endorsement.

Aligning Education and Labor Market Outcomes

Increase and improve transparency of learning outcomes that lead to further education and employment through high-quality credentials beyond high school. By 2025, 60 percent of Americans will need some type of high-quality credentials beyond high school (Source: Lumina Foundation). Over 95 percent of jobs created during the recovery have gone to workers with at least some college education (Source: Georgetown University Center on Education and Workforce).

Identify ways to connect to the goals, strategies and actions related to Pathways to Opportunity: The Virginia Plan for Higher Education. Virginia's 2018 attainment rate is 57 percent

and the state is working toward an overarching goal of 70 percent by 2030. Partner with the State Council of Higher Education to support job seekers who want to pursue a career in technology leveraging funds from the [Talent, Innovation, and Equity Partnership](#).

Make connections with Virginia Economic Development Partnership Authority's future Office of Education and Labor Market Alignment. Connect with [Office of Education and Labor Market Alignment](#) on data analysis and data translation for actionable insights for policymakers, higher education institutions, students and employers. This can include specific sectors (technology, education, trade sectors, regional information etc.)

Encourage experiential learning opportunities. Look to sync with experiential learning opportunities and employer engagement regionally via [The Virginia Talent and Opportunity Partnership](#).

Affordable Pathways

Support dual enrollment and other education acceleration program initiatives in order to expand students opportunities for advancement in higher education. Dual enrollment programs (high school - community colleges - 4 year institutions) to give students access to college courses while in high school. Which will help reduce the amount of time they spend in college and obtain their degree faster.

Current working technology professionals can pursue certifications and continuing education opportunities. People with industry certifications in cybersecurity and software development are in high demand by employers. As noted in the [NVTC Greater Technology Workforce Needs Assessment (](#)2018), companies desire the related skills and competencies that are needed to obtain the certification. Digital badges can also be pursued by emerging professionals who want to show off their digital technology skill sets to potential employers.

Promote multiple pathways for career development and look to use stackable education and credentials. Establish and communicate the benefits of shorter-term programs to students to help them get ready for work (workforce credit). Provide degree completion in high school. Current examples: CodeRVA HS and Goochland have early training programs and incentives for college credit or certification. Consider larger scale availability of "digital fluency" and "data analytics" courses (including development and sharing of content across many levels). In addition, support the use of stackable credentials and certification for teachers. A law was passed by the [Virginia General Assembly in 2019](#), giving the VDOE the ability to establish a microcredential program for elementary and secondary school teachers.

Look at regional, state and national best practices including evaluation of current platforms and tools used in Virginia's Pre-K-20 for career exploration and alignment. Endorse and

communicate VDOE's just recently released career counseling poster tool. The tool is focused on STEM education and the various "on and off ramps" illustrating that starting with a technical certification is not an ending to educational attainment, but a way of accelerating in your lane. This shows that students can change lanes, can exit and enter on different ramps to adjacent careers.

Promote models of success in underrepresented groups to encourage K-12 students to pursue tech careers. Increase retention by implementing successful mentorship models that support students through their higher education experience. Providing that support can guide them on the path to pursue tech careers. Cultural differences and socioeconomic challenges may prevent students from seeking the support that they need. To assist with those challenges, provide mentors or support coaches to students for periodic check-ins. Also, provide solutions to potential barriers preventing their educational success. This can help facilitate and increase the participation of underrepresented students pursuing tech careers.

Launch an active communication and marketing campaign on trade professions. Rewrite the narrative around trades for both students and parents as well as adult/non-traditional students. Highlight that the trades as cool, lucrative and upwardly mobile career paths. Build into the conversation entrepreneurship opportunities for technician-level workers.

Workforce Development Resources

Internships and Early Career Programs

Provide equitable and meaningful internship opportunities for high school students. Increase the number of internships for high school students to participate in as the current number is limited. Partner with MAXX Potential to offer their virtual internship experience to more high-school students. For example, the simulator is currently offered at CodeRVA as a 6-week experience for high school students. It simulates real world experiences and tasks, which is designed to be as realistic as possible for students. Students can choose which field they want to work in, such as cybersecurity and software development. "This one-of-a-kind experience will give them a better feel for the multitude of professional job opportunities and pathways available in the technology industry."

Investment in mentorship opportunities from business and industry organizations providing employees that work in engineering, computer engineering, and digital tech fields the time, flexibility and opportunity to serve as mentors. Our conversations with K-12 teachers/specialists highlighted the opportunity and programs like AT&T Aspire that include a focus on AT&T employees mentoring students to help them discover their career passions and potential, leveraging technology, relationships and social innovation to help all students make their biggest dreams a reality.

Increase support for entry level rotational programs that help college graduates transition to early careers. These programs, such as the CarMax IT Academy, help participants learn various aspects of the business and provide a variety of team-building, training, networking and mentorship opportunities from experienced associates. The associates are successful managers who help guide participants to success.

Provide career switcher incentives to join key fields. Incentivize career switchers that choose to work in technology related careers such as software development, web development, computer systems, computer programming, etc.

Training and Talent Management

Implementation of a framework/methodology and community engagement such as the U.S. Chamber of Commerce Foundation's Talent Pipeline Management. To guide Talent Pipeline Management implementation and address the talent needs of the region's technology community, NVTC launched the Tech Talent Employer Collaborative. The Employer Collaborative brings together senior HR/talent acquisition leaders from NVTC member companies to address the shared workforce needs of local technology employers. "The demands of today's economy require a strategic alignment between classroom and career that better supports students in their transition to the workforce. More than 2,000 employers across the country are finding that alignment and seeing results by making Talent Pipeline Management (TPM) a priority. There is a known challenge of finding sufficient internship opportunities for students under 18 years of age. A work-based simulator approach is a potential alternative solution."

Development and delivery of training programs with public and private partners defining employer needs, developing and testing training and education solutions to meet these needs, and scaling solutions that work throughout the Richmond region. An example is the NYC Tech Talent Pipeline. Industry leaders from 60+ companies have reviewed RFPs, evaluated and shaped curricula, assessed potential talent, and trained program teams to effectively support the development, delivery and evaluation of new and expanded programs designed to equip candidates for 21st century jobs.

Align employer's needs with job training and education competencies including gap analysis. Use research on economic conditions and the labor market, like data produced by NOVA Workforce to help develop a talent pipeline that meets the needs of employers in the region.

Communication and Information Sharing

Communication Strategies for Students and Parents

Identify stakeholders in order to develop communication strategies. Communicate with youth about camps, pathways, and careers. This can be done through face-time with professionals and role model representatives related to their demographics and region. Communicate with parents about opportunities for their children. Connect with guidance counselors about pathways for youth and communicate with educators so that they are better informed to present career or course options. Include businesses in conversations surrounding pathways, courses and experiences that will better support youth going into STEM. Acquire a description of the workforce pipeline which will then help create relevant educational experiences for students.

Identify tools to communicate with parents, students, educators, and businesses about tech talent pathways and careers. Identify the best message that will help create better support for youth going into STEM and create relevant educational experiences. The tools to best communicate with the audience will change. Identify the best tool to use when communicating with a particular audience. Such as a website, social media platforms, ad campaigns, conferences, trainings, and courses.

Develop a strategy to present engineering, computer science, and technology ensuring a broader base for STEM literacy. We need to show STEM and STEM education as accessible to everyone to enrich their everyday lives. Explore opportunities to create experiences for the general public to engage STEM experiences. Especially in the ever-changing aspects of technology and how it is an essential tool used through creativity, critical thinking, and problem-solving.

Communication Strategies for Organizations and Institutions

Help develop one of the STEM Network/Hubs for the Richmond region, following a recommendation in the September 2020 Virginia STEM Education Commission Final Report. Numerous states have developed a 'hub' network or ecosystem to help develop and disseminate STEM language, communication, and programming. It helps create a more relevant localized voice since the State has a breadth of STEM understanding and connections. Some potential partner examples include: JFF, STEM Ecosystems, V-POST (VA Partnership for Out-of-school Time) the Afterschool/Camp Programming landscape survey. Which focuses on winter/spring engineering experiences for young females in middle school or high school.

Develop strategy and resources to increase the awareness of engineering careers and elevate the experiences of professionals that could reach deeper into marginalized communities. These strategies should include identifying local partners that may contribute to a more considerable

collective impact (i.e., V-POST and United Way). This collaborative approach will ensure we expose more youth to the opportunities in our storytelling and modeling for what is possible for our students, families, and communities. This exposure will also create touchpoints and contacts that will help develop a more resilient student to not only enroll in post-secondary STEM programs but gain more confidence in their capability to obtain their degree. Which creates a broader workforce pipeline.

Moving Forward

There have been hundreds of individual and group conversations related to the question "how do we create, sustain and evolve the educational pathways that provide high-value opportunities to everyone?" The complexity underlying this question is enormous, particularly given the accelerating pace of technological change and the increasing importance of individual and community understanding of and participation in the Digital Economy. Tech companies believe that 70 - 80% of all new future jobs will require moderate to high understanding of digital technologies. The Pandemic added credence to that projection. The future is full of promise for any individual who can access and participate in the educational experiences that are gateways to these opportunities. Just getting a step onto the tech-ed pathway is a start. Many technology professionals are not degreed engineers or computer scientists but instead entered into high-value careers with tech-adjacent skills and basic digital knowledge.

We are fortunate to have statewide leadership that understands the importance of technical and tech-adjacent skills and many new programs have been enacted from the top-down. However, the ability and resources required to translate policy intent and funding into frontline activity is essential to make a step change in expanding the Pathways. There is no easy approach to close educational gaps, and there must be more broad-based, high level discussions. Expanding the Tech-ed Pathways must have appropriate priority, and the discussions must have teachers, parents, community leaders and business people collectively engaged in programs that result in building trusted, effective engagement with individual students. This is beyond any single entity, agency or policy. Along our Tech-ed Pathways planning journey, we engaged with senior level policy developers and administrators, individual teachers, and other passionate individuals impacting 10 - 20 students at a time. We now need to multiply and scale these programs that are proven to work.

The workgroup carefully examined successful case studies and also discovered barriers that inhibit access. In an attempt to provide structure around our thoughts, we categorized and approached the situation via the multiple factors that can be examined individually and also collectively in order to create a large-scale conversation and call to action.

Factor 1. Providing Holistic Student Support, Awareness and Confidence Building (K - 12):

There is strong evidence that K-12 education will have new modalities and initiatives following the Pandemic. There is much better access to new content, improved delivery modes and more initiatives that create high-value outcomes. The current generation of students reportedly have a better understanding of educational values, but they may not have awareness of Pathways. Part of this is

driven by nonconventional forces; not only do we have effective nonprofit overlay programs such as Achievable Dream Academy and Partnership for the Future, but the large tech companies (Amazon, Google, etc) are rapidly becoming embedded in our K-12 educational systems. Social media and peer success are powerful forces, and the availability of short courses are an effective gateway onto the Tech-ed Pathways. There is clear evidence that public school systems are creating curriculum and programs to interface with both the supportive (interventional) nonprofits and the tech companies that expand course offerings and skills development. The Governor's STEM Commission recognizes the value of these changes; the primary need is to expand and scale the most effective programs and also ensure the lower income schools have the resources and capabilities to participate.

Factor 2. Creating Private Sector Engagement; Mentoring and Experiential Learning:

The appendix material contains a partial listing of the non-profits, foundations and businesses that are helping to expand access to the Tech-ed Pathways. There are a few organizations, such as CodeVA, ChamberRVA, VCU and business partners who are heavily committed to act as a catalyst to bring experiential learning and private sector resources to all communities across Region 4. The GoVA planning grant provided the opportunity for these groups to share ideas, but more work is necessary. Each of these groups will continue to meet, seek to expand the discussion and highlight programs that have significant impact. For example, the work group will collectively support Chamber RVA and RVAtech as they expand programs to bring large numbers of mentors into the classroom; CodeVA and VCU will continue to expand and upgrade learning content and in-class programming. VCU and Bank of America have recently combined educational outreach programs with Richmond Public Schools. We need to celebrate successes and bring more energy to interface directly with educators and students.

Factor 3. Improved Educator Support and Training:

Regional public school systems are attempting to create expanded Tech-Ed Pathways but there is a concern that many classroom teachers and counselors are not equipped with the knowledge and awareness of Tech-ed Career Pathways. This is raised as a core issue and should not be seen as a shortcoming on any individual or organization. Training for the traditional sciences is well established (even though there is a large shortage of qualified science teachers) but training related to the digital economy and associated technologies is generally not supported as part of educator training. The work performed by CodeVA is making a difference, but it is limited in scope and is often not highly prioritized (i.e., digital courses are often not considered for credit or college placement).

Our workgroups were not able to finalize recommendations on educator training, incentives to upgrade digital knowledge, and the associated support resources even though this issue was raised in almost all conversations. VCU Engineering and VCU Education, together with CodeVA and various business partners, are engaged on this issue but a much larger, focused discussion is required. The Governor's STEM Commission also recognizes the need for focusing on this important issue.

Factor 4. Supporting Infrastructure and Essential Resources:

There are several issues of note regarding infrastructure and access to essential resources for learners, but the most significant is access to broadband and digital technology. After much effort, the Commonwealth is making significant progress in this area. The urgency needed for this expanded infrastructure support should be similar to that of other high-priority issues like the Covid-19 vaccination program or finding shelter for homeless veterans. Our K - 12 students should have digital access to learning and the resources in place to ensure those technologies are operational. Our workgroup would like to see goals set for this important work.

Factor 5. Financial & Tangible Resources:

The conventional education institutions (public schools) are the backbone of our educational ecosystem, but they have limitations and generally lack flexibility. There are established techniques and processes to effect change or drive growth in an organization; can we take a page from highly effective organizations in the private sector to rapidly install resources to offset shortcomings? Can we use incentives from the tech and venture community; what if we provided a pool of funds to support proven and effective after school programs, academies and other overlay initiatives? These funds would be administered outside the conventional school systems and could be targeted to the lower income, under-represented communities with a mandate to create capabilities found in the higher income communities.

Many of the community-led initiatives identified during this project are effective at various levels, but they are all small scale. It is easy to imagine a scenario where each of the non-conventional groups had funding to double in size. The cost of this experiment would be a fraction of the societal costs associated with failures in the current system.

As a closing comment; the Region has the ability to create effective dialog on many levels. We are fortunate to live in a Region that places high value on individual success and is engaged to effect positive change on many levels. It is also clear that many regions across the Country are moving forward faster than Central Virginia. It is imperative that all organizations examine their respective missions, question how they can engage in a way that creates personal trust across all demographics and incomes, and do all this at a faster pace. There are generations of young people whose success

life depends upon our readers expanding relationships and aggressively creating access to pathways toward positive opportunities.

Acknowledgments

The College of Engineering expresses its appreciation to all the individuals and organizations that contributed their ideas and energies to the project. The appendices contain the full list of participants who were engaged, and we are deeply indebted to all of them.

Special thanks to the collaborators on this project from the College of Engineering:

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The College also wants to thank Todd Waldo, Founder and CEO of Hugh Helen LLC, for his collaboration and leadership.

We also want to thank the Marketing and Communication team in the College of Engineering for their contributions to the project creative assets and engagements. Special thanks to Kendra E. Gerlach, Rebecca Jones, Dustin Kratoch and Emi Endo.

Appendices

Appendix 1 - Phase 1 Data

Community College Tech Programs

Community College	Program
J. Sargeant Reynolds Community College	Information Systems Technology, Cybersecurity (CS certificate)
J. Sargeant Reynolds Community College	Information Systems Technology, Computer Programmer (CS certificate)
J. Sargeant Reynolds Community College	Information Systems Technology, AAS
J. Sargeant Reynolds Community College	Information Systems Technology, Cloud Computing
J. Sargeant Reynolds Community College	Engineering, AS
John Tyler Community College	Computer Science, AS
John Tyler Community College	Engineering, AS
John Tyler Community College	Information Technology, AAS (Cybersecurity track)
John Tyler Community College	Cybersecurity, CSC
John Tyler Community College	Cybersecurity and Network Foundations, CSC

Demographics, Education, and Earnings

School District Population

City/County	2018-2019		2019-2020	
	8th Grade	12th Grade	8th Grade	12th Grade
Chesterfield	4,811	4,849	4,924	4,762
Hanover	1,409	1,480	1,449	1,411
Henrico	3,889	3,740	4,090	3,757
Richmond City	1,665	1,212	1,722	1,140
Hopewell	292	257	317	249
Charles City	61	45	49	46
Colonial Heights	230	225	206	214
Powhatan	340	360	372	341
Prince George	461	436	501	441
Dinwiddie	316	302	348	327
Surry	62	61	57	54
Sussex	75	59	71	72
Goochland	212	224	217	203
Greensville	144	175	159	149
New Kent	273	233	287	229
Petersburg	242	255	256	250

Source: Virginia Department of Education, School Quality Profiles

AP Courses and Exams

Students taking 1 or more AP exams and courses are indicated below. The numbers reflect the amount of courses and exams that were taken. However, it does not represent the number of students that have taken exams or courses. We can determine which counties have administered the most exams and courses. Figure 6 indicates that about 4,800 AP courses were taken in Chesterfield School District and 3,500 exams were taken. Henrico County had the second most with 4,000 courses and 3,000 exams taken. The number of exams and courses that were taken during the 2017-2018 and 2018-2019 did not indicate any significant change. The amounts were about the same during both academic years.

AP Courses and Exams by School District, 2017-2018
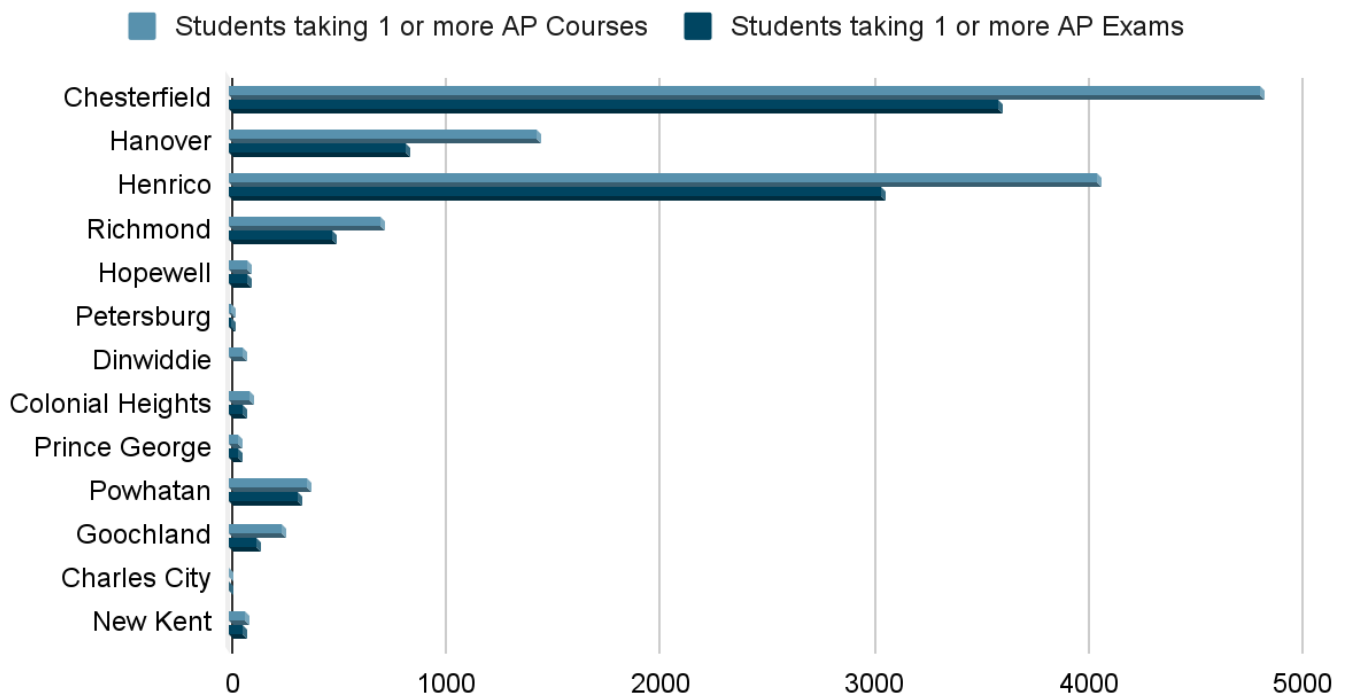
Source: Virginia Department of Education, 2017-2018

AP Courses and Exams, continued

AP Courses and Exams by School District, 2018-2019

■ Students taking 1 or more AP Courses   ■ Students taking 1 or more AP Exams
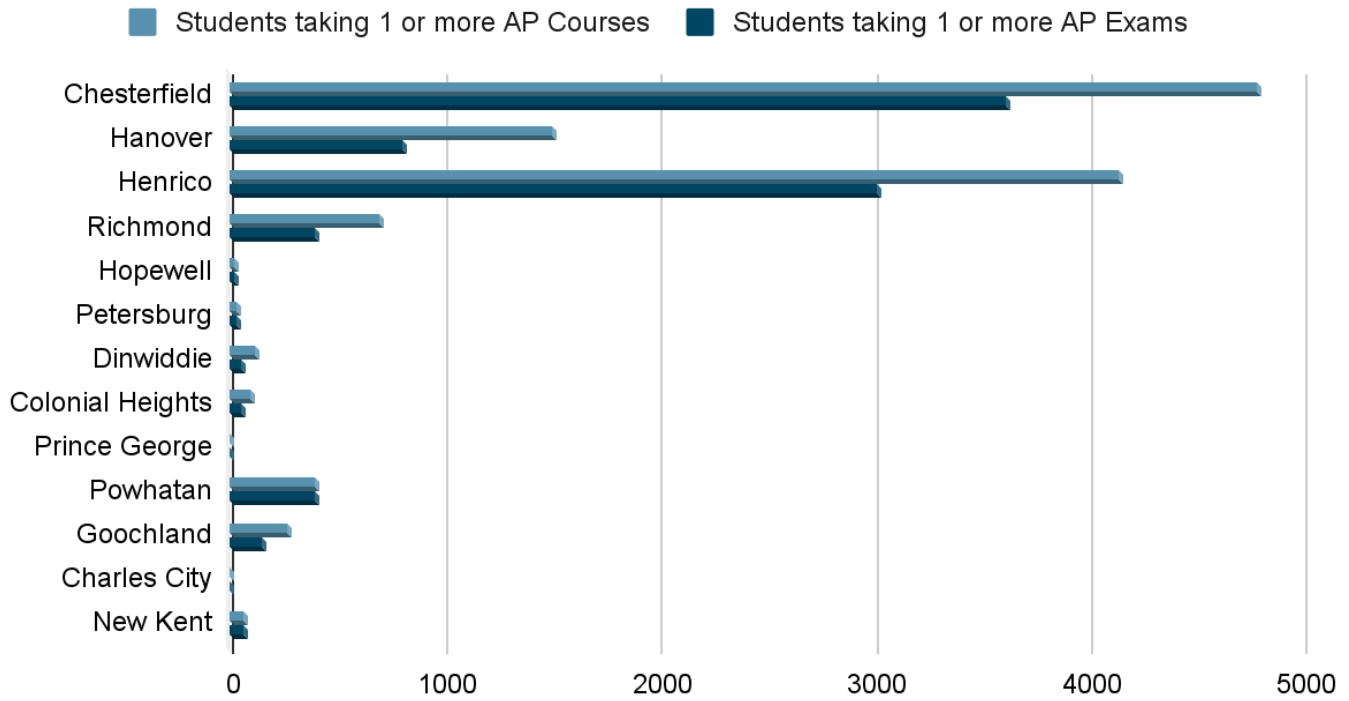
Source: Virginia Department of Education, 2018-2019

High School Enrollment in AP Classes by Race

Chesterfield

Chesterfield County Public Schools: Enrollment in AP Classes
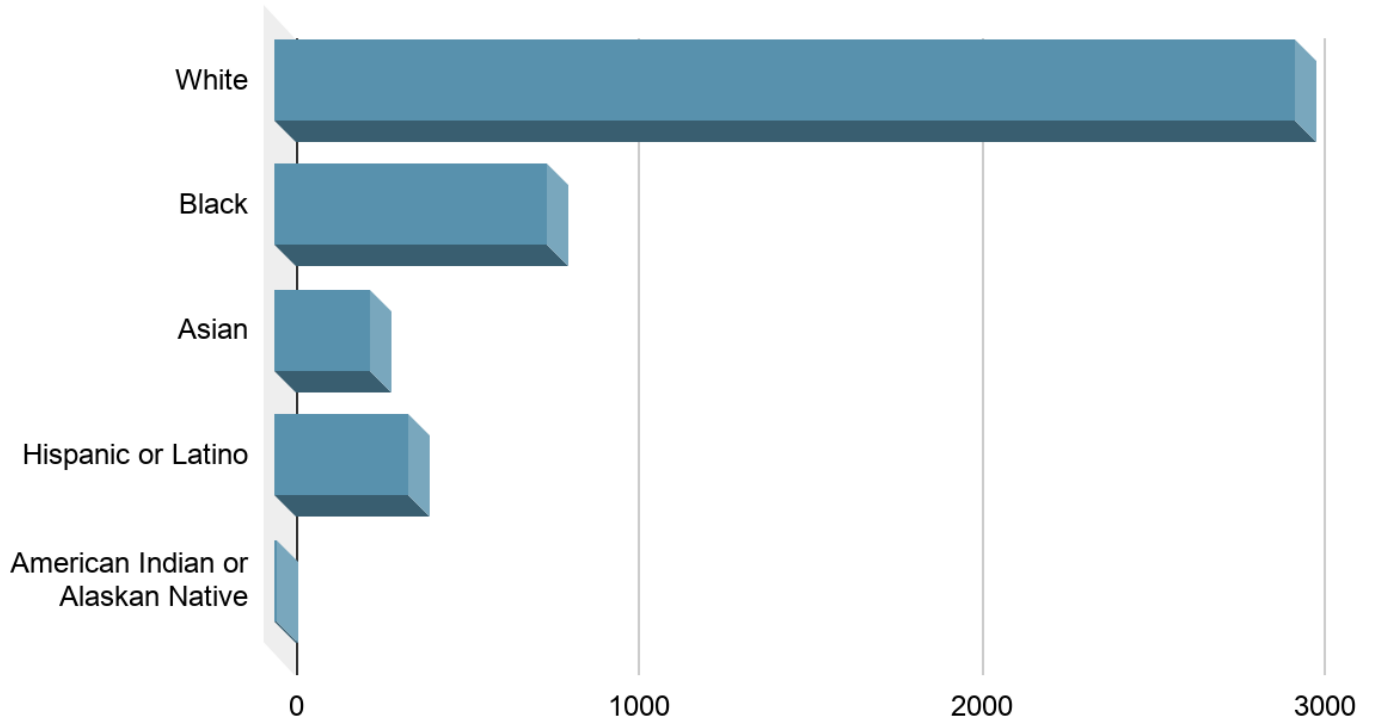
Source: Civil Rights Data Collection, 2017-2018

Hanover

Hanover County Public Schools: Enrollment in AP Classes
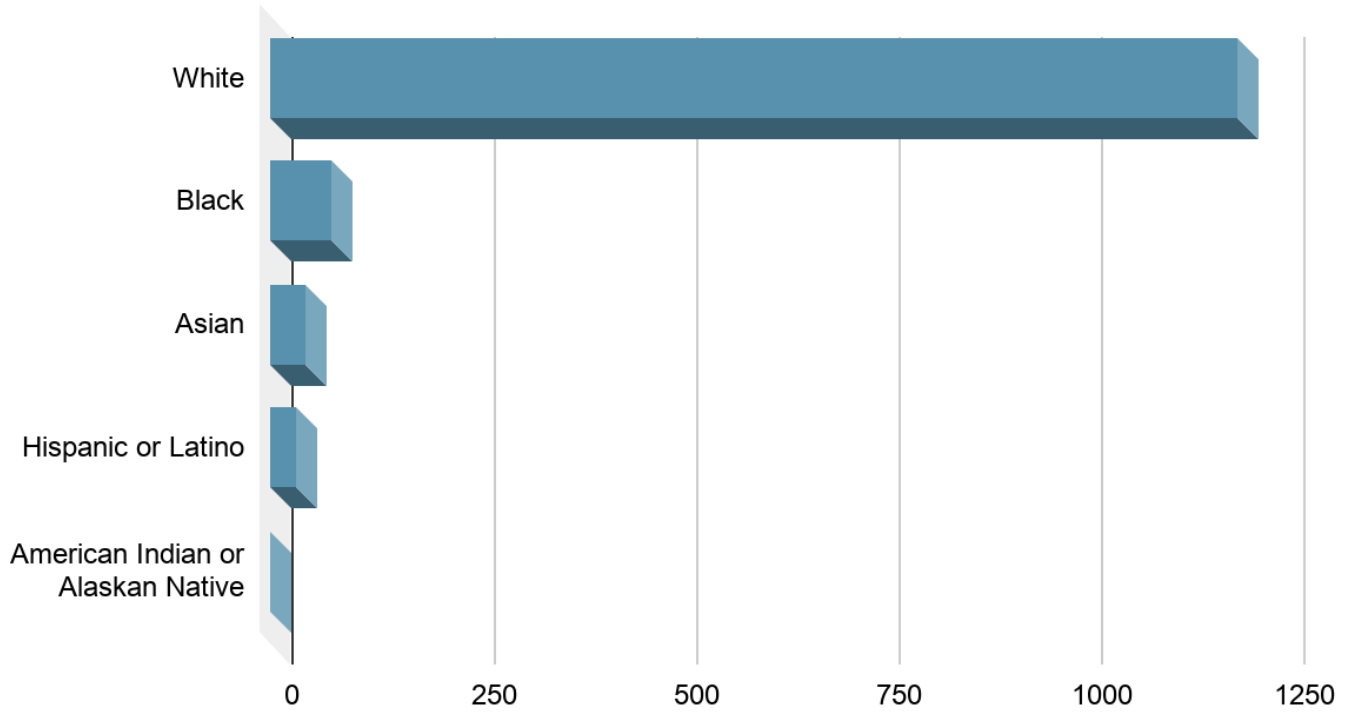
Source: Civil Rights Data Collection, 2017-2018

Henrico

Henrico County Public Schools: Enrollment in AP Classes

Source: Civil Rights Data Collection, 2017-2018

VCU
College of Engineering

GO
VIRGINIA

VIRGINIA INITIATIVE FOR
GROWTH &
OPPORTUNITY
IN EACH REGION
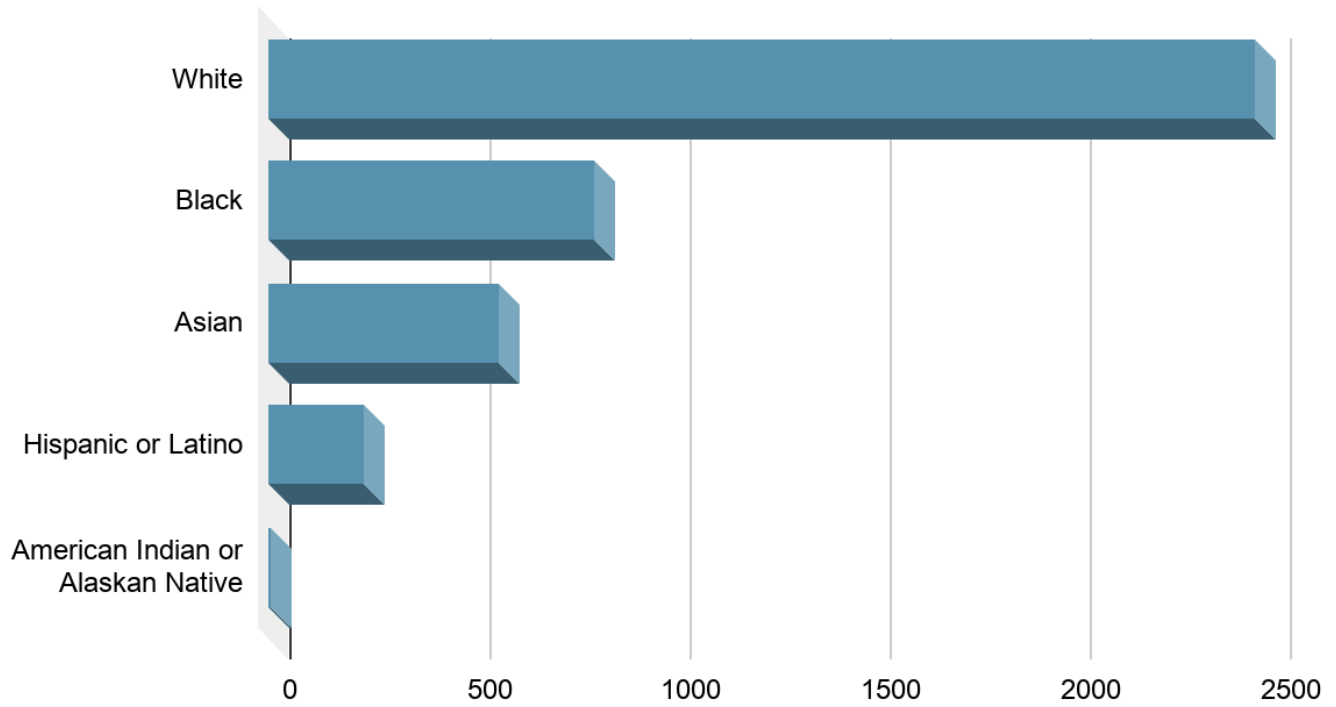
Richmond City

Richmond City Public Schools: Enrollment in AP Classes

Source: Civil Rights Data Collection, 2017-2018

VCU
College of Engineering

GO
VIRGINIA

VIRGINIA INITIATIVE FOR
GROWTH &
OPPORTUNITY
IN EACH REGION
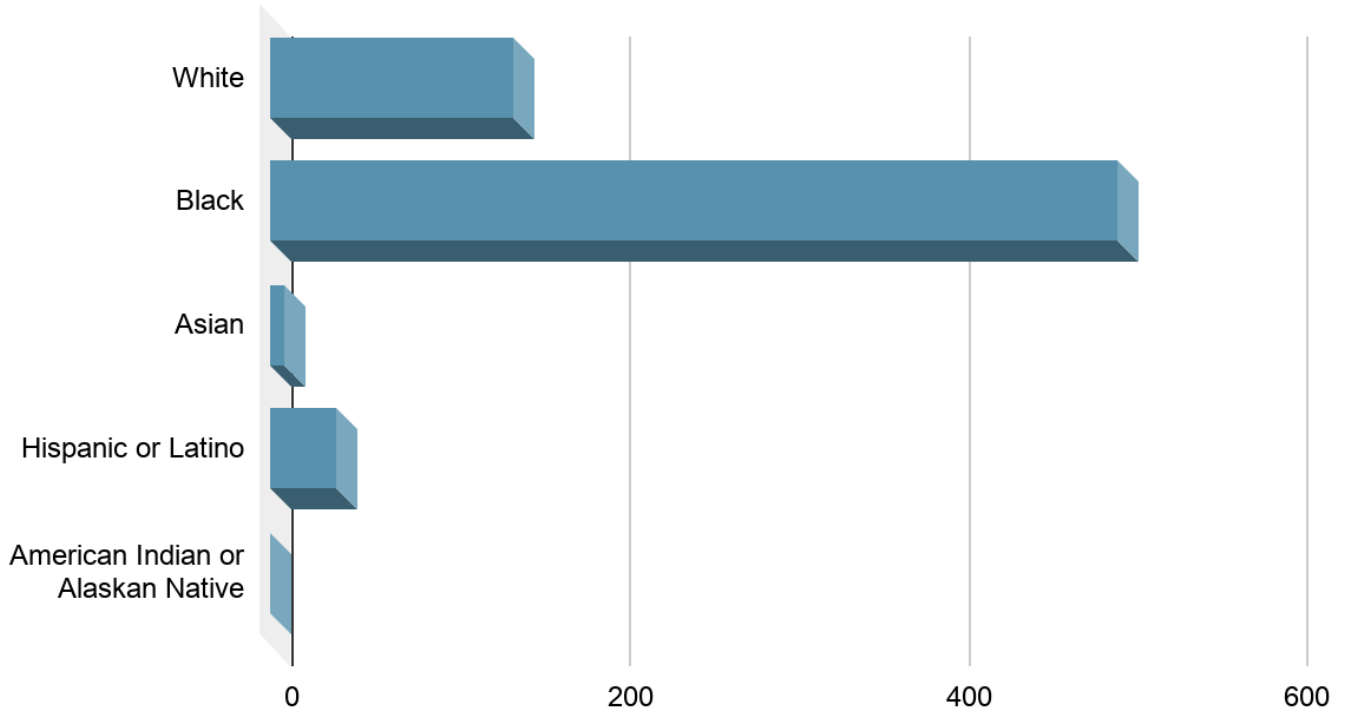
38

College Degrees and Graduation Trends

Virginia: Bachelor Degrees by Gender and Occupation
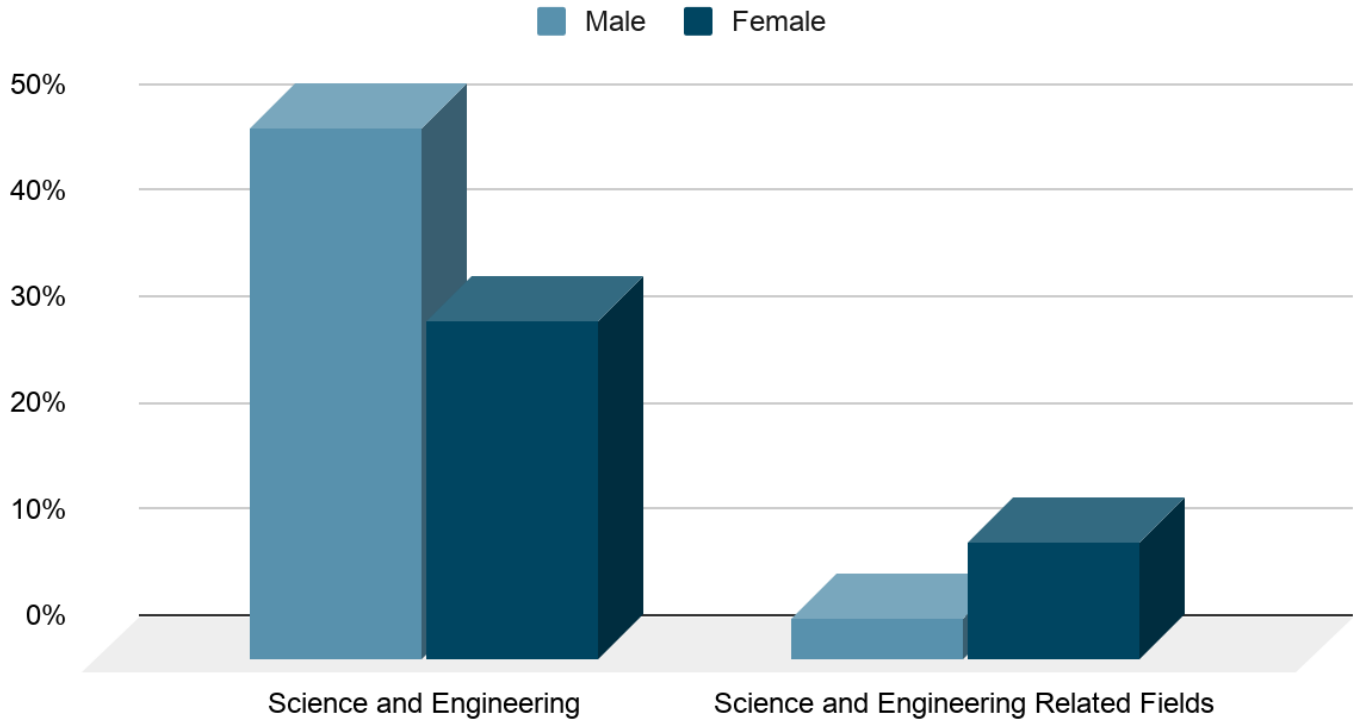
Source: U.S. Census Bureau, 2019 American Community Survey 1-Year Estimates

Educational Attainment

Virginia: Race and Educational Attainment

■ High school graduate or higher ■ Bachelor's degree or higher
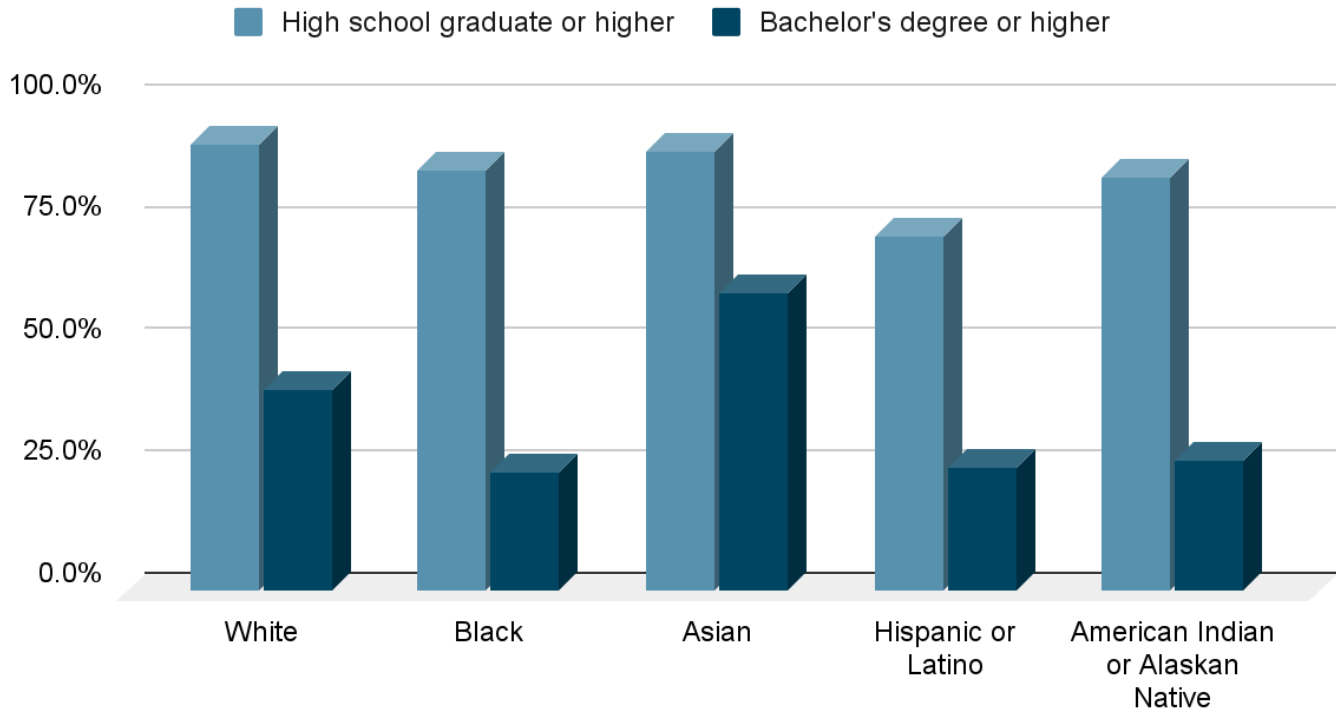
Source: U.S. Census Bureau, 2015-2019 American Community Survey 5-Year Estimates

Median Earnings

Median Earnings by Gender and Educational Attainment
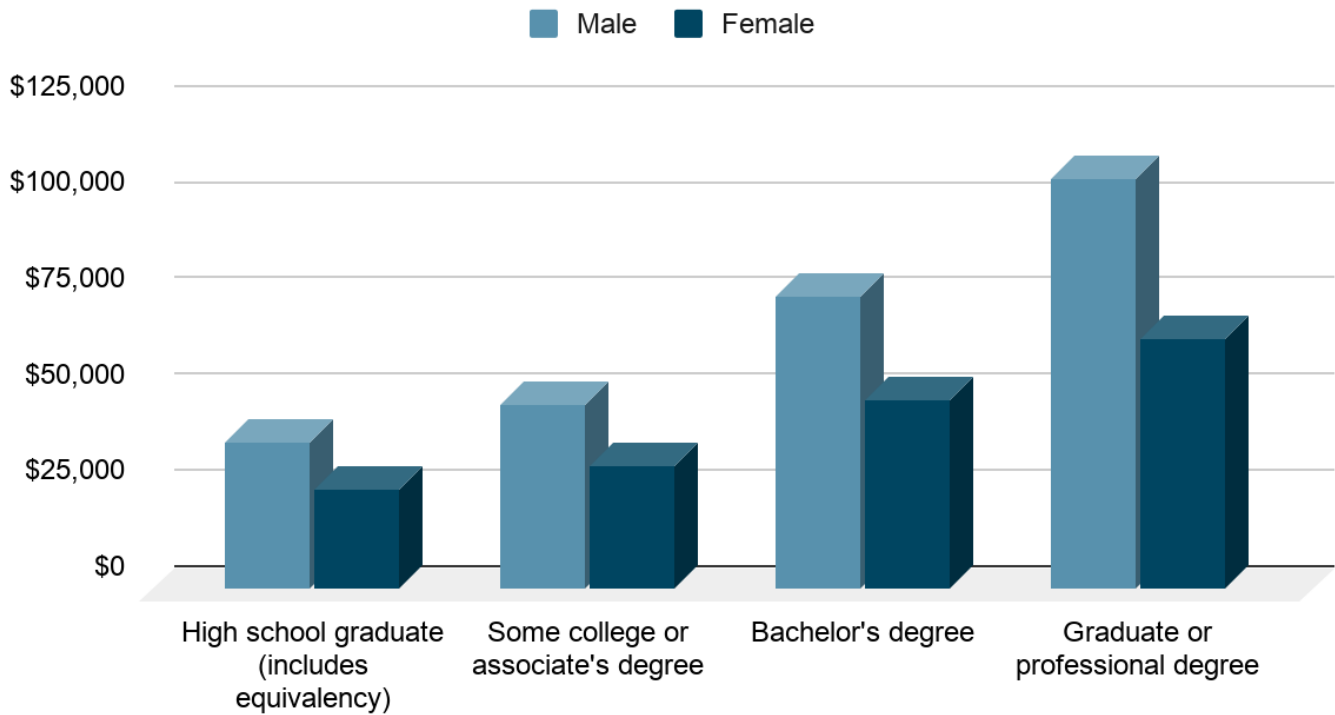
Source: U.S. Census Bureau, 2014-2019 American Community Survey 5-Year Estimates, 25 years old and over

Median Earnings by Occupation and Gender

Virginia: Median Earnings by Occupation and Gender
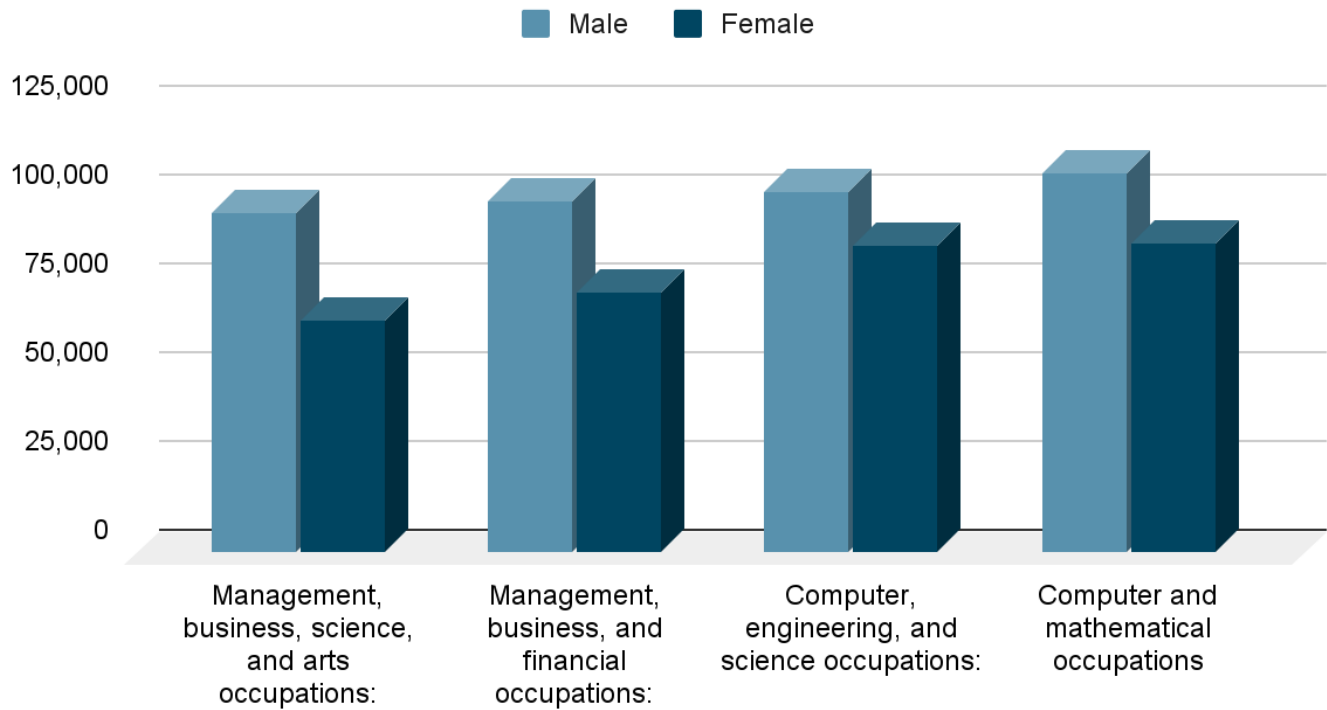
Source: U.S. Census Bureau, 2019 American Community Survey 1-Year Estimates

Employment

Virginia: Tech and Tech Adjacent Occupations
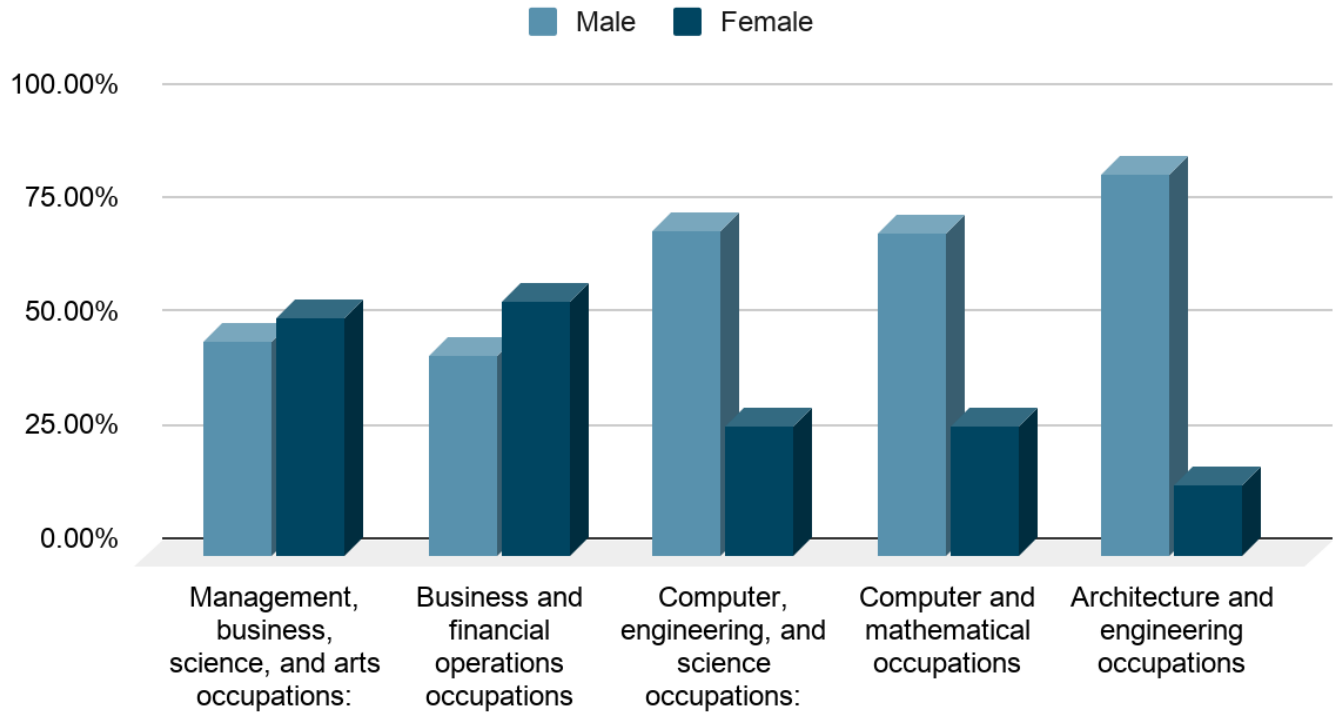
Source: U.S. Census Bureau, 2019 American Community Survey 1-Year Estimates

Top 20 Employers in Richmond, VA

Employer	Business	# of Employees
Capital One Financial Corp.	Financial services, call center	13,000
Virginia Cmnwlth. Univ. Health Syst	Health care	9,313
HCA Virginia Health System	Health care	7,628
Bon Secours Richmond	Health care	7,136
Dominion Virginia Power	Energy	5,433
SunTrust Banks Inc.	Banking	3,810
Altria Group Inc.	Cigarettes and wine	3,800
Amazon.com	Online retail	3,800
Wells Fargo	Banking	2,902
Anthem Blue Cross and Blue Shield	Health Insurance	2,655
United Parcel Service	Package distribution	2,490
DuPont	Chemicals and fibers	2,376
Bank of America	Banking	1,921
Markel Corporation	Insurance	1,886
Federal Reserve Bank of Richmond	Reserve bank	1,882
Verizon Communications	Telecommunications	1,700
University of Richmond	Private university	1,578
General Dynamics Corp.	Call center	1,450
CarMax Inc.	Auto sales	1,306
Southside Regional Medical	Health Care	1,280

Source: Greater Richmond Partnership. "Top Private Employers." Greater Richmond Partnership, n.d.,

https://www.grpva.com/data-reports/leading-employers/top-private-employers/. Accessed October 2020.

Top Paying Certifications

Certification	Salary
Google Certified Professional Cloud Architect	$175,761
AWS Certified Solutions Architect – Associate	$149,446
CISM – Certified Information Security Manager	$148,622
CRISC – Certified in Risk and Information Systems Control	$146,480
PMP® – Project Management Professional	$143,493
CISSP – Certified Information Systems Security Professional	$141,452
CISA – Certified Information Systems Auditor	$132,278
AWS Certified Cloud Practitioner	$131,465
VCP6-DCV: VMware Certified Professional 6 – Data Center Virtualization	$130,226
ITIL Foundation	$129,402
Microsoft Certified: Azure Fundamentals	$126,653
Microsoft Certified: Azure Administrator Associate	$125,993
CCA-N: Citrix Certified Associate – Networking	$125,264
CCNP Routing and Switching	$119,178
CCP-V: Citrix Certified Professional – Virtualization	$117,069

Appendix 2 - Phase 2 Data

K-12 School District Interview Questions

1. Can you tell me more about your STEAM/STEM curriculum?

2. Do the science and math teachers collaborate together?

3. What resources/tools do you use to teach your students?

4. Is there a lot of participation from middle school students in STEM related courses?

5. Have there been some challenges that have affected your students' learning process? If so, what are they?

6. Can you tell me more about your work-based learning initiative? Have there been some STEM work-based learning opportunities?

7. Do you know how many students from your district that take certifications/credentials?

8. What does your school need in order to be successful in educating students in technology/STEM?

Community Organization Survey Questions

1. Name of organization

2. Who is your Executive Director? Please include name, email, and address

3. When was your organization founded?

4. Where are you located?

5. Where do you offer your classes or programs?

6. How long have you been implementing your programs?

7. What is your vision, mission, and value statement (if applicable)?

8. What STEM programs do you offer?
   a. Coding
   b. Robotics
   c. Computer programming
   d. Other, please specify_____

9. How often do you offer STEM programs?
   a. Weekly
   b. Monthly
   c. Yearly
   d. Other, please specify_____

10. Do you offer summer camps? If so, what kind?

11. What activities are offered during your summer camp programs?

12. Do you offer after school programs? If so, how often?

13. How often do your after school clubs meet? (can include pre-covid schedule)
    a. Weekly
    b. Monthly
    c. Quarterly
    d. Other, please specify_____

14. What activities are offered during your after school clubs or programs?

15. Are you offering virtual classes?

16. Is there a cost to participate? If so, how much?

17. What teaching tools do you use for your programs?

18. Is programming grade specific?
    a. K-5th
    b. 6th-8th
    c. 9th-12th
    d. Other, please specify_____

19. Do you have gender specific programming?

20. What skills do your students need in order to be successful in your program?

21. How many students participate in your programming yearly?

22. How many students participate per program?

23. How many students complete your programs yearly?

24. What geographic areas make up your enrollment?

25. How do you measure success in your organization? (ex: increased skill level of participants, the number of participants, etc.)

26. What are some challenges that you face as an organization? (ex: funding, low participation, etc.)

27. What are some of the challenges that prevent your students from participating fully in your program? (ex: can be personal, financial, etc.)

28. What kind of skills do your students gain after participating in your programs?

29. Are students prepared to go to the next level after completing your program?

30. What are your short term, intermediate, and long term goals for your students or program?

31. What kind of support do you need in order to make your program more successful?

32. What teaching tools do you use for your programs?

33. How often do you evaluate your programs?

34. Do you know of any STEM related community organizations that would be interested in participating in this survey? If so, please list below

Community Organizations List

Organization	Website	Phone	Address
National Society of Black Engineers-Richmond Chapter	https://www.nsberichmond.org/	(804) 251-1656	P.O. Box 75462 Richmond, VA 23236
Partnership for the Future	https://www.partnershipforthefuture.org/	(804) 967-2559	4521 Highwoods Pkwy, Glen Allen, VA 23060
CodeVA	https://www.codevirginia.org/	(804) 727-9817	300 E Broad St, Richmond, VA 23219
The STEM Leadership and Achievement Academy	http://www.stemleadershipacademy.org/	(804) 926-4767	2261 Cardiff Way, Richmond VA 23236
The Build Forward Foundation	https://www.rvabuild.com/en/page/bff-about	(804) 528-5818	3301 Rosedale Avenue Richmond, VA 23230
FIRST Chesapeake	https://www.firstchesapeake.org/	(804) 572-8454	8161 Mechanicsville Turnpike, Suite I Mechanicsville, VA 23111
NextUp RVA	https://www.nextuprva.org/	(804) 409-5639	3409 W Moore St, Richmond, VA 23230
Girls For A Change	https://girlsforachange.org/	(804) 405-2827	100 Buford Rd, Bon Air, VA 23235
Tech Em Studios	https://techemstudios.com/	(804) 476-0278	1123 Gaskins Rd b600, Richmond, VA 23238
Little Scholars	https://www.littlescholarsllc.com/	(804) 447-4095	1512 Willow Lawn Dr UNIT 204, Richmond, VA 23230
Code Ninja	https://www.codeninjas.com/va-glen-allen	(804) 396-4411	10811 W Broad St., Suite 17 Glen Allen, VA, VA 23060
Boy Scouts	http://hovc.org/	(804) 355-4306	8090 Villa Park Drive Henrico, VA 23228

Girl Scouts	https://www.comgirlscouts.org/	(804) 746-0590	4900 Augusta Ave Suite 200, Richmond, VA 23230
Coder Dojo at Richmond Public Library	http://rvacoderdojo.org/index.html		101 E Franklin St Richmond, VA 23219
Capital One's C-1 Coders	https://coders.capitalone.com/		
Nubian Village Academy for Stem	https://www.nvastem.org/	(800) 463-1137	

Appendix 3 - Community Engagement Collateral

Community Engagement Survey

Hello:

You are invited to participate in our survey for the Tech Talent Pathways Initiative. VCU College of Engineering would like your input on recommendations that were developed in collaboration with the education and business community.

It will take approximately **10-15 minutes** to complete the survey. There are **4 areas of focus** we would like your input on. Please rank the recommendations in order of importance and effectiveness. Your responses will be included in the final report which will reflect community voice.

A special opportunity for everyone who submits this survey or attends one of our community events! We will select **4** of you to receive a scholarship to attend CodeVA's Eureka Workshop summer camp. Also, an additional **4** of you will win tickets for admission to the Science Museum of Virginia.

If you have questions at any time about the survey, you may contact Touri Goode at the email address: goodetn@vcu.edu.

Thank you very much for your time. Please start the survey now by clicking on the **Next** button below.

---

* I can best be described as a:

○ K-12 Student

○ College Student

○ Parent of K-12 Student

○ Industry Professional

---

*Which of the following best describes your current occupation?

○ Architecture and Engineering

○ Arts, Design, Entertainment, Sports, and Media

○ Building and Grounds Cleaning and Maintenance

○ Business and Financial Operations

○ Community and Social Service

○ Computer and Mathematical

○ Construction and Extraction

○ Education, Training, and Library

○ Farming, Fishing, and Forestry

○ Food Preparation and Serving Related Occupations

○ Healthcare Practitioners and Technical

○ Healthcare Support

○ Installation, Maintenance, and Repair

○ Legal

○ Life, Physical, and Social Science

○ Management

○ Office and Administrative Support

○ Personal Care and Service

○ Production

○ Protective Service

○ Sales and Related Occupations

○ Transportation and Materials Moving Occupations

○ Other (please specify)

_____

* Residential zip code

<div style="border:1px solid #ccc;"> </div>
_____

Area 1: Teacher Training and Student Connections

This set of recommendations focus on teacher training opportunities and student connections through education, community, and industry. Please rank in order of importance and include any additional recommendations that we may have missed.

Teacher Training and Student Connections

Training and Professional Development for current K-12 Teachers. Please rank (1-3) in order of most important, with 1 being the most important and 3 being the least important:

Train educators in computer science and add salary incentives when they become technology education teachers

-- Select -- ⌄

Provide and encourage professional development opportunities for educators

-- Select -- ⌄

Encourage internship and externship opportunities for educators

-- Select -- ⌄

Student Connections through Coursework, Community Organizations and Industry to Enhance Technical Skills. Please rank (1-4) in order of most effective, with 1 being the most effective and 5 being the least effective

Identify early learning opportunities for students to creatively apply engineering skills, problem solving, collaboration, and critical thinking.

-- Select -- ⌄

Connect students with community organizations that are advancing tech education within the community in order to increase awareness, hands-on learning opportunities, participation, and competency level

-- Select -- ⌄

Focus on year to year growth on students' technical skills as they progress through their K-12 STEM curriculum.

-- Select -- ⌄

Create a region-by-region virtual clearinghouse for internships, externships, and experiential learning opportunities for K-12 students

-- Select -- ⌄

Are these recommendations helpful towards training educators and enhancing students technical skills?

○ Yes

○ No

Teacher Training and Student Connections

* Teacher Training and Student Connections

Why are they not helpful towards training educators and enhancing students technical skills?

Are there any additional recommendations that we should consider in this area for teacher training and student connections? If so, please tell us

Area 2: Aligning Higher Education Opportunities with Industry

This set of recommendations focus on aligning education with equitable career opportunities for students and working professionals. Please rank in order of importance and effectiveness and include any additional recommendations that we may have missed.

Aligning Higher Education Opportunities with Industry

Aligning Education and Labor Market Outcomes. Please rank (1-4) in order of most important, with 1 being the most important and 4 being the least important:

Increase and improve transparency of learning outcomes that lead to further education and employment through high-quality credentials beyond high school

-- Select --

Identify ways to connect to the goals, strategies and actions related to Pathways to Opportunity: The Virginia Plan for Higher Education

-- Select --

Make connections with Virginia Economic Development Partnership Authority's future Office of Education and Labor Market Alignment

-- Select --

Encourage experiential learning opportunities

-- Select --

Affordable Pathways. Please rank (1-7) in order of most effective, with 1 being the most effective to 7 being the least effective:

Increase investment in college students who want to become teachers, helping them gain a technology education endorsement with their teacher's license

-- Select -- ⌄

Support dual enrollment and other education acceleration program initiatives in order to expand students opportunities for advancement in higher education

-- Select -- ⌄

Current working technology professionals can pursue certifications and continuing education opportunities

-- Select -- ⌄

Promote multiple pathways for career development and look to use stackable education and credentials

-- Select -- ⌄

Look at regional, state and national best practices including evaluation of current platforms and tools used in Virginia's Pre-K-20 for career exploration and alignment

-- Select -- ⌄

Promote models of success in underrepresented groups to encourage K-12 students to pursue tech careers

-- Select -- ⌄

Launch an active communication and marketing campaign on trade professions

-- Select -- ⌄

Are these recommendations helpful towards identifying affordable pathways for students and working professionals?

◯ Yes

◯ No

Aligning Higher Education Opportunities with Industry

* Aligning Higher Education Opportunities with Industry

Why are they not helpful towards identifying affordable pathways for students and working professionals?

Are there any additional recommendations that we should consider for aligning higher education opportunities and industry? If so, please tell us

Area 3: Equitable Internships and Professional Development Training for Students and Working Professionals

This set of recommendations focus on equitable internships and professional development training opportunities for students and working professionals. Please rank in order of importance and include any additional recommendations that we may have missed.

Equitable Internships and Professional Development Training for Students and Working Professionals

Internships and Early Career Programs. Please rank (1-4) in order of most important, with 1 being the most important and 4 being the least important:

Provide equitable and meaningful internship opportunities for high school students

-- Select -- ⌄

Investment in mentorship opportunities from business and industry organizations providing employees that work in engineering, computer engineering, and digital tech fields the time, flexibility and opportunity to serve as mentors

-- Select -- ⌄

Increase support for entry level rotational programs that helps college graduates transition to early career

-- Select -- ⌄

Provide career switcher incentives to join key fields

-- Select -- ⌄

Training and Talent Management. Please rank (1-3) in order of most important, with 1 being the most important and 3 being the least important:

Implementation of a framework/methodology and community engagement such as the U.S. Chamber of Commerce Foundation's Talent Pipeline Management

-- Select -- ⌄

Development and delivery of training programs with public and private partners defining employer needs and scaling solutions throughout the Richmond Region

-- Select -- ⌄

Align employer's needs with job training and education competencies including gap analysis

-- Select -- ⌄

Are these recommendations helpful towards increasing the availability of equitable internships, entry level jobs, and training programs?

◯ Yes

◯ No

Equitable Internships and Professional Development Training for Students and Working Professionals

* Equitable Internships and Professional Development Training for Students and Working Professionals

Why are they not helpful towards increasing the availability of equitable internships, entry level jobs, and training programs?

Are there any additional recommendations that we should consider for equitable internships and professional development training for students and working professionals? If so, please tell us

Area 4: Communication and Information Strategies for Parents, Students and Institutions

This set of recommendations focus on communication strategies for parents, students, and institutions. Please rank in order of importance and include any additional recommendations that we may have missed.

Communication and Information Strategies for Parents, Students and Institutions

Communication Strategies for Students, Parents, and Institutions. Please rank (1-5) in order of most important, with 1 being the most important and 5 being the least important:

Identify stakeholders in order to develop communication strategies

-- Select -- ⌄

Identify tools to communicate with parents, students, educators, and businesses about tech talent pathways and careers

-- Select -- ⌄

Develop a strategy to present engineering, computer science, and technology ensuring a broader base for STEM literacy

-- Select -- ⌄

Help develop one of the STEM Network/Hubs for the Richmond region, following a recommendation in the September 2020 Virginia STEM Education Commission Final Report

-- Select -- ⌄

Develop strategy and resources to increase the awareness of engineering careers and elevate the experiences of professionals that could reach deeper into marginalized communities

-- Select -- ⌄

Are these recommendations helpful towards developing effective communication strategies for students, parents, and institutions?

◯ Yes

◯ No

Communication and Information Strategies for Parents, Students and Institutions

* Communication and Information Strategies for Parents, Students and Institutions

Why are they not helpful towards developing effective communication strategies for students, parents, and institutions?

Are there any additional recommendations that we should consider for communication and information strategies for parents, students and institutions? If so, please tell us

Tech Talent Pathway Marketing Assets - Social Media graphics

Graphic 1

Graphic 2

Graphic 3

Graphic 4

Tech-Talent Pathways
Graphic Treatment and Overall Visual Concepts
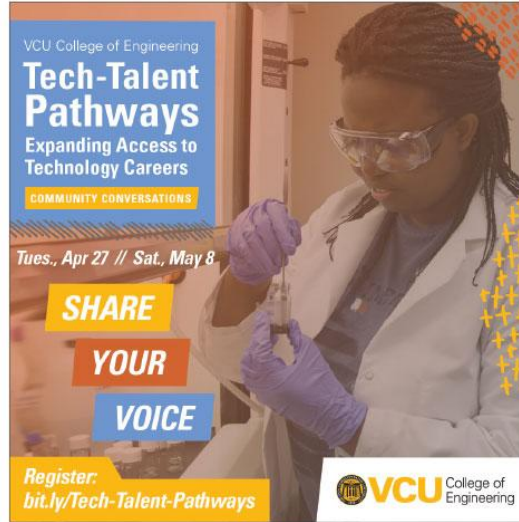
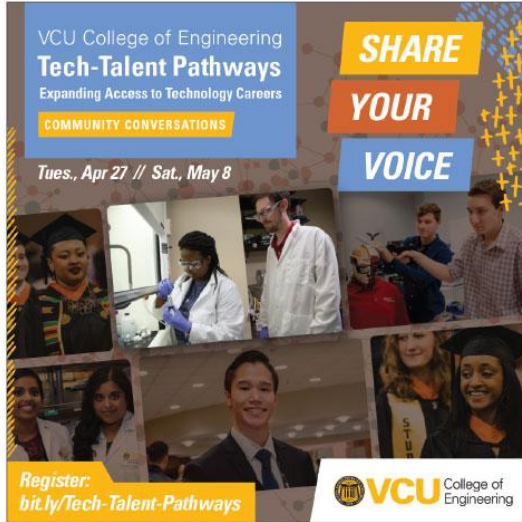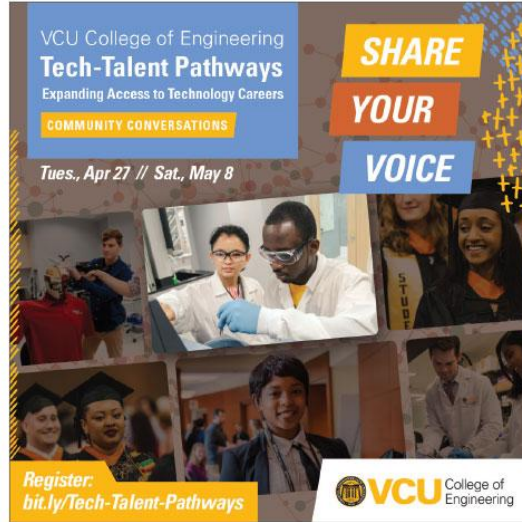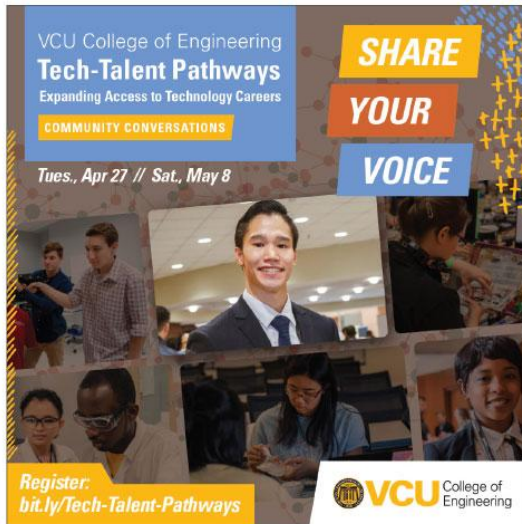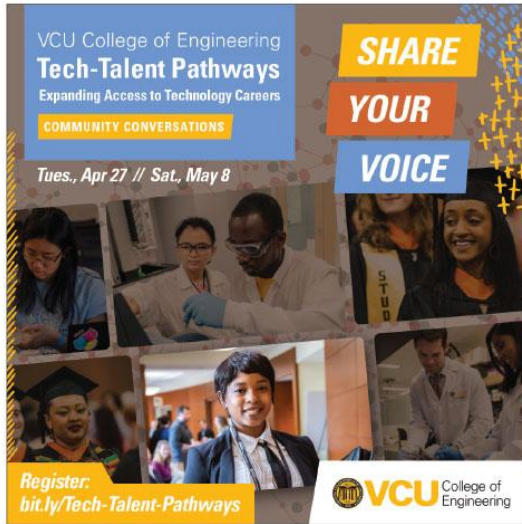Graphic 5

Graphic 6

Tech-Talent Pathways
Graphic Treatment and Overall Visual Concepts

Graphic 7

Graphic 8

Graphic 9

Graphic 10

Tech-Talent Pathways
Graphic Treatment and Overall Visual Concepts

Graphic 11

Tech-Talent Pathways
Graphic Treatment and Overall Visual Concepts

VCU landing page

Tech Talent Pathway Marketing Assets - Partner Resources Web Page

https://www.hughhelenllc.com/ttp-assets

Video: https://drive.google.com/file/d/1E4_XLZQpxRUHJPBJZGUENgZRAer4TLpI/view

Video

Post Date:
April 21, 2021

Instagram Caption:
Current trends indicate that careers in technology are on the rise, creating more opportunities in Virginia's digital economy.

VCU College of Engineering's (@vcu_eng) Tech-Talent Pathways presents an active response by establishing linkages between community members, business leaders, and community organizations. Through these partnerships, we hope to eliminate disparities in tech-education and contribute to a highly skilled workforce.

What's your role in all of this? We need your voice!
Join us on April 27 at 12pm or May 8 at 11am for our Virtual Community Conversations. Your feedback will help our education, government, business, and nonprofit partners create recommendations to expand access in Central Virginia.

Visit bit.ly/Tech-Talent-Pathways to register!

Thanks in advance for doing your part and supporting equity in tech.

Directions for Posting

Instagram
Download video here. Uploaded video via Instagram and when prompted, select *Long video* for IGTV posting. Use the provided caption.

Share original post from VCU College of Engineering's Instagram

Facebook
Share original post from VCU College of Engineering's Facebook page

LinkedIn
Share original post from VCU College of Engineering's LinkedIn page

Twitter
Share original post from VCU College of Engineering's Twitter page

YouTube
Share original post from VCU College of Engineering's YouTube channel

Hero Graphic
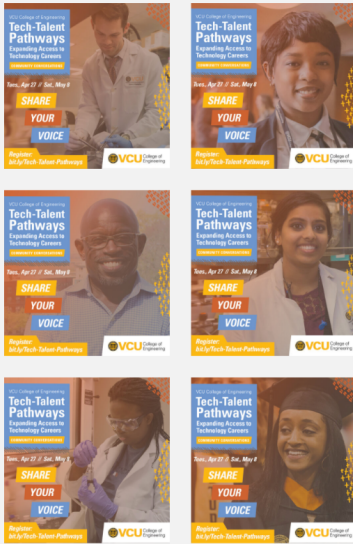
Select your preferred image(s) and download
HERE

Post Date:
April 26, 2021

Caption:
The VCU College of Engineering is excited to share the Tech-Talent Pathways initiative. The goal of this initiative is to identify and fill gaps in tech education using an active and collaborative approach to bring more equity to these opportunities.

We look forward to joining forces and hearing your ideas at our Community Conversations on April 27 at 12pm or May 8 at 11am.

Visit bit.ly/Tech-Talent-Pathways to register. If you're unable to attend, you can also share your voice by completing a brief survey at the link above.

Post Date:
May 3, 2021

Caption:
The VCU College of Engineering is excited to share the Tech-Talent Pathways initiative. The goal of this initiative is to identify and fill gaps in tech education using an active and collaborative approach to bring more equity to these opportunities.

We look forward to joining forces and hearing your ideas at our Community Conversations on May 8 at 11am.

Visit bit.ly/Tech-Talent-Pathways to register. If you're unable to attend, you can also share your voice by completing a brief survey at the link above.

BONUS: Submit a survey or attend one of our community events for your chance to win!
Four of you will receive a scholarship to attend CodeVA's Eureka Workshop summer camp.

Four of you will win tickets for admission to the Science Museum of Virginia.

Special thanks to CodeVA and Science Museum of Virginia for their support and partnership.

Multi-photo Graphic

Select your preferred image(s) and download **HERE**

Post Date:
April 28, 2021

Caption:
We all have a role to play in eliminating barriers to access within the tech-education community.

VCU College of Engineering's Tech-Talent Pathways aims to build a highly skilled workforce, increase job access in Virginia's digital community, create tech-education pathways, increase access to tech-education in underserved communities, and encourage partnerships that nurture innovation. Because this is a collaborative effort, we need your voice to make it all happen.

Join us on May 8 at 11am for our Virtual Community Conversations.

Visit bit.ly/Tech-Talent-Pathways to register!

BONUS: Submit a survey or attend one of our community events for your chance to win!
Four of you will receive a scholarship to attend CodeVA's Eureka Workshop summer camp.

Four of you will win tickets for admission to the Science Museum of Virginia.

Special thanks to CodeVA and Science Museum of Virginia for their support and partnership.

Post Date:
May 5, 2021

Caption:
We all have a role to play in eliminating barriers to access within the tech-education community.

VCU College of Engineering's Tech-Talent Pathways aims to build a highly skilled workforce, increase job access in Virginia's digital community, create tech-education pathways, increase access to tech-education in underserved communities, and encourage partnerships that nurture innovation. Because this is a collaborative effort, we need your voice to make it all happen.

Join us on May 8 at 11am for our Virtual Community Conversations.

Visit bit.ly/Tech-Talent-Pathways to register!

BONUS: Submit a survey or attend one of our community events for your chance to win!
Four of you will receive a scholarship to attend CodeVA's Eureka Workshop summer camp.

Four of you will win tickets for admission to the Science Museum of Virginia.

Special thanks to CodeVA and Science Museum of Virginia for their support and partnership.

Quote Graphic

Download **HERE**

Caption:
We all have a role to play in eliminating barriers to access within the tech-education community.

VCU College of Engineering's Tech-Talent Pathways aims to build a highly skilled workforce, increase job access in Virginia's digital community, create tech-education pathways, increase access to tech-education in underserved communities, and encourage partnerships that nurture innovation. Because this is a collaborative effort, we need your voice to make it all happen.

Join us on April 27 at 12pm or May 8 at 11am for our Virtual Community Conversations.

Visit bit.ly/Tech-Talent-Pathways to register!

A special opportunity for everyone who submits a survey or attends one of our community events!
Four of you will receive a scholarship to attend CodeVA's Eureka Workshop summer camp.

Four of you will win tickets for admission to the Science Museum of Virginia.

Special thanks to CodeVA and Science Museum of Virginia for their support and partnership.

Email Messaging

Email Subject Line 1: Tech-Talent Pathways: VCU College of Engineering Promotes Equity in Tech Education
Email Subject Line 2: VCU College of Engineering Promotes Equity in Tech Education

Together with education, business, government and nonprofit partners, VCU College of Engineering has produced recommendations to support more people pursuing education and careers in technology.

Your feedback on these recommendations will help our education, government, business, and nonprofit partners create recommendations to expand access in Central Virginia.
Visit bit.ly/Tech-Talent-Pathways for more information and to register for the virtual events. Or, you can complete a brief survey to share your thoughts.

Let's do our part in supporting equity in tech.

Community Conversations
Tuesday, April 27 at 12pm
Saturday, May 8 at 11am

A special opportunity for everyone who submits a survey or attends one of our community events!
We will select four of you to receive a scholarship to attend CodeVA's Eureka Workshop summer camp.

And four of you will win tickets for admission to the Science Museum of Virginia.

Special thanks to CodeVA and Science Museum of Virginia for their support and partnership.

Appendix 4 - Work Group Members and Stakeholder Organizations

Work Group Members

Name	Position	Company
Brian Anderson	President and CEO	ChamberRVA
Peter Blake	Director	State Council of Higher Education for Virginia
Raymond Burton	Dean, Science, Technology, Engineering and Math	J. Sargeant Reynolds Community College
Matt Catatachea	Coordinator of Technology Integration and Innovation	Goochland County Public Schools
Chris Dovi	Executive Director	CodeVA
Chuck English	Virginia STEM Coordinator	Science Museum of Virginia
Kume Goranson Ed.D	Executive Director	CodeRVA Regional High School
Miles Gordon	Director of Government and Community Relations	Virginia Commonwealth University
Dawit Haile, Ph.D.	Dean, College of Engineering and Technology	Virginia State University
Kim Mahan	Founder and Partner	MAXX Potential
Sharaza Nelson	Director, Workforce Programs	ChamberRVA
Emily Salmon	Senior Associate	State Council of Higher Education for Virginia
Sandy Turnage	Director of Corporate Relations	Virginia Commonwealth University
Bruce Watson	Director, Career and Technical Education/STEM	Goochland County Public Schools
Charles Watson	Careers Outreach Facilitator and JVG Jobs Specialist	Richmond Public Schools
Alida Williamson Smith	Assistant Principal	Richmond Technical Center

Stakeholder Organizations

Abbott

Activation Capital

Altria

Amazon

AMC Technology

Apex

Astyra

AWS

AWS Educate

Bank of America

Brightspot

CapitalOne

CapTech

CarMax

CGI Federal

ChamberRVA

Chesterfield Economic Development

Chesterfield County Public Schools

CodeRVA Regional High School

CodeVA

Commonwealth of Virginia

Community College Workforce Alliance

CoStar

Decide Smart

Development and Alumni Relations

Dominion Energy

EAB

Federal Reserve Bank

FIRST Chesapeake

Gateway Region Economic Development

GE Digital

General Dynamics IT

Genworth

Girls for a Change

Goochland County Public Schools

Government Relations

Greater Richmond Partnership

Grow Capital Jobs Foundation

Hanover County Public Schools

Henrico County Public Schools

Henrico Economic Development

Hopewell City Public Schools

Hopewell/Prince George Chamber of Commerce

IBM

Ippon

John Tyler Community College

Major Clarity

Mathscience Innovation Center

MAXX Potential

Metropolitan Educational Research Consortium (MERC)

Microsoft

National Society of Black Engineers-Richmond Chapter

NextUp RVA

Nubian Village Academy for Stem

Partnership for the Future

Petersburg City Public Schools

Reynolds Community College

Richmond Public Schools

RVATECH

SCHEV

Society of Women Engineers, RVA

The Metropolitan Business League

The STEM Leadership and Achievement Academy

TimeStudy

VA STEM Education Commission

VCU Center for Community Engagement and Impact

VCU College of Engineering Foundation

VCU School of Education

Virginia Children's Engineering Council

Virginia Community College System

Virginia Department of Education

Virginia Economic Development Partnership

Virginia State University

Virginia Union University

VP Strategic Enrollment

VPM

WillowTree

Wipro