The Future of Work-Based Learning for Cyber Jobs

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Introduction

The continuously evolving nature of cybersecurity demands an agile and tactical approach to learning and skill development. One method of meeting this demand is through work-based learning. Work-based learning is a type of educational programming that exposes students to the knowledge and skills required for a given career or industry and occurs in a workplace setting through on-the-job training or an environment that closely resembles the workplace.[1] It includes internships, apprenticeships, youth employment programs, project-based learning, and experiential learning.

Work-based learning is not unique to the cybersecurity field, but it is part of a broader workforce ecosystem shift to embrace practices such as skills-based hiring and leveraging alternative educational pathways. For example, the U.S. Office of the National Cyber Director's (ONCD) 2023 *National Cyber Workforce and Education Strategy* (NCWES) contains lines of effort specifically aimed at work-based learning under "Strategic Objective 3.2: Promoting Skills-Based Hiring and Workforce Development."[2] The NCWES calls upon employers to focus on skills needed for cyber jobs rather than college degrees or experience as indicators of qualification, and also to increase on-ramps into the workforce through work-based learning opportunities.

Quantitative research shows that work-based learning is an effective learning mechanism, but little qualitative research exists for the cybersecurity workforce specifically. This roundtable discussion provides insight from 16 academics, practitioners, and educators into what makes work-based learning unique, effective, and valuable for the cyber workforce. Participants are not named as the roundtable was conducted under the Chatham House Rule.

Key Takeaways

Participants agreed work-based learning provides:
- Practical opportunities for career readiness or career advancement.
- Structured, experiential, and hands-on learning that focuses on industry needs, training on industry-specific tools, or the current cyber threat landscape.

Participants agreed that the cybersecurity workforce needs to:
- Move past the "either/or" system so that work-based learning and traditional education is more of a "both/and" system. Higher education values theoretical learning, but these values are not always the same in industry. However, a substantial knowledge base is required for just about any occupation in the cybersecurity field, and is sometimes best delivered in a traditional educational setting.

Participants believe effective approaches to work-based learning for cyber are:
- Ecosystem development.
- Programs that are paid and long in duration.
- Policy incentives to make work-based learning attractive to employers.

Participants perceive certain challenges that limit the utilization or adoption of work-based learning for cyber:
- Finding people who are willing to provide the opportunity remains a challenge for the academic community.
- Mid-career or nontraditional learners and rural communities have limited accessibility to such programs.

Discussion and Analysis

Participants were asked to consider four questions with respect to cyber education and workforce development at all levels and stages. First, participants were asked what work-based learning means to them as a way to discover and establish common ground among participants. Second, participants were asked to discuss the value of work-based learning compared to traditional degrees to begin assessing how experts compare and contrast these different educational models. Third, participants were asked to discuss the most effective work-based learning approaches, which allowed participants to extrapolate or provide examples for topics mentioned in the previous question. Fourth, participants were asked what challenges might prevent more learners from utilizing work-based learning pathways, which provided participants an opportunity to discuss policy and ecosystem recommendations.

1. What does work-based learning mean to you?

Participants were first asked to describe what work-based learning means to them as a way to discover and establish common ground. Participants agree that work-based learning provides:

- ***Practical opportunities for career readiness or career advancement.*** In this context, career readiness refers to creating pathways from the K-12 education system to community college, university, or the broader workforce. Career advancement refers to mid-career transitions, upskilling and reskilling the existing workforce, or adult learners entering the workforce. There was no strong indication that either the K-12 or higher education system excels at offering work-based learning. However, roundtable participants largely agreed that K-12 work-based learning focuses on career readiness, whereas higher education focuses on career advancement because of the types of learner populations it serves.

- **Structured, experiential, and hands-on learning that focuses on industry needs or the current cyber threat landscape.** The workforce needs this type of learning because cyber occupations are continually evolving. Work-based learning meets those needs more effectively than a traditional degree path without routine or regular training, as some participants pointed out that not all colleges or universities have the capacity to engage employers in a way that will keep their curriculum relevant and responsive.

These descriptions cohere with definitions from federal legislation that addresses work-based learning and workforce development. Thirty-three states define work-based learning in a statute or regulation.[*3] Some states simply adopt the definition from Perkins V:

- **The Strengthening Career and Technical Education for the 21st Century Act of 2018 (Perkins V).** The term "work-based learning" means sustained interactions with industry or community professionals in real workplace settings, to the extent practicable, or simulated environments at an educational institution that foster in-depth, first-hand engagement with the tasks required in a given career field, that are aligned to curriculum and instruction.[4]

- **The Workforce Innovation and Opportunity Act of 2014 (WIOA).** Sec. 109 says: "provide opportunities for work-based learning experiences (including internships, short-term employment, apprenticeships, and fellowships)" and [Sec. 109] "work-based learning experiences, which may include in-school or after-school opportunities, or experience outside the traditional school setting."[5]

- **The Every Student Succeeds Act of 2015.** Sec. 1112 says: "work-based learning opportunities that provide students in-depth interaction with industry professionals and, if appropriate, academic credit."[6]

2. What is the value of work-based learning compared to the traditional four-year college degree?

Participants agreed that work-based learning ensures cybersecurity skills are immediately applicable, relevant, and in some cases, specifically tailored to a business or industry. It also provides training and experience with industry-relevant cybersecurity tools. Participants agreed that work-based learning has always existed outside of the traditional education system, and that, in most situations, a student or learner must choose between completing work-based learning programs and a college degree program. It was noted that not all traditional universities or colleges have the

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* States with asterisks next to their name include a workforce or postsecondary definition of work-based learning, not just a definition for K-12 education: Alabama*, Arkansas, California*, Colorado*, Connecticut*, Delaware, Florida*, Idaho, Illinois, Indiana, Iowa*, Kansas, Kentucky, Louisiana, Maryland, Michigan, Minnesota, Mississippi, Montana, Nebraska, New Hampshire, New Jersey, New Mexico, North Carolina, Oklahoma*, Rhode Island, South Dakota*, Tennessee*, Utah*, Vermont*, Washington State, West Virginia, Wisconsin.

resources or capacity to engage industry or employers in a way that will keep their curriculum relevant or current with evolving trends in the field.

However, participants agreed that work-based learning should be more of a both/and system instead of the common either/or model, expressing that they would like to see a combination of the two systems in which learners receive required technical instruction in the classroom and then are able to practice that learning in a workplace environment while earning additional certifications, accreditations, and wages. Combining the two approaches creates a complementary system in which students receive related technical instruction in the classroom and apply those skills in realistic environments while working toward a degree.

Additionally, participants noted that work-based learning greatly serves non-traditional students. As an example, one participant highlighted that a mid-career learner might not always have the ability to commit to a two- or four-year academic program without a means of financial support. Work-based learning provides learners in this situation with an opportunity to earn wages while moving toward a credential or completion of an academic program.

Broader research on the topic is also optimistic regarding the potential of work-based learning. For employers, the value is in developing dedicated talent pipelines and training prospective employees in company-specific ways. For students and learners, the value is in exposure to high-quality learning opportunities that provide experience in specific industries and occupations. In some cases, work-based learning is shown to have had positive effects on student outcomes such as academic success, job placement, starting salary, and student confidence.[7] For example, bachelor's degree recipients who held paid internships are more likely to earn more than $4,500 on average per year than those who do not participate in paid internship programs.[8] Work-based learning can be especially useful for low-income students or learners who might not otherwise have access to opportunities or higher education in general.[9]

For cybersecurity specifically, another example is found in the Biden administration's Cybersecurity Apprenticeship Sprint in 2022. Registered apprenticeships—a form of work-based learning—are touted as a proven earn-while-you-learn model. The sprint sought to build a pipeline of skilled workers through the apprenticeship model by focusing on underserved communities.[10] The results were promising: 1,000 apprentices were hired into the private sector, of which 42% were people of color and 32% were female.

One participant noted that work-based learning is difficult to facilitate in the K-12 system because it is difficult to grade, mostly because it is hard for teachers to fairly evaluate students who are working across varying projects without common benchmarks. On top of this, teachers must adhere to state-mandated standards and curricula that limit student exposure to this type of learning. This speaks to a broader criticism of workforce development outside of traditional academic pathways, which is that there are few shared benchmarks that outline skill development—and how to both obtain and measure them—for different industries and occupations.[11]

Fortunately for cybersecurity, a framework for cyber jobs and associated skills and knowledge already exists, which academic programs and industry can use to tailor, measure, or test certain knowledge, skills, and abilities of prospective employees who do not possess a college degree. The National Initiative for Cybersecurity Education (NICE)—an office within the National Institute of Standards and Technology (NIST)— Cybersecurity Workforce Framework establishes a common language that describes cybersecurity work and the knowledge and skills needed to complete that work.[12] There are five work role categories: (1) Oversight and Governance, (2) Design and Development, (3) Implementation and Operation, (4) Protection and Defense, and (5) Investigation. The NICE Framework is used by both the public and private sectors for objectives such as promoting career discovery, supporting education and curriculum development, supporting work-based learning, assessing candidate skills, and planning workforce capabilities.[13]

3. What are the most effective work-based learning approaches?

There are commonly accepted guiding principles of effective work-based learning programs such as offering compensation, establishing cross-sector partnerships, supporting career entry and advancement, and providing meaningful job tasks that build career skills and knowledge.[14] However, given the specific focus on the "both/and" system in the previous question, the roundtable discussion centered on which factors or environments make the "both/and" model successful.

As a result, participants focused on the necessary development of local ecosystems to support the "both/and" system. Participants offered several examples of school systems that offer cybersecurity programs in partnership with both local higher education institutions and private sector organizations.[†] Developing local ecosystems to support cybersecurity education is one of the guiding imperatives of the NCWES, which states that a model cyber education and workforce development ecosystem

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[†] For privacy reasons, specific examples mentioned during the roundtable will not be named.

should include components such as diverse stakeholders, multisector partners, and experiential learning.[15] The ONCD also published a cyber workforce and education ecosystem toolkit, which offers yet another perspective on the power of such ecosystems: developing local and regional technological resiliency.[16]

Education and workforce ecosystem development may be organized and led at the federal, state, or local levels.[17] Of course, part of the successful development of local or regional cyber education ecosystems is based on geography and proximity to opportunity. While a motivation for developing local ecosystems might be to build that community technological resiliency, it is only as effective as its existing infrastructure. Several participants noted that serving rural communities can be challenging. Students and learners who might want to stay in their local communities are often forced to leave in pursuit of a cyber job elsewhere. In addition, participants also noted how the effectiveness of certain characteristics of work-based learning also depends on the learner's needs, the workforce's needs, the program's ability to meet them, and the availability of funding. Federal funding programs have supported specific and regionalized schemes for cybersecurity workforce ecosystem development.

As an example, NICE facilitates the Regional Alliances and Multistakeholder Partnerships to Stimulate (RAMPS) Cybersecurity Education and Workforce Development program. As the name suggests, the program brings together employers, academic institutions, and community organizations to align the cyber workforce needs of local businesses and nonprofit organizations with the learning objectives of education and training providers.[18] The program awarded its first grants in 2016. Reported outcomes suggested the pilot was successful. For example, the Cyber Prep Program at Pikes Peak Community College in Colorado established a partnership with school districts and employers to create workforce development pathways that addressed local workforce needs.[19] As a result, university and community college articulation agreements saved students approximately 50 credit hours, and internship partnerships placed over 100 students with local employers.

Additionally, the National Security Agency (NSA) launched Cyber Clinics in four U.S. states. These clinics are operated and funded through institutions that are designated as National Centers of Academic Excellence in Cyber (NCAE-C). The clinics support communities and small businesses that would otherwise not have access to resources such as cyber risk assessments or planning assistance, while also providing students with the opportunity to exercise classroom instruction. According to the ONCD, the Cyber Clinic model has attracted more than $25 million in private sector investment, which enabled the opening of an additional 45 clinics at NCAE-C institutions.[20]

4. What challenges or barriers prevent more utilization?

Throughout the discussion, it became evident that two factors prevented increased utilization of work-based learning education: employer interest and accessibility. While participants acknowledged that work-based learning serves non-traditional students such as mid-career learners, they also recognized that the current system does not always serve these students effectively. Previous CSET research on the AI workforce revealed similar conclusions, noting that updates to the WIOA should include funding allowances for wraparound services, such as childcare and transportation costs, so that nontraditional learners are enabled to participate.[21]

It is clear that work-based learning programs require partnership between educational institutions and employers to be successful. Consensus formed around the idea that finding employers who are willing to provide the opportunity remains a challenge for the academic community. Participants identified a critical need to incentivize employer participation—which is echoed in empirical research.[22] There are fundamental differences between internship programs and registered apprenticeship programs. For example, a typical company internship program is designed by the employer, who also retains control over wages, responsibilities, duties, and hiring. For registered apprenticeship programs, the employer must adhere to externally developed terms as mandated by the U.S. Department of Labor or a State Apprenticeship Agency, which theoretically limits their control over those same factors.[23]

This is not to suggest that one work-based learning program is superior to another. Instead, it highlights why employers might be less incentivized to participate in ecosystem-driven work-based learning programs over ones that are internally developed, and why participants expressed the need for policy incentives to encourage broader employer participation. While federal funding certainly assists with the creation and sustainability of education and workforce development ecosystems, as evidenced by the RAMPS program, it is state- and local-level policy that impacts work-based learning more directly because it is more agile and responsive. For example, at least 38 states offer tax credits for hiring apprentices or tuition support for registered apprentices.[24‡]

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‡ The states are: Alabama, Arkansas, California, Colorado, Connecticut, Delaware, Florida, Georgia, Illinois, Indiana, Iowa, Kansas, Kentucky, Louisiana, Maine, Maryland, Massachusetts, Michigan, Mississippi, Missouri, Montana, Nevada, New Jersey, New York, North Carolina, North Dakota, Ohio, Pennsylvania, Rhode Island, South Carolina, Tennessee, Texas, Virginia, Washington State, West Virginia, Wisconsin, and Wyoming.

Others participants noted that the onus falls on employers to respond or react to changes in the workforce development system—especially for cybersecurity. For employers, the value of work-based learning is that it can be structured to serve any learner, allowing employers to reskill or upskill their existing workforce. One participant highlighted that technology skills have an ever-shrinking half-life and that employers need to be willing to provide training opportunities to their existing employees. Similarly, when discussing the previous question, participants expressed the idea that there is a "broken first rung" of the cybersecurity career ladder that is discouraging students from utilizing work-based learning opportunities. Participants who were educators expressed concern for students who do not qualify for entry-level positions because of a lack of experience or necessary credentials, despite having a university degree. For example, it was observed that many cybersecurity job descriptions prioritize years of experience over demonstrable skills—a dynamic intensified by the staggering 450,000 cybersecurity vacancies in the United States.[25]

Lastly, it is worth noting that the components of work–based learning that seem to do well—registered apprenticeship and career and technical education (CTE)—share a robust repository of data and effectiveness assessments allowing for evidence-based research to identify areas of strength and weakness. For cyber workforce development, efforts to improve data collection and sharing are already underway. Mandated by the CHIPS and Science Act of 2022, the Cybersecurity Workforce Data Initiative exists to assess the feasibility of producing national estimates and statistical information on the cybersecurity workforce.[26]

Conclusion

This roundtable provided valuable and diverse insights into how work-based learning is serving and supporting cyber education and workforce development. The group found that because the nature of cybersecurity is constantly evolving and changing, it is imperative that the education system also evolve and respond to adequately prepare students. At the same time, the onus of responsibility also falls on employers to update hiring practices and develop internal workforce training efforts. The value of work-based learning for cyber jobs should not be that it is a separate form of learning compared to the traditional four-year degree. Rather, the value of work-based learning should be that it is complementary to traditional classroom instruction and provides students with tangible and practical experience.

In summarizing the discussion, two recommendations emerge: (1) prioritize local and regional ecosystem development and (2) create and support policies that encourage broader work-based learning participation. Education and workforce ecosystem development is largely spearheaded by the local academic community, but it can be better supported by local and state policy to encourage employer participation. While a majority of states have policies to encourage employer participation in work-based learning and other policies that support work-based learning initiatives, research suggests that most states do not appropriately leverage their own mechanisms.[27] At the federal level, the ONCD, DOL, and NICE continue to lead efforts to support ecosystem initiatives.

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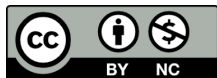
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