PESC®
BEST PRACTICES

iQ4 AND NATIONAL STUDENT CLEARINGHOUSE AWARDED 1ST PLACE IN 18TH BEST PRACTICES COMPETITION
EXTENDING THE CAPACITY OF HIGHER EDUCATION TO SCALE THE OUTPUT OF VERIFIED WORKFORCE-READY GRADUATES

Washington, D.C.   The Board of Directors of PESC is pleased to announce iQ4 and the National Student Clearinghouse as 1st Place Winners of PESC's 18th Annual Best Practices Competition for its submission, ***"Extending the Capacity of Higher Education to Scale the Output of Verified Workforce-Ready Graduates."***

The award-winning submission received high praise from the PESC Board for its open and broad collaborative approach, sophisticated automation, transparent capacity, use of national standards and innovative technology employed, and for the positive results and outcomes it immediately produces.

The overall goal of this initiative is "to scale the next generation workforce by accelerating technology-risk and cybersecurity skills training," and is accomplished through a financial, industry-driven coalition, the Cybersecurity Workforce Alliance (CWA). The CWA originally formed in 2015 with iQ4, City University of New York (CUNY), John Jay College of Criminal Justice, the State University of New York, University at Albany, and eight senior cybersecurity executives, and now has 500+ members. CWA members "virtually mentor the college student workforce in solving scenario-based cybersecurity business problems to accelerate awareness, experience readiness and scale the student workforce, so they are more attractive to hire and can provide almost immediate value to the private sector by improving a company's technology and security capabilities globally."

The competency-based model, proven in the cybersecurity sector, is transportable across all faculty, disciplines and industry sectors, and leverages the NIST Critical Infrastructure Framework and the National Initiative for Cybersecurity Education (NICE Workforce Framework), now automated on the iQ4 Workforce Risk and Mobility platform and made available as open source.

Students from public higher education institutions can now graduate with a combined academic and workplace skills portfolio, captured in a co-curricular transcript, and are landing career-inspired jobs, having no prior background or experience, with companies that have never hired from those institutions before. "On-the-job training while in class" is transformational and salary levels are life-changing.

> "On behalf of the iQ4 team, the CWA and our strategic partner the National Student Clearinghouse, we are thrilled and honored to receive this 1st place award and very special recognition. Data Standards, Trusted Source, Empowerment, Mobility and its value to students, education and employers, are the centerpieces of our work. Our teams continue to work relentlessly to solve the student workforce readiness challenge, that can measure applied knowledge, performance and progression, at massive scale, core to our Skills Passport co-curricular data driven credentialing. Industry can now utilize academic and applied learning data, to map student skills, competencies and academic accomplishments to their hiring needs. Working together we will transform our next generation workforce."
> **FRANK C. CICIO, JR., CEO and Founder, iQ4 Corporation**

MULTIPLE STAKEHOLDERS | ONE VISION

"This is a next generation solution that is showing real results. Determining industry and job profile standards are at the heart of this initiative along with the platform itself, enabling workforce and education to collaborate. The result is a demonstrable closing of the skills gap. The National Student Clearinghouse and iQ4 are very honored to be recognized."
RICARDO D. TORRES, President and CEO, National Student Clearinghouse

"When the history of cybersecurity is written, the CWA and the Epic Challenge Program will be hailed as trailblazers in cybersecurity education. I strongly believe that we, the consortium members of the CWA, are not only creating the next generation of the cybersecurity workforce, but also preparing them to protect and defend this great nation. The work we do here protecting our national critical infrastructures is a part of our journey towards the attaining the ultimate technological nirvana: cyber-resilience and freedom from cyber warfare."
GOPAL PADINJARUVEETIL, Vice President, Chief Information Security Officer Auto Club Group, Michigan

"We are pleased at the University at Albany, SUNY to be working with our partners on this virtual internship in this cybersecurity project-based course. It inspires our students to work hard and learn in a powerful way that builds on their academic curriculum to get them work-ready before graduation. The documentation in the iQ4 platform of the skills learned adds a critical component and the partnership with the National Student Clearinghouse provides authenticity, access, and scale. From my perspective in Higher Education, this work is transformational and the PESC award recognizes that."
JAMES STELLAR, Interim President, University at Albany, SUNY (State University New York)

"The virtual internship has provided our students with a remarkable learning opportunity.   Through it, they learn about what cybersecurity work is like; they develop soft skills through industry mentor feedback that help them gain entry to one of fastest growing global career sectors."
ANNE LOPES, Associate Provost for Strategic Initiatives and Dean of Graduate Studies, John Jay College/CUNY (City University of New York)

"Preparing the next generation of cybersecurity experts through higher education is a mutual passion between iQ4 and EC-Council. This starts by incorporating real-world skills, hands-on education and stackable credentials in Cybersecurity domains. Tracking knowledge, skills and abilities within these credentials, while being able to translate those into marketable records for students to showcase to employers is invaluable. We congratulate iQ4 and the National Student Clearinghouse on their successful efforts."
WESLEY ALVAREZ, Director of Academics, US. The International Council of E-Commerce Consultants (EC-Council)

"Congratulations to the CWA for being recognized for its hard work in preparing students who are ready to meet the demands of the financial industry. It is exciting to see CWA, a financial, industry-driven coalition, successfully address many of the objectives in NICE's Strategic Goals, *Accelerate Learning and Skills Development*, *Nurture a Diverse Learning Community*, and *Guide Career Development and Workforce Planning*."
BILL NEWHOUSE, Deputy Director for the National Initiative for Cybersecurity Education (NICE), National Institute of Standards and Technology (NIST), U.S. Department of Commerce

"This program takes a unique approach to teaching by applying assignments to actual work the student would likely perform on the job. In addition, the use of current cyber security threats and industry professionals involved in the creation of the curriculum, assignments, lectures, and the live critiquing of assignments provides students with the ability to hear what the expectations as a future employee. The often long jump that a student needs to make from learning theory in the classroom to applying their learning and demonstrating their ability is eliminated through this learning approach."
CHRYSANTHE CUPONE, Manager, Information Security Awareness, IT Risk Management and Services, American Express

"By the extension of the workplace into the classroom via mentors and 'real world' curriculum, the program provides one of those unique opportunities to positively impact not only students, but security professionals (mentors), the Cybersecurity industry, and the Business. It is truly a win for all."
TERESA DUROCHER, Information Security Professional

"Working with our partners, we have "cracked the code" in creating an innovative technology solution, that presents complex data, and respects privacy, in a powerful and compelling user experience! We are all exploring new groundbreaking frontiers that will raise the bar and help level the playing field for students globally."
KYLE HAMILTON, Chief Innovation and Data Science Officer, iQ4

"The NIST National Cybersecurity Workforce Framework (NCWF) is being adopted internationally, so this initiative has two key values: first for overseas students studying in the USA and then returning home with verifiable credentials and, secondly, for the global expansion of the Cybersecurity Workforce Alliance with workforce ready candidates."
PETER MEEHAN, Head of International and Partnerships iQ4

The award-winning submission made by iQ4 and the National Student Clearinghouse is posted on the PESC website with prior winners at http://www.PESC.org. An Awards Ceremony will be held during the General Sessions at PESC's Spring 2017 Data Summit being held May 3-5, 2017 in Washington DC at the Embassy Row Hotel.

For more information about iQ4, please contact CWA@iQ4.com or visit www.iQ4.com.

For more information about the National Student Clearinghouse, please visit www.studentclearinghouse.org.

For more information about NIST NICE including an upcoming webinar on Wednesday April 19, 2017 2:00 pm EDT *Rethinking Credentials for Cybersecurity Careers*, please visit https://www.nist.gov/itl/applied-cybersecurity/nice.

PESC's Empowering the Mobility of Digital Academic Credentials | Spring 2017 Data Summit on *Best Practices in Education Data Systems* is being held May 3–5, 2017 in Washington DC and is co-sponsored by Connecting Credentials.

PESC celebrates its 20th Year Anniversary October 18–20, 2017 at EDiNTEROP 2017 | PESC Fall 2017 Symposium and Data Summit to be held at the Radisson Admiral Hotel Harbourfront in Toronto.

NEW GROUPS FORMING AT PESC

JSON Task Force - PESC is establishing a Task Force to advise PESC Members and the education community on the impact and utility of JSON in the education domain and its relationship to XML. Under the continued leadership of the PESC Technical Advisory Board, this Task Force will continue the ongoing discussions about JSON and ultimately recommend what action, if any, PESC should undertake as a result of the emergence of JSON.

CREDENTIAL ENGINGE/HR-XML/PESC Mapping Workgroup — A joint Workgroup is forming to open discussions with stakeholders in credentialing to analyze, compare, discuss enhancements and identify opportunities to advance interoperability. Under the continued leadership of the PESC Academic Credentialing and Experiential Learning Task Force and with input from the Education Record User Group (ERUG), this Workgroup will identify updates or enhancements to PESC Approved Standards.

EWP/EMREX/PESC Mapping Workgroup — PESC is forming a Workgroup to analyze, compare, discuss enhancements and identify opportunities to advance interoperability with Erasmus Without Paper (EWP) and EMREX. Under the continued leadership of the ERUG, this Workgroup will identify updates or enhancements to PESC Approved Standards.

XML REQUEST/RESPONSE Development Workgroup — PESC is forming a Workgroup to develop Request and Response XML standards for all PESC Approved Standards. Under the continued leadership of the Steering Committee of the Standards Development Forum for Education and with input from the ERUG, this Workgroup will develop and produce Request and Response formats useable for all PESC Approved Standards.

The inaugural convenings of these Groups will occur at PESC's Spring 2017 Data Summit, taking place May 3-5, 2017 in Washington, D.C. at the Embassy Row Hotel in Dupont Circle. See www.PESC.org for more info.

PESC IS SPONSORED ANNUALLY by Credentials Solutions, National Student Clearinghouse, Oracle and Parchment Inc. PESC partners include AACRAO, APEREO, ARUCC, EMREX, EWP, Groningen Declaration Network, Internet2, SHEEO, and the US Department of Education's Common Education Data Standards (CEDS) Initiative.

PESC IS A PROUD EXHIBITOR at AACRAO's Annual Meeting, ARUCC's Annual Meeting, and the Annual STATS-DC Conference of the National Center for Education Statistics (NCES) of the US Department of Education.

PESC IS A PROUD SPONSOR of AIR's Annual Conference and of the Annual California Electronic Transcripts Workshop and CCCApply.

PESC IS A PROUD MEMBER/AFFILIATE/SIGNATORY of is AACRAO, of the NCES National Forum on Education Statistics, and of the Groningen Declaration Network.

PESC HAS A STRONG HISTORY that includes AACRAO, SPEEDE, EDI, ANSI, X12, Canada, the US Department of Education and Y2K. Read more at www.PESC.org.

IN FULFILLING ITS NON-PROFIT MISSION, all PESC Approved Standards are available to the education community online free of charge at www.PESC.org.

ABOUT PESC

ESTABLISHED IN 1997 AT THE NATIONAL CENTER FOR HIGHER EDUCATION & HEADQUARTERED IN WASHINGTON DC, PESC is an international, 501 (c)(3) non-profit, community-based, umbrella association of data, software and education technology service providers; schools, districts, colleges and universities; college, university and state systems; local, state/province and federal government agencies; professional, commercial and non-profit organizations; and non-profit associations & foundations.

LEADING THE ESTABLISHMENT & ADOPTION OF DATA EXCHANGE STANDARDS ACROSS THE EDUCATION DOMAIN. Through open and transparent community participation, PESC enables cost-effective connectivity between data systems to accelerate performance and service, to simplify data access and research, and to improve data quality along the Education lifecycle. PESC envisions global interoperability within the Education domain, supported by a trustworthy, inter-connected network built by and between communities of interest in which data flows digitally and seamlessly from one community or system to another and throughout the entire eco-system when and where needed without compatibility barriers but in a safe, secure, reliable, legal, and efficient manner.

ABOUT PRIVACY While PESC promotes the implementation and usage of data exchange standards, PESC does not set (create or establish) policies related to privacy and security. Organizations and entities using PESC Approved Standards and services should ensure they comply with FERPA and all local, state, federal and international rules on privacy and security as applicable. For more information, see www.PESC.org.

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iQ4-Cybersecurity Workforce Alliance

Applied Learning and Standards Based Performance Metrics

EXTENDING THE CAPACITY OF HIGHER EDUCATION TO SCALE THE OUTPUT OF VERIFIED WORKFORCE-READY GRADUATES

Authors:

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iQ4-Cybersecurity Workforce Alliance Applied Learning And Standards Based Performance Metrics

Executive Summary:

1. An industry-led movement called the Cybersecurity Workforce Alliance (CWA) accelerates the supply of workforce ready entry-level candidates with a virtual-internship model. **Industry experts mentor learners to solve scenario-based cybersecurity business problems to accelerate awareness, experience, readiness and scale the student workforce.**

2. Virtual-internships and CWA online learning community, grounded in competency-based learning. Extending the workplace into the classrooms via the iQ4 Workforce Supply Chain and Mobility Platform (iQ4), which underpins the CWA virtual community. **The CWA competency-based model, proven in the cybersecurity sector, is transportable across all faculty, disciplines and industry sectors.**

3. The CWA leverages the NIST- Critical [Cybersecurity] Infrastructure framework and the National Initiative for Cybersecurity Education (NICE) taxonomy, which describe the specialties, competencies and knowledge skills and abilities required for Job Family functions required to operate a NIST framework effectively. iQ4, with JPMorgan Chase, co-chair the NICE Workforce Workgroup to make the taxonomy useful and transportable across all sectors. The taxonomy has been extended under this leadership to 1,235 rows of 4-tiers including KSAs. The Financial Services industry has adopted NIST/NICE, as have the Federal Communications Commission (FCC) with the Utilities Technology Commission (UTC) expected to follow soon because in a standards-based Alliance they do not have to 'go-it-alone". The taxonomy also describes learning outcomes which industry can describe to Education so courses can be aligned to measured outcomes. Students are assessed against the KSAs for data driven verifiable credentials. **The taxonomy has been automated on the iQ4 Platform and is made available to Alliance members as "Open Source".**

4. Digital Academic and Supplemental Transcripts integrate verified student career related activities from the iQ4 platform (community service, apprenticeships, internships, co-ops, externships, service learning, mentoring etc.) with a new Portal from the National Student Clearinghouse (NSC). **Student records include verified credentials showing academic and experiential learning progress and performance.**

Addressing the Cyber Skills Gap:

The weak link in the supply chain of qualified cybersecurity workers is the capacity of educational institutions to produce the number of workers needed to fill the millions of cybersecurity job openings projected by 2020. The pipeline to a workforce of trained professionals ready to contend with the ever-changing landscape of threats is restricted by the limited numbers of trained faculty and the time consuming formative feedback processes needed for growth in competencies.

Transformation Required: Building the capacity and broadening the expertise of colleges and universities to prepare learners with the skills that employers need to address the newest threats requires an industry-education partnership that replicates on-the-job training. This will assure that graduates are ready to productively contribute to cybersecurity teams on the day they are hired.

The Solution:

The CWA is a division of iQ4 Corporation, is a 502-member (and rapidly growing) industry driven movement, formed in January 2015, with the City of New York (CUNY) John Jay College of Criminal Justice, to scale the next generation workforce by accelerating technology-risk and cybersecurity skills training. CWA members mentor the college student workforce, so they are more attractive to hire and can provide almost immediate value to the private sector by improving a company's technology and security capabilities globally. CWA mentors are practicing cybersecurity experts with professional expertise, knowledge of regulatory requirements and experience responding with the most current threats and responses. By virtually extending the workplace into universities and colleges the CWA develops "workforce readiness" and has demonstrated a reduced post-hire training time by 3-6 months, which is delivering a Return on Investment (RoI) to Industry of over 30:1. In the past two years, CWA mentors have projected that participation will reduce an employer's typical first and second year attrition and rejection rates by improving the percentage of "good-fit" hiresi. Most importantly, the CWA supports the recruitment and retention of cybersecurity students from all disciplines. Between 2015 and 2016, 193 students participated in the Epic Challenge with less than a 5% percent dropout among open enrollment students and a single dropout in programs which require a student application.

Benefiting from NIST/NICE Standards

The CWA education to Industry supply chain curriculum is based on the NIST Critical Infrastructure Framework and NICE Taxonomy, which underpins it.

The content for a CWA challenge covers core competencies e.g., knowledge, skills, and abilities relating to the identification, detection, protection against, response to and recovery from an insider threat including how to build and maintain communications with executives, peers and regulators. Plus, the essential skills (e.g., teamwork and communications skills), which are required in the workforce. The assignments of the virtual internship are designed to assess both core competencies and essential (soft/professional) skills.

Learning outcomes are centered around the NITS/NICE frameworks to deliver the values described in the graphic, below.

General knowledge and awareness – Knowledge of:

- Cyber threats and vulnerabilities
- Cybersecurity principles
- The need for apply security within national and international laws, regulations, policies, and ethics as they relate to cybersecurity.
- Core in demand Cyber security roles and the basic work profiles of those roles when working in teams (e.g. Risk, CISO/InfoSec, IT Analysts, Governance, Compliance, Behavioral Analysts)
- Basic risk management processes (e.g., methods for assessing and mitigating risk)
- The nuances within Insider Threat landscape e.g. between IP Theft, Sabotage, Collusion, etc.

The NICE taxonomy is used to identify the KSAs that students are taught and measured on for the role they will play within their team based project throughout the course. Role Description: -

As the students are candidates to entry-level roles, they are assessed (only) on the 10 core principle KSAs for that role; whereas in a full professional role the job may require circa 40 KSAs – some "required" and some an "asset".

Information Security Officer: Example entry-level KSAs below.

10 **Skills & Personal Qualities**

| Add skills... | | ≣ All Categories | 🔍 |

Skill	Yrs. Exp.	Required	

Essential Skills

CRITICAL THINKING
˅ Analytics   ✕

| ✔ | Demonstrates the ability to identify and evaluate problems or issues | 8 | ✔ |

PROFESSIONAL DEVELOPMENT & LEARNING
˅ Professionalism   ✕

| ✔ | Consistently meets expected results within deadlines | 3 | ✔ |

COMMUNICATION
˅ Strategic Communication ✕

| ✔ | Communicates appropriately with people at various levels and backgrounds, even if they have differing viewpoints. | 2 | ✔ |

˅ Verbal Communication ✕

| ✔ | Able to communicate a point demonstrating logic, reasoning, and soundness of argument. | 0 | ✔ |

˅ Written Communication ✕

| ✔ | Demonstrates a mastery of language structure and syntax through formal and informal writing. | 0 | ✔ |

Cybersecurity - Oversee and Govern

TRAINING, EDUCATION, AND AWARENESS
˅ Financial Industry Awareness ✕

| ✔ | Knowledge of Financial Industry (e.g., banking, insurance, securities) Products and Processing | 0 | ✔ |

SECURITY PROGRAM MANAGEMENT
˅ Information Assurance ✕

| ✔ | Knowledge of information assurance (IA) principles used to manage risks related to the use, processing, storage, and transmission of information or data. | 0 | ✔ |

˅ Risk Management ✕

| ✔ | Knowledge of risk management processes (e.g., methods for assessing and mitigating risk). | 0 | ✔ |

Cybersecurity - Operate and Maintain

SYSTEMS SECURITY ANALYSIS
˅ Information Systems/Network Security ✕

| ✔ | Knowledge of cybersecurity principles. | 0 | ✔ |

˅ Vulnerabilities Assessment ✕

| ✔ | Knowledge of cyber threats and vulnerabilities. | 0 | ✔ |

iQ4 Platform

The CWA uses the iQ4 Workforce Supply Chain and Mobility platform to promote efficient standards-based collaborations between the industry and educational partners. iQ4 consists of three components that support workforce pipeline development: the taxonomy tool (of industry defined role profiles), digital passport, and the Epic Challenges.

Digital Passport: Comprehensive Proficiency Profile for individuals which reports on technical/career competencies, essential (soft) skills, work-related experiences, personal highlights, interests, and formal and informal education (shown in Figures 1, 2, 3 & 4).

- Provides a record of career related activities such as: community service, apprenticeships, internships, co-ops, externships, service learning, mentoring etc.
- Validates proficiency reporting and confirm prior learning through project-based assessments or challenges
- Documents progress on career pathways/roadmaps and credential "stacking" across institutions
- Reduces the time and cost required to complete credentials through competency-based pathways which identifies gaps in individual proficiencies and provides recommendations for appropriate courses/learning experiences/training
- Identifies subject matter experts that can respond to learner questions
- Assures data integrity of measured assessments through *National Student Clearinghouse[ii]* validation of co-curricular transcripts.
- Students active data résumés are transportable between iQ4's Passport on the iQ4 Workforce Risk and Mobility Platform and NSC's "MyHub" digital mobile academic records Platform.

See over for screenshots

Figure 1: NSC MyHub Portal: my education, my transportable information

Figure 2: NSC MyHub Portal: empowering students with *their* data

Figure 3: NSC MyHub Portal: example transcript – course report

Figure 4: iQ4 Student's Digital Passport – an active data résumé"

Standards and Taxonomy Tooling: a unified framework for understanding the competencies associated with different credentials, certifications, degrees. The Platform tooling includes an automated version of the National Initiative for Cybersecurity Education (NICE) / NIST Cybersecurity Workforce Framework (skills mapping in Figure 6) and which align Cyber/Risk job families to teaching outcomes and educational designations, including National Security Agency Centers of Academic Excellence.

- Provides a common language lexicon and industry defined role profiles that represent entry level positons which enables employers to describe the competency gaps in their workforce that they need to address
- Enables the comparison of the vast landscape of credentials to identify competencies associated with employer required certifications
- Supports diversity efforts by representing, women, military and corporate training in terms of competencies

The first action a student undertakes is to complete their digital Passport, described in the associated user guides. Based on CWA member, industry and customer feedback a new user interface, improved navigation to assemble skills or assemble job family roles. (Figure 4).

Figure 6: Standard (NICE) Taxonomy Student Skills and Proficiency Assessment
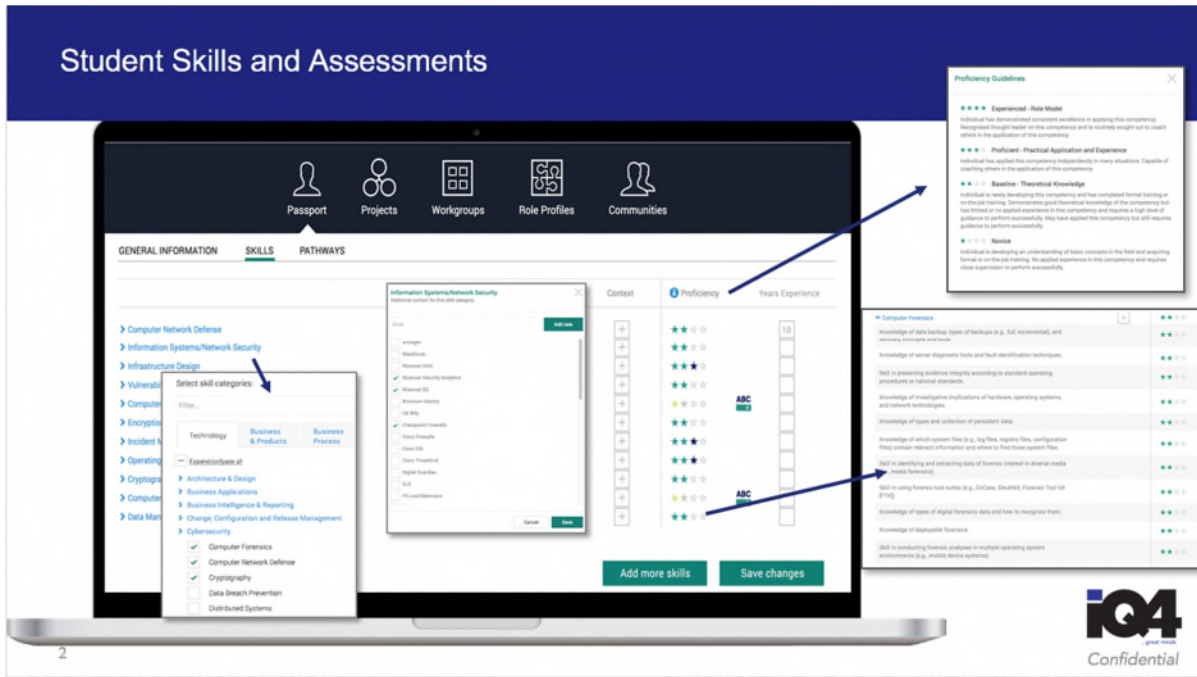
Project-Based Learning and Assessment (Epic Challenges): "virtual-*menternships™*" in which students perform authentic job roles (ex. technical, procedural, legal, behavioral, skills and proficiency) as part of interdisciplinary project teams mentored by industry subject matter experts with faculty oversight. (Students monitor their progress and receive feedback for their performance through the engagement interfaces pictured in Figure 7.)

Figure 7: Platform Interactions – Student Engagement Interfaces
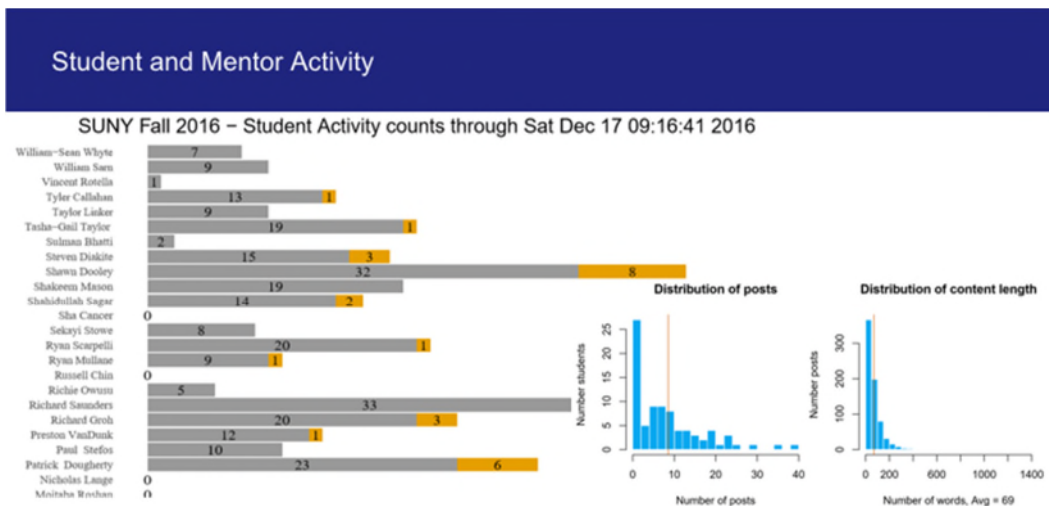
Web - Weekly Project Activity
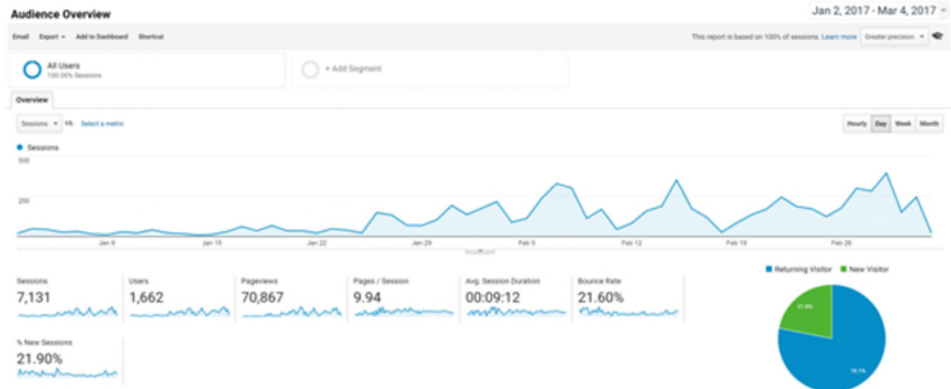
6

Features of the iQ4 virtual learning platform:

1. Virtual applied learning platform creates massively scalable (critical thinking) problem-based learning experiences by extending the workplace into the classroom. Learners solve real-world problems and receive independent measures of their performance (Figure 9).

2. Mentor and peer assessment of learning outcomes, real-time knowledge and soft skills in a variety of contexts including classroom, work-based and online learning validates reported proficiencies are provided to the learners in real-time (Figure 9)

Figure 9: Analytics: Including Mentor Assessments

Weekly Mentor assessments of Assignments – to show measured *performance* and *progression* from which to academia, mentors and hiring managers can surmise *potential*.
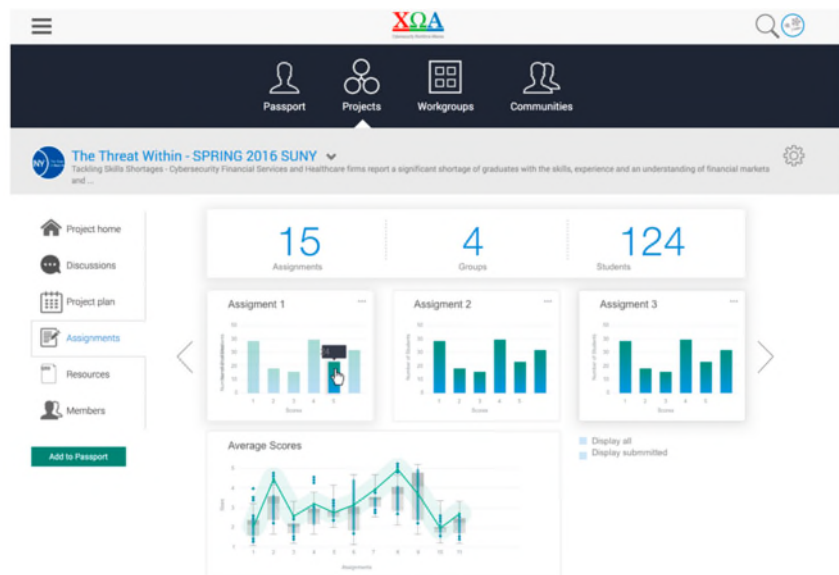
3. Community of practice provides the deliberate practice and continuous corrective feedback required for growth in competencies
4. Orientation unit (Cyber101) provides background information and context to non-technical members of the project teams to successfully participate in the Epic Challenges. The CWA alumni mentor resource pool comes faculty and students across multiple disciplines such as information technology, law enforcement, medical/business administrators, accountants, psychology, communications, and mathematics)
5. Virtual partner learning environments and tools augment existing facilities and technical tool access. Current partners include EC Council Cyber Range laboratory exercises and Red Owl Insider Threat Digital Surveillance system.
6. Student-Mentor ratios averaging 8-1 increases the course capacity of a single faculty member. One faculty member serves as the facilitator who administrates and aligns the CWA to existing courses and departmental curriculum. The industry mentors serve at no cost to the educational institution and lead projects teams, typically of eight students.
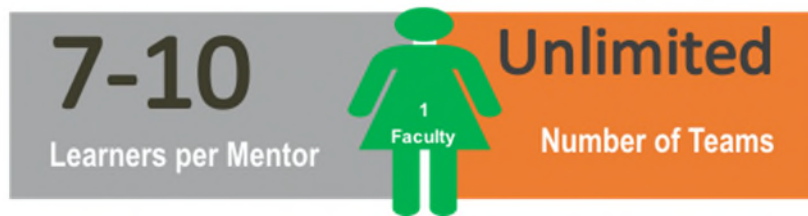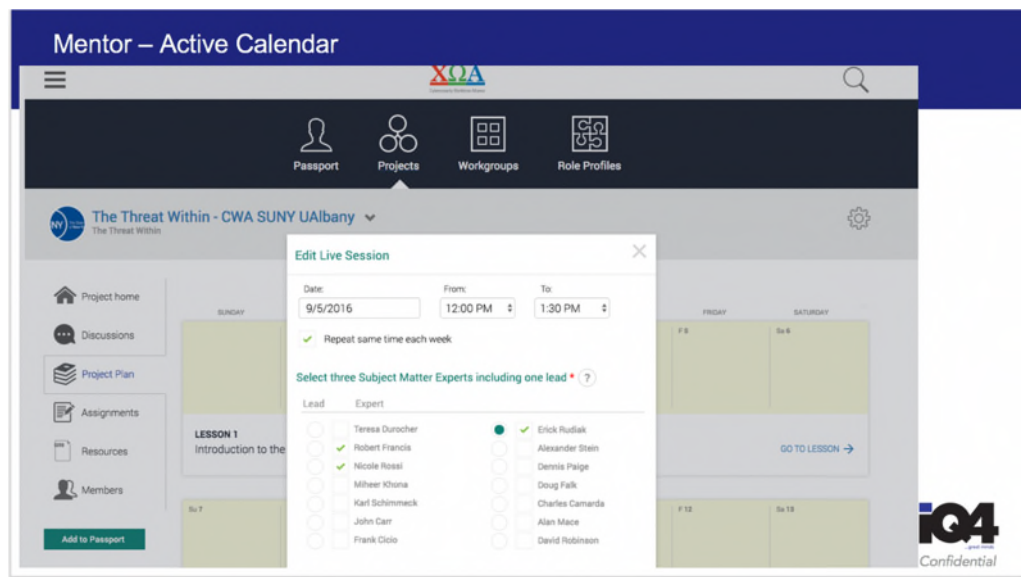

Figure 10: Assigning Mentors to Project Teams and Curriculum Dates

Ease of use –

Flexibility in scheduling mentors or substitute into curricula and weekly mentoring sessions

Learning outcomes – Great Jobs

The Epic Challenge is part of the applied learning initiative at the John Jay College of Criminal Justice, City University of New York, and the College of Emergency Preparedness, Homeland Security and Cybersecurity at the University at Albany, State University of New York. CWA graduates are already strengthening the cybersecurity workforce, for example, at the FBI, Mellon, New York District Attorney's Office, International Securities Exchange, Deloitte, the New York State Emergency Resilience, The United States State Department, PwC, Capgemini, The New York State Governor's Office, K2Security, Regeneron Pharmaceuticals, Dave and Busters Inc. and are conducting research at Harvard.

Competency-Based Education

The Department of Education defines competency as "the ability to apply or use knowledge, skill, behaviors to successfully perform critical work tasks, specific functions, or operate in a given role or position[iii]."

Recent trends indicate that more employers are requiring college degrees from their candidates and more non-traditional students need workforce specific training[iv]. Therefore, employers and educators are returning to strategies which can accelerate competency development or the degree attainment process. Competency-based education has been proposed as a solution because it provides recognition for prior learning and work experience, learner-centered self-paced educational experiences, and competency development aligned with workforce needs[v]. This brief reviews the research on competency-based education as it relates to the success of the CWA applied learning and performance measurement.

Competency-based education (CBE) is routed in the educational reforms of the 1950's which linked the mastery of scientific principles to improved national security. During this time, the solution to the perceived lack of scientific talent was to provide and improve educational opportunities[vi]. The Findings and Declaration of Policy section of the National Defense Education Act (1958) states,

> *"The Congress hereby finds and declares that the security of the Nation requires the fullest development of the mental resources and technical skills of its young men and women. The present emergency demands that additional and more adequate educational opportunities be made available. The defense of this Nation depends upon the mastery of modern techniques developed from complex scientific principles. It depends as well upon the discovery and development of new principles, new techniques, and new knowledge.*

We must increase our efforts to identify and educate more of the talent of our nation[vii] (p.183.)"

An educated strong workforce will both assure and support growth in the economy, "expand opportunity, and widen the pathway to the middle class[viii]. Furthermore, there is an urgent need for a trained workforce to address the crisis in cybersecurity. Therefore, the return to a CBE strategy could represent an evidence-based approach to education and training that successfully addressed national defense in the 1950's[ix].

CWA: Competency-Based Learning and Assessment

> Hopefully, sooner than later, education systems will realize the importance of not just lecturing their students but instilling the skills needed to succeed in the workforce
> **Arrissa | Information Security Officer | DDoS | Information Science - Communication**

Through the CWA collaboration a network of employer mentors, faculty and Epic Challenge student alumni is growing to meet the hiring needs of the CWA industry members and provide a member ecosystem to sustain the competency-based virtual "virtual-menternships™" model. The CWA adopted the competency-based education (CBE) approach as a means to bring a cost-effective solution to higher education to address the learning needs of underserved populations.

"Social stratification is embedded in the current system of U.S. higher education: only a small and privileged set of people participates in the selective, residential college experience. A study of new enrollments since 1995 conducted by Georgetown University's Center on Education and the Workforce demonstrates large disparities among whites and non-whites. The data show that 92 % of new white enrollments were in 468 of the most selective colleges, while 72% of new Hispanic enrollments and 68 % of new African-American enrollments were at two-year and four-year open-access schools. Completion rates at the two-year and open access schools are much lower (49%) than the selective schools (82%)[x].

High cost of tuition is just one of the barriers to higher education from underserved

populations[xi]. Testimonials from the first two years of Epic Challenges underscore Pont's research which indicates that adults who do not pursue training or education require more information or incentives for them to overcome barriers of time or lack of motivation[xii]. The Epic Challenges connects education and training to real jobs, career advancement opportunities, and pathways. "Having the opportunity to speak and interact with industry mentors was beyond what any of us had imagined. This program solves problems which I had always found backwards with the employment system. First employers require students to have real-life experience when they aren't willing to give enough people opportunities to display their skills. Many students are discouraged because their skills do not fit directly with what employers are looking for. Working on a real-life problem made the project more enjoyable since the skills can also get you hired. This experience exposed me to cyber security and its importance." (Epic Challenge Student)

Furthermore, the CWA addresses the reliability and validity of degrees and credentials by engaging industry in the education process. "If industry professionals do not take the time and resources to educate future generations, there would be a huge lag in innovation and professionalism since you must hire these people anyway; why not at least expose them to the real thing early giving them the interest and experience (Epic Challenge Student)."

> This [Epic Challenge] class taught me vast amount of information that I plan on retaining. This class has changed the way I view cyber security. When I started this internship, I didn't know what to expect and turns out this internship was nothing like I had thought it would be. I learned the core values of cyber security that rest on the NIST framework. The mentors critiquing us on our memos and projects helped me learn how to take constructive feedback and apply it to better our work. I learned the differences between academic writing and business writing skills. I believe this virtual internship provided real world experience. I would recommend this internship to anyone who is interested in gaining real world experience and not only cyber security experience.
> **Abdullah | Compliance Analyst |Bad Gateway | Informatics**

The Epic Challenges validate degrees and credentials by using demonstrated mastery as the measure of proficiency (Figures 3 & 5). This means that Epic Challenges learning starts at a student's current competency level and supports his/her growth to the mastery target established by CWA and faculty. The competency-based Epic Challenge uses performance metrics established by industry SME's and faculty on the iQ4 platform. The 2017 Epic Challenge, called "Threat Inside", was a virtual real-world project curriculum, defined by industry and engaged faculty, mentors and student multidisciplinary teams. The core competencies included in the 2017 challenge assessed the knowledge, skills, and abilities relating to the identification, detection, protection, response and recovery from an insider threat. The educational outcomes included building and maintaining

communications with executives, peers and regulators. These are essential skills (e.g., teamwork and communications skills), which are required in the workforce.

Participation in the Epic Challenge serves to magnify an employer's commitment to the program. One mentor from the 2016 Epic Challenge wrote, *"Just had a chance to review all the materials and the students did a really good job. I will speak with our HR on how we can have a mini-career day to invite the students to the company HQ where we can give a quick session on what we do, how we are structured and how we are dealing with some of the same issues that addressed in the assignment. Give them an opportunity to ask questions, provide some feedback, etc."*

Figure 11: (Top) iQ4 Proficiency Profile by Line of Business and Job Family with Career Pathways Below
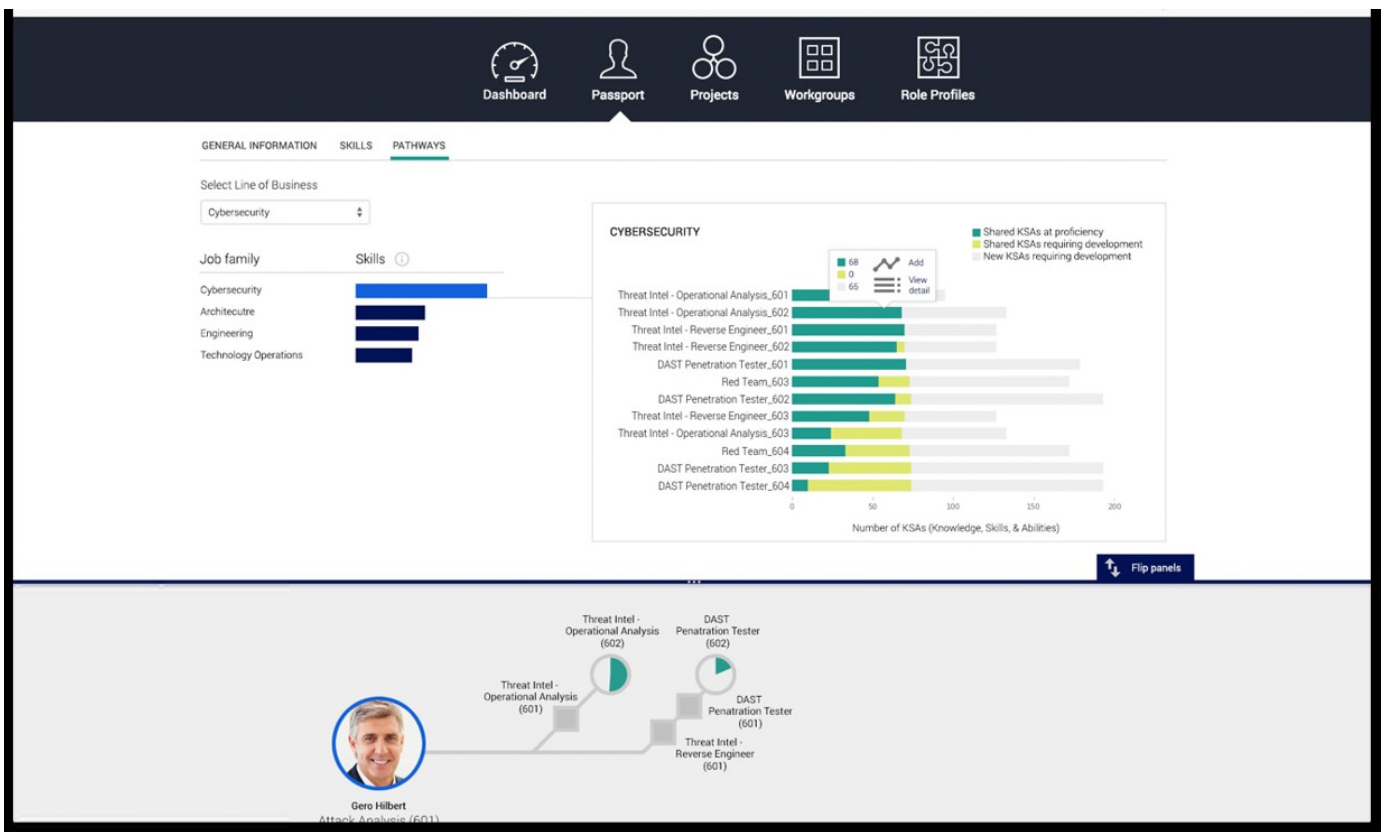

CWA Industry members have concluded that the three-month Epic Challenge program results with students having *"the poise, knowledge and confidence equal to a new hire with six to twelve months' experience"*[xiii]. There are four characteristics of CBE that are integral parts of the Epic Challenges and the CWA approach that the U.S. Department of Education correlates with successful learning outcomes[xiv].

1. Planning for competency-based education initiatives: The CWA industry members work closely with faculty to ensure that the objectives of the Epic Challenges are clearly defined. Furthermore, Epic Challenge scenarios, learning activities and course projects have been pilot tested, evaluated and revised to assure a smooth transition to implementation at a large scale.

Selecting assessment methods:

1. The Epic Challenges use formative assessment techniques from the faculty member, industry mentor and peers to provide real-time corrective feedback so that the students will demonstrate a high level of proficiency in the summative assessment.
2. Creating and ensuring that learning experiences lead to competencies: With measurable competency objectives as the targets the iQ4 proficiency progression in the Digital Passport enables learners monitor their own progression toward specific competency goals (Figure 11).
3. Reviewing assessment results to identify changes needed to strengthen student outcomes: The iQ4 proficiency progression in the Digital Passport identifies trends in all students' competency development and can provide targeted instructional interventions to address gaps in student competency development.
4. Using analytics within industry and States to identify workforce risk by shortage in numbers and competency so to advise education the priority skills and competencies Industry needs.

Figure 12: Dashboards: Workforce Risk, Vulnerabilities Needing Professional Development
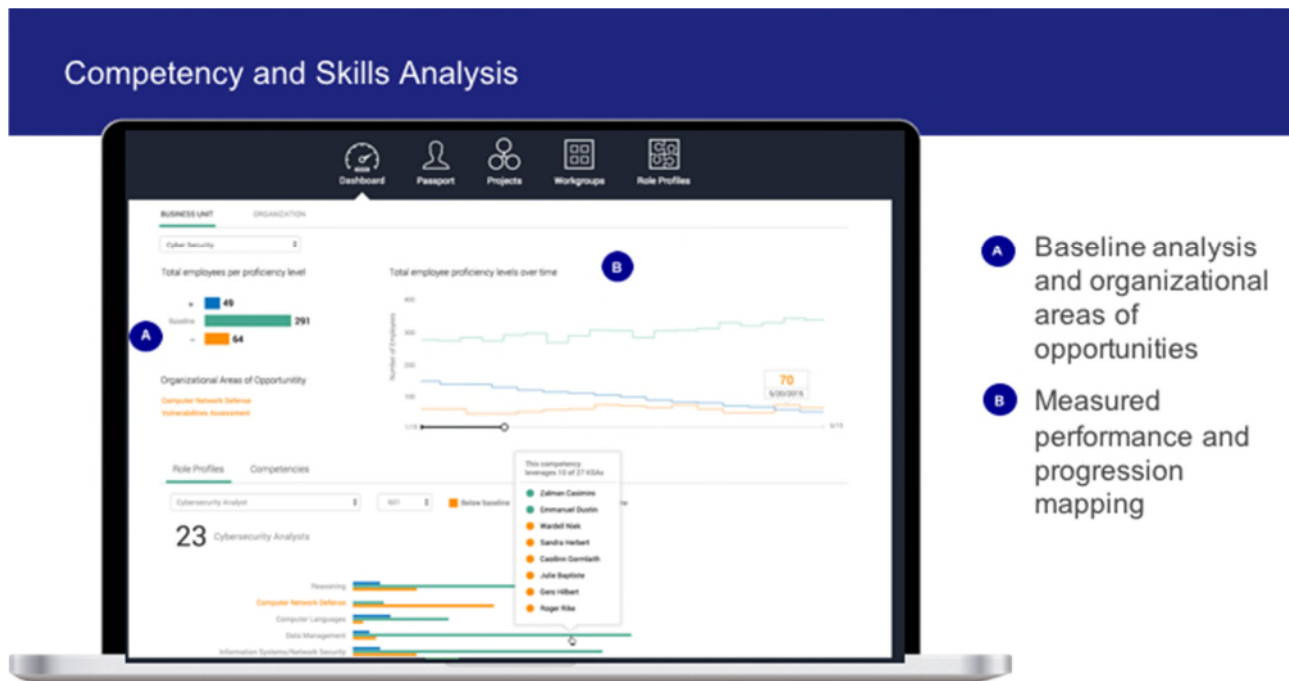
The CWA represents a competency-based solution that addresses the accessibility affordability of higher education. The CWA industry mentors increase the capacity of educational institutions with content expertise. The mentors also provide external assessment which contribute to the reliability and validity of degrees and credentials. Finally, the CWA is competency-based training and education that connects to career advancement opportunities and pathways for all learners.

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Endnotes

[i] Personal communication, CWA Mentor- Senior Advisor, Federal Reserve Bank of New York.

[ii] National Student Clearinghouse, a nonprofit education organization, is the trusted and neutral partner to more than 3,600 secondary and post-secondary institutions in the United States. They serve their educational partners by securely compiling the academic records of students and facilitating the validated exchange student enrollment, performance and related information to prevent resume fraud.

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[xiii] Personal communication. CWA Mentor – Federal Reserve Bank Of New York

[xiv] U.S. Department of Education, National Center for Education Statistics (2002). *Defining and Assessing Learning: Exploring Competency-Based Initiatives*, NCES 2002-159, prepared by Elizabeth A. Jones and Richard A. Voorhees, with Karen Paulson, for the Council of the National Postsecondary Education Cooperative Working Group on Competency-Based Initiatives. Washington, DC.