

Reach to Teach: Preparing Cybersecurity Experts as Adjunct Community College Faculty

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Abstract: While the nation should maintain and expand the educational capabilities in cybersecurity given the current high demand for this sector, currently there exists a capacity issue: students cannot readily be added to the education system, especially at the Community Colleges level, because trained faculty to accommodate expanded academic demand are scarce. Cybersecurity experts in the workforce have the potential to fill the need for part-time cybersecurity faculty at the Community College level. The challenge is to prepare these technology-savvy individuals with classroom pedagogical insights and skills which not usually part of a cybersecurity experts skillset.

A research question for this development project is “Can we use an online environment to provide pedagogy training for potential adjunct community college faculty.” Currently, the Reach To Teach project is exploring this possibility through a research effort engaging current faculty, as well as education experts, and a pilot Reach To Teach online course that is being made available to these cybersecurity experts. The Reach to Teach pilot is a set of six sessions, each of which includes the following: introduction to Community Colleges, ethics, and ideas for classroom pedagogy (e.g. the general structure of a course, crafting goals and objectives, techniques for moving explanations from the concrete to the abstract, using group work using case studies, and using discussions in classes).

The team hosted a content review with community college educators and the pilot has been evaluated by 12 members of the target population. Their suggestions for improvement included. In addition to addressing these concerns, the revised pilot includes a modified interactive experience, Viewers are now able leave comments that can be read and replied to by course leaders or other individuals viewing the material.

1 THE NEED

In order to maintain and expand capabilities in the world of cybersecurity – whether planning new technologies for the internet of things (IoT), preparing defenses, constructing offensive tactics, or developing appropriate policies – a well-educated workforce is needed (Gray, 2016; Heritage Organization, 2013; NSF 2013; The White House, 2014). In the United States alone, to fill available government jobs which the Department of Homeland Security indicates is in the many thousands, numerous pathways have to be opened including on the job training, community college programs as well as traditional four year and graduate programs. Each of these avenues educates and trains individuals to

work at different levels and in different capacities in our ‘cyber’ world.

The most recent Cybersecurity Commission Report (Cybersecurity Commission, 2016) includes Imperative 4 which addresses building workforce capabilities. As they note, building such a workforce is not possible without an education pathway for potential members of the cyber-workforce. Currently, there is a capacity issue: students cannot readily be added to the education system, especially, at the community college level, because trained faculty are scarce. The weak link in the cybersecurity workforce supply chain is often finding faculty and teacher effectiveness. Therefore, the success of Imperative 4 depends, in large part, on the capacity of our educational institutions and capabilities of our educators.

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One solution has been the National Science Foundation (NSF) supported Scholarship for Service (SFS CyberCorps) program both at the university and now the community college level. The SFS Program provides scholarship funding for students in the areas of cybersecurity. All recipients are required to work within the Federal, State, Local or Tribal Government as a cybersecurity professional for a period of time equal to the length of the scholarship. So far, however, graduates have primarily gone to federal government agencies, national labs, or Federally Funded Research and Development Centers.

Community colleges are institutions of higher education, typically two-year experiences that have an “open enrollment” for students who have graduated from high school. A community college usually provides workforce education as well as college transfer academic programs. The nation is looking to our community colleges as an untapped source of cybersecurity workers for the various workforce needs. According to the NSF, “Community colleges can play a critical role in giving students the hands-on skills that are needed on the front lines (of) defending computer networks, (Heritage Organization, 2013)”. And, while some community colleges have existing programs in cybersecurity and have dedicated full time faculty, according to the Center for Community College Student Engagement, more than 58% of community college classes are taught by adjunct faculty. Although the data is not broken out by discipline, informal conversations with local community college leaders revealed that they rely heavily on adjunct faculty, and most of these have no teaching experience when they begin. Lankard (1993) says part-time faculty are employed primarily for their professional competence rather than their pedagogical training, therefore many lack the teaching skills and teaching experience required to ensure instructional integrity in the classroom. In fact, “No formal preparation for a teaching position is required other than the desired academic credential” Twombly and Townsend (2008, p15) and for students who complete a community college education is the quality, preparation, and pedagogical skills of the faculty have to be central. According to the American Association of Community Colleges, there has been huge growth in the percentage of higher education faculty teaching in community colleges and the biggest group contributing to that growth are the part time faculty.

A typical advertisement indicating the requirements for a cyber-security faculty member at a community college includes: Bachelor's degree

(Master's preferred) and five years of work experience as a Computer Forensics professional. They are also expected to have technical qualifications and certifications such as: CompTIA Network+, CompTIA Security+, CISCO certifications, CISSP, SANS, Certified Ethical Hacker (CEH)), as well as a knowledge of Programming Languages, excellent written and oral communications skills, experience in leadership including a history initiating and managing change, working with others toward shared goals and developing others.

Nearly 4 in 10 students in higher education attend a community college. A typical community college, unlike a student in a 4-year research university or liberal arts college, are employed at least part-time, have a family, are enrolled only part time, or a combination of all three. Personal and global economics have a great deal to do with an individual's choice to attend a community college as they offer a lower cost option and different time demands. As a group, community college students are not as homogeneous as students in four-year programs. Many entering community college students are older than 19-year-old freshmen in 4-year universities, and more are returning students seeking new employment opportunities. Community college students can have bachelors or advanced degrees, and are likely working full- or part- time with huge demands (including children) on their non-class time. The community college student, like every student, is not monolithic –some are more prepared than others but as a group they are like other students; however, their experiences provide them with choices towards either a terminal degree or as a pathway as a stepping stone to a 4-year institution or are enrolled at both a community college and a 4-year at the same time using the community college to fill in gaps (thereby often ‘serving two masters’).

2 FILLING THE NEED

The Reach to Teach pilot focuses on the more than 2,200 nationwide SFS CyberCorps alumni, all of whom have at least a bachelor's degree and most have a master's degree (some even a PhD). They are highly educated and have unique experiences that they can bring to the classroom. These men and women, as current or former government employees, have had access to the latest technologies, wrestled with the current problems and policies facing the nation, have taken leadership roles and have a wide network upon which to rely for developing academic and career

goals. Even those who have left government service usually work with cybersecurity content on a daily basis. Graduates from the 2013 cohort, and before, have at least 5 years of cybersecurity work experience

The pilot program for **Reach to Teach** concept offers SFS cyber-experts the opportunity to participate in this online program with the expectation that they will consider working with one of their local community colleges as an adjunct faculty member. As noted above, cyber-experts have the requisite cybersecurity content knowledge and experience to teach at this level. However, they typically do not have teaching experience or knowledge of diverse classroom learning and assessment techniques. Furthermore, most are not (yet) a product of the community college pathway and they do not understand the community college student and their challenges/opportunities.

Educator capacity building is built upon classroom research. The Reach to Teach pilot provides an asynchronous, online course to build teaching capacity as framed by (Newmann et al., 2000; King and Newmann, 2004) research. This work asserts that educational change requires improvements to staff knowledge, skills and dispositions. Reach to Teach coursework is designed to build faculty capacity in key areas such as assessment, curriculum resources, expectations for students, building sense of self-efficacy, learner characteristics, legal obligations, and the use of online learning to support individual and collaborative projects. Reach to Teach uses Angelo and Cross' (1993) Classroom Assessment Techniques to support participants' ability to facilitate learning. Typical classroom Assessment Techniques (CATs) which are short, anonymous assessments such as requiring students to complete a one sentence summary of material, or a student-generated list of real-world applications, have been demonstrated to increase faculty-student interactions and active classroom participation (Angelo and Cross, 1993; Morris, 1994; Samanta, 1994; Simkins, 2018)

3 REACH TO TEACH

3.1 The Six Sessions

Reach to Teach is designed to address target faculty expectations concerning the pedagogy for successful classroom teaching. This is crucial because an educator's expectations for their student is critical for student success (Newmann et al, 2000).

The content of this course provides background information and learning experiences to build an understanding of the community college environment, the student body and the related learning opportunities. The material addresses the following questions:

- What is the role of a community college in cybersecurity career preparation? What do employers expect from community college students and their preparation?
- What support do community college students need to advance – those who are less experienced as well as those with experience?
- What opportunities can be provided to develop each student's skills, while still offering the most dedicated students a chance to pursue their academic interests as fully as possible?
- What challenges and benefits does classroom diversity bring to classroom discussions and projects?
- How do you harness the community college students' life and work experiences to improve the classroom and projects?
- What pedagogic tools are worthwhile in this setting?

Cyber-experts who complete Reach to Teach would be in a position to serve both as technically and pedagogically prepared adjunct faculty. This potential increase in available adjunct faculty would enable the education of more cybersecurity students which would in turn add qualified workers to the cybersecurity work-force in numbers higher than currently possible. As the cyber-experts move into adjunct teaching positions at community colleges, the community college students will benefit from the intellectual and employment experiences of cyber-experts who were previously not adjunct faculty at community colleges.

3.2 Development of the Online Reach to Teach Program

In the fall of 2017, we convened an online focus group of Community College faculty and researchers and one face to face workshop of community college faculty, 4-year CyberCorps faculty and teacher education faculty to provide detailed direction on the learning science and resources to include in the course. The workshops and follow-on work resulted in actual teaching strategies and units for Reach to Teach. The online focus group produced a scope and sequence chart. The face to face, 2-day workshop in

January 2018 found the resulting chart too complicated and overly pedantic. The result of the workshop was a revised scope and sequence chart, of which Sessions 1 and 2 are shown in Figure 1.

Topic	Time	Session 1	Session 2
Introduction	3 min.		
Community College Context	5 min.		
Legal and Ethical Issues	5 min.	Ethical concerns in the classroom	Definition of plagiarism
Instructional strategy	27 min.	Setting Objectives	Going from concrete to abstract
Applications	7 min.		
Assessment	5 min.	Formative assessment	Feedback and Performance Assessment
Engaging students	5 min.	Ice breakers	Providing Support
Review	3 min.	Review	Review

Figure 1: Sample Scope and Sequence: Sessions 1 and 2.

3.3 Pilot

Based on the results of the online discussion group and the workshop, a series of 6 sessions were sketched out. Requests for interviews on first person experiences were made to community college colleagues. Community College leaders were interviewed concerning the mission, benefits and challenges of teaching at a community college. Content was gathered that was consistent with the scope and sequence developed after the face to face workshop. Videos available on You-tube and other sources were included to avoid re-inventing the wheel. The content of the six sessions, presented in a very simple Power Point series with minimal layout and with video snippets, was reviewed by our two community college experts of the grant. Before handing the material over to a graphic artist to prepare the distribution version, it was imperative to resolve two issues – how to make the sessions independent of a leader but at the same time have an interactive feel and how to make the sessions easily accessible. While the latter was readily addressed by storing the Power Point sessions on a public Dropbox, the former was more of challenge.

Reach to Teach encourages active learning in the session discussions, but without a moderator it would be difficult to support true active learning. And, creating the materials that would depend on a moderator limited, we believed, the access to the

materials themselves. “Students” would have to be gathered into some sort of cohorts and the sessions run on some schedule. Our vision was more of an independent resource that could be used in the true engineering education concept of ‘just in time learning’ (Simkins, 1994). The decision was to ask questions during the sessions and encourage the students to think about their answers before proceeding to the next slide or to do the homework before the next session. In either case, subsequent slides asked the students “Did you think of this?” and suggested a few possible answers or homework solutions.

With these two issues (temporarily) resolved, the graphics expert prepared a template for all sessions. The consistent look and feel of the visuals contribute to the ‘moderator independent’ structure of Reach to Teach. Additionally, the templates make edits and revisions easy to accomplish. Finally, all sessions were narrated. Final versions were distributed for evaluation.

4 EVALUATION

As noted above, while pedagogic training is important, there is typically no required classroom training for adjunct faculty and therefore nothing against which we might compare our material. If there is training at all, it is related to forms and procedures of the college than to pedagogy. Some community colleges encourage that departments assign mentors to new adjunct faculty. Our evaluation was based on multiple reviews: content literature review, content validation with adjunct coordinators at community colleges, content refinement through community participation, and content review by community participation. Feedback in these categories was received from educators and potential students.

The content validation was achieved by reviews from working adjunct and permanent community college faculty through the online blog and through conference workshops and presentations. The sessions were made available online (<https://blogs.gwu.edu/seas-reachtoteach/>). (The authors continue to welcome comments from readers who access these sessions. A comment sheet is available at the site). The sessions have been informally reviewed at one Community College Cybersecurity Conference (3CS, 2018) and were well received.

A team of students, who were not part of the design or development of the 6 sessions created an evaluation rubric (Figure 2) and shared the sessions

with 12 SFS CyberCorps alumni, the typical target of the project. Of the 12, none had ever taught at the community college. One had been a teaching assistant during some graduate work, but was responsible only for grading homework, not for creating a lesson. All indicated they thought they might enjoy teaching at a community college. None felt that they would be teaching in the next six months, but would consider it in the future. Respondents reported that they required about an hour to review the material and comment the evaluation form. Since the sessions themselves are about an hour long, it seems that reviewers may not have watched every moment of the various videos.

- * Learning Objectives were clear
- * Course content was organized and well planned
- * Course workload was appropriate
- * Course was organized to all students to participate fully
- * Rate your confidence to teach at a community college before these sessions
- * Rate your confidence to teach at a community college after these sessions
- * What aspects of this session were particularly valuable or novel
- * How would you improve this session?
- * If any, what topic(s) would you remove/move? Why?
- * What materials do you suggest we include in these sessions? (Audio, video?)

Figure 2: Survey Questions for Each Session.

The survey review yielded 4 positive outcomes. All respondents agreed that the learning objectives were clear and the course organization was such that all students could participate fully. Reviewers positively commented concerning the course content and the novel aspects of the session(s).

For example: “I Strongly Agree; Teaching and the history of community colleges was interesting; Highlighting the importance of class objectives having observable results was immediately useful”

“It (sic the session) provided examples of what the instructor is trying to teach. The embedded guest presentations were very engaging the iterative approach shown for refining objectives was engaging and felt useful”.

There were two categories of outcomes to be addressed to improve the sessions. The editorial ones were easily resolved and they included correcting a

broken link and a typo or two. One comment suggested the annotated video about the structure of a lesson could be removed, but others considered it valuable. Suggestions for improvements included adding closed captioning, suggested moving the password discussion and expanding the discussion on case studies for clarity on the importance of goals and objectives for their use.

One of the biggest challenges continued to be how to make the sessions as interactive as possible without requiring a leader or a cohort structure. We are currently reviewing Annoto (<https://www.annoto.net/>) as a tool to provide asymmetric interactivity to the site. Figure 3 shows the opening of Session 1 with the interactive comment icon in the upper right-hand corner.

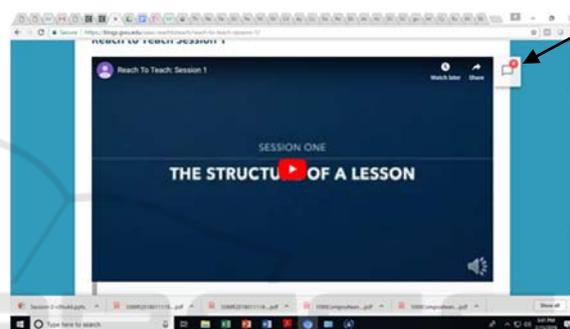


Figure 3: Reach to Teach.

Figure 4 indicates what the system looks like when a viewer has left a comment or started a dialogue.



Figure 4: Asynchronous comments and replies.

5 FUTURE WORK

The sessions are now readily available and we expect to host a wide-reaching field study to determine whether the cybersecurity experts can, and will, use these sessions. And, if they do use them, do they find them useable and useful for their adjunct teaching experience.

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