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Proposal paper in support of uniquely crafted externships/course projects.

As with proposal paper #1, this proposal supports many of the ideas presented in the CFP and specifically addresses these questions:

- What skills and knowledge should people in the field have, and how should that be acquired?
- How do we get more US citizens—and a more diverse population —into cybersecurity in meaningful ways?
- What kinds of resources and materials for use in education and training are needed, how do we get them developed, and how do we measure their effectiveness?
- What are some good ways to “future-proof” the education we provide?

One area lacking significantly in cybersecurity education is hands-on experience that aids in student learning and which can be listed on student resumes. In academia, most learning is passive which makes recall and complete understanding of a subject more difficult. This results in a shortage of well-educated and trained workers in cybersecurity. Students learn best and have a means to ‘relive’ the experiences through relevant, hands-on learning. One way to help students understand the cybersecurity job environment, and therefore provide a better assessment of understanding than traditional lecture courses, is to provide an immersive experience through in-depth, real world projects. Presently, most cybersecurity topics are presented as silos and not infused into other disciplines or even shown as a compliment to other IT and cybersecurity content areas. Learning requires context and a base of knowledge to best apply those concepts to situations, resulting in students synthesizing ideas to create solutions, just like what is expected when students are on the job.

To solve this problem we could include hands-on projects from the community and partner on-ground courses with online courses/schools to expose more students to these opportunities.

Those on-ground would perform the actual tasks while those participating remotely will offer consultative services. In an entirely online situation students could complete projects remotely including researching a problem and offering the best solution, with security infused into the solution design. Actual implementation may be left to the company or an on-ground class.

While ambitious, this idea can work. My courses and students are proof of its success. I have been the teacher for on-ground and online students as we completed over 115 IT and cybersecurity projects for nonprofits in Ohio, Indiana and Texas. While my on-ground students did the bulk of hands-on work, my online students offered design and troubleshooting assistance and participated from different states, countries, some while serving in the military in places like Kabul, Japan, Germany, and two were on nuclear submarines! This idea works. We even completed a project for a battered woman's shelter where the women had to perform the work and the men had to act as consultants as no men were allowed onsite.

So far, all of the work has been completed by my students while I worked for multiple educational institutions. The on-ground students usually consist of a single class for a single school but have included several online students who either lived nearby or were able to travel to the location. The remote assistance in the form of research, troubleshooting, code/plan review were often from different schools where I taught online and participated as volunteers instead of a designated course project.

This semester I had a student participate who was enrolled at a school where I do not teach as he was the significant other of a current student and he was able to provide a level of expertise the class did not possess. The team he worked with was grateful for his assistance and experience and the project progressed faster than anticipated because of it.

The application of this proposal could result in two potential applications of this concept: 1) Train teachers to facilitate their own outreach and inclusion of hands-on community projects for their online and/or on-ground classes, and; 2) Partner teachers who are online with teachers willing to participate on-ground to benefit communities, open opportunities for experience and volunteerism to their students, and offer project-based learning activities which are much more authentic and realistic than many traditional projects and research papers.

Obviously, option 1) empowers teachers to facilitate the process independently while option 2) would require a bit more coordination between faculty and partnering institutions, but I promise it is worth it!

Often, we begin the volunteer work with a risk assessment which provides the organization with the knowledge of what is needed to protect people, property, and processes. Completed projects have included planning, designing, and building networks (usually with equipment supplied by the organization, but a few times we refurbished equipment or raised money to purchase the equipment), operating system security, secure development of middleware, website development and implementation, network/application/wireless troubleshooting, funding integration (ability to accept donations), and many others.

Not every project requires a site visit. For example, this semester in my secure development course we worked on development of two websites, a mobile application, middleware for a dentist's office, and a new distribution of Linux. Some of those were real non-profit projects and others were of my creation but which could be marketed – such as the mobile application which could be sold (low cost) in the app store with all proceeds going to the cybersecurity club, and the Linux distribution would include the names of all participants as creators and be available at DistroWatch. No site visits were necessary. The class had more than 60 students including a mix of graduate and undergraduate students. The graduate students on each project served as the project managers. The project will continue through the summer.

This concept need not apply only to academic classes. On several occasions the course work was augmented by assistance from the computer club, (which I advised) which facilitated assessing donated computers, wiping hard drives, installing Linux and OpenOffice. One project with the local Rotary club had students create a resource center in Belize (yes, the projects have had international impact, too!).

I do require nondisclosure agreements and releases of liability on all sides (students and nonprofit organization). All participants receive letters on letterhead from the assisted organization thanking the student by name for their contribution (for security and privacy, the address used is that of the school). The appropriate level of jargon and specifics is included as I

write the letters and I remain the point of contact for confirmation of their efforts and experience so the nonprofit is not overwhelmed with calls for references. All students can list their participation on their resumes as volunteerism and work experience.

As proof of concept I offer the award I received in June 2017 at the Community College Cyber Summit (3CS) for Teaching Innovation in the area of Community Outreach (won under my former name: Denise Pheils) and the research behind this community project method which was presented at the 2013 ACM InfoSec Curriculum Development Conference at Kennesaw State University and was published as:

Pheils, D. (2013). Applying a Community Project Approach to IT and Security Courses. In *Proceedings of the 2013 on InfoSecCD '13: Information Security Curriculum Development Conference* (InfoSecCD '13). ACM, New York, NY, USA, , Pages 79 , 9 pages.

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