Brooks Crossing Innovation Laboratory Cybersecurity Internship Reflection Paper

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CYSE 368: Internship Class
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Fall 2023
12/06/2023

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Introduction

This paper covers my experiences as a cyber security intern working at the Brooks Crossing Innovation Laboratory from the period of August 2023 to December 2023. The details of the internship were presented as a position for individuals with an interest in teaching K-12 Science, Technology, Engineering, and Math (STEM) fundamentals as well as K-12 cybersecurity. Additionally, the position had responsibilities to teach usage in 3D printing, maker space, virtual reality, robotics, Raspberry Pis, and other STEM-related avenues. I chose this location to do my internship because of the unique position I would have to both learn more about cybersecurity and to teach newer generations cybersecurity principles and fundamentals.

Upon joining the Brooks Crossing Innovation Lab, I created three goals/learning objectives to achieve while completing my internship. One of the objectives I hoped to achieve was the capacity to apply the skills I learned in a real-world environment. Whether it be education outside a classroom setting, setting up equipment or diagnosing issues, or exercising cybersecurity techniques, being able to recreate my experiences in the internship outside in the real world was a quintessential goal for me. Another goal was for me to gain a greater understanding of cybersecurity concepts. A great way to be more proficient at something is to teach it because to teach something well, the instructor must know the topic well. By educating others in cybersecurity, I hoped to gain a better overall understanding of cybersecurity and its intricacies. The third learning objective I gave myself was to become more experienced with the different machines and utilities at the Brooks Crossing Innovation Lab. Something that stood out to me in the job description for this internship was the need to learn about and maintain various machines at the ILab's maker space. Machines ranging from 3D printers, virtual reality headsets, Raspberry Pi creations, resin and fabric printers, laser engravers, and routing machines. By learning the workings of these machines and their software I would have a wider range of skills and become more versatile when encountering obstacles or creating projects.

In its entirety, the internship program at Brooks Crossing Innovation Lab is a positive experience that reflects the organization's mission to help people learn STEM fundamentals. While I did not have a large selection of internships to choose from, I would certainly prefer the ILab internship due to the structure of the program and its flexibility. The atmosphere and the way everyone interacted with each other led to healthy mediums of learning different things and techniques I will continue to use throughout my career. Certain aspects of the ILab's internship program that made it enjoyable for me also made it quite challenging in ways that forced me to be proactive with my learning and to enforce self-discipline when meeting deadlines. Regardless of the challenges I have had to endure, this internship resonated with me as a prominent objective of the program is to teach STEM/cybersecurity to younger ages, which was the topic of every single cybersecurity paper I have written at ODU. Besides the learning objectives I made upon joining the Brooks Crossing ILab, I had another goal to gauge the knowledge gap between average users and their understanding of basic computer security in an on-the-ground setting. Getting personal experience on the disparity of user understanding with cyber security gave me more material for future projects pertaining to cybersecurity training for employee orientation.

Organization Details and Orientation/Initial Thoughts

The Brooks Crossing Innovation Laboratory is a STEM (Science, Technology, Engineering, and Mathematics) learning center located at 550 30th Street Newport News, Virginia. Formally opened on August 24th, 2019, it is affiliated with and categorized by Old Dominion University as a community outreach facility. The Innovation Lab's primary purpose is to help individuals of all ages learn STEM concepts and fundamentals with workshops and interactive activities. As a learning center, the Brooks Crossing ILab does not have any products to sell, but it does offer its space for field trips, educational functions, and commercial ventures. The most common service used at the ILab is being the host for field trips from local schools. At least once a week the ILab will have a school over to work on an interactive STEM challenge or activity, making the plurality of users at the ILab K-12 students. The ILab also hosts weekly/bi-monthly events encouraging the local community to come and create personal projects using their maker space and its machines such as 3D printers and laser engravers. In addition to the maker space nights, people are free to sign up for a time slot using the maker space to work on projects for their own business or personal venture. Weekly DJ lessons are also given at the ILab as well as time slots for people to utilize their recording studio for songs or podcast episodes. Featured among the events at the Innovation Lab is the cybercode academy, where cybersecurity interns create lessons and activities focused on teaching either cybersecurity concepts or programming fundamentals.

As I was accepted into the program as a cybersecurity intern I entered orientation without much prior knowledge of the Innovation Lab. At the time of my acceptance, there was very little information about the cybersecurity intern position on the internet and the most information I got was from the laboratory director in emails, which gave me a very general understanding that I would be teaching, creating challenges, and maintaining their maker space and lab environment. Orientation was condensed into one day where the program manager showed me and another intern around and were introduced to the lab space and the machines we would work with. Following that day, the new interns were tasked with learning each major maker space machine and creating something with each of them. Before the orientation and training, I had the initial expectation that my role as a cybersecurity intern would be mostly dealing with cybersecurity challenges and education while other maker space duties were background and support-based. However, the training gave me the impression that maintaining the entire maker space and taking a more active role in non-cybersecurity education would be just as important. The environment of the lab itself was quite impressive, there were many commercial-grade 3D and resin printers among other machines in their maker space. The entire area was in one warehouse-style room with the maker space on one side and the room where the interns worked on the other end with many tables and chairs in the middle for workshops. The program manager and the other new intern were very friendly and put my anxieties at ease about the working environment.

Management Structure/Environment, Supervision

There are only two major authority figures in the Brooks Crossing Innovation Lab: the lab director and the program manager. During my time at the internship, there were also two graduate assistants who assisted the program manager in training the interns with different aspects of the program. Most if not all of the supervision of the interns was done by the program manager, while the lab director dealt with administrative responsibilities. The program manager's method of supervision was informal and trusting of the interns whenever she was not

actively training us on how to use one of the machines. Task assignments were designated from a shared Google Doc that everyone had access to. The Doc was split into daily/weekly/long-term projects that interns could select to do or have the program manager assigned to them. Apart from the initial designation of tasks, the program manager would occasionally check in throughout the day to make sure there weren't any concerns or questions. The hands-off style of supervision at the ILab made the program feel more mature than a classroom environment and allowed the interns to take charge of their own schedules. The drawback of the program's hands-off management style was that it made it very easy to lag behind in the development of a project or task if time was not utilized properly. The program manager's supervision would reach its zenith whenever the interns would assist in a workshop or field trip with a large number of people. While the management style at the Brooks Crossing ILab made it difficult at times to stay on track with tasks and duties, overall it was an effective way of supervision and it allowed me to cultivate my discipline for future jobs.

Major Duties, Assignments, and Projects

As a cybersecurity intern, I had various responsibilities ranging from IT/diagnostic duties to creating cybersecurity challenges. The most important duties I had were the cybersecurity lessons and challenges and assisting the program manager with workshops and field trips. Most field trips and events hosted at the ILab are headed by only the program manager and require help from interns in order to be successful. Even though the job description for cybersecurity interns has an emphasis on creating challenges, the field trips during my time at the ILab were many and numerous in attendance, requiring every available resource to make sure the events went well. The field trips were also the ILab's primary source of outreach and advertisement so making sure schools had a good experience took priority. An example of a field trip I assisted with was when a local middle school came to learn scratch code and programmed a robot to traverse an obstacle course (Figure 1). When not assisting with field trips, interns were tasked with helping out individuals working on their projects whenever possible. As stated before, people could sign up for a time slot for the maker space to work on personal projects (Figure 2). The people who usually came to work on their projects required help using the machines, resulting in IT assistance being an important part of the internship's responsibilities. The other major duty of the cybersecurity interns was the cybersecurity challenges we needed to create. Every month the ILab would host an event named the CyberCode Academy where the grad assistant and cybersecurity interns created cybersecurity or programming lessons for K-12 audiences. Examples of CyberCode Academy projects done in the past include DDoS machines using a Raspberry Pico, coding alarm sensors with Python, and phishing attack awareness (Figure 3).

Each of my aforementioned duties and responsibilities was necessary to the Brooks Crossing ILab either because they helped the reputation and outreach of the lab, increased the scope of education offered by the lab, or increased the support of those looking to work on personal projects. By assisting the program manager with field trips and events, the ILab was able to take on more field trips with greater numbers in attendance. Likewise, by performing more IT and tech support duties for people coming to work on projects increases the ILab's rapport with the local community and allows the lab to be recommended to a wider range of audiences. With the inclusion of the CyberCode Academy, the ILab is now able to educate the community in a wider range of topics. Better cybersecurity education is crucial to the ILab's mission statement of STEM enrichment for its community.

Skills/Knowledge Used and Learned

To succeed as a cybersecurity intern at the Brooks Crossing Innovation Lab, I had to utilize a variety of skills I acquired over the years. Due to the unique nature of the internship position and its responsibilities, I used more than just my cybersecurity acumen at the ILab. The most important non-cybersecurity skills I utilized at the lab were the teaching skills I learned while being a sailing instructor and a violin teacher. My first job was as a sailing counselor at a summer camp where I taught kids how to sail. That job gave me invaluable experience in educating children and maintaining a positive learning environment that carried over to my later job of teaching the violin to younger children. The combined experience from these two opportunities allowed me to approach education at the ILab with an adaptive and understanding mentality. It was also imperative to use the cybersecurity skills I learned at Old Dominion University to perform well as an intern. Specifically, skills in system security and vulnerability/risk assessment were used to educate the community and to create cybersecurity challenges. Additional knowledge I used for the internship includes an understanding of different operating systems and miscellaneous IT techniques to assist individuals with their projects at the ILab maker space.

By carrying out tasks as a cybersecurity intern at the ILab, my understanding of cybersecurity has changed. As a result of teaching cybersecurity fundamentals and creating cybersecurity challenges, my overall understanding of cybersecurity became more rounded. While teaching aspects of cybersecurity to an audience, I was simultaneously reinforcing them in my mind.

ODU's Role in Internship Success

My education at Old Dominion University was crucial in my success as a cybersecurity intern at the Brooks Crossing Innovation Lab. Even though a major skill I used in the program was youth education gained from outside the university, I would have been unable to teach cybersecurity concepts if I had not learned them first at college. Essentially most of every lesson or challenge I created/helped create stemmed from a class I had taken at ODU. Most prominently concepts like penetration testing, vulnerability assessment, and programming directly correlate with lessons in ILab events. While there were many connections between my education in college with the material taught at the ILab, there were also experiences at the lab that required me to learn skills that ODU had not taught me yet. One of which was resource negotiation in a laboratory setting. I assisted the program manager in negotiating virtual lab resources from Cova CCI to establish our own cyber lab. Discussing Parameters like resource allotment, account access, and lab infrastructure were completely new to me and had not been taught in any class. Another valuable skill I learned while creating cybersecurity challenges for the ILab was scripting in Linux. While I have not taken a class at ODU that taught Linux scripting, I had to learn how for a CyberCode Academy event.

Fulfillment of Learning Objectives

My internship at the Brooks Crossing Innovation Laboratory successfully fulfilled the three previously established learning objectives/goals I gave myself before joining. My first goal was to be able to apply the skills I had learned in a real-world application, which I accomplished by successfully creating my very own cyber lab with multiple virtual machines, learned from my

experiences at the ILab creating cybersecurity challenges and lab infrastructure. Additionally, while I have not yet created a cybersecurity training seminar for employees I am fully capable of doing so as a result of my time teaching at the ILab.

The second learning objective I gave myself before joining the internship was to gain a greater understanding of cybersecurity concepts. I have accomplished this objective by repeatedly and extensively teaching people of all ages about cybersecurity fundamentals. An excellent way to become more knowledgeable/proficient in a field is to teach it, and by teaching cybersecurity I have succeeded in gaining a deeper understanding of my lesson material.

The last goal I set for myself was to become more experienced with the machines at the ILab maker space. This learning objective was by far the most successful goal out of the three. Before joining the internship program I had zero experience and knowledge on how 3D printers, laser engravers, CNC routers, and resin printers worked. By spending months creating my own projects and helping people with theirs, I have gained a proficient understanding of the makerspace hardware and software.

Most Motivating/Exciting Aspects of the Internship

The most motivating/exciting aspects of the internship at the Brooks Crossing Innovation Laboratory would have to be the opportunities to teach STEM to a perpetually rotating audience of fresh minds. The nature of the ILab as a learning center for the local community gives interns a constant supply of people to teach STEM topics to, allowing the community to become more learned in cybersecurity/STEM and to become better teachers. While having STEM education being a primary responsibility may not have been very exciting for the other cybersecurity interns, I found the opportunity to practice cybersecurity training techniques very beneficial and exciting. Many of the cybersecurity papers I wrote at ODU involved topics pertaining to cybersecurity training and mending the human bottleneck in cybersecurity through early education. To be able to get hands-on experience with the exact topic of interest of mine was one of the driving factors behind choosing the Brooks Crossing ILab internship program.

Another exciting aspect of the ILab internship was the opportunity to learn about many different machines in their maker space. Unlike other internships, the Brooks Crossing ILab is specifically geared towards STEM education and hosting a space for project creation, both using various printers and fabrication machines. As a part of the training process and the daily responsibilities of a cybersecurity intern, I worked very closely with commercial-grade printers and engraving machines that allowed people to actualize their creativity. As a result, I was able to become very proficient with 3D modeling/design software and hardware that I am now able to use for my own projects.

Most Discouraging Aspects of the Internship

The most discouraging aspects of the Brooks Crossing Innovation Lab internship were the short amount of time spent at the ILab and the lack of funding for new equipment. Overall, there were not many aspects of the ILab internship that discouraged me in any capacity, the environment and responsibilities were very positive and I learned many things and made many connections with others in my field. However, an aspect out of the ILab's control that was discouraging was being unable to spend more time with the program. The ILab's internship program accepts interns only for a limited timeframe and my time at the ILab ends in mid-December. Having only one academic semester at an internship makes it difficult to finish long-term projects and to get a sufficient amount of experience when also being a full-time

student. Another discouraging factor of the ILab internship was the lack of funding to get new equipment. The Brooks Crossing ILab is still in its infancy as a learning center and still figuring out its financials and funding. As a result, the lab operates with very few paid positions and acquires new equipment via donations by a wishlist system. Having financial restrictions when creating lab infrastructure made it discouraging at times whenever we could not proceed with a plan due to not having the resources.

Most Challenging Aspects of the Internship

The most challenging aspect of the Brooks Crossing Innovation Lab internship was keeping up with deadlines and balancing internship duties with classwork as a full-time student. Due to the time constraint of only having one academic semester as cybersecurity interns, projects are assigned and must be completed quickly so as to not fall behind schedule. Additionally, while I was interning at the ILab I was also taking 15 credits worth of classes at Old Dominion University. Initially, I thought that I would be fine doing both the internship and my full course load, however, due to two of the classes starting halfway through the semester I quickly became overwhelmed. The project pipeline at the ILab is fast-paced and self-directed, making it easy to fall out of schedule and get behind on deadlines if interns aren't exercising discipline and good time management. Coupled with my full course load, it became very difficult for me to maintain my project schedule and subsequent responsibilities. Even though other cybersecurity interns at the ILab won't be in my specific situation, the fast nature of the program becomes a significant challenge when also juggling other responsibilities.

Recommendations to Future Interns

If given the opportunity, I would give several recommendations to future Brooks Crossing ILab interns pertaining to time management, self-study, and education. While the ILab was a wonderful internship experience, there were doubts at the beginning due to the organization's lack of information about the program. I recommend future interns email ahead and contact both the lab director and program manager about the exact parameters of the cybersecurity intern's responsibilities and duties. Many people are not suited to/prepared for teaching younger ages and may get overwhelmed if only expecting cybersecurity responsibilities. Additionally, I also recommend that future interns exercise strict time management while at the ILab. The time interns have there is short and there are many responsibilities and projects to work on, the lack of discipline in managing those responsibilities could snowball into a very negative experience. Some may look upon the ILab's hands-off management style and may think of it as unstructured and sloppy, however, I recommend they view it as a valuable learning experience to cultivate better time management skills. Another recommendation for future interns at the ILab is to be proactive in cybersecurity research for intern responsibilities and challenges. Besides one of the graduate assistants, there will not be anyone to teach you cybersecurity concepts you have not yet learned in university. Therefore, it is imperative that cybersecurity interns take their education into their own hands and do research into cybersecurity concepts that can be used in future lessons and workshops. The final recommendation for future ILab cybersecurity interns is to prepare for youth education and learn general education techniques. A large portion of the ILab's internship program revolves around education for the surrounding community and being able to competently interact with an audience as an instructor plays into the success of the program's lessons/workshops. The ability to teach adequately not

only improves the success rate of information retention but also makes the instructor more proficient in understanding the topic.

Conclusion

In Conclusion, the cybersecurity internship at the Brooks Crossing Innovation Lab was a very educational and beneficial experience. My responsibilities as a cybersecurity intern involved creating challenges that teach cybersecurity concepts and serving a support role in field trips and projects at the maker space. Initially, I expected my responsibilities to be almost purely cybersecurity and IT with the maker space, however, as I was trained and as time progressed I realized learning the maker space machines and helping with field trips almost took priority in the program. The ILab itself is a fledgling organization that only has several paid positions and authoritative figures, creating a unique working environment where the program manager works closely with the interns on preparing events. The management style outside of hosting events is hands-off, relying on the interns themselves to choose their projects and establish proper deadlines to meet. This set of circumstances allowed me to learn important skills and created more structure for my future career path.

My experiences at the Brooks Crossing Innovation Lab will influence the remainder of my time at college by being more proactive in research outside of class curriculum. To properly create cybersecurity challenges on a diverse range of concepts, I had to do extensive research on certain topics that ODU had not taught me. Needing to do more research made me realize that cybersecurity classes at ODU would not be enough to do a sufficient job both at the ILab but also in real life. Following this realization, I have been more proactive in learning cybersecurity concepts in addition to my current class curriculum and will continue to do independent research past my graduation and into my working career.

Working as a cybersecurity intern at the Brooks Crossing ILab reinforced my belief that proper cybersecurity training is the solution to the human bottleneck in cybersecurity defense. By teaching people of all ages STEM and cybersecurity fundamentals as part of the ILab's workshops and events I have become more proficient in teaching and more adept in creating cybersecurity-based educational presentations. The experiences and skills I gained while at the ILab influenced me to pursue a career in cybersecurity training, creating and administering seminars for employees to prevent cyber attacks.

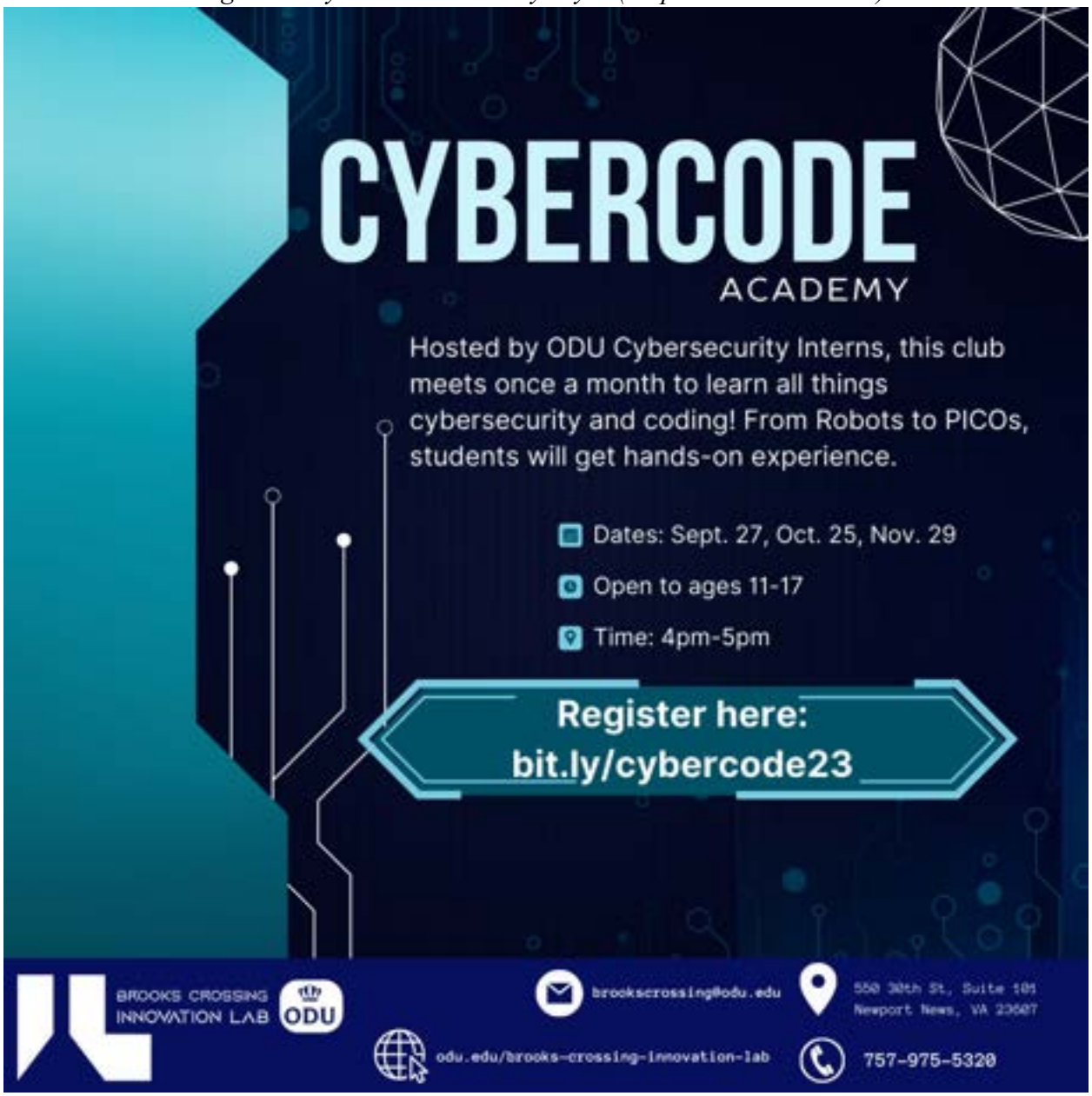
In total, the internship program at the Brooks Crossing Innovation Lab was an invaluable experience that taught me many important lessons and fulfilled the three learning objectives I made at the beginning of the program. The workshops and events allowed me to apply my cybersecurity knowledge in real-world applications like creating instructional presentations for system security. The repeated educational events I have had to help teach have given me a greater understanding of cybersecurity fundamentals and more nuanced cybersecurity techniques from needing to research topics for the monthly CyberCode Academies. By learning how to operate the many fabrication machines at the maker space and helping others with their projects, I have gained a solid foundation of how to 3D print, laser engrave, and resin print anything that I would like to make. The friends, skills, and memories I made at the Brooks Crossing ILab made the internship experience unforgettable and very beneficial to my career.

Appendices:

Figure 1: Scratch Code Workshop

Figure 2: Making Personal Projects at the Maker Space

Figure 3: CyberCode Academy Flyer (no pictures were taken)



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Pictures: https://twitter.com/odubcilab