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Enhancing Online Delivery of Practical Labs for Cyber Security Course Using Virtual Laboratories

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Abstract: - This research work is to create a application as web service to make it available on web for web service discovery. The most significant yoga stance is well-known on a global scale and supports the health advantages advocated by the ancient sages. OpenPose estimates that computer vision technology can help yoga practitioners achieve the greatest form and alignment. The integration of the OpenCV, Python, and MediaPipe frameworks is the main emphasis of this research project in order to develop an OpenPose estimation system for yoga poses. A camera is used to capture the yoga practitioner's motions, and a deep learning model is used to predict the important body parts. The algorithm then looks at these essential aspects to determine if the practitioner is doing the pose correctly or whether any adjustments are needed. The device gives the practitioner immediate feedback, allowing them to modify their alignment and posture as necessary. The OpenPose estimate system can help with the practice of yoga by offering detailed visualizations of the essential body parts throughout each posture in addition to providing real-time feedback Practitioners may more clearly understand the right form and alignment and make the required adjustments by utilizing this visualization. Additionally, the OpenPose estimation system enables the tracking of development over time. Practitioners who want to practice alone at home or may not have access to an instructor can also benefit from it. This paper offers a MediaPipe, OpenCV, and Python-based OpenPose estimation system for yoga positions. For optimal form and alignment, the tool may offer real-time feedback and visual representations of key body parts throughout each position. It is useful tool for yoga teachers and students, enhancing yoga's safety and efficacy while supporting the practice.

Keywords: Web Service Discovery, Web Service, yoga, posture, alignment, feedback, Deep learning, OpenCV, Python, and MediaPipe.

Introduction

This study investigates the use and adaptation of the Virtual Labs approach to enhance the effectiveness of online lab teaching for cyber security-related courses. Security-related courses have been recommended to be embedded in the related curriculums of higher education institutions to meet the gap in demand and supply of the security specialist. Cybersecurity or security education is becoming imperative due to the exponential trend and alarming cases of cyber-attacks and the lack of trained specialists in the area (Parrish et. al., 2018). In most universities, more than one security courses are offered which demonstrated the importance of the courses. The courses have different learning outcomes, but they share one expected outcome which is the ability of the students to use current techniques, skills, and tools necessary for computing practice. All security courses require that the theoretical knowledge imparted to the students be adequately accompanied by practical experience through laboratory experiments. However, due to COVID19, the teaching of practical labs has been shifted to online mode. This poses additional challenges to educators in terms of teaching and learning. Therefore, a solution for remedying the issues is essential to enhance the effectiveness of learning and teaching.

Challenges in Online Delivery of Practical Labs for Cyber Security Course

Teaching security is a complex task due to the disjoint between theory and practice. Therefore, lab teaching is an integral part to close the gap. However, due to COVID19, lab teaching has been shifted to online mode This poses critical challenges that become the barriers to achieve the learning outcome such as the following:
a. The security modules for laboratory exercises normally consist of time-consuming and complex hands-on activities on topics such as ethical hacking, intrusion detection, penetration testing, attacks simulations,

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malware analysis, security auditing, cryptography, and many more (Bamasag, 2015).

b. From the lecturer's aspect, the struggle lies in ensuring all students understand the instructions since the subject is purely technical. Without physical monitoring, it is hard to do that.

c. The traditional method for laboratory teaching is through the physical laboratory. Arguably, a physical laboratory presents the most ideal and realistic environment for students to learn due to easy access to machines and tools. With online mode, it is missing the benefit of ease of obtaining immediate attention and direct guidance from the lecturer.

d. For the students, the challenges exist in factors such as limited personal machine capability to run the simulation tools, network connectivity, and bandwidth constraint that can potentially disrupt the learning process because they might need to install the software at their own personal machines. Students faced difficulty in downloading huge amounts of data required for some security investigations, especially over slow internet connections. Furthermore, most of the tools are not platform independent, running only on Windows Operating System (OS) computers, while some others only ran on Linux OS.

Requirements for Online Practical Labs for Cyber Security Course

To overcome the challenges, to enhance the online practical labs delivery, to increase students' engagement and motivation and to introduce learning across a wide range of Cyber Security domains, the following requirements have been defined:

Teaching
a. Adoption of the lab exercises do not require any changes in the course structure.
b. The lecturers require only Internet to access the lab environment. No VPN set up is necessary.
c. The teaching process must be based on micro-learning blocks, the duration of which must range from 5 to 25 minutes.

Learning
a. The security modules for laboratory exercises must be easy to understand and self-explanatory.
b. The laboratory exercises must cover a wide set of topics.
c. The students require only internet to access to the lab environment. No VPN set up is necessary.
d. The learning environment does not require to be installed at any University infrastructure (no other cost involved) and must be platform independent.
e. The learning environment is available 24/7.
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Potential Solution for Online Practical Labs for Cyber Security Course

Based on the requirements, it has been identified that Virtual Lab (VL) can be a potential solution. A VL includes a range of related virtual experiments which share simulations and learning resources through the usage of virtualization and cloud computing technologies (Tobarra et. al, 2019). Virtualization provides the ability to create and host multiple machines within one physical machine, thereby allowing the development of complex scenarios with a minimal hardware commitment. Virtualization facilitates a mechanism for creating and deploying authentic computer security laboratory experiences for students while minimizing the associated configuration time and reducing the associated hardware requirements. The students can access the VL via an internet connection through their computers as opposed to install the network tools in their resource-limited machines. A plethora of activities and practical problem scenarios accessed by the students at any time. It has been reported that VL is an efficient approach in providing opportunities for autonomous and self–learning (Syamsuddin, 2019).

Adoption of Virtual Lab for Online Practical Labs for Cyber Security Course

At the initial stage, the focus of the adoption is on the lab environment and lab contents.

Lab Environment

The chosen lab environment for initial adoption is SEED lab. SEED stands for SEcurity EDucation (Du,2011). These labs are built upon a Linux virtual machine. The image of the VM can be downloaded from the SEED Lab's website. Educators and students just need to use a single computer or laptop to work on these labs with minimal configurations and specifications. All software used in the labs is open-source and free. It fosters ubiquitous access to students studying in various enrolment modes, which caters well for online learning.

Lab Contents

The lab contents were originally obtained from the SEED lab. The contents from SEED Lab are very extensive and comprehensive cover wide range of cyber security related topics. However, the contents were edited to suit the learning outcome for certain topics, for ease of delivery and for retaining student's engagement and motivation.

The practical tasks included in the topics were arranged based on micro-learning principles. The tasks were grouped and further arranged into sub-tasks with respective achievable objective. Each task was assigned a difficulty level from the easiest task (easy) to the most difficult task. Students can feel sense of accomplishment after they have managed to complete the tasks.

The Students' Satisfactory Level on Initial Adoption of Virtual Lab for Practical Labs for Cyber Security Course

A survey was administered to 3 batches of Cyber Security course students from different semesters to gauge their level of satisfaction on the delivery. One of the components of the survey was soliciting their satisfaction level on the lab delivery. It is a question that uses a 5-point Likert scale from very dissatisfied to very satisfied. The adoption was just introduced in the most recent semester (Sem 3). The impact of the initial adoption is reflected in the increased unit of very satisfied scores as per depicted in Figure 1.
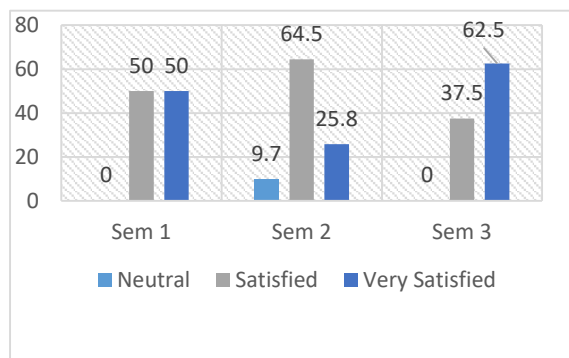
Figure 1. Student satisfaction scores for Online Lab Delivery of Cyber Security Course

Conclusion and Further Works

From constructivism theoretical perspective, Virtual Lab (VL) can be a great platform for educators to use as a tool for learners to experience the Cyber Security practical skills and reflect upon those experiences, to build new knowledge via an online learning. Accessing online lab facilities to execute hands-on activities from anywhere and anytime is imperative not only during COVID-19, but in general at any time as most of the universities are now offering online mode teaching. On-campus students can also re-emphasize their learning using the online labs outside their class times. Based on the survey, the student satisfaction score is higher in the units that implemented VL compared to their previous offerings without VL. Despite their advantages, choosing the right type of VL is not a simple task. There are still limitations exist in SEED Labs with regards to downloading and setting up the virtual environment. The next phase of the project is to investigate the feasibility of other cloud-based virtualized environment such as i-Labs as the platform for the delivery of the online practical labs for few Cyber Security-related courses.

References
1. Parrish, A., Impagliazzo, J., Raj, R. K., Santos, H., Asghar, M. R., Jøsang, A., & Stavrou, E. (2018) Global perspectives on cybersecurity education for 2030: a case for a meta-discipline. In Proceedings Companion of the 23rd annual ACM conference on innovation and technology in computer science education (pp. 36-54).
2. Bamasag, O. (2015). On the enhancement of teaching method for information security course. International Journal of Technology Enhanced Learning, 7(1), 36-43.
3. Tobarra, L., Robles-Gómez, A., Pastor, R., Hernández, R., Duque, A., & Cano, J. (2019). A Cybersecurity Experience with Cloud Virtual-Remote Laboratories. In Multidisciplinary Digital Publishing Institute Proceedings (Vol. 31, No. 1, p. 3).
4. Syamsuddin, I. (2019). VILARITY-Virtual Laboratory for Information Security Practices. TEM Journal, 8(3), 1011-1016.
5. Du, W. (2011). SEED: hands-on lab exercises for computer security education. IEEE Security & Privacy, 9(5), 70-73.