ClubZero: Breaking Barriers in Cybersecurity Education Through Browser-Based Simulation

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Abstract

Cybersecurity education requires a combination of conceptual understanding, technical proficiency, and practical experience to prepare students to address the security challenges of modern computing environments. Although lectures and instructional materials introduce foundational concepts such as access control, network segmentation, firewall configuration, and system hardening, students often encounter difficulties translating theoretical knowledge into practical technical skills. Hands-on laboratory activities provide opportunities for learners to apply security principles, experiment with system configurations, and develop problem-solving abilities in controlled environments. However, implementing effective cybersecurity laboratories presents significant challenges for educational institutions, particularly those with limited computing resources, technical support personnel, or infrastructure budgets. Traditional laboratory environments frequently depend on virtual machines, specialized software, and cyber ranges that require extensive installation, configuration, maintenance, and troubleshooting. These requirements can introduce technical barriers that reduce instructional flexibility, limit accessibility, and divert valuable time from learning objectives. To address these challenges, this presents ClubZero, a browser-based cybersecurity simulation platform designed to make practical cybersecurity education more accessible, flexible, and manageable.

ClubZero provides students with an interactive, simulated Linux environment accessible through a standard web browser, eliminating the need to install or configure virtual machines on individual computers. Within this environment, students can execute commands, explore system administration concepts, construct simulated server architectures, configure firewall rules, and perform system hardening activities. These capabilities allow learners to engage directly with representative cybersecurity tasks while developing familiarity with command-line interfaces, security configurations, and the relationships between system components. By presenting these activities within a browser-based interface, ClubZero seeks to reduce the technical and logistical barriers associated with traditional laboratory deployments. Students can concentrate on understanding security concepts and completing practical exercises rather than resolving local installation problems or configuring complex computing environments before beginning an assignment.

In addition to its student-facing capabilities, ClubZero incorporates instructional features intended to support flexible course design and facilitate classroom management. Instructors can develop customized scenarios that align with specific learning objectives, instructional topics, and student skill levels.