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GAMIFIED CYBERSECURITY EDUCATION THROUGH THE LENS OF THE INFORMATION SEARCH PROCESS: AN EXPLORATORY STUDY OF CAPTURE-THE-FLAG COMPETITIONS

[RESEARCH-IN-PROGRESS]

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ABSTRACT

Aim/Purpose	Capture the Flag (CTF) challenges are a popular form of cybersecurity education where students solve hands-on tasks in a game-like setting. These exercises provide learning experiences with various specific technologies and subjects, as well as a broader understanding of cybersecurity topics. Competitions reinforce and teach problem-solving skills that are applicable in various technical and non-technical environments outside of the competitions.
Background	The Information Search Process (ISP) is a framework developed to understand the process by which an individual goes about studying a topic, identifying emotional ties connected to each step an individual takes. As the individual goes through the problem-solving process, there is a clear flow from

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	uncertainty to clarity; the individual's feelings, thoughts, and actions are all interconnected. This study aims to investigate the learning of cybersecurity concepts within the framework of the ISP, specifically in the context of CTF competitions.
Methodology	A comprehensive research methodology designed to incorporate quantitative and qualitative analyses to draw the parallels between the participants' emotional experiences and the affective dimensions of learning will be implemented to measure the three primary goals.
Contribution	This study contributes significantly to the broader landscape of cybersecurity education and cognitive-emotional experiences in problem-solving.
Findings	The study has three primary goals. First, we seek to enhance our understanding of the emotional and intellectual aspects involved in problem-solving, as demonstrated by the ISP approach. Second, we aim to gain insights into how the presentation of CTF challenges influences the learning experience of participants. Lastly, we strive to contribute to the improvement of cybersecurity education by identifying actionable steps for more effective teaching of technical skills and approaches.
Recommendations for Practitioners	Competitions reinforce and teach problem-solving skills applicable in various technical and non-technical environments outside of the competitions.
Recommendations for Researchers	The Information Search Process (ISP) framework may enhance our understanding of the emotional and intellectual aspects involved in problem-solving as we study the emotional ties connected to each step an individual takes as the individual goes through the problem-solving process.
Impact on Society	Our pursuit of advancing our understanding of cybersecurity education will better equip future generations with the skills and knowledge needed to address the evolving challenges of the digital landscape. This will better prepare them for real-world challenges.
Future Research	Future studies would include the development of a cybersecurity curriculum on vulnerability exploitation and defense. It would include practice exploiting practical web and binary vulnerabilities, reverse engineering, system hardening, security operations, and understanding how they can be chained together.
Keywords	cybersecurity, Capture-the-Flag, information search process, gamification

AUTHORS

Albert Tay, an IT & Cybersecurity faculty member at Brigham Young University, received his Ph.D. in Communication and Information Sciences from the University of Hawaii, Manoa. Dr. Tay is co-PI on the NSF CyberCorps Scholarship for Service grant ($3.7 million).

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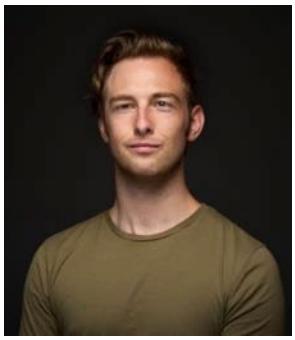

Drew Wilson is a Computer Science student at Brigham Young University. Drew is a teaching assistant for Computer Science courses. He also serves as a research assistant at the Cybersecurity Research Laboratory. He is vice president of the Cybersecurity Student Association and is interested in applying machine learning to cybersecurity tools and processes. He has participated in many cybersecurity competitions, including the National Cyber League, where his team placed 3rd, and Hack the Building, which emphasized securing ICS technology against APTs.

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Dallin Kaufman is currently a cybersecurity student at Brigham Young. He volunteers at the Cybersecurity Research Laboratory. He also teaches introductory cybersecurity classes and leads the CTF group for the Cybersecurity Student Association. He participated in the National Cyber League Team competition (placed 3rd nationally) and the National Collegiate Cyber Defense Competition (placed 8th nationally).