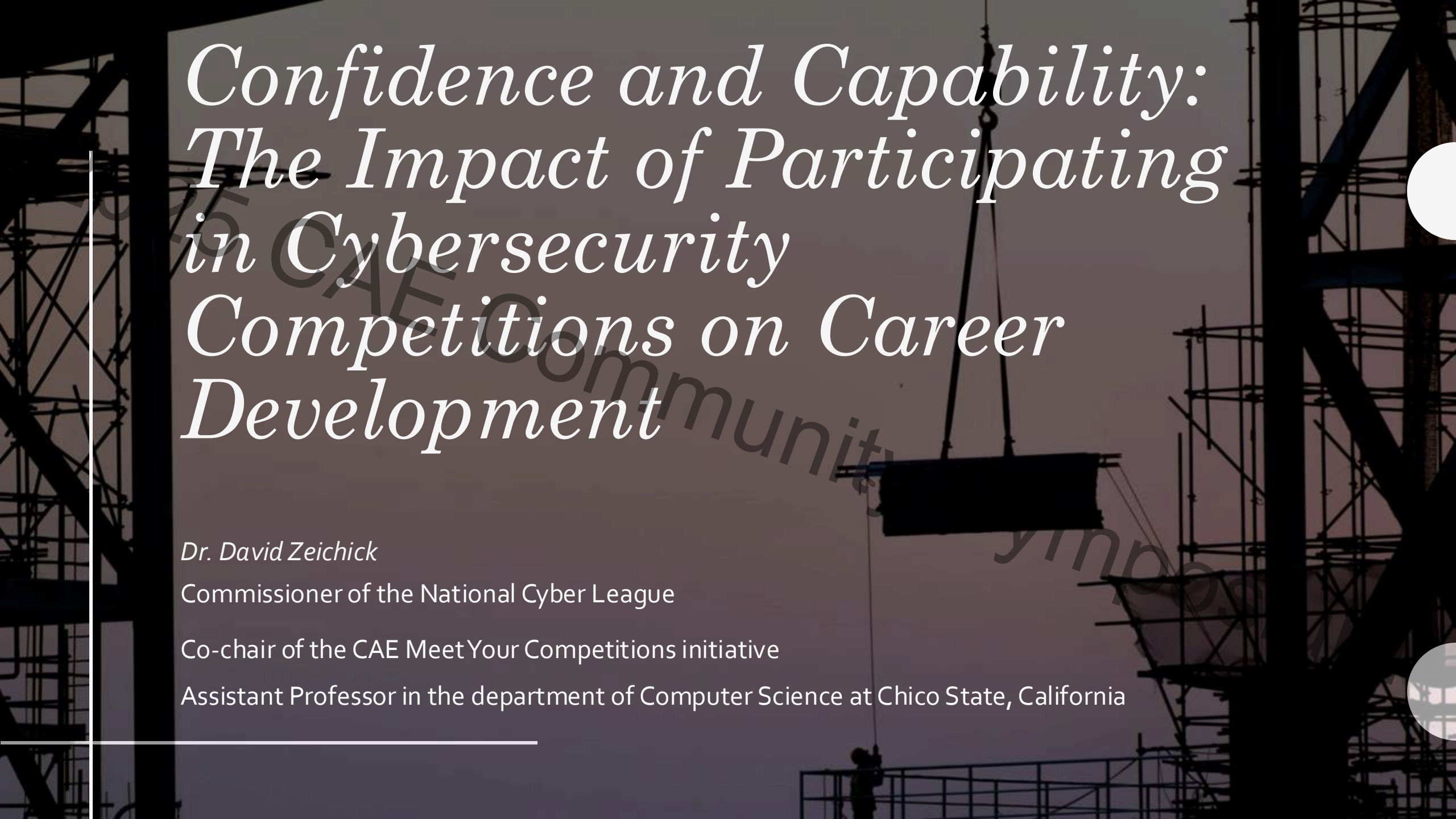




Confidence and Capability: The Impact of Participating in Cybersecurity Competitions on Career Development

Dr. David Zeichick

Commissioner of the National Cyber League

Co-chair of the CAE Meet Your Competitions initiative

Assistant Professor in the department of Computer Science at Chico State, California

Why lack of talent?

- Current cyber training environments do not accurately mirror real-world cyber situations
 - Employers and teachers have different perceptions of skills needed
- et al.,
employers, educational leaders, and
employees (Jang, 2015),

Industry's take on graduates' preparedness

graduates lack practical, hands-on skills in cybersecurity

the practical, transferable skills

are in demand by the market

- Many studies indicate that teamwork and communication are crucial skills, yet recent graduates often lack proficiency in these areas. [Passow, 2012]
- These gaps primarily revolve around practical, hands-on, and in-depth technical skills (Williams et al., 2021)

Students' perception of their ability to succeed

- Self-efficacy has a noteworthy impact not only on student performance but also on their career choices
- Intro classes should help promote this

tions, satisfaction, and choices of

choices (Sandler, 2000)

e introductory courses should promote career efficacy, empowering students to be confident in their abilities for success (Bratosin,

Hands-on Learning!

- ABET says that the integration of hands-on and practical cybersecurity instruction is a vital component in the effort to modernize engineering education
- Also has proven to improve retention

Preparing Students for Industry

- Achieving a balance between teaching students the theory (the "why") and training them to apply that theory (the "how") is essential in education

- should promote hands-on learning, assessments based on real-world scenarios, and problem-solving rooted in industry challenges (John et al., 2020)



POWERED BY

CYBER SKYLINE

2025

Skills covered:



Cryptography



Password
Cracking



Log Analysis



Enumeration/
Exploitation



Scanning



Network Traffic



Web App



Open Source



Forensics

**No specialized
hardware or software
necessary. You can
even start playing NCL
from a Chromebook!**

Let's Ask Past Competitors

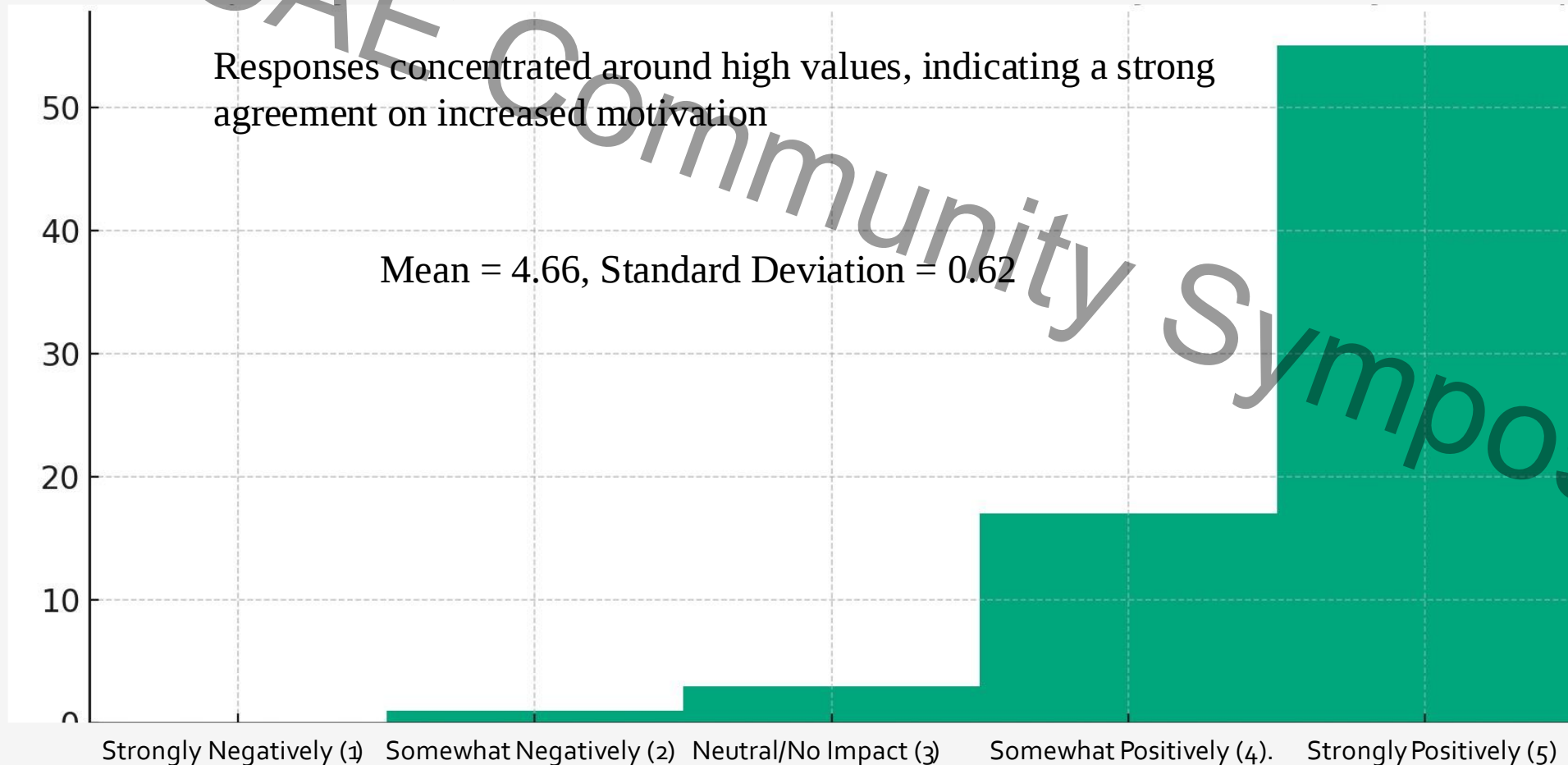
- 62 NCL alumni now working in cybersecurity were contacted over LinkedIn
 - 34 completed the survey (a 55% response rate)
- 6,013 NCL alumni that recently graduated were emailed a link to the survey
 - 47 completed the survey (just a .8% response rate)

The Survey

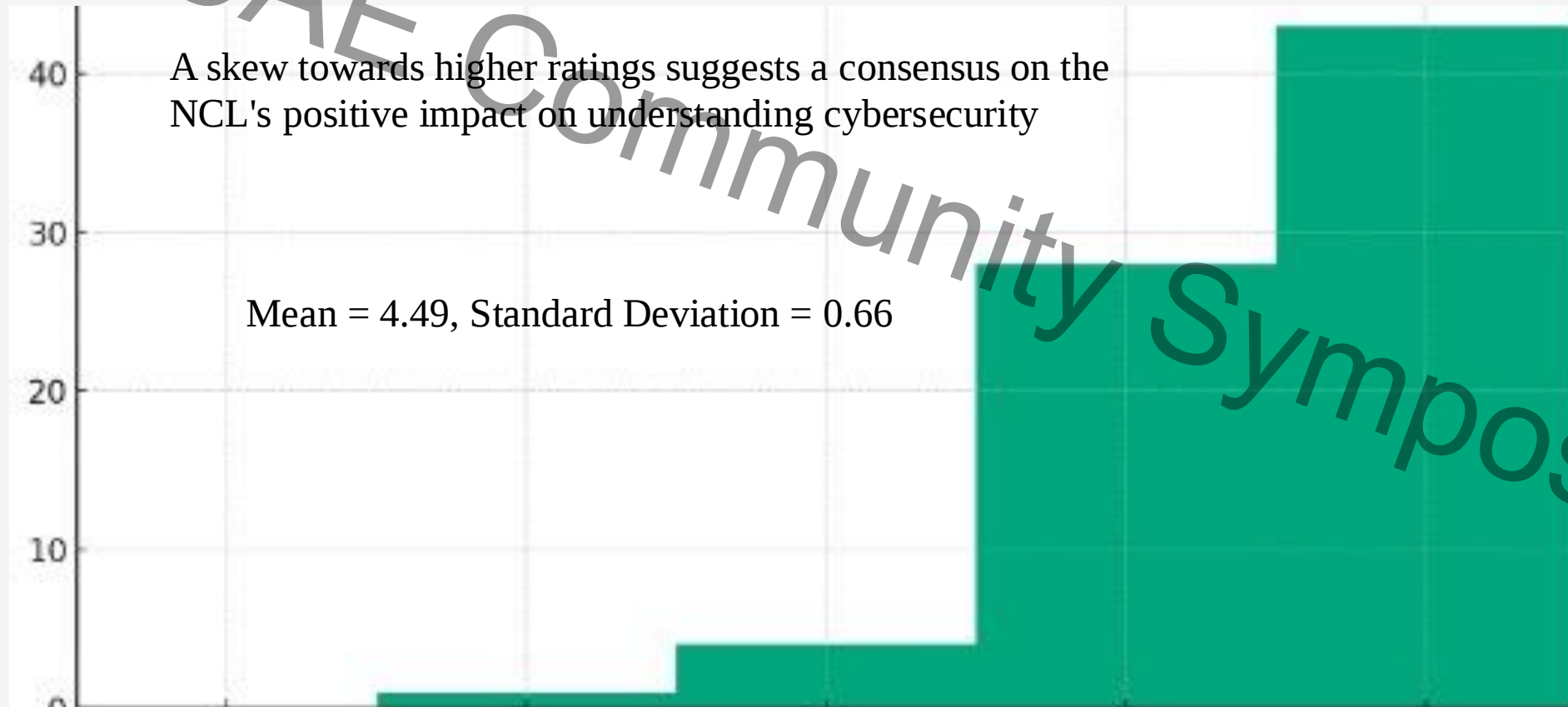
- 35 questions
 - 27 quantitative queries using a Likert scale
 - 5 open-ended qualitative inquiries
 - 1 binary yes/no question
 - 2 queries for consent to disclose their identity
- conducted online via Survey Monkey

Quantative Questions	Average (1-5)
To what extent did the NCL impact your motivation to learn more about cybersecurity, either positively or negatively?	4.67605634
To what extent did the NCL influence your willingness to engage in solving a cybersecurity problem, either positively or negatively?	4.52112676
To what extent did the NCL influence your understanding of cybersecurity, either positively or negatively?	4.49295775
To what extent did the NCL affect your self-directed learning capabilities, either positively or negatively?	4.3943662
To what extent did the NCL influence your pursuit of lifelong learning in the cybersecurity field, either positively or negatively?	4.30985915
To what extent did the NCL affect your confidence in the cybersecurity field, either positively or negatively?	4.23943662
I have recommended or encouraged others to participate in the NCL based on my experience.	4.22535211
The NCL provided hands-on experience that was not available in my formal education or training.	4.21126761
I found the learning experience in the NCL to be more beneficial than traditional classroom or online courses.	4.16901408
The hands-on challenges in the NCL were the most beneficial for my professional development.	4.07042254
I believe that participating in the NCL offered a competitive edge when applying for jobs in the industry.	3.87323944
To what extent did the NCL positively influence the expansion of your thinking abilities?	3.85915493
The skills and knowledge I gained from the NCL are directly relevant to my current job responsibilities.	3.8028169
To what extent did the NCL influence your ability to abstract and generalize cybersecurity concepts?	3.78873239
Participating in the NCL influenced my choice of cybersecurity specialization or area of interest.	3.69014085
Participating in the NCL helped me secure a job in the industry.	3.4084507
To what extent did the NCL enhance your group collaboration skills?	3.31428571
How closely did the activities in the NCL mirror real-world cybersecurity scenarios?	3.21428571
I found networking opportunities through the NCL beneficial for my professional journey.	3.18309859
I am interested in mentoring or guiding future participants in the NCL.	3.17142857
Some aspects of the NCL were less relevant or useful for my career in cybersecurity.	3.12676056
I believe there is a gap between the challenges posed in the NCL and real-world cybersecurity threats.	3.12676056
Have you encountered problems in your current job that resembled those presented in the NCL?	2.73239437
Do you remain active in cybersecurity competitions post-employment?	2.21428571
To what extent was the interviewer familiar with the NCL during your job interviews?	1.97101449
To what extent, if any, did hiring managers indicate that your participation in the NCL influence their decision to interview you?	1.73913043

To what extent did the NCL impact your motivation to learn more about cybersecurity. either positively or negatively?

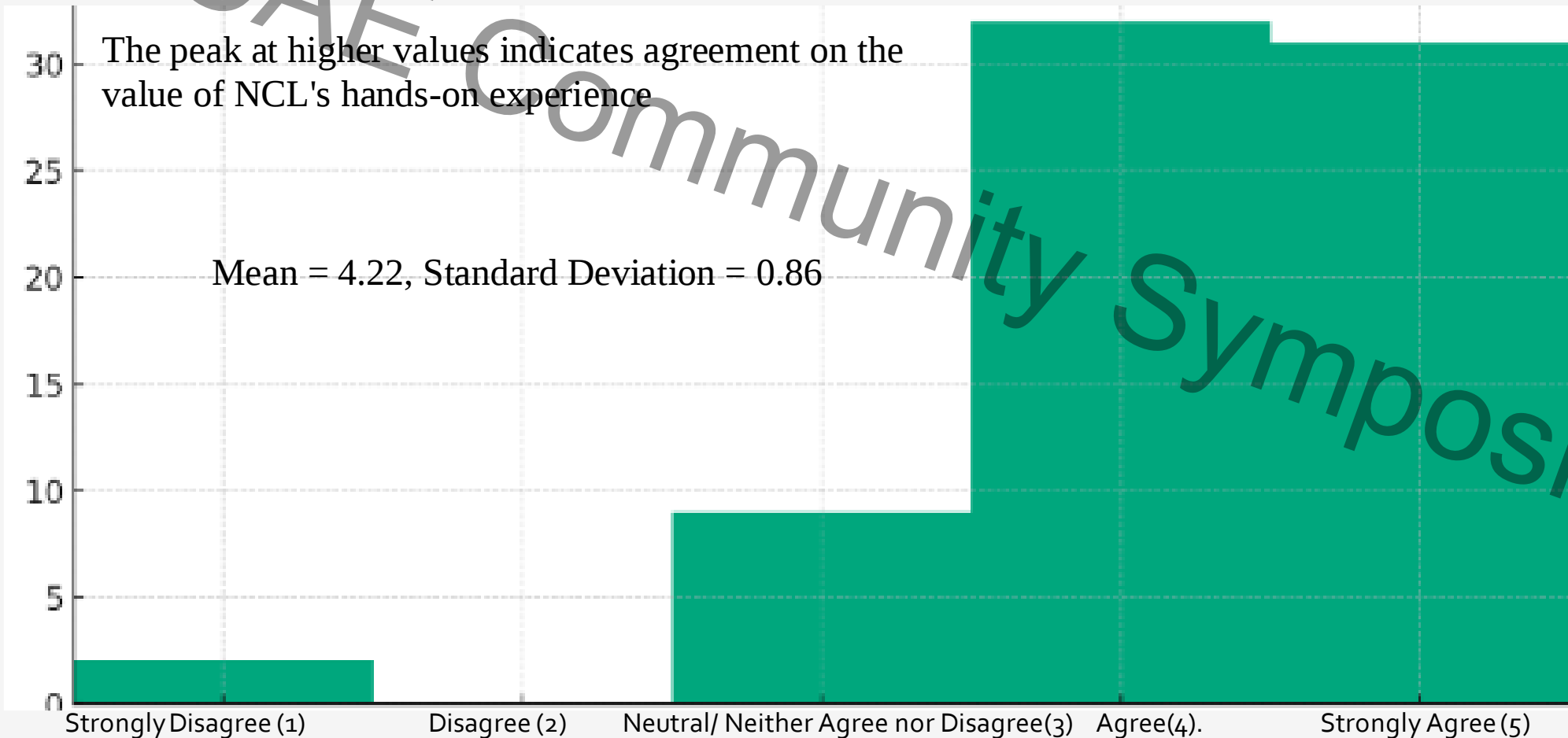


To what extent did the NCL influence your understanding of cybersecurity, either positively or negatively?

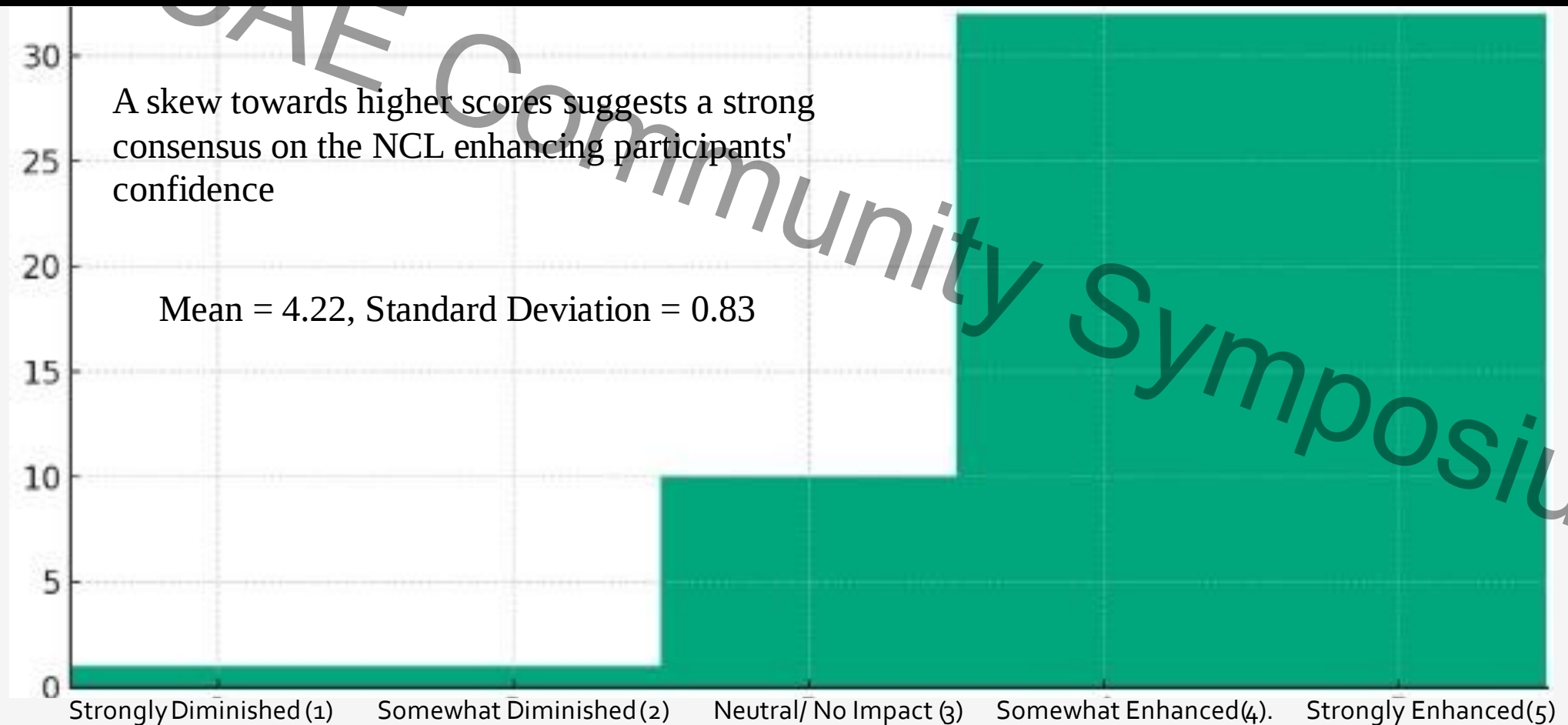


Strongly Negatively (1) Somewhat Negatively (2) Neutral/No Impact (3) Somewhat Positively (4) Strongly Positively (5)

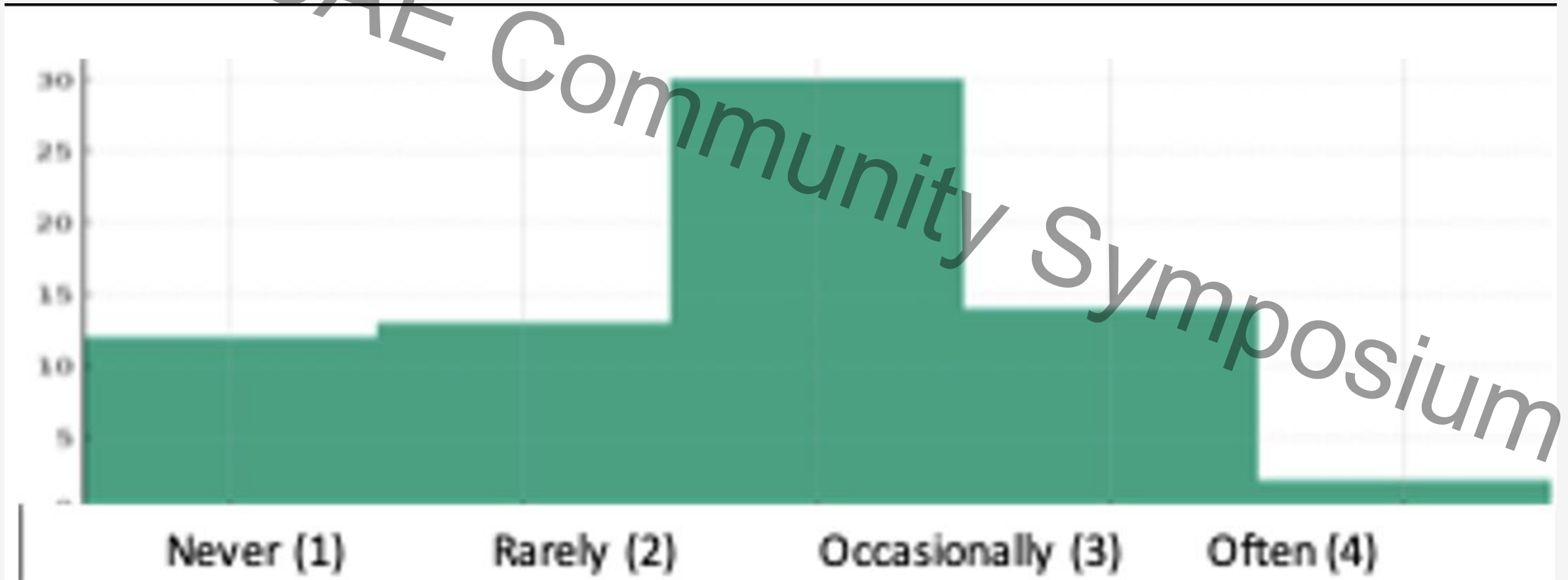
The NCL provided hands-on experience that was not available in my formal education or training?



To what extent did the NCL affect your confidence in the cybersecurity field, either positively or negatively?



Have you encountered problems in your current job that resembled those presented in the NCL?



How closely did the activities in the NCL mirror real-world cybersecurity scenarios?

This reflects varied opinions on how closely NCL activities mirror real-world scenarios



Works cited

- Raineri, Ellen M., and Tamara Fudge. "Exploring the Sufficiency of Undergraduate Students' Cybersecurity Knowledge Within Top Universities' Entrepreneurship Programs." *Journal of Higher Education Theory & Practice* 19, no. 4 (2019). http://www.digitalcommons.wvu.edu/businesspress.com/JHETP/JHETP19-4/7_RaineriEM_19_4_.pdf.
- Allen, P. D., and K. A. Straub. "Using Games to Enrich Continuous Cyber Training." *Johns Hopkins APL Technical Digest* 33, no. 2 (2015).
- Bandura, Albert, Claudio Barbaranelli, Gian Vittorio Caprara, and Concetta Pastorelli. "Self-Efficacy Beliefs as Shapers of Children's Aspirations and Career Trajectories." *Child Development* 72, no. 1 (January 2001): 187–206. <https://doi.org/10.1111/1467-8624.00273>.
- Bratosin, Bogdan Alexandru. "Cyber Defense Exercises and Their Role in Cyber Warfare | Journal of Mobile, Embedded and Distributed Systems," December 2, 2014. http://jmeds.eu/index.php/jmeds/article/view/Cyber_Defense_Exercises_and_their_Role_in_Cyber_Warfare.
- DeWitz, S. Joseph, and W. Bruce Walsh. "Self-Efficacy and College Student Satisfaction." *Journal of Career Assessment* 10, no. 3 (August 2002): 315–26. <https://doi.org/10.1177/1067270201000303>.
- Hutchison, Mica A., Deborah K. Follman, Melissa Sumpter, and George M. Bodner. "Factors Influencing the Self-Efficacy Beliefs of First-Year Engineering Students." *Journal of Engineering Education* 95, no. 1 (January 2006): 39–47. <https://doi.org/10.1002/j.2168-9830.2006.tb00876.x>.
- Jang, Hyewon. "Identifying 21st Century STEM Competencies Using Workplace Data." *Journal of Science Education and Technology* 25, no. 2 (April 1, 2016): 284–301. <https://doi.org/10.1007/s10956-015-9593-1>.
- John, Samuel Ndueso, Etinosa Noma-Osaghae, Funmini Oajide, and Kennedy Okokpujie. "Cybersecurity Education: The Skills Gap, Hurdle!" In *Innovations in Cybersecurity Education*, edited by Kevin Dalmi and Guillermo Francia III, 361–76. Cham: Springer International Publishing, 2020. https://doi.org/10.1007/978-3-030-50244-7_18.
- Kalnishkan, Yuri. "Learning Style Models and Teaching of Computer Science." *Accessed: Oct 6 (2005): 2019*.
- Katsantonis, Menelaos N., Ioannis Mavridis, and Dimitris Gritzalis. "Design and Evaluation of COFELET-Based Approaches for Cyber Security Learning and Training." *Computers & Security* 105 (June 1, 2021): 102263. <https://doi.org/10.1016/j.cose.2021.102263>.
- Katsantonis, N. Menelaos, Isabella Kotini, Panayotis Fouliras, and Ioannis Mavridis. "Conceptual Framework for Developing Cyber Security Serious Games." In *2019 IEEE Global Engineering Education Conference (EDUCON)*, 872–81, 2019. <https://doi.org/10.1109/EDUCON45019.8725061>.
- Lent, Robert W., Hung-Bin Sheu, Daniel Singley, Janet A. Schmidt, Linda C. Schmidt, and Clay S. Gloster. "Longitudinal Relations of Self-Efficacy to Outcome Expectations, Interests, and Major Choice Goals in Engineering Students." *Journal of Vocational Behavior* 73, no. 2 (2008): 328–35.
- Lukowiak, Marcin, Stanisław Radziszowski, James Vallino, and Christopher Wood. "Cybersecurity Education: Bridging the Gap Between Hardware and Software Domains." *ACM Transactions on Computing Education* 14, no. 1 (March 2014): 1–20. <https://doi.org/10.1145/2538029>.
- Machado, R., P. Guerreiro, E. Johnston, M. Delimar, and M. Brito. "IEEEXtreme: From a Student Competition to the Promotion of Real-World Programming Education, Proceedings of 39th Frontiers in Education Conference." *San Antonio*, 2009.
- Martini, Ben, and Kim-Kwang Raymond Choo. "Building the next Generation of Cyber Security Professionals." *Martini B and Choo KK R*, 2014. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2431592.

Works cited

- McGettrick, Andrew, Lillian N. Cassel, Melissa Dark, Elizabeth K. Hawthorne, and John Impagliazzo. "Toward Curricular Guidelines for Cybersecurity." In *Proceedings of the 45th ACM Technical Symposium on Computer Science Education*, 81–82. SIGCSE '14. New York, NY, USA: Association for Computing Machinery, 2014. <https://doi.org/10.1145/2538862.2538990>.
- Mostafa, Mahmoud, and Osama S. Faragallah. "Development of Serious Games for Teaching Information Security Courses." *IEEE Access* 7 (2019): 169293–305. <https://doi.org/10.1109/ACCESS.2019.2955639>.
- Mouheb, Djedjiga, Sohail Abbas, and Madjid Merabti. "Cybersecurity Curriculum Design: A Survey." In *Transactions on Edutainment XV*, edited by Zhigeng Pan, Adrian David Cheok, Wolfgang Müller, Mingmin Zhang, Abdenour El Rhalibi, and Kashif Kifayat, 93–107. Lecture Notes in Computer Science. Berlin, Heidelberg: Springer, 2019. https://doi.org/10.1007/978-3-662-59357-6_9.
- Newhouse, William, Stephanie Keith, Benjamin Scribner, and Greg Witte. "National Initiative for Cybersecurity Education (NICE) Cybersecurity Workforce Framework." *NIST Special Publication* 800, no. 2017 (2017): 181.
- O'Neill, G., and T. McMahon. "Student-Centred Learning: What Does It Mean for Students and Lecturers," Vol. 1. Dublin: AISHE, 2005. http://www.aishe.org/readings/2005-1/oneill-mcmahon-Tues_19th_Oct_SCL.html.
- Passow, Honor J. "Which ABET Competencies Do Engineering Graduates Find Most Important in Their Work?" *Journal of Engineering Education* 101, no. 1 (January 2012): 95–118. <https://doi.org/10.1002/j.2168-9830.2012.tb00043.x>.
- Ponton, Michael K., Julie Horine Edmister, Lawrence S. Ukeiley, and John M. Seiner. "Understanding the Role of Self-Efficacy in Engineering Education." *Journal of Engineering Education* 90, no. 2 (April 2001): 247–51. <https://doi.org/10.1002/j.2168-9830.2001.tb00599.x>.
- Raineri, Ellen M., and Tamara Fudge. "Exploring the Sufficiency of Undergraduate Students' Cybersecurity Knowledge Within Top Universities' Entrepreneurship Programs." *Journal of Higher Education Theory & Practice* 19, no. 4 (2019). http://www.digitalcommons.www.na-businesspress.com/JHETP/JHETP19-4/7_RaineriEM_19_4_.pdf.
- Sandler, Martin E. "Career Decision-Making Self-Efficacy, Perceived Stress, and an Integrated Model of Student Persistence: A Structural Model of Finances, Attitudes, Behavior, and Career Development." *Research in Higher Education* 41 (2000): 537–80.
- Sessa, Valerie I., and Manuel London. *Continuous Learning in Organizations: Individual, Group, and Organizational Perspectives*. Psychology Press, 2015. <https://books.google.com/books?hl=en&lr=&id=6wXICQAAQBAJ&oi=fnd&pg=PP1&dq=Continuous+learning+in+organizations:+Individual,+group,+and+organizational+perspectives&ots=4HZB5UFhYi&sig=tFy3qH-aRVlcvCZ8NNHBY2RXs4>.
- Sigholm, Johan, Gregory Falco, and Arun Viswanathan. "Enhancing Cybersecurity Education through High-Fidelity Live Exercises (HiFLiX)," 7553–62. IEEE conference proceedings, 2019. <https://urn.kb.se/resolve?urn=urn:nbn:se:fhs:diva-8340>.
- Zeldin, Amy L., and Frank Pajares. "Against the Odds: Self-Efficacy Beliefs of Women in Mathematical, Scientific, and Technological Careers." *American Educational Research Journal* 37, no. 1 (March 2000): 215–46. <https://doi.org/10.3102/00028312037001215>.

QUESTIONS?

2025 CAE Community Symposium