Developing Tools for Cybersecurity Education and Assessment

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PROBLEM STATEMENT

There is a growing need for highly-trained cybersecurity professionals. Providing the best training possible for the next generation requires continued development of educational tools and techniques. Specifically:

- Established principles and frameworks in education need to be tested in the cybersecurity domain.
- Cybersecurity is a rapidly evolving and highly adversarial domain, making adaptability and creativity key educational components.

BLOOM'S TAXONOMY

A framework for classifying levels of knowledge to develop progressive assessments at each level.

We are using this to develop instructional tools based on assessment of important concepts in cybersecurity.

- **Remember:** To recognize or recall knowledge from memory.

- **Understand:** To construct meaning from material when presented via different formatted messages or activities.

- **Apply:** Carrying out or using a procedure through executing, or implementing.

- **Analyze:** Differentiate, organize, and attribute components and functionality of a concept.

- **Evaluate:** Making judgements based on criteria and standards.

- **Create:** Putting elements together, and/or reorganizing them into a new pattern, to form a coherent/functional whole.

Industry Recommendations

Existing recommendations from industry sources on important cybersecurity skills and knowledge:

- NICE Framework (NIST)

- Cybersecurity Curricula 2017 (ACM, IEEE, others)

- National Centers for Academic Excellence in Cybersecurity (NSA, FBI, others)

Comparison of Recommendations

There is a stark difference between the learning outcomes in the CSEC2017 and the task descriptions in the NICE Framework. The CSEC2017 is concentrated at the "Understand" level, while the NICE Framework is more evenly distributed across the higher levels. This represents a significant gap between what the CSEC2017 is recommending be taught, and what the NICE Framework says are important professional skills.
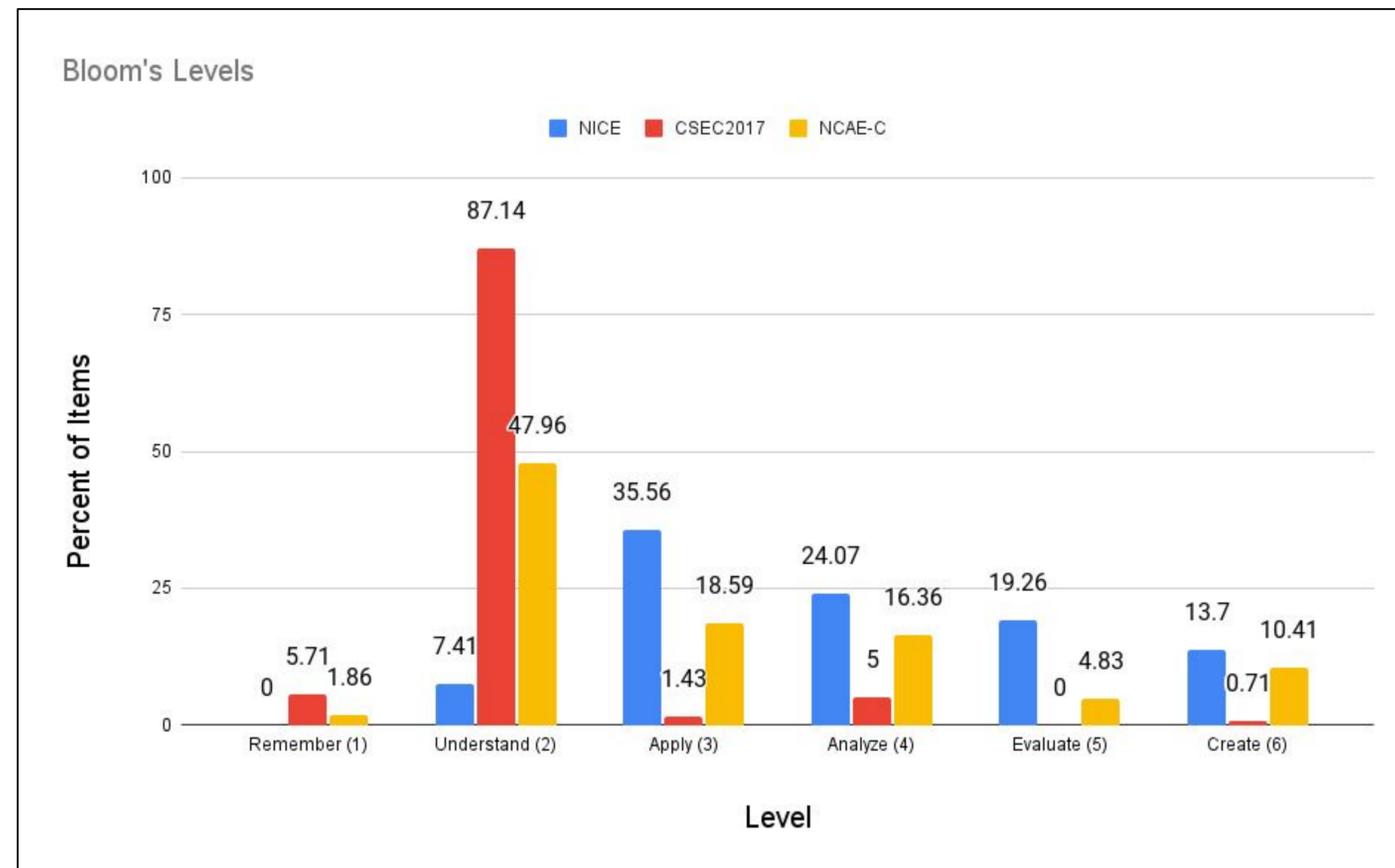
FUTURE DIRECTIONS

The main goals of this work moving forward are:

- Use Bloom's Taxonomy to guide development of assessments (Anderson et al, 2001)

- Design lessons that teach to the assessment while following established instructional design principles for multimedia learning (Mayer & Fiorella, 2022)

- Investigate the efficacy of established instructional design principles when applied to cybersecurity.

ACKNOWLEDGEMENTS

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