Cybersecurity Competition Comparison

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Three current cybersecurity competitions

There are numerous cybersecurity competitions worldwide, but for this exercise, the three competitions listed below are discussed. While their missions and objectives may differ, they are all forms of Capture the Flag (CTF) competitions designed to help participants identify vulnerabilities ("flags") in programs and websites (Cybersecurity Degrees, n.d). They include:

1. Pwn2Own
2. NCCDC: National Collegiate Cyber Defense Competition
3. Picoctf

Comparison based on six criteria or features (mission, practical skills, learning/knowledge, CTF type, Area of interest, and Eligibility)

	Pwnium (Chromium.org, n.d)	**NCCDC: National Collegiate Cyber Defense Competition** (CCDC, n.d)	**Picoctf** (Thornton, 2023)
Mission	To inspire involvement in efforts to improve the Chromium project's security.	To provide a controlled, competitive environment for higher education institutions to evaluate their learners' understanding and proficiency in addressing information systems' challenges.	- To encourage young people to pursue computer science and cybersecurity. - To identify and nurture the best young talents in cybersecurity.
Practical skills	Hands-on skills in detecting and fixing bugs.	Design, configuration, and protection of networks.	Hands-on skills and experience in solving real-world cybersecurity challenges.

Learning/knowledge	Identifying and correcting security vulnerabilities.	Protecting network infrastructures and information.	Addressing real-world cybersecurity problems.
CTF type	Jeopardy style (hacking challenge to identify vulnerabilities in a browser).	Mixed competition (combines both jeopardy and attack/defense-style).	Jeopardy style (hacking challenges to teach students cybersecurity).
Area of interest	Ethical hacking, improving browser security.	Management and protection of the available network infrastructures in institutions.	Reverse engineering, cryptography, forensics, web exploitation, and binary exploitation.
Eligibility	Anyone above the age of majority in their home country, not under any sanctions from the U.S., has stable internet access and is permitted by the home country's laws.	Students in higher education institutions.	High school and middle school students.

Pros and cons of each competition

1. Pwnium

Pros:

- There are minimal entry barriers because anyone can participate, provided they are of the right age and their country's laws allow them to do so.
- Participants gain experience in identifying and fixing bugs in browsers.
- Google Company benefits from improved security for its Chrome browser since the competition is aimed at enhancing the browser's safety by identifying flaws.

Cons:

- The focus is limited to a single aspect of identifying bugs in the Google Chrome browser.

- Rewards are also limited to cash and computer devices.

2. NCCDC: National Collegiate Cyber Defense Competition

Pros:

- Provide learning institutions with an opportunity to assess their systems and programs.
- It offers an opportunity for learners to apply their theoretical knowledge to practice.
- Promote teamwork spirit, professional ethics, and constructive engagements between the participants.
- Promotes awareness about cybersecurity issues among the participants.

Cons:

- Preparing for the competition can be a challenge to the hosting institution.
- It is mainly focused on network management operations.
- Students shoulder their traveling expenses.

3. Picoctf

Pros:

- Provides the participants with all the necessary tools to face the challenges.
- It provides students a platform to apply theoretical knowledge into practice by exposing them to real-world challenges.
- Inspires high school and middle school students to pursue careers in computer science and cybersecurity.
- Participants are provided with video games to make the experience more captivating.

Cons:

- Participation is limited to high school and middle school students.
- Focuses primarily on the offensive aspect of cybersecurity challenges.

Competitions successes in achieving their goals

As indicated above, the three competitions discussed in this paper have different missions, meaning their success level is also gauged differently. For instance, Pwnium's primary objective is to inspire participation in efforts to improve the Chromium project's security, and it has been able to achieve that by using the exploits sent by participants to fix the bugs in Google Chrome. For instance, Google was reported to have used the full exploits received in 2012 to strengthen the browser's security. According to the company, these adjustments made Chrome more secure and able to deal with the identified attacks in the future (Google Chrome Blog, 2012). Such reports suggest that the competition has helped the company to achieve some of its goals.

The NCCDC, on the other hand, aims to provide a controlled, competitive environment for higher education institutions to evaluate their learners' understanding and proficiency in addressing information systems' challenges. Institutions that have hosted the competition have reported benefits to them and their students, suggesting that the competition has achieved their primary goals. For instance, RIT reported benefits such as the provision of opportunities for faculty members and students to expand their knowledge and skills (Markowsky et al., 2015). It also credited the event for galvanizing and motivating staff and students to work as a team and boosting its reputation through the exposure of its programs.

Finally, Picoctf's primary goals included encouraging young people to pursue computer science and cybersecurity and identifying the best young talents in cybersecurity. Reports from the participants suggest that the competition has achieved one of its core objectives of inspiring students to pursue computer science and cybersecurity courses. According to Thornton (2023), 64% of students who participated in Picoctf 2019 indicated that they became interested in pursuing

a career in cybersecurity after participating in the competition. This finding highlights the competition's ability to inspire young people to pursue cybersecurity courses.

Benefits to the competitors other than the stated goals

Apart from their stated goals, the competitors have received other benefits, including gaining exposure and financial rewards, especially for those who succeed in winning the competition. It is also worth noting that participation in these competitions provides the competitors with valuable opportunities to interact and engage with stakeholders in the industry, thus building networks that could help them in their professions or future endeavors. They also gain confidence in tackling cybersecurity issues and building relevant skills.

Suggested improvements for each competition

The cons associated with Pwnium include limiting its focus on identifying bugs in the Google Chrome browser. This limitation implies that the competition can improve by expanding the scope of the participants' challenges. Such a move would go a long way to improving the competitors' proficiency in cybersecurity matters. Rewards should also be diversified, including sponsoring participants to continuous learning. The challenges identified for NCCDC can be addressed by the organizers, providing the competitors with all the necessary tools to tackle the tasks assigned. Picoctf cons include limiting participation to high school and middle school students and focusing primarily on the offensive aspect of cybersecurity challenges. These cons suggest that the competition can be improved by expanding the scope to cover both defense and attack aspects and allowing students from other training institutions to participate. Using a mixture of the jeopardy- and attack/defense styles could also improve the competition by exposing the participants to both sides of cybersecurity.

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