
John Morelock, Virginia Tech
Zachary Peterson, Cal Poly, San Luis Obispo
Innovating CS and Security Education
CPE123: Security
Alternate Reality Games

- Inspire counterfactual thinking
- Maintain engagement
- Provide an authentic context for course material
Game & Course Design

Iterative design process

Starting with KSAs, LOs, and an initial story

Weekly refined and aligned topics to story

Resulting in a design document
Try again!

Passdigit: [Input field] Enter

HINT: Your favorite 1-digit number
Try again!

Passdigits:  

HINT: Your favorite 3-digit number
HINT: You'll never break this randomly chosen 6-character uppercase/lowercase/digits password. Certainly not online.
What's this? NO0bs playing with passwords?

Your realize your classwork is as public as a story on cable news.

Tell your professor to learn to protect you better than this.

```
SELECT * FROM db.users;
test,
smj,
asd,
```
환영

Welcome to Dark Park! My name is Daniel Park. My mission is simple: to provide all of the Dark Web a safe port to communicate, lurk, exchange tips, hide or possibly share secrets as the case may be, receive news the rest of the Internet never sees, to be your one stop shop to everything you love about the Dark Web. And it is ALL FREE! So join me, set up a guaranteed secure account here, beyond the street lights in the shadows of Dark Park!

Log in to Post!
Methods

1. Qualitative analysis of student focus groups
2. Quantitative analysis of student survey
Answering Research Question 1

What aspects of the ARG affected student experience in the course?
Qualitative Data Collection

2 focus groups  
\( n = 20 \)  
(4 female, 16 male)

Interview protocol on perceptions of course, game, and security
Qualitative Data Analysis

Open coded for various aspects of student experience

Categorized codes to discern general patterns across responses
Aspects of student experience analyzed

Positive and negative aspects of the course

Positive and negative aspects of the ARG

Suggested changes to the course and ARG

Changes in students’ behaviors, perceptions, and understanding related to cybersecurity
Results: The ARG provided an authentic context to motivate problem-solving

“Even though we all knew exactly when [the ARG] started and exactly what was going on, it was way more engaging than just getting assignments...when you’re like, “Hey, we’re doing an attack,” you’re like, “Oh, I know this is fake, but it’s exciting.”

-Male focus group participant
Results: The ARG provided an authentic context to motivate problem-solving

"The game, that made it more fun. And even though some things ended up taking multiple hours, it didn’t feel like it was a task. It felt like it was just a fun thing to do."

-Male focus group participant
Results: Even inauthentic elements were enjoyable

“I think because, at least for me, I knew from the beginning [the ARG] wasn’t real, that even though throughout the quarter [with the introduction of videos], it became like more obvious, I still really enjoyed the videos...I showed my family members, and it was really cool.”

-Female focus group participant
Results: Authenticity often clashed with ethicality

“...I missed the first day of this class when you said that this was not a real thing we were doing. So I actually thought we were doing a phishing attack against a person...I was like, “This could so be real, and then we’re just going to go and do the worst possible thing?” So I had that whole thing, like, “No, I’m not going to participate.”

-Male focus group participant
Results: Authenticity often clashed with ethicality

“...I think on the other end though, making [the ARG] more fake and not as believable I think made the [ethical] line a lot clearer...seeing this in a game and a set setting, you’re not harming someone else, this is completely within [Cal Poly’s] system...It was nice to know that it wasn’t real and we were doing it in practice, rather than I think it would have been a huge issue if like it wasn’t like that.

-Female focus group participant
Results: The course changed students’ perceptions of the cybersecurity profession

“...You have to be right on defense 100% of the time. And on attack, you only have to be right once. And so, I was thinking about that, and it makes [cybersecurity] a very important profession, given how it must be a perfect system in that way. So it seems like it’s actually way more necessary.

-Male focus group participant
Results: The course changed students’ perceptions of the cybersecurity profession

“I’m going to get into web security. I don’t know, it looks fun...I think that what this class did tell me is don’t get into cryptography. Okay, I’m not going to lie. I was falling asleep during the lecture because I was just, I couldn’t grasp it. But web security, I was into it.

-Female focus group participant
Answering Research Question 2

How did students’ motivation-related experiences in the course differ based on gender?
Quantitative Data Collection

Electronic survey
n = 54
(14 female, 40 male)

Likert-scale items on student achievement motivation
Measuring Achievement Motivation: Eccles’ Expectancy-Value Theory (EVT)

**Expectancy for Success** - Confidence in one’s ability to succeed

**Attainment Value** - Importance of doing well

**Utility Value** - Usefulness to future plans

**Intrinsic Interest Value** - Enjoyment of participation

**Cost** - Perceived difficulty and effort required to do well
Quantitative Data Analysis

Comparison of male and female responses on EVT Constructs

Two-sided t-test
Results: Women had less confidence and found the course harder and requiring more effort than men.
Results: Women had less coding knowledge to start

“I felt like with a lot of the labs, I knew conceptually what I had to do, but I did not have the skills in writing code to actually do it, because all the lectures were conceptual, and I seemed to understand them. But then I had no tools to go in and do that in the lab.”

-Female focus group participant
Discussion

Ethics

Gender Gap

Hard Work
Conclusion

Plans to revisit and refine coursework
Increase reality
Ultimately release as a package