



27<sup>th</sup> annual **INCOSE**  
international symposium

Adelaide, Australia  
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Klew Williams // Worcester Polytechnic Institute // Massachusetts, USA

# **Alternate Reality Games in the Systems Engineering Classroom**

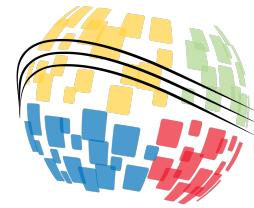
with Dr. Alexandrina Agloro and Dr. Shamsnaz S. Bhada (previously Virani)



# ARGs in the Classroom

What can novice systems engineers learn from playing an Alternate Reality Game?

**How to accommodate and discuss “human factors” such as gender in systems.**



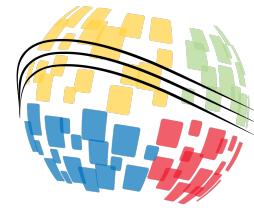
# ARGs in the Classroom

The in-class ARG was an immersive, experiential learning event which is otherwise very difficult to recreate.



Alternate Reality Games (ARGs) for systems engineering

# Research Goals and Approach



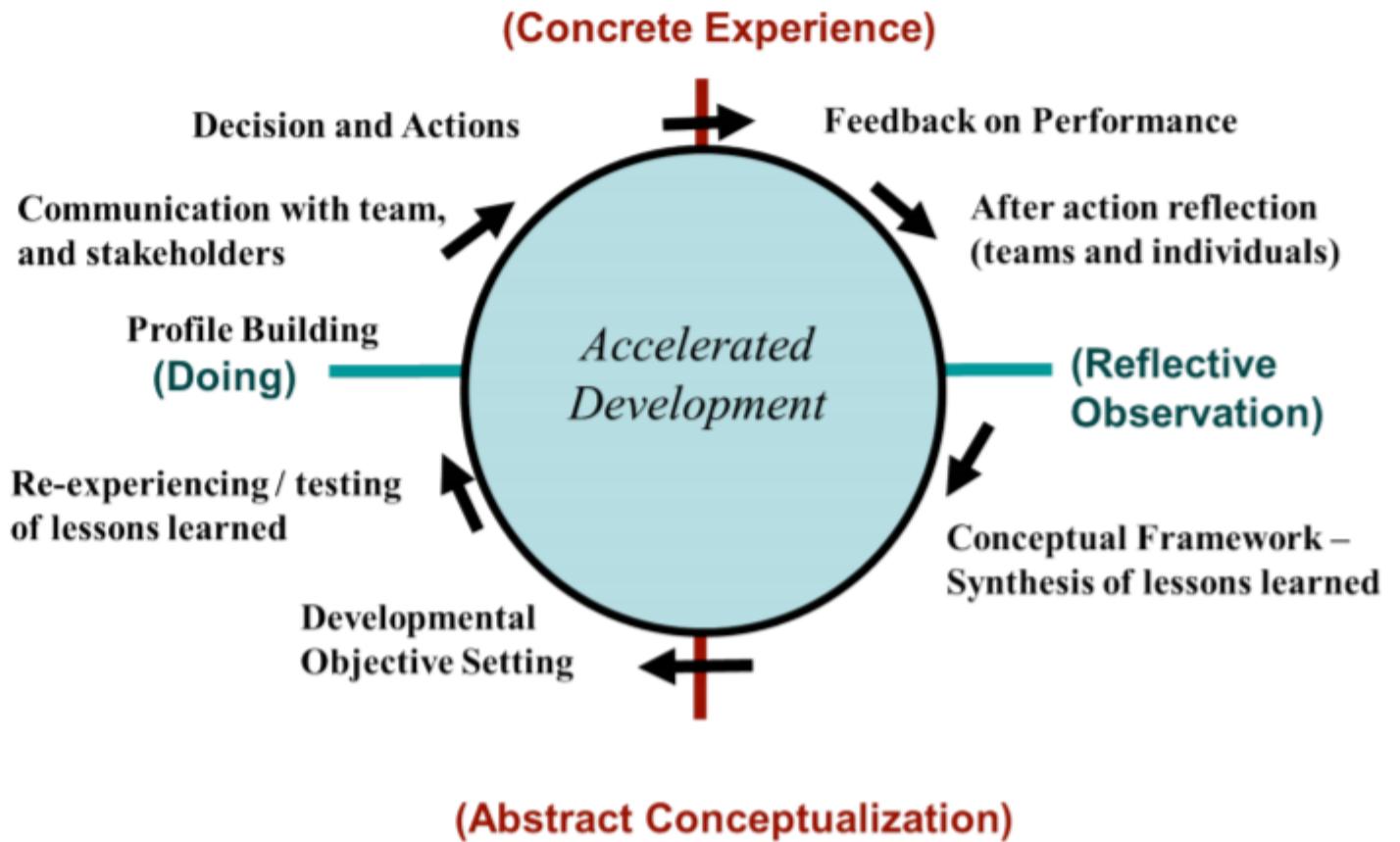
# Mission Statement

Teach students how to think and rethink through systems involving humanistic concerns.

## WHY?

Fight “human blindness” – account for the *human in the loop!*

# Literature



**Figure 2. All Phases of Experiential Learning to be Engaged**

Investigating an Innovative Approach for Developing Systems Engineering Curriculum: The Systems Engineering Experience Accelerator (2011)



# Literature

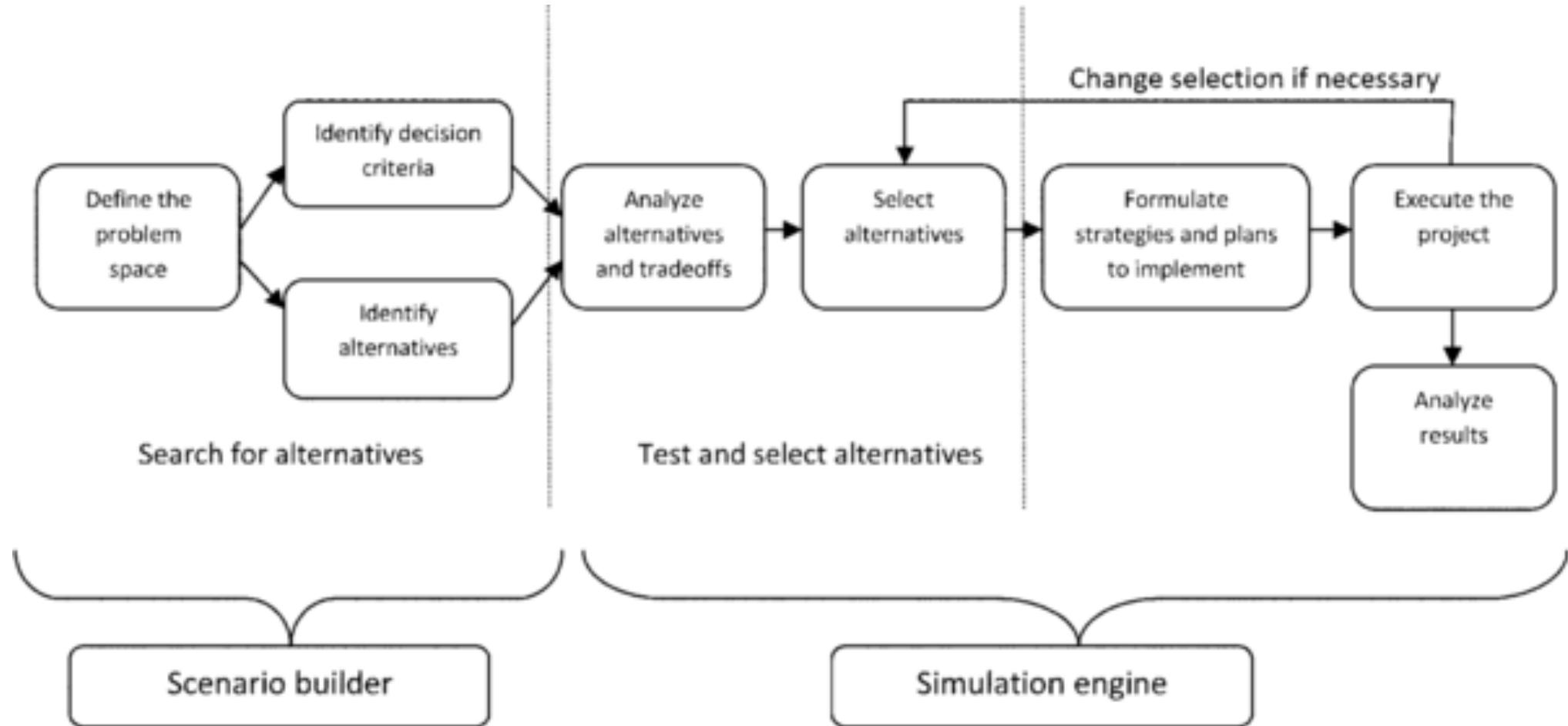
...and by Flushman, Gondree, and Peterson:

Alternate reality scenarios can “**help bridge concepts into the real world**, drawing students into fictional scenarios presenting authentic problems.”

This is Not a Game: Early Observations on Using Alternate Reality Games  
for Teaching Security Concepts to First-Year Undergraduates (2015)

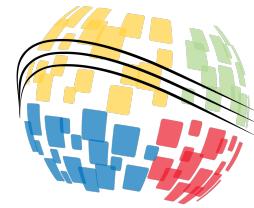
[www.incose.org/symp2017](http://www.incose.org/symp2017)

# Literature

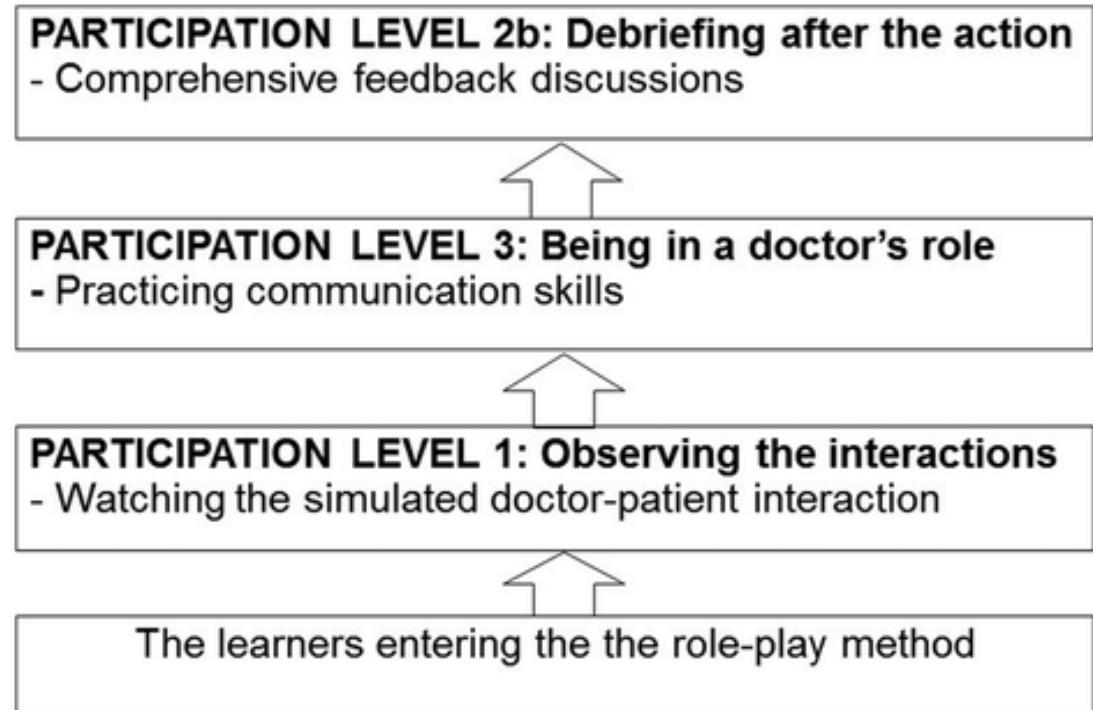
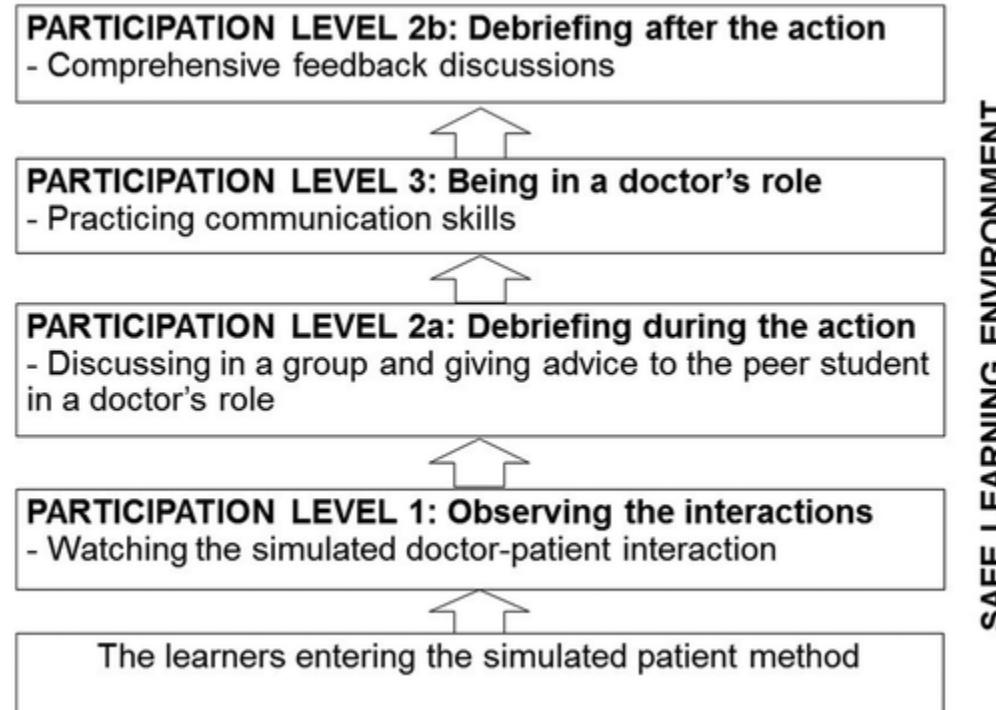


A Simulation-Based Approach in Support of Project Management Training  
for Systems Engineers. Systems Engineering 17 (2012)

# Literature



...and by Koponen, Pyörälä, and Isotalus:



Communication Skills for Medical Students. Simulation & Gaming: Results  
From Three Experiential Methods (2014)



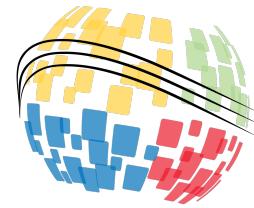
# Experience Goals (Learning Goals)

1. Systems analysis in a realistic scenario
2. Revising requirements mid-process
3. Considering human uncertainties
4. Investigating the problem domain through narrative



Designing an ARG to teach humanistic concerns to novice Systems Engineers

# Game Design



# Design Goals

1. Modularity
2. Ease of implementation and reproduction
3. Ease of data collection
4. Realism



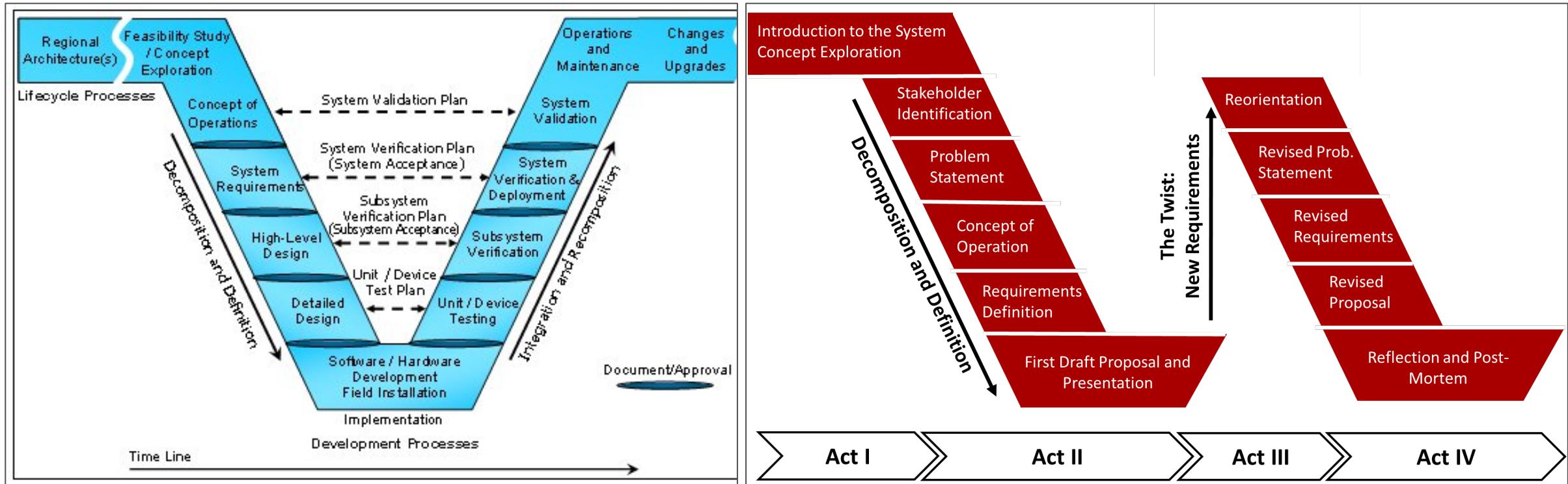
# Design Challenges

1. How to generate buy-in in a classroom setting?
2. How to establish a complete fiction with limited resources?
3. How to make this experience reproducible in *any* classroom?



# Design Goals

We patterned our plot on the V model.



[Federal Highway Administration, 2013]



# Finalized Scope Summary

**Deliverables:** 4 key milestones (aligning with the ARG acts)



Executing story beats and actor communications in SYS 501

# Implementation in the Classroom

# ARG Materials

Students were given information mocked up and distributed as realistically as possible.

Three violent attacks on WPI over weekend • Worcester Mag

## Three violent attacks at WPI over weekend

By Thomas Fencer –



Unidentified WPI Police officer involved in an investigation

In an unprecedented weekend, three violent attacks on campus occurred on WPI property on Saturday, setting off a truly frightening start.

"We have never had a series of violent attacks in our history," says Worcester Magazine. "Three people were attacked on campus by WPI Campus Police will be referred to the Worcester PD."

Neither WPI Campus Police nor Worcester Police have released identities of the victims, citing privacy concerns.

Page 1 of 2

telegram.com  
WORCESTER, MASSACHUSETTS

More information on campus attacks

By George Coney  
Telegram & Gazette Staff



File Photo of Rubin Campus Center on WPI Campus

PRESS RELEASES

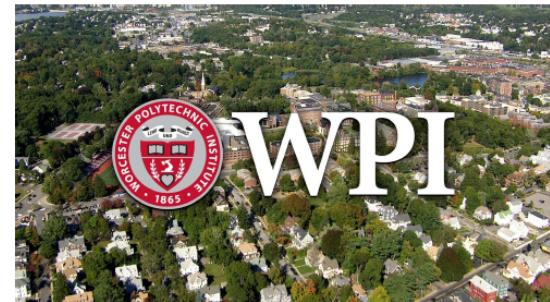
Media Contact

Shannon Vera

WPI Sources Health and Safety Proposals from the Community

To address recent health and safety concerns on campus, WPI asks students, staff, and community members to propose new safety activities.

SHARE



WPI

You! Yes, you! You may be the individual WPI needs to help improve our already world-class campus safety climate. WPI is and will continue to be an incredibly secure place to work and study, and part of maintaining that excellent track record is to constantly seek ways to improve our programs and offerings.

It is with this community spirit in mind that WPI asks Worcester at large to submit complete, comprehensive, and actionable proposals to improve WPI campus safety.

As many of you know, WPI has invested a huge amount of money into campus projects such as the construction of the WPI Sports & Recreation Center in 2013 and the ongoing creation of the [Foisie Innovation Studio](#) and [Messenger Residence Hall](#). WPI sees the creation and improvement of safety programs to be a similar investment in the future of WPI.

Already, a number of WPI safety programs have seen incredible success, such as the [WPI Emergency Preparedness plan](#). We are looking for proposals to support, expand, or augment these fantastic programs to ensure WPI remains a leader in safety and security.

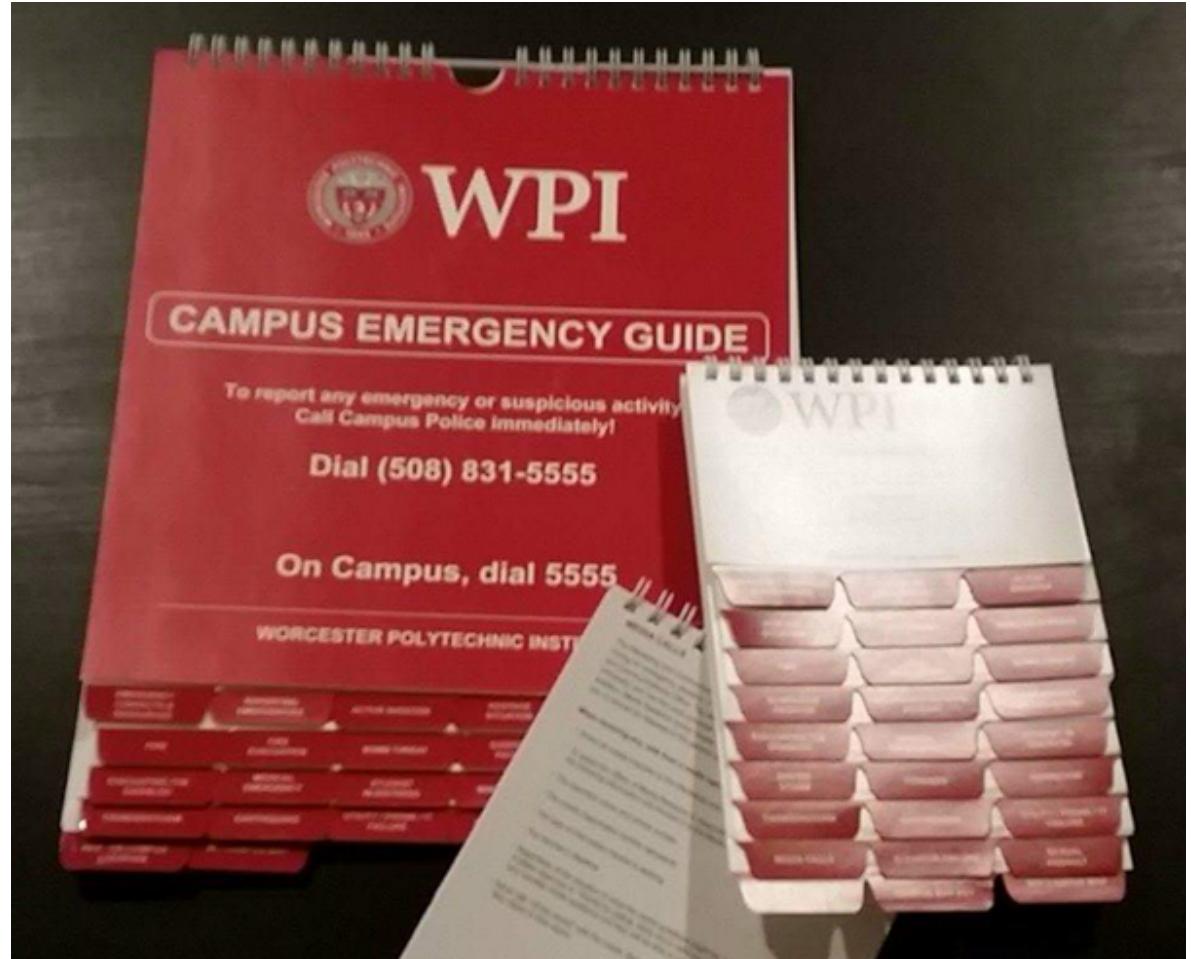
www.incose.org/symp2017

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# Real World Materials

Students also received tactile materials for realism and research assistance.





# Actors Portraying Stakeholders

ARG used three in-class actors; the game master (me!) answered emails.

Prof. Dean O'Donnell



Klew Williams



Keenan Gray





# Data Collection Points

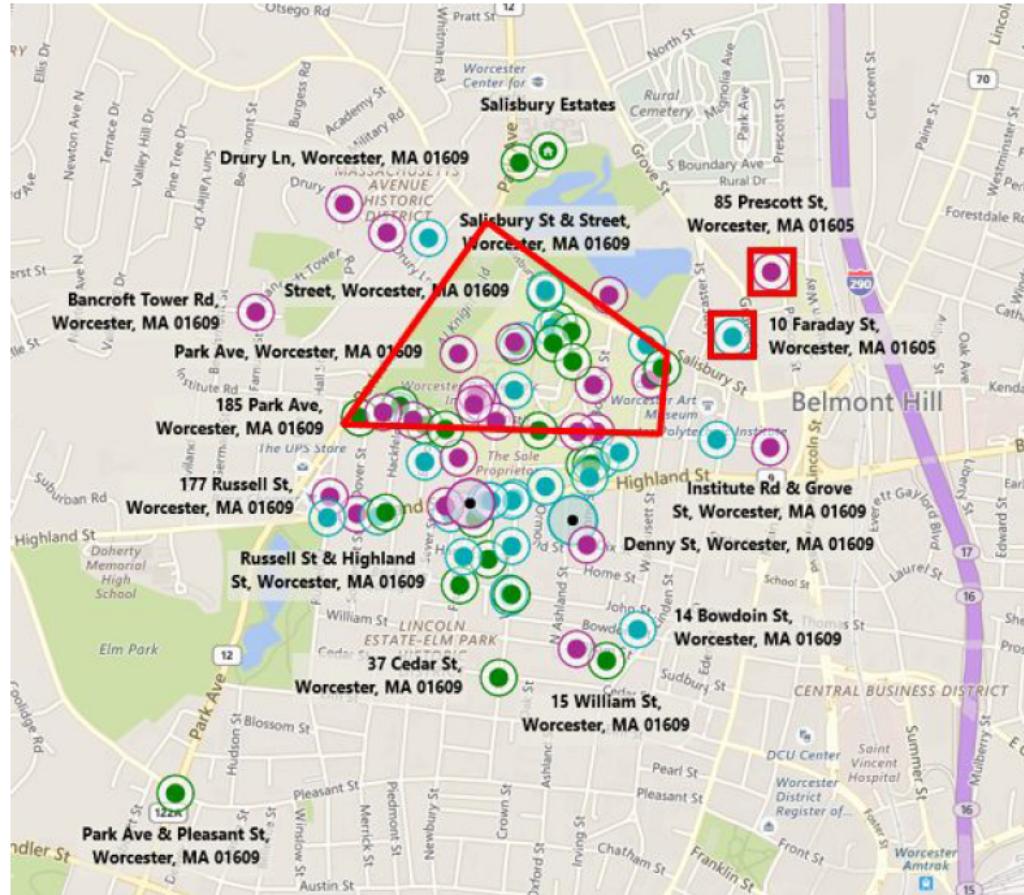
- Assignments (Group)
- Surveys (Individual)
- Post-Mortem Essays (Group)
- Post-Mortem Discussion (Class)



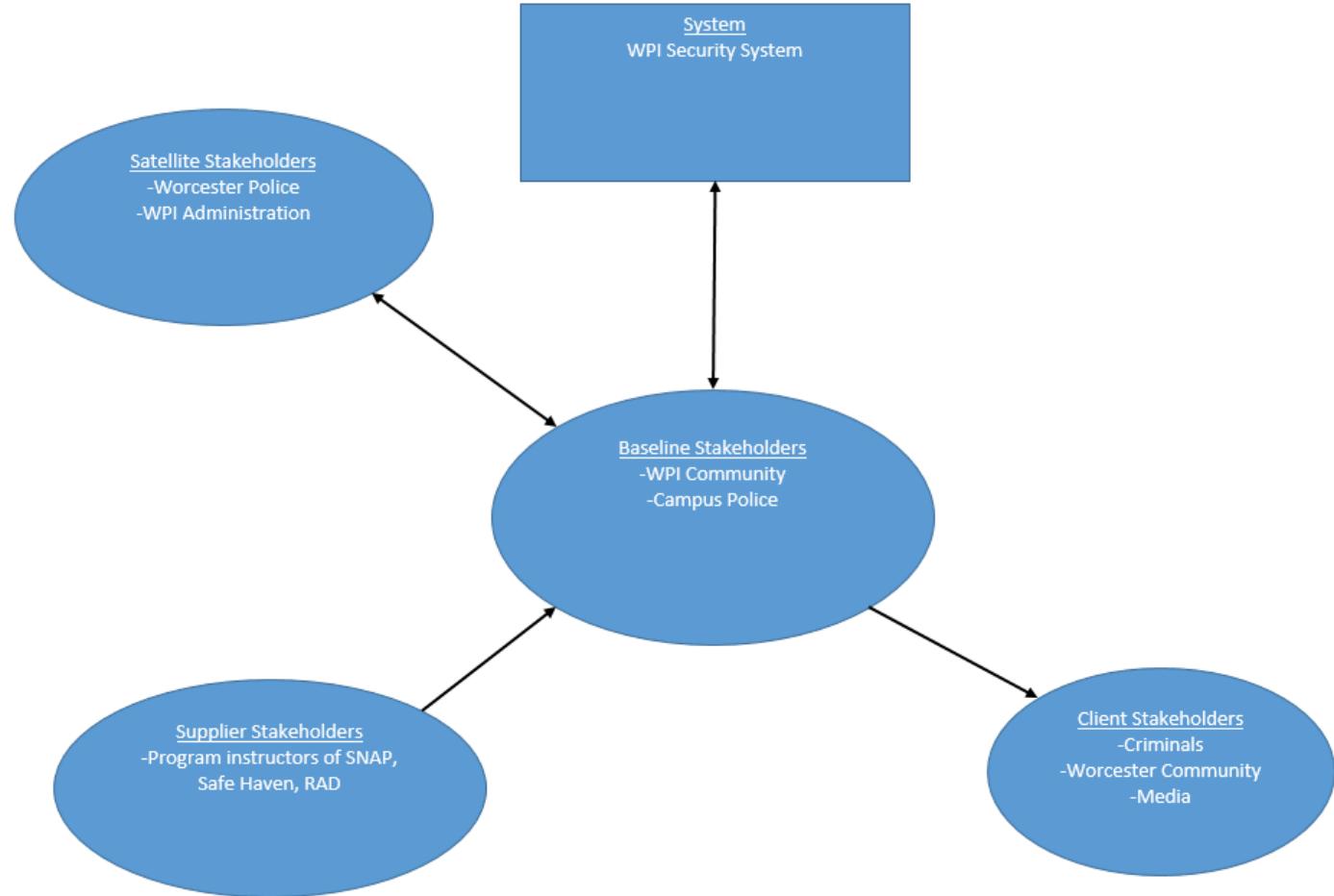
# Student Work Examples

## WPI Criminal Activity

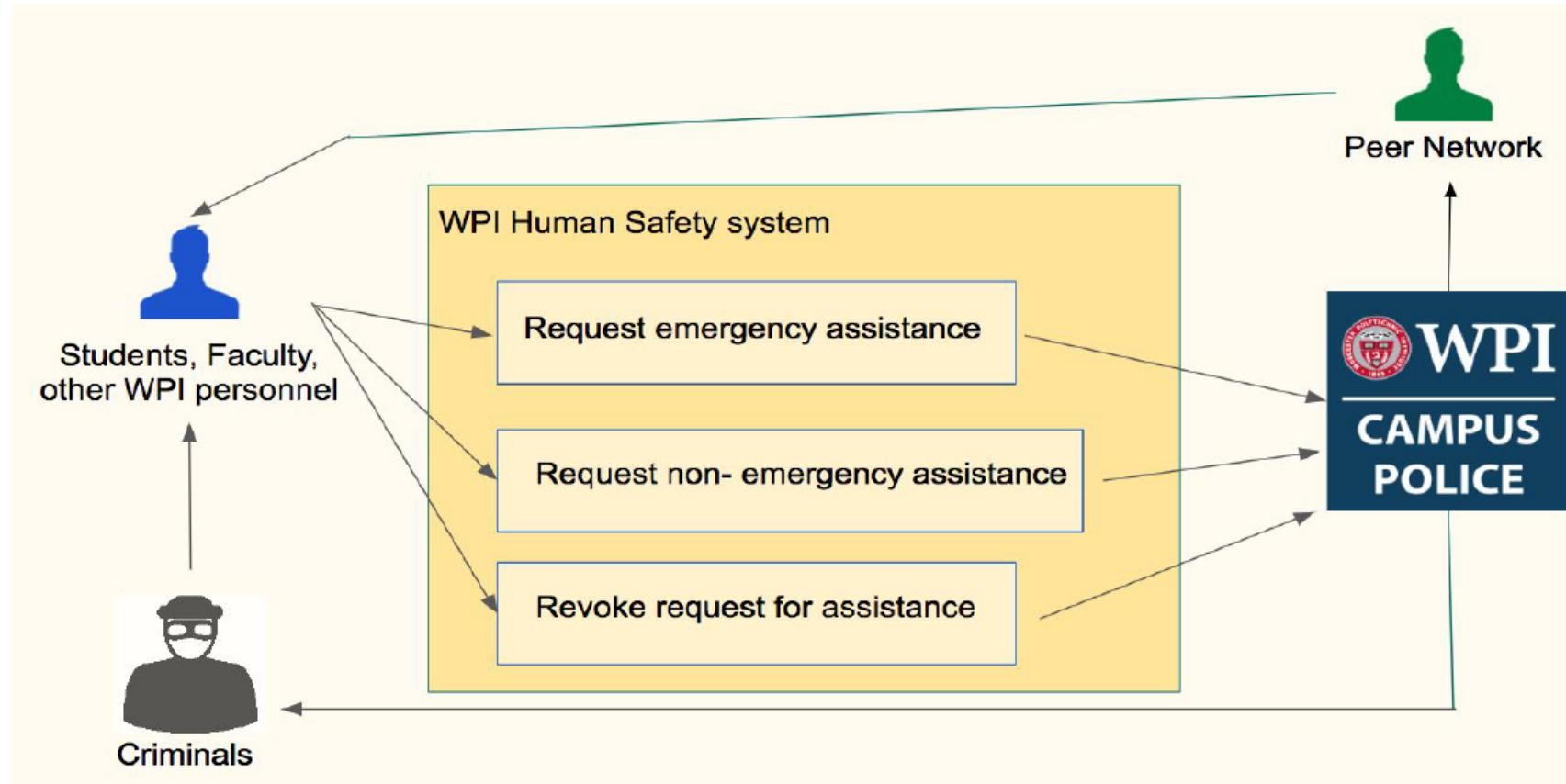
- 1.33 crimes/month [1]
- Off-campus: 48 of 80 (60%)
- Not considering 5 vacation months
- Only considers crimes that meet Clery Act
- Many on-campus crimes were from WPI students



# Student Work Examples

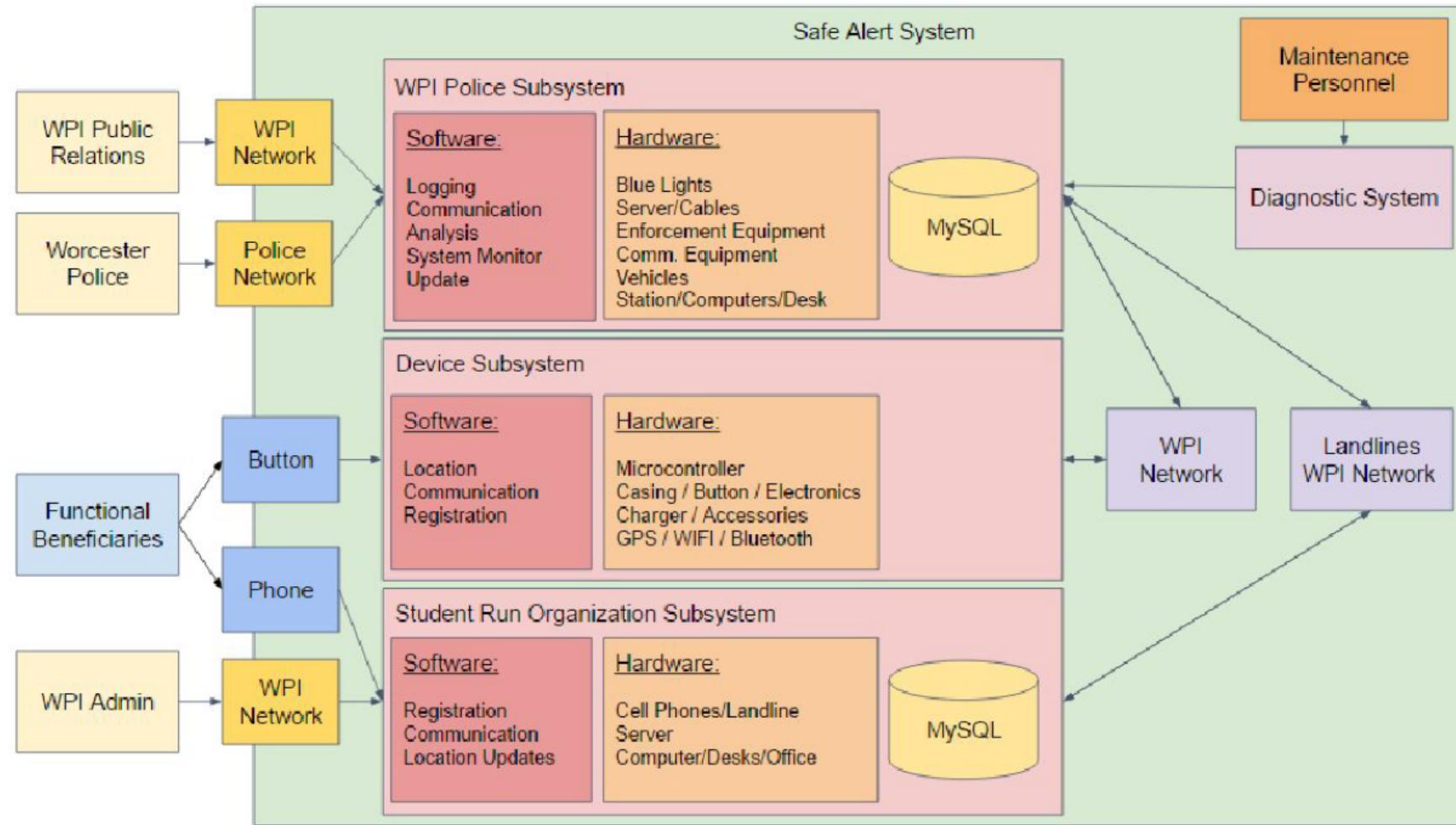


# Student Work Examples



**Figure 3.3.** Use Case for the WPI community.

# Student Work Examples





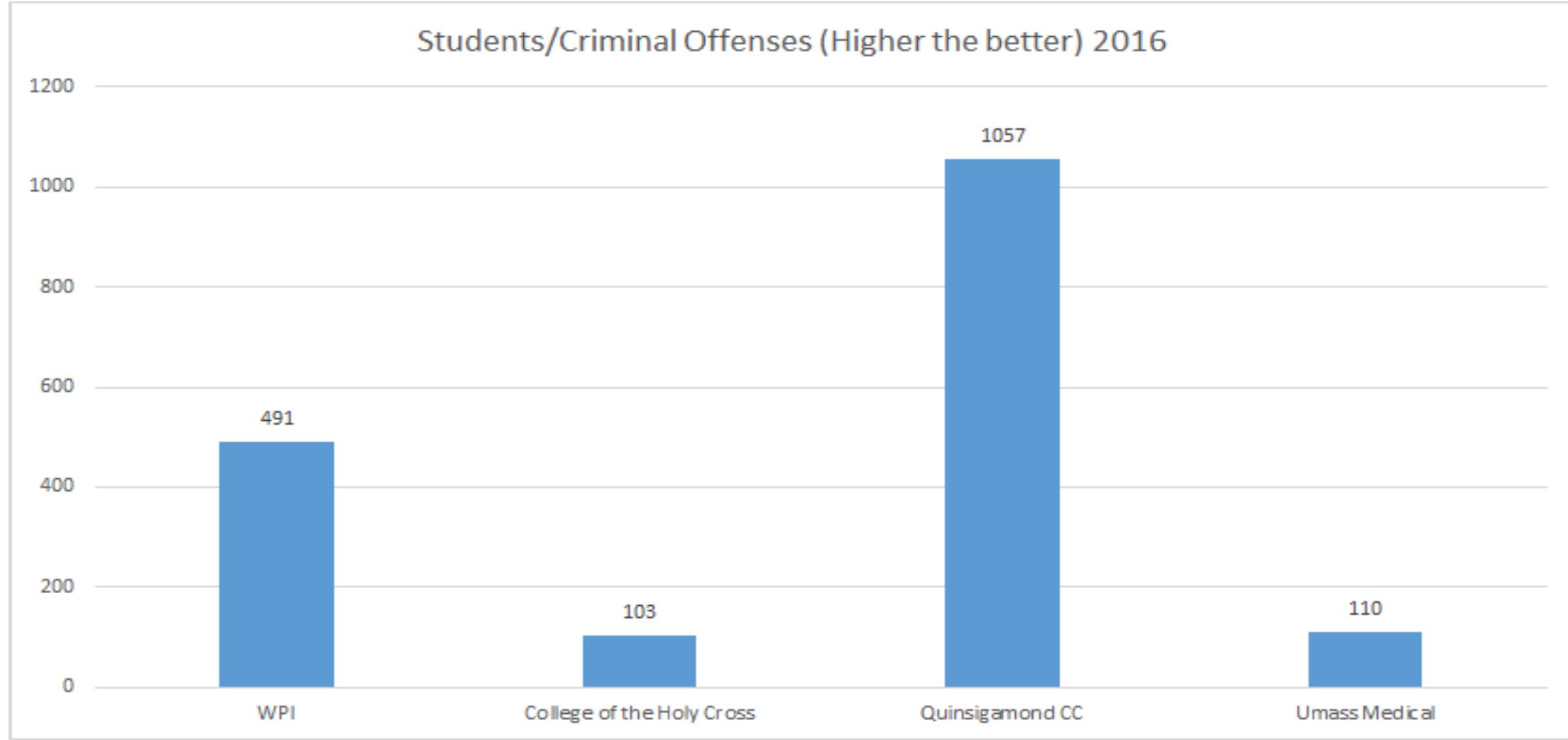
Feedback, analysis, and recommendations for the future

# Results and Lessons Learned



# Results by Learning Goal

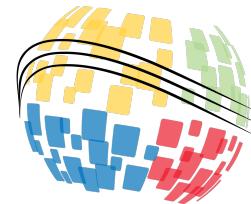
US Department of Education





# Results by Learning Goal

“Yeah, it was kind of like the new information was like, ‘We have this new really important thing for you to do that’s a **subset of what we already told you to do...**’”



# Results by Learning Goal

Criticality	High	Student volunteer could get killed	Attacker infiltrates student group	
	Medium	Student volunteer could get hurt Malfunctioning device burns	Prank emergency calls	Phone number taken / Privacy
	Low	Location and ID information stolen		Increase of tuition
		Low	Medium	High
			Likelihood	

**Figure 3.5.** Risk analysis resulting matrix



# Results by Learning Goal

“So I felt like it was, it probably very instructive to have this be such a human-focused system rather than a mechanical system. But it made it hard to apply things we learned in class....And **bridging that gap was hard.**”

“It was sometimes **hard to tell when something wasn’t a requirement** because none of the stakeholders felt strongly about it and when it wasn’t a requirement because it hadn’t been developed as part of the game”



# Highlighted Feedback

- “I don’t really feel that it had much of an impact on group dynamics.”
- “So, you know, security systems aren’t like a glorious fun thing but it’s something you could actually solve, and we could see, we can use some of the things we learned from Systems Engineering to apply to something more real.”
- “No effect, I did not look too deeply or question the validity of the scenario or data that we were given, I wanted to focus more on developing a system that met the needs of the scenario” – example of pushback

# An Unexpected Lesson





# Key Takeaways

1. Actors: early and often
2. Scenario rooted in reality
3. Invest in acclimating students to the conversation

