Bridging the Gap: Developing Innovative Minds Early On for Cybersecurity

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The Space Race

- The launch of Sputnik I into space on October 4, 1957, by the Soviet Union meant one thing:
  - The U.S. had fallen behind the Russians
    - National security and national pride was on the line!
- A positive effect on math and science education
  - The federal government for the first time made a major investment in K-12 curriculum development
    - Goal of NSF financed projects was to teach basic principles and have students apply their knowledge by *doing*
  - The race to the moon!
    - But after Neil Armstrong won the race in 1969, public support for this effort returned to normal levels

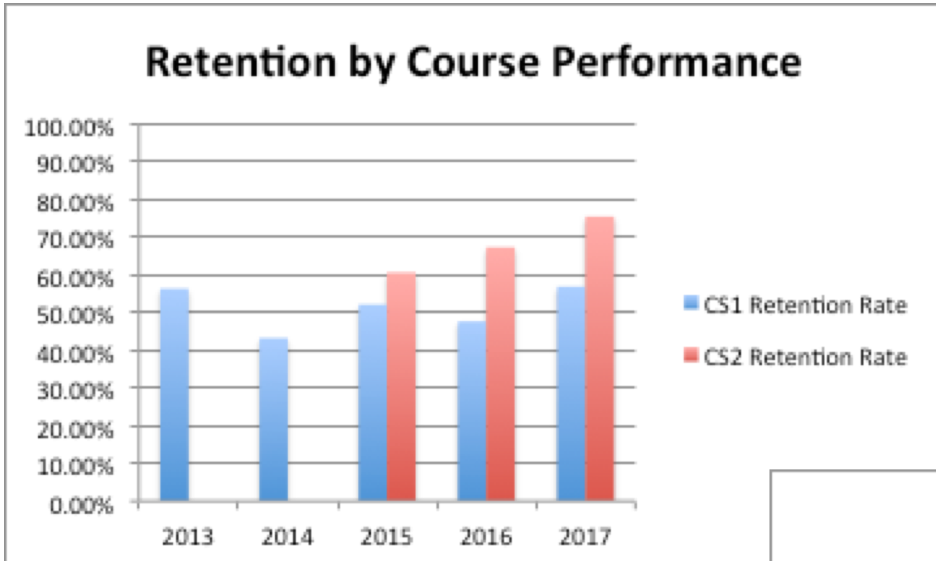
Motivation

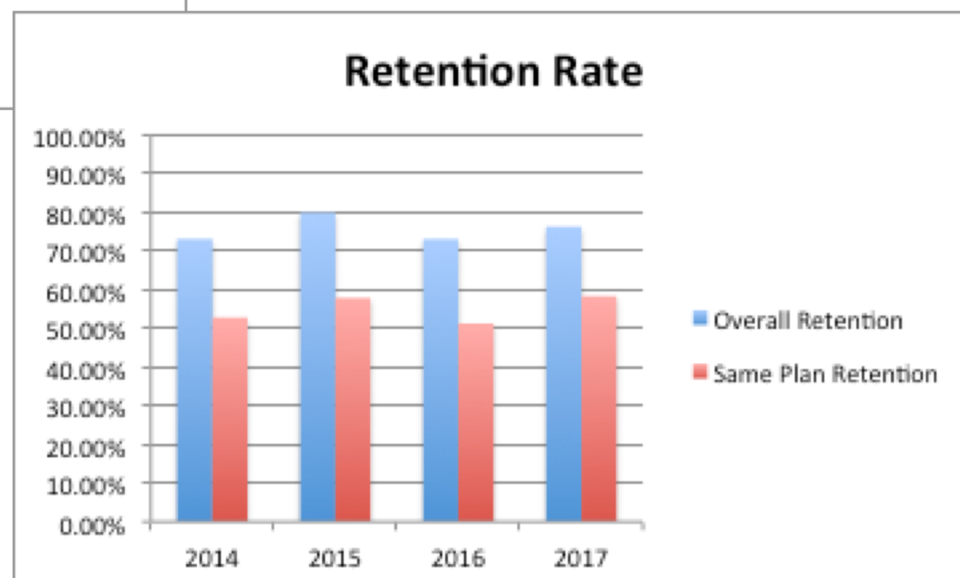
- So what does all this have to do with what we're talking about today?
  - We are at the same *precipice* today that we were back then, but instead of…
    - The Space Race — Cyber Warfare
    - The Soviet Union — Nation-States
  - The good news is that computer science and related programs with a special interest in cybersecurity are experiencing tremendous growth
    - The bad news: forecastors are predicting a catastrophic shortage in workers to fill open positions in cybersecurity by 2020 and beyond

Motivation

- So why the disconnect?
  - If there's so much interest, why aren't we developing enough qualified candidates?
    - Job forecasts have been unable to keep pace with the dramatic rise in cybercrime
    - One report predicts there will 3.5M unfilled jobs in cybersecurity by 2021 (Cybersecurity Jobs Report 2018-2021)
- We hypothesize that by the time students enroll in a higher education institution, it may already be too late
  - Lack of preparation – many students are unable to handle the complexity, creativity requirements, and continually changing environment in cybersecurity

Freshman One-Year Retention Rate

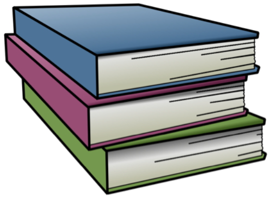




Core Competencies and Skills

- Critical Thinking
  - Analysis and evaluation leading to understanding and decision-making
- Effective Communication
  - Listening and translating, sending and receiving messages
- Creativity (and Innovation)
  - Conception to implementation
- Problem Solving (through Negotiation and Collaboration)
  - Understanding the situation
  - Exchange of information, ideas, and perspectives
- Self-Awareness (and Self-Efficacy)
  - Conscious knowledge of own strengths and weaknesses
- Research
  - Try new things, dig deeper

Thinking Outside of the Textbook



- Traditional approaches, such as the lecture model, that emphasize
  - Rote learning through memorization and regurgitation
  - Routine application of procedures and practice

  will not develop and enhance the needed skills

- To develop higher-order skills required in cybersecurity, students must
  - Engage in open, active learning using meaningful learning activities that are valuable and relevant
  - Have individual and collaborative real-world experiences that will sustain student engagement

Project-Based Learning

- Collaborative research projects and field-based activities targets personalized, collaborative, and informal, or self-directed, learning
  - Balances theory and practice
  - Allows students to move from a passive to an active learning experience that is engaging and promotes further learning
  - Can include service learning within the local community

A Culture of Innovation

- Innovation has three components:
  1. An idea,
  2. Its implementation, and
  3. The outcome (execution) that produces a change
- Innovation is not just for the top 10% of the class
  – Need to address and motivate the bottom 30% – 50%
- Innovation must become the collective responsibility of the community
  – Needs a nurturing environment to flourish
    - Difficult because disrupts the established routine and pushes implementers out of their comfort zone
  – Without community buy-in, efforts will fail

Conclusion

- Goal is to create self-motivated students who have the confidence in creativity and innovation through intelligent risk taking, collaboration, and opportunity recognition
  - Involves teaching and motivating all students to work in unscripted and unknown environments
  - Increasing the number of computer science graduates depends on getting kids interested at a younger age
    - Important for overcoming stereotypes as well as confidence and identity issues
  - Increasing the number of K-12 schools teaching innovation through computer science

Conclusion (cont'd)

- Teachers must be taught to teach well
  - How can a science project be converted into innovation?
  - "Train the Trainer" approach to show teachers how to show the path to innovation
    - Able to take up a risky hypothesis
    - Not afraid of getting negative results
  - Innovate in every aspect of life and study
    - Make innovation contagious, make it a culture