NAVAL POSTGRADUATE SCHOOL

# CHUNK Learning: Proof of Concept


By

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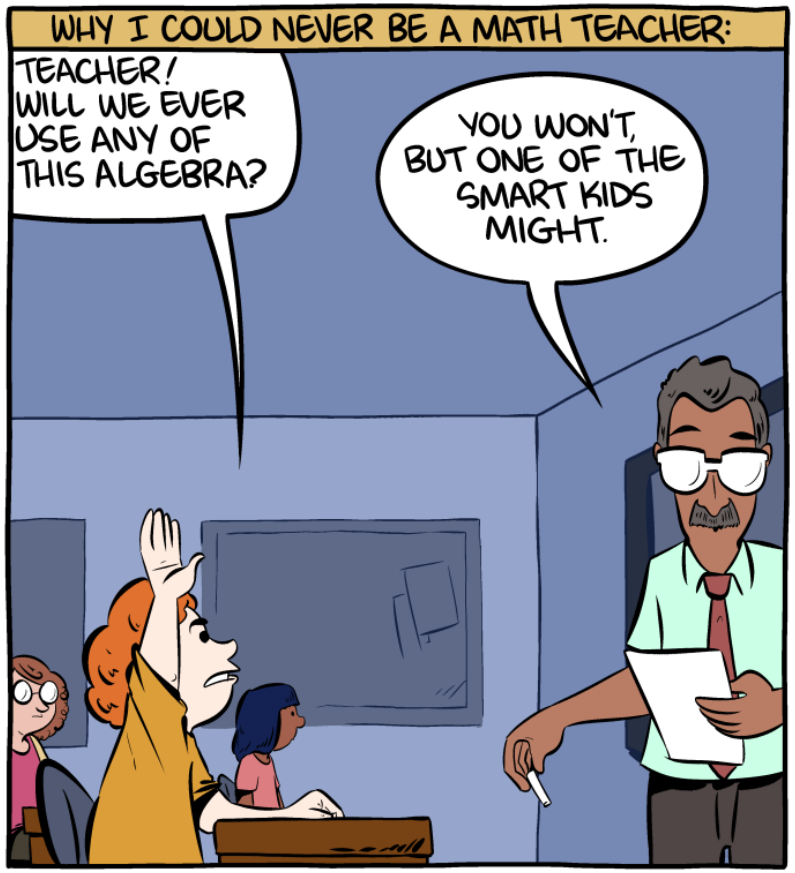


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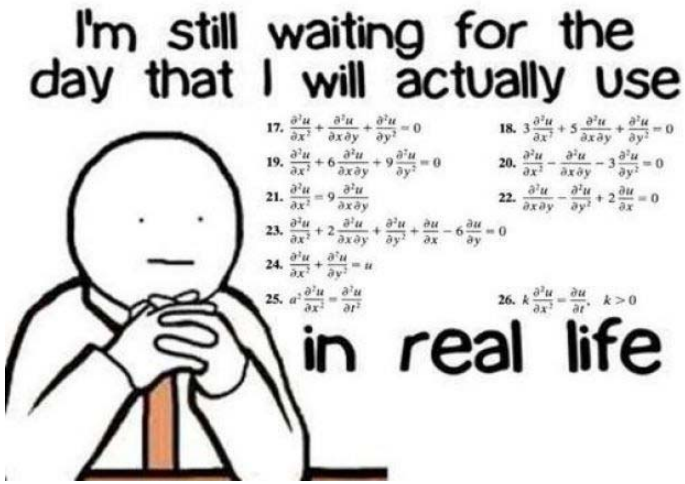
# The Challenge

CHUNK

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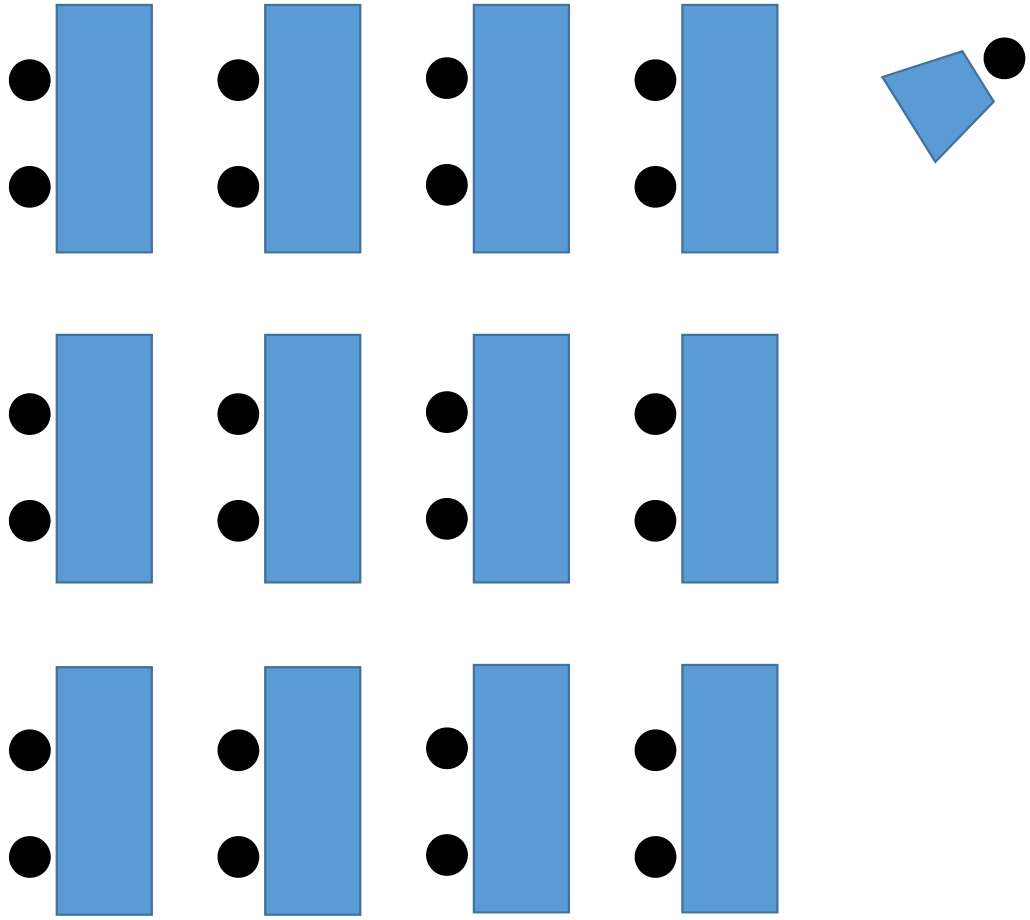
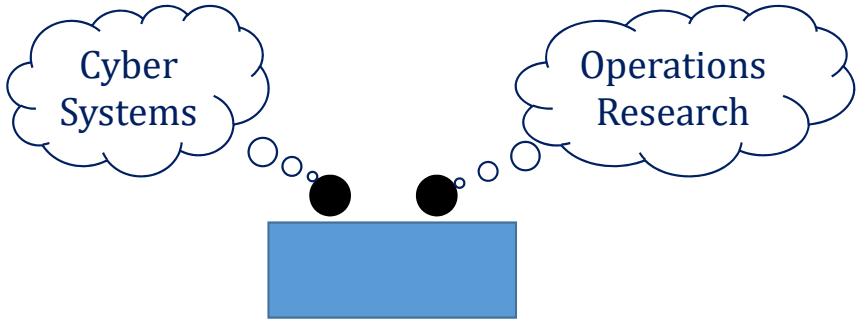


# The Vision

*A modular real-time and adaptive teaching-learning method for enhanced and personalized education which enables the student to heuristically discover and learn based on personal background and interests.*



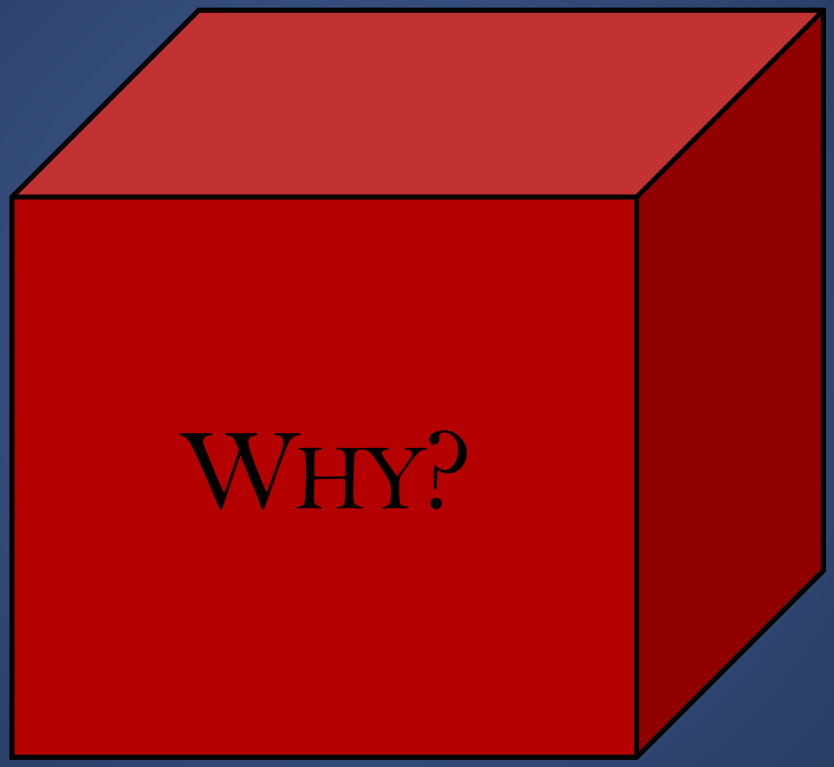
# CHUNK

## Curated Heuristic Using a Network of Knowledge

### A personalized, adaptive learning platform.

CHUNK Learning breaks away from the predictable pattern of traditional education models and provides content delivery that respects the different capabilities, learning styles, and approaches to problem-solving of every learner. Students are empowered by a system that ensures learning is efficient, flexible, and respectful of their time.

- **Offers** intense, short, and focused educational modules
- **Stimulates** interest and demonstrates relevance of topics
- **Integrates** new information with learner's pre-existing knowledge
- **Provides** personalized and individualized education
- **Optimizes** content and methodology delivery to meet the needs of each learner


WHY?

# Why CHUNK Learning now?

Science of Learning

Network Science

Digitally Native Students

Personalized Online Resources

# Educational Landscape

CHUNK

## Traditional Education

- Linear
- Teaching to the 'average' student
- One time access to SME
  - Supplement with online resources (YouTube, Khan Academy, etc.)

## A 21st Century Education

- Chunked, modular & networked
  - Future work: badges
- Adaptive & respectful of learner's time
- Based on own skills & abilities
- Prior experiences and interests
- SME curated resources
  - Human element

**Slide 8**

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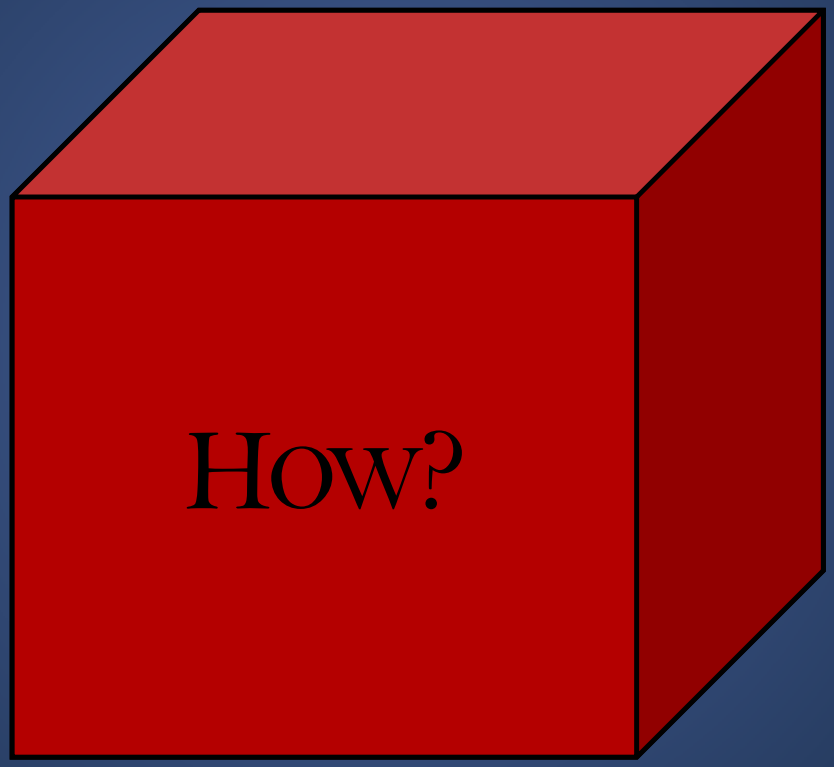
Isenhour, Michelle (LTC), 7/27/2019


How?

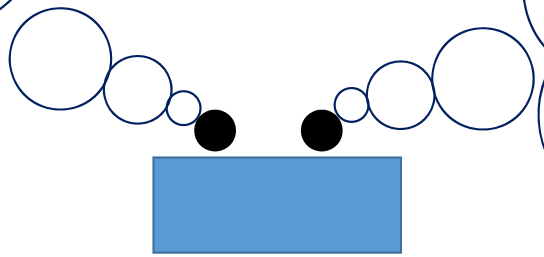
# How CHUNK Learning?
# User Profiles!

CHUNK

*Each learner maintains an "online" profile:*

- *Personal Background*
- *Competency*
- *Preferred Instructional Methods*
- *Skills*
- *Interests*
- *Goals*
- *Type of Learner*

**Learner Profile**:
- Cyber Systems
- Civilian, 20 years experience
- Active Learner
- Good with Python, C, Fortran
- Slow Reader
- Slight Test Anxiety
- Loves Professor Isenhour

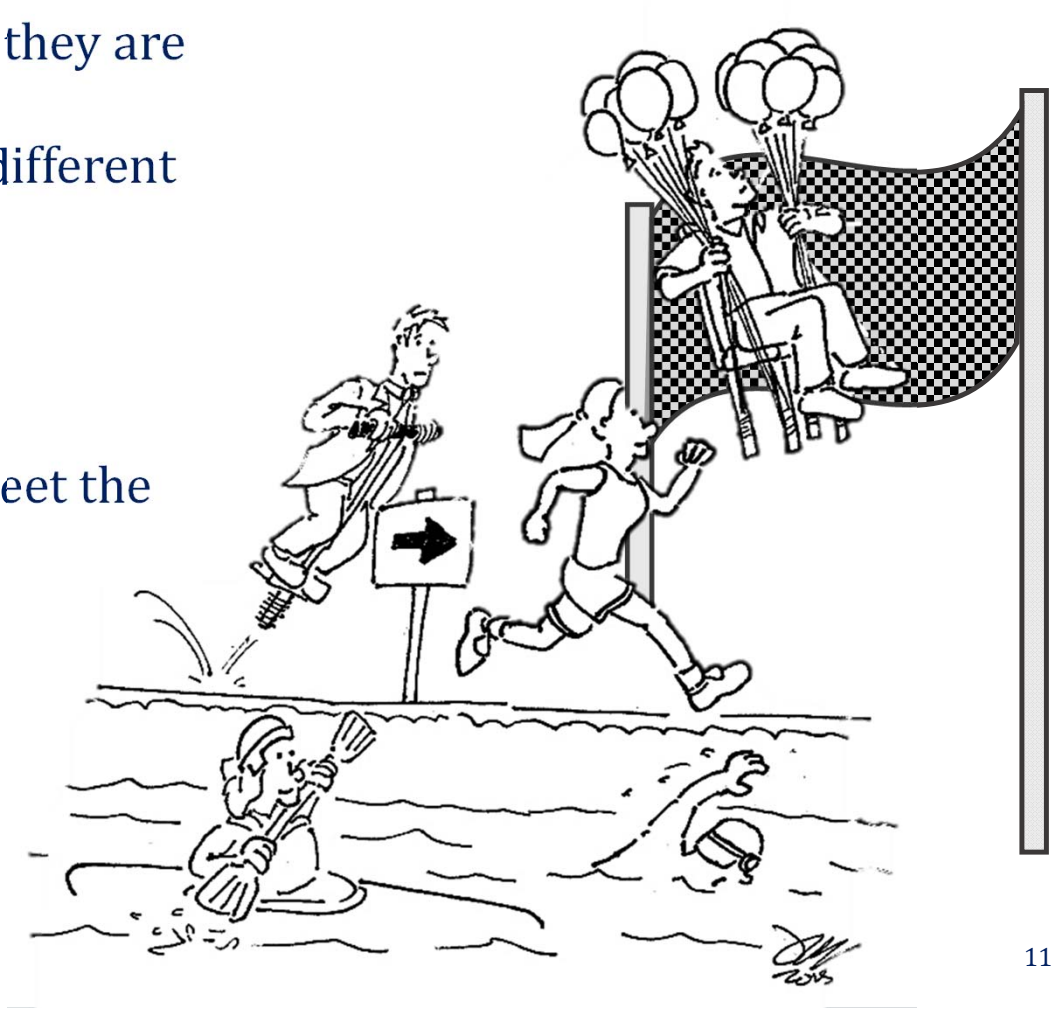


**Learner Profile**:
- Operations Research
- Lieutenant, US Navy
- B.S. in Systems Engineering
- Mad Skillz with Excel
- Wants to Learn R
- Interested in Wargaming and Wargame Analysis

# How CHUNK Learning?
## Individualized Instruction

CHUNK

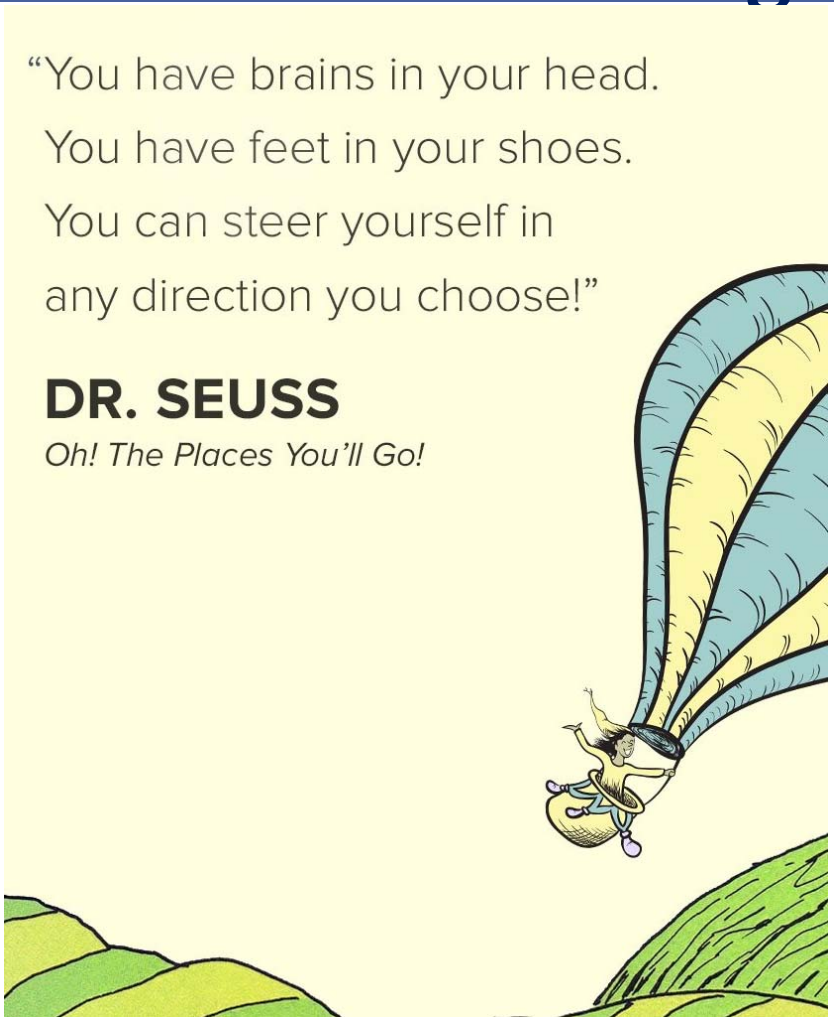
- Objective: meet students where they are (pace & needs)
- Recognizing that students have different
  - gaps
  - backgrounds
  - skills and
  - prior experiences
- Variety of curated activities to meet the academic needs of each student
  - PPT
  - videos
  - PDF/html
  - demos
  - code, etc.
- Instructor facilitated education

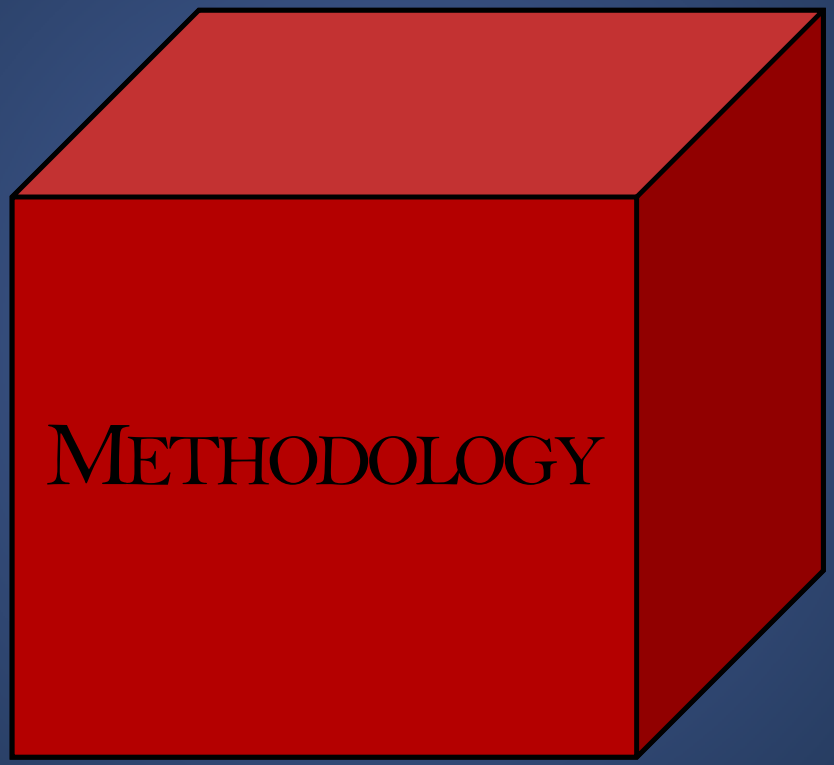


# How CHUNK Learning? Personalized Student Learning

CHUNK

- Objective: engaged & active learner, supporting deep & long-lasting learning
- Anchoring to existing experiences
- Tailoring to personal interests of various learners
  - accessible, respectful of users' time
  - academic and career goals
  - best fit learning modality
- Promoting active learning
  - managing own learning
  - generating exploratory engaged life-long learners (TED talks)




METHODOLOGY

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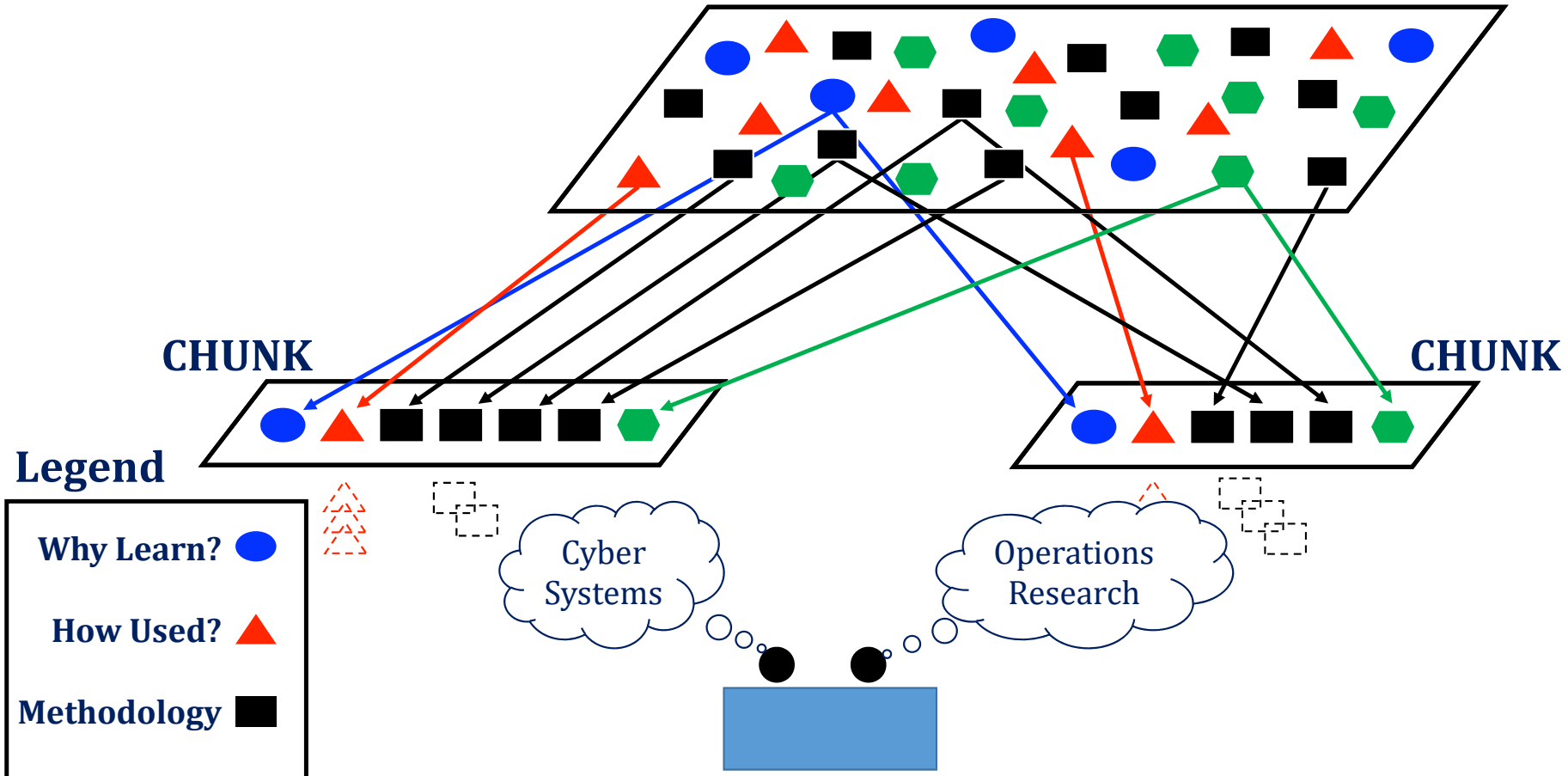
CHUNK

# The Concept




*A modular real-time and adaptive teaching-learning method.*

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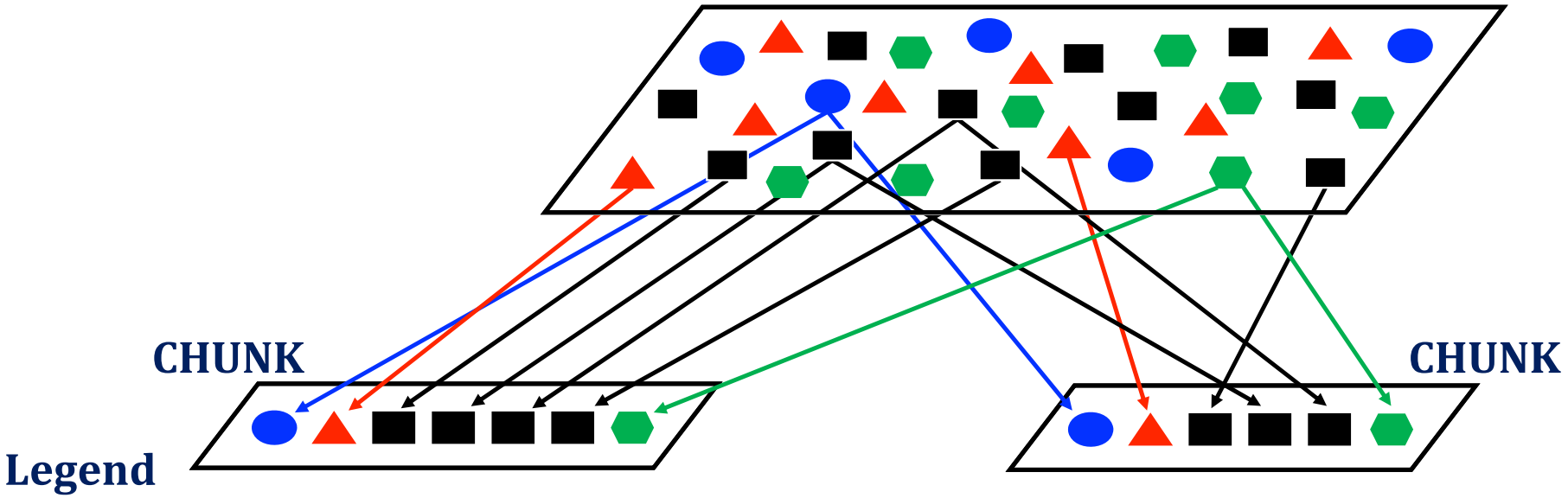
CHUNK

# The Concept




**Curated Heuristic Using a Network of Knowledge for Continuum of Learning (CHUNK Learning)**

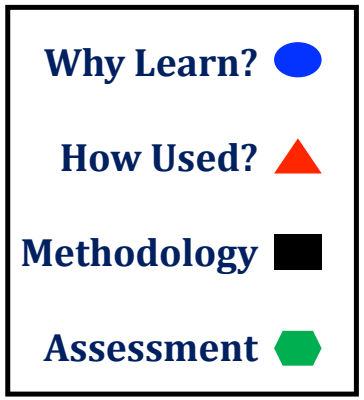
*A modular real-time and adaptive teaching-learning method.*

# The CHUNKlets

CHUNK

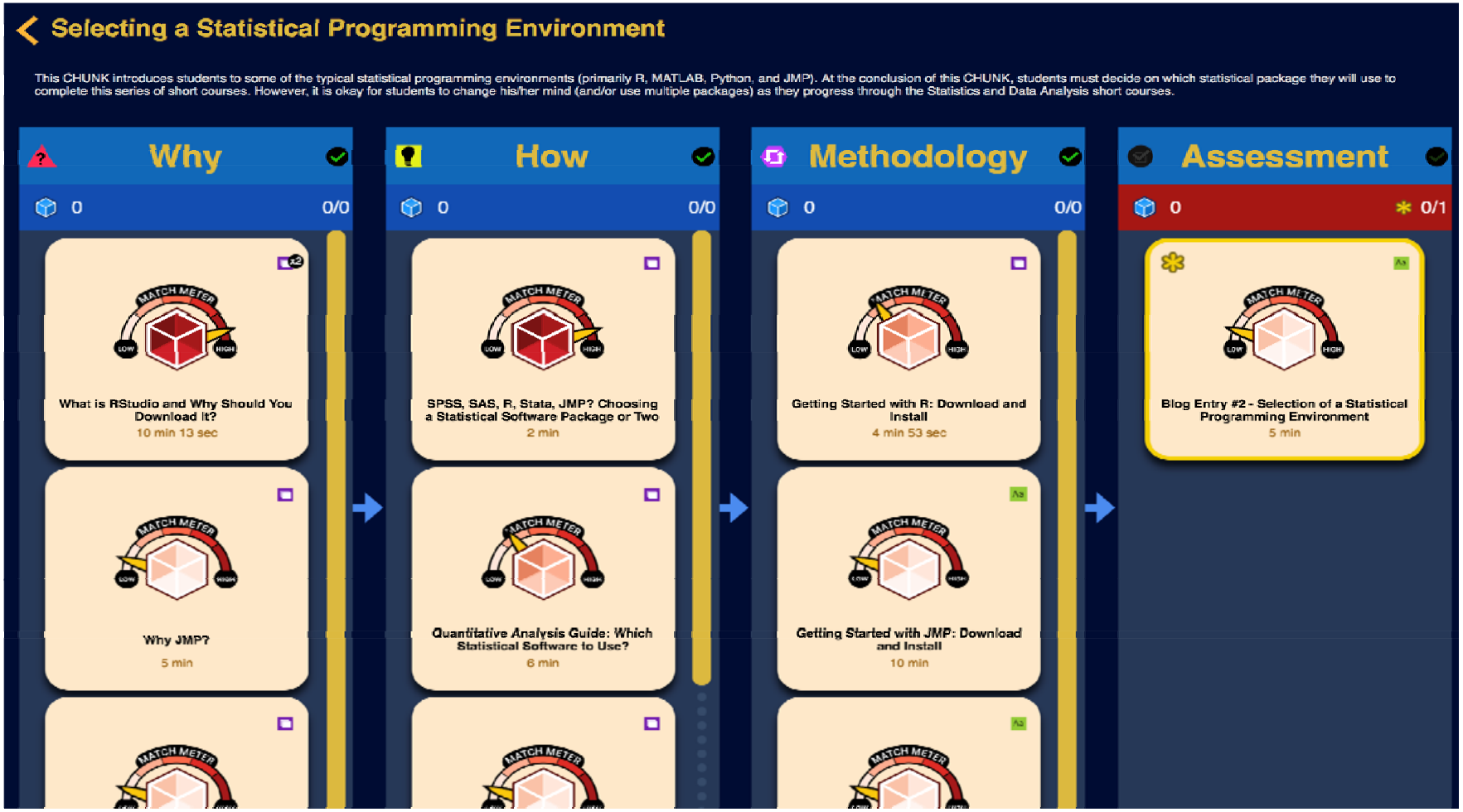
**CHUNK**

**Legend**




- ***Why Learn it?***
  - *1-3 minute video highlighting why the student should learn the concept.*
- ***How to Use it?***
  - *3-5 minute video on how the concept is used in practice (discipline based).*
- ***Methodology***
  - *A combination of instructional methods: assigned reading, slide review, example problems, in-person discussion or lecture, etc.*
- ***Assessment***
  - *Some form of assessment – test, report, etc. Opportunities for remedial learning incorporated.*

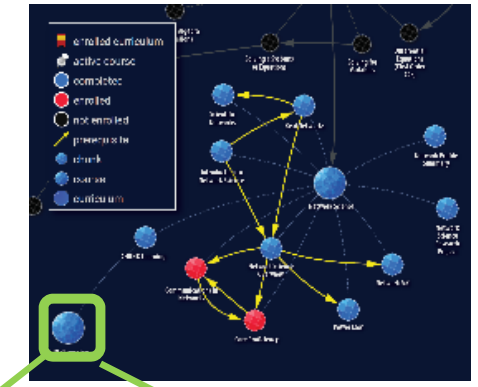
# Sample CHUNK

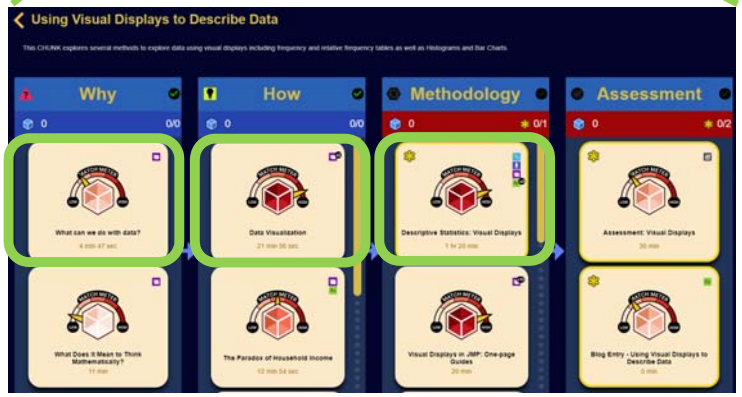


# Current Methodology:
## *CHUNK and CHUNKlet Recommendations*

Each exploratory user receives:

- A **CHUNK recommendation** based on keywords that are categorized relating to **content**
  - Discipline
  - Skill
  - Topic
- From it, a **CHUNKlet recommendation** based on keywords that are categorized relating to **likeability and style**
  - Instructor
  - Author
  - Application
  - Activity Type
  - Learning Method





# Current Methodology:

## *User profile & preferences*

CHUNK

### Current recommendation system

- Syntactical similarity of keywords: CHUNKlet recommended based on its similarity to user's profile keywords
- Content relevancy feedback: positive or negative on of the content in the completed CHUNKlet)
- Quality feedback: rating of 1-5 on the quality and usefulness of the CHUNKlet


Python, Networks


Python, Statistics


Linear equations



How can the user's profile automatically update based on the feedback of completed CHUNKlets? And what is the impact?

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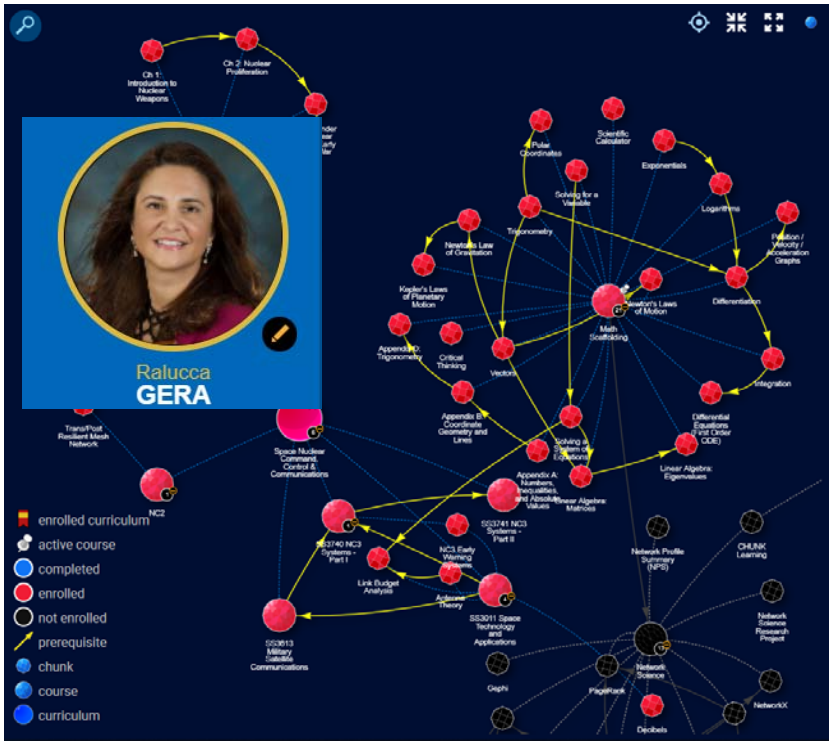
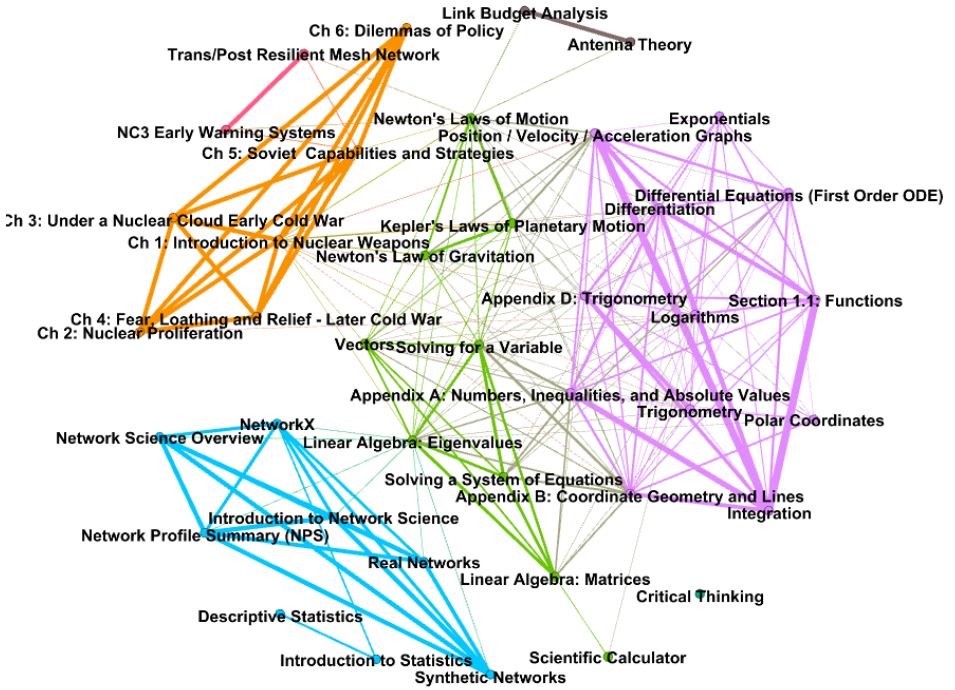
# Using Network Science:

## *Ontological vs syntactic CHUNKs similarity in the network*




Visible to students (ontological: pre-requisites)

Will be used for recommender system (syntactic similarity)

- Three layers of nodes: users, CHUNKlets, and CHUNKs
- Edges: all edges are present with different weights based similarity



By Daniel Diaz, Paul Keeley, Nickos Leondaridis-Mena, Matt Mille, and Ralucca Gera at NPS

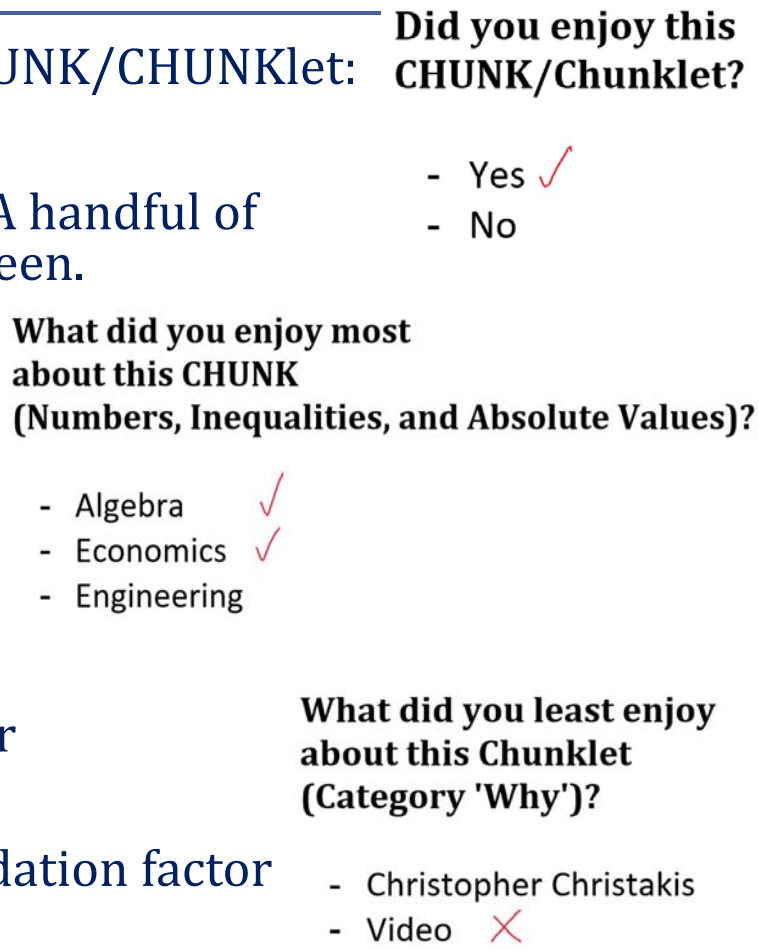
# Methodology

## *Updating user's profile*

CHUNK

Capture the user's experience on completed CHUNK/CHUNKlet:

- If YES → what about it did you like the most. A handful of representative keywords will populate the screen.
  - ➢ Content related keywords for CHUNK
  - ➢ Method related keywords for CHUNKlets
  - ➢ If these keywords are not already present in the user's profile, they are added for future recommendations.
    - If the keyword is already present, then its value is multiplied by a scaling factor
- If NO → the key word is multiplied by a degradation factor



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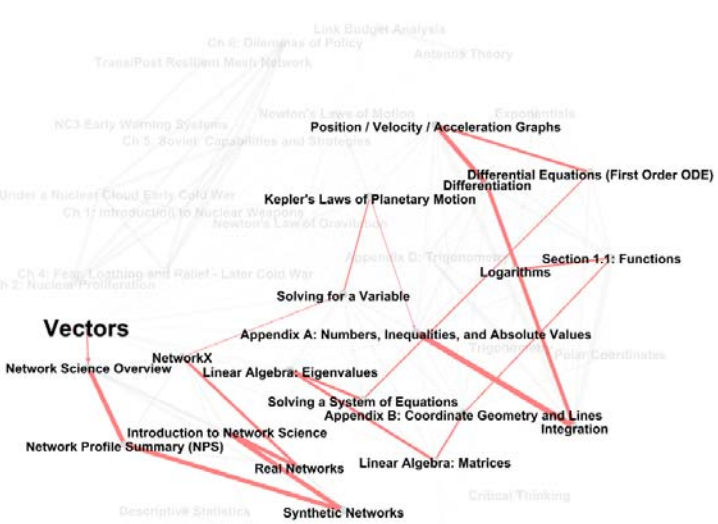
# Visual Results: Dynamic profile vs static profile

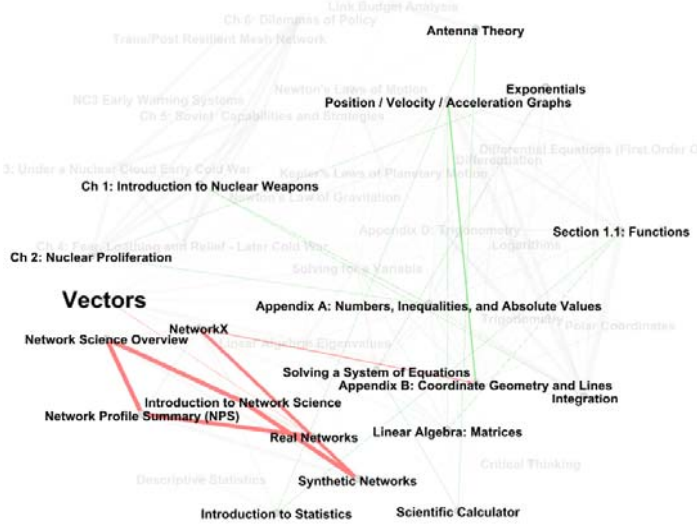
## *Same Profile*

**Updating a user's profile** at the end of each CHUNKlet prolongs the user's relevant exploratory path.

Updating profile: 'network', 'science'




Static profile: 'network', 'science'




Because the user's profile is not updated at the end of each CHUNKlet, the user cannot acquire new keywords, no new edges are added to the path

Legend:
Nodes: CHUNKlets
Edges (red lines): the path taken by user (the width of the edges is proportional to the similarity of the user to that CHUNKlet).



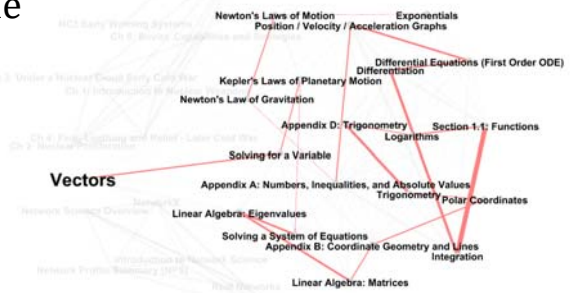
By Daniel Diaz, Paul Keeley, Nickos Leondaridis-Mena, Matt Mille, and Ralucca Gera at NPS

# Visual Results: Network discovery

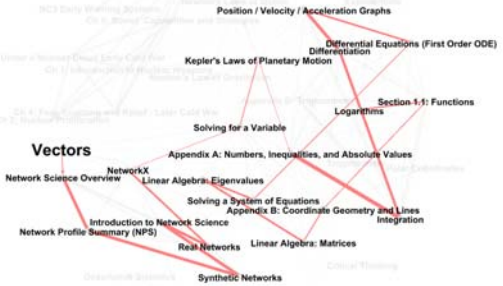
## *4 different profiles*

**Recommender System** (no randomness): the different paths taken by each user demonstrate that our recommender system provides unique & appropriate recommendations based on user input

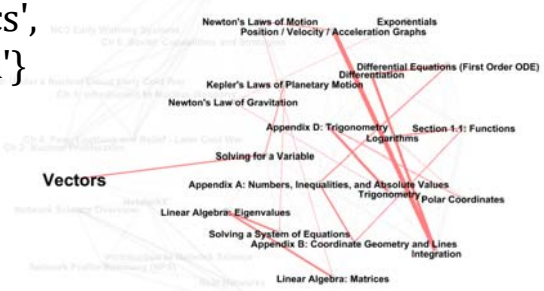
The Null profile
{}



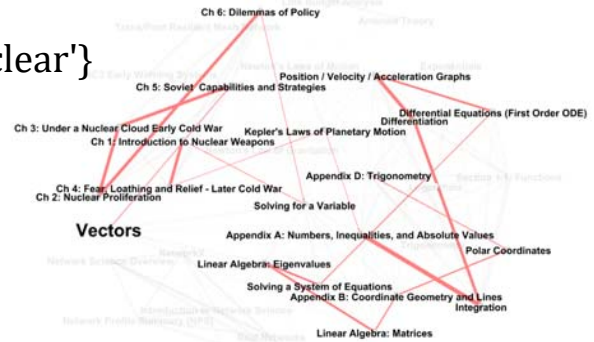

Network science profile
{'network','science'}



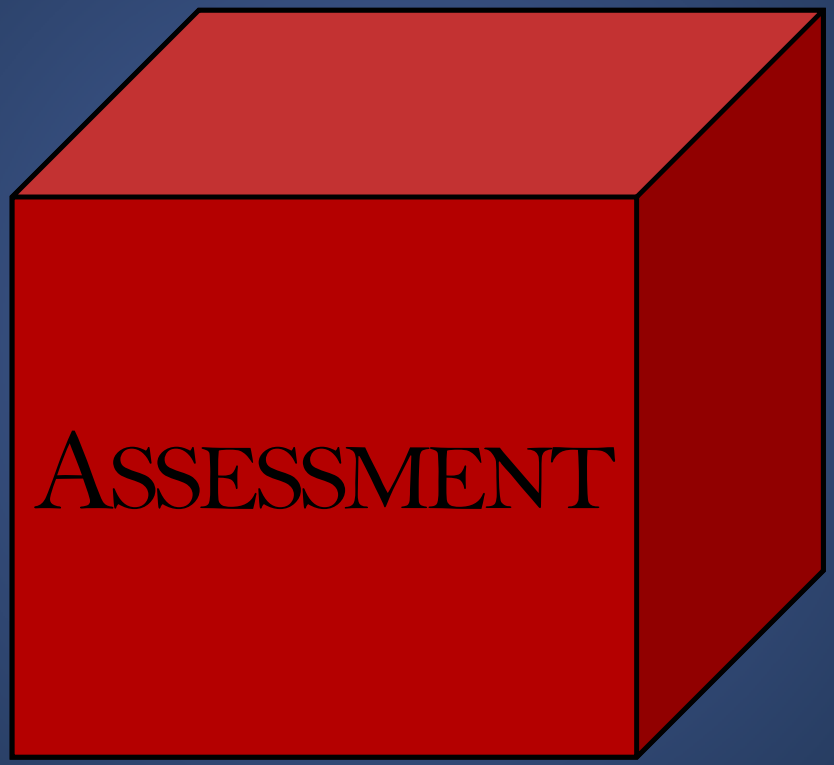

Physics profile
{'rockets','physics',
'newton','motion'}




Space profile
{'space','war','nuclear'}




Visually: unique & appropriate recommendations based on user input


ASSESSMENT

# Assessment: Current Piloting Efforts

I) *Remediation*

- Diagnostic and prescriptive (pretest, remediation, post-test): filling in gaps in knowledge/skills for specific math/physics topics for NC3 certificate
- Reinforcing previous learning
- Expanding current knowledge & skills
- Connector between related skills
- Develop knowledge and skills – logical/mathematical domain

II) *Classroom augmentation*

- Some type of hybrid teaching:
  - Ralucca: “flipping the interest in topic”
  - Michelle: “CHUNK enriched instruction” -- demo now!

# The Future

- Extend proof of concept to include:
  - Author interface and content management system
  - Recommender system with integrated AI
  - System and user analytics interface (report generation)
- Develop research questions and instruments to assess:
  - System operation and functionality
  - Student learning
- Build video repository...need help from subject matter experts across every discipline
  - Why Learn it?
    - 1-3 minute video highlighting why the student should learn the concept.
  - How to Use it?
    - 3-5 minute video on how the concept is used in practice (discipline based).
- Solicit ideas on how to incorporate disciplinary knowledge at varying levels of breadth and depth

The authors would like to thank the Air Education Training Command and the U.S. Department of Defense for partially funding this work.


We welcome your thoughts!

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CHUNK

# References


- www.CHUNKLearning.net
- https://wiki.nps.edu/display/CHUNKL/CHUNK+Learning+Home
- Ralucca Gera, Michelle L. Isenhour, D'Marie Bartolf, Simona Tick "CHUNK: Curated Heuristic Using a Network of Knowledge" The Fifth International Conference on Human and Social Analytics 2019
- Mario Andriulli, Ralucca Gera, Michelle Isenhour, Maria Smith, and Shane Smith, "Adaptive Personalized Network Relationships in the CHUNK Learning Environment" The Fifth International Conference on Human and Social Analytics 2019
- Ralucca Gera, Alex Gutzler, Ryan Hard, Bryan McDonough, and Christian Sorenson "An Adaptive Education Approach Using the Learners' Social Network" The Fifth International Conference on Human and Social Analytics 2019
- Daniel O. Diaz, Ralucca Gera, Paul C. Keeley, Matthew T. Miller, and Nickos Leondaridis-Mena "A Recommender Model for the Personalized Adaptive CHUNK Learning System", The Fifth International Conference on Human and Social Analytics 2019