Teaching with Video Games

1American Society of Naval Engineers, George Mason University, Navatek, Ltd.
What is **FLEET**?

- Video Game funded by ONR
- $1,000 Grants available for schools to assist with adoption
- Engineering design process gameplay with Physics simulator

**FLEET MISSIONS**

**SEARCH & RESCUE**
Save sailors and their sinking ship

**AUV RETRIEVAL**
Retrieve unmanned vehicles after their mission

**SUPPLY & LOGISTICS**
Supply bases around the world

[www.fleetengineering.org](http://www.fleetengineering.org)
Agenda & Overview

- 9-9:15: Introductions/Reasons for attending
- 9:15-9:30: Frameworks for discussing teaching/video games
- 9:30-10: Overview of teaching with FLEET video game
- 10-10:30: Activity overlapping with break
- 10:30-11: Scott Martin & Orin Adcox Presentation and Q&A
- 11-11:45: Thomas Doctson Presentation and Q&A
- 11:45-12:45: Lunch
- 12:45-1:45: Activity – Creating a teaching moment
- 2-2:45pm: Activity – Scoping unit(s) of education
- 2:45-3pm: Evaluating educational outcomes
Education exists in Systems

- Students exist in families & classes
- Classes exist in schools and communities
- Schools/Districts exist on social media
- Macrosystem is the culture/values

**Note:** Micro- refers to the most immediately impactful systems while Meso- is the interactions between those systems
Students develop skills over time

Piaget’s Stages of Growth

➢ Birth-7: Think in images/symbols, begin to ask “Why?”
➢ Roughly 7-11: Hypothetical thinking not developed, but think about concrete objects. Can use inductive knowledge.
➢ Ages 12-20: Can think formally, abstractly, metacognitively. These abilities allow for greater problem solving and creativity.
# Math Skills are a Factor

<table>
<thead>
<tr>
<th>Grade</th>
<th>Numbers</th>
<th>Operations</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>Count to 1,000 use &lt;20</td>
<td>1-step problems (+, -)</td>
</tr>
<tr>
<td>3</td>
<td>Count to 1,000,000, use &lt;100</td>
<td>All 4 operations</td>
</tr>
<tr>
<td>4</td>
<td>Use fractions, decimals, $</td>
<td>3-step problems and fractions</td>
</tr>
<tr>
<td>5</td>
<td>All numbers available</td>
<td>Variables, using fractions &amp; decimals</td>
</tr>
<tr>
<td>6</td>
<td>Ratios introduced</td>
<td>Using ratios</td>
</tr>
<tr>
<td>7</td>
<td>Proportional reasoning</td>
<td>Using proportions</td>
</tr>
</tbody>
</table>
Students struggle with words only seen in school or in a specific subject

Tier 1 (everyday words)

Tier 2 (academic vocabulary)

Tier 3 (domain-specific)

<table>
<thead>
<tr>
<th>Word</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Faraway Alaska</td>
<td>Japanese gardens</td>
</tr>
<tr>
<td>Tourists</td>
<td>Japanese cherry trees</td>
</tr>
<tr>
<td>Reports</td>
<td>Riverbanks</td>
</tr>
<tr>
<td>Newspapers</td>
<td>Bloomed</td>
</tr>
<tr>
<td>Fascinating</td>
<td>Blossoms</td>
</tr>
<tr>
<td>Huge glaciers</td>
<td>Petals drifted down</td>
</tr>
<tr>
<td>Spouting whales</td>
<td>Snowfall</td>
</tr>
<tr>
<td>Native people</td>
<td>Japanese</td>
</tr>
<tr>
<td>Guidebook</td>
<td>Cherry trees</td>
</tr>
<tr>
<td>Alaska</td>
<td>National symbol</td>
</tr>
<tr>
<td>Washington</td>
<td>Crowds gathered</td>
</tr>
<tr>
<td>Traveling</td>
<td>Honor</td>
</tr>
<tr>
<td>Japan</td>
<td>Sakura</td>
</tr>
<tr>
<td>Sailed</td>
<td>Japan</td>
</tr>
<tr>
<td>Ocean</td>
<td>Japan National Geographic Society</td>
</tr>
<tr>
<td>Japan</td>
<td>Nations of Japan</td>
</tr>
<tr>
<td>Carriages</td>
<td>Journey</td>
</tr>
<tr>
<td>Rickshaw</td>
<td>Washington, D.C.</td>
</tr>
<tr>
<td>Ancient temples</td>
<td>Proud</td>
</tr>
<tr>
<td>Japanese art</td>
<td>Capital</td>
</tr>
<tr>
<td>Speak Japanese</td>
<td>Land</td>
</tr>
<tr>
<td>Japan</td>
<td>Recent construction project</td>
</tr>
<tr>
<td>Its</td>
<td>Swampy area</td>
</tr>
<tr>
<td>Especially</td>
<td></td>
</tr>
</tbody>
</table>
Depths of Problem Solving

DOK 1: Recall
DOK 2: Skills and Concepts
DOK 3: Strategic Thinking
DOK 4: Extended Thinking

What is the knowledge?
How can the knowledge be used?
Why can the knowledge be used?
What else can be done with the knowledge?
Gamifying Engineering: Initial data and results from implementing a naval engineering video game (work in progress)

Michael Briscoe¹, Dr. Leigh McCue², Dr. David Kring³, Maggie Craig³
¹American Society of Naval Engineers ²George Mason University ³Navatek, Ltd.
SUMMARY: FLEET Educational Program

1. FLEET video game is an authentic physics simulator and replicates the engineering design process.
2. Curricula explore concepts using labs, simulations, & teamwork
3. Dozens of engineering-related text sets.
4. $1,000 mini-grants to help you get started
5. Completely Free!

www.fleetengineering.org
FLEET is not a video game, it’s a physics simulator.
FLEET Game Play

**Objective:**
Design and build a viable ship that can rescue a group of shipwrecked mariners. Make sure you stay under budget, stay close to design displacement, and have all the necessary equipment. Remember, you need to get the men out of the water as quickly as possible. Salvaging their lives wins a bonus.

**Data:**
Mission Completed!

**Design:**

**Test:**
Engineering Design & Gaming

Engineering Design Process in FLEET Curricula

Challenge:
Design a ship that will perform the best Search & Rescue mission.

Ask
(identify needs & limits)

Imagine
(sketch a plan)

Improve
(what can be better?)

Test Data

Create & Test
Teamwork & FLEET

1. We encourage FLEET use in teams of 3-5.
2. The driver is never any other position of power.
3. Suggested roles include:
   1. Research Physicist
   2. Project Manager
   3. Captain
   4. First Mate (person that steers)
Overview of FLEET Curricula

Lesson 1. Create engineering process
Lesson 4. Recording forces
Lesson 7. FLEET All-Star Break
Lesson 10. FLEET Awards

Lesson 1. What’s our process?
Lesson 2. How can we work on a boat?
Lesson 3. Reverse engineering ships
Lesson 4. Sink that boat!
Lesson 5. Steady!! Steady!!
Lesson 6. Search & Rescue
Lesson 7. FLEET All-Star Break
Lesson 8. The Force is Strong in your ship!
Lesson 9. A speedy design
Lesson 10. FLEET Awards
Managing FLEET LESSONS

**Hands-on Lessons**

- Water in container or sink.
- Sheets with engineering process requiring, design, testing and data collection.
- Celebrate groups that use the inquiry processes listed in the standards.
- Explore physics concepts and develop engineering vocabulary for simulator use.

**Simulator Lessons**

- Ideally, each group has a computer.
- Continue to emphasize your classroom norms (science notebooks, written hypothesis, data collection tables, etc.).
- Celebrate groups that use the inquiry processes listed in the standards.
## FINDINGS: Likert-Type Items

<table>
<thead>
<tr>
<th>Item</th>
<th>Question Stem</th>
<th>M</th>
<th>SD</th>
<th>% Agree/Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>Participation in FLEET increased my interest in pursuing a STEM career.</td>
<td>2.80</td>
<td>0.84</td>
<td>74%</td>
</tr>
<tr>
<td>3</td>
<td>Participation in FLEET increased my interest in pursuing a naval engineering career.</td>
<td>2.30</td>
<td>0.96</td>
<td>39%</td>
</tr>
<tr>
<td>4</td>
<td>The FLEET software was easy to navigate.</td>
<td>2.76</td>
<td>0.99</td>
<td>72%</td>
</tr>
<tr>
<td>5</td>
<td>I would recommend FLEET to a friend.</td>
<td>3.04</td>
<td>0.76</td>
<td>83%</td>
</tr>
<tr>
<td>6</td>
<td>Overall, I am satisfied with my decision to participate in FLEET.</td>
<td>3.24</td>
<td>0.71</td>
<td>87%</td>
</tr>
</tbody>
</table>
**FINDINGS:** Overall, I am satisfied with my decision to participate in FLEET. (#6)
FINDINGS: Participation in FLEET increased my interest in pursuing a STEM career. (#2)
FINDINGS: Participation in FLEET increased my interest in pursuing a naval engineering career. (#3)
**FINDINGS: Qualitative Results**

1. Do you have any recommendations for future versions of the FLEET software?
2. Do you have any recommendations for future ASNE capstone experiences?
3. Do you have any further comments you wish to share?

- 6 students suggested improving the graphics
  - (e.g., “Better graphics - more textures”),
- 4 students suggested changes to the ballast-tank interface
  - (e.g., “More ease when filling the ballast tanks”)
- 3 students requested more missions
  - (e.g., “possibly more missions”)
Findings: Qualitative Results

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Recent **PROGRAM ANALYSIS** by Users

1. There is a gap between the curricula which are focused on introductory physics students and the more formal naval engineering materials.
2. Some of the educational materials are not well organized.
3. Lessons required more adaptations because of materials and time.
4. “PUBLICITY” — Other teachers and students had not heard of the program which created a barrier to adoption for both.

NEXT STEPS

1. Complete **open-source documentation** of FLEET code
2. Conduct another round of **survey** data collection.
3. Plan and execute **pre- and post-test** intervention evaluation.
4. **Continue refining** educational curricula.