Summer 2019

FLEET Overview & Update!
What is **FLEET**?

- Video Game funded by ONR (2016-2019)
- $1,000 Grants available for schools to assist with adoption
- Engineering design process gameplay with physics simulator

FLEET is supported by the Office of Naval Research through grant N00014-16-R-FO03. The content is solely the responsibility of the authors and does not necessarily represent the official views of ONR.
QUICK HISTORY


• First cohort of data, 2016-2017, was gathered from pilot and capstone schools.

• Second cohort of data, 2017-2018, was gathered from capstone and grantee schools.

• Current data collection from capstone, grantee schools, and all registered FLEET users.
  • This school year we promoted FLEET curricula for middle and high school.
  • We attended 50 maker faires, STEM nights, engineering conferences, robotic competitions, etc.
  • Each quarter the number of FLEET users have increased 33%.
FLEET is not a video game, it’s a physics simulator.
Supporting Research

Productive Disciplinary Engagement (PDE) model (Eagle & Conant, 2002)

1. Problematize the subject matter
2. Provide authority to solve problems
3. Hold users accountable for their decisions
4. Provide relevant resources

FLEET Game Play

Objective

Design

Data

TEST

FLEET Curriculum
Authority: Users as **NAVAL ENGINEERS**

**FLEET Curriculum**
Accountability in FLEET Curriculum
FLEET Growth

New FLEET Users (Total: 1,083 unique users)

- **2016-2017**: 108
  - Teacher Training
  - Refine 2 missions
  - 1st Virtual Training
  - Complete 2 missions
  - PA Capstone

- **2017-2018**: 328
  - More Virtual & In-person trainings

- **2018-2019**: 647
  - West-Coast Capstone
  - Combat Practice
  - VA/NC Capstone
  - 4 Complete Missions

Milestones

- 2016-2017: Teacher Training, Refine 2 missions, 1st Virtual Training, Complete 2 missions, PA Capstone
- 2017-2018: More Virtual & In-person trainings
- 2018-2019: West-Coast Capstone, Combat Practice, VA/NC Capstone, 4 Complete Missions
FLEET Growth

Grantees and Events over 3 School Years

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Teacher Training</td>
<td>1</td>
<td>8</td>
<td>15</td>
</tr>
<tr>
<td>Refine 2 missions</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1st Virtual Training</td>
<td>1</td>
<td>19</td>
<td>51</td>
</tr>
<tr>
<td>Complete 2 missions</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PA Capstone</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>More Virtual &amp; In-person trainings</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>West-Coast Capstone Combat Practice</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4 Complete Missions</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Grantees

Events
Resources: Overview of **FLEET** Curricula

Lesson 1. What’s our process?

2. How can we work on a boat?

3. Reverse engineering ships

4. Sink that boat!

5. Steady!! Steady!!

6. Search & Rescue

7. **FLEET** All-Star Break

8. The Force is Strong in your ship!

9. A speedy design

10. **FLEET** Awards
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?)

Create & Test

Test Data

Massachusetts Department of Elementary & Secondary Education 2016.

2016 Science and Technology/Engineering Curriculum Framework

Survey Instruments

• Student Survey
  • 4 demographic questions (gender, race, ethnicity, age group)
  • 2 FLEET participation questions (# of missions, types of events)
  • 5 Likert-type questions
  • 1 STEM participation question
  • 3 open-ended qualitative feedback questions

• Educator Survey
  • 4 demographic questions (gender, race, ethnicity, age group)
  • 2 FLEET participation questions (# of missions, types of events)
  • 5 Likert-type questions
  • 1 STEM participation question
  • 3 open-ended qualitative feedback questions
### 2017 & 2018 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>
### 2019 Preliminary 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>2.83</td>
<td>0.96</td>
<td>63%</td>
</tr>
<tr>
<td>3</td>
<td>Participation in FLEET increased my interest in pursuing a naval engineering career.</td>
<td>2.43</td>
<td>1.06</td>
<td>48%</td>
</tr>
<tr>
<td>4</td>
<td>The FLEET software was easy to navigate.</td>
<td>2.89</td>
<td>1.07</td>
<td>74%</td>
</tr>
<tr>
<td>5</td>
<td>I would recommend FLEET to a friend.</td>
<td>3.04</td>
<td>0.97</td>
<td>77%</td>
</tr>
<tr>
<td>6</td>
<td>Overall, I am satisfied with my decision to participate in FLEET.</td>
<td>3.20</td>
<td>0.91</td>
<td>81%</td>
</tr>
</tbody>
</table>
2017 & 2018 FINDINGS: Correlations

Table 1: Means, standard deviations, and correlations of survey data (N = 46)

<table>
<thead>
<tr>
<th>Questions</th>
<th>M</th>
<th>SD</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1.37</td>
<td>0.84</td>
<td>------</td>
<td>0.03</td>
<td>0.66**</td>
<td>0.33*</td>
<td>0.31*</td>
</tr>
<tr>
<td>2</td>
<td>2.80</td>
<td>0.84</td>
<td>0.09</td>
<td>0.24</td>
<td>0.54**</td>
<td>0.29</td>
<td>0.77**</td>
</tr>
<tr>
<td>3</td>
<td>2.30</td>
<td>0.96</td>
<td>0.16</td>
<td>0.03</td>
<td>0.50**</td>
<td>0.38**</td>
<td>0.27</td>
</tr>
<tr>
<td>4</td>
<td>2.76</td>
<td>0.99</td>
<td>0.08</td>
<td>0.24</td>
<td>0.29</td>
<td>0.31*</td>
<td>0.77**</td>
</tr>
<tr>
<td>5</td>
<td>3.04</td>
<td>0.76</td>
<td>0.16</td>
<td>0.03</td>
<td>0.50**</td>
<td>0.38**</td>
<td>0.27</td>
</tr>
<tr>
<td>6</td>
<td>3.24</td>
<td>0.71</td>
<td>0.08</td>
<td>0.24</td>
<td>0.29</td>
<td>0.31*</td>
<td>0.77**</td>
</tr>
</tbody>
</table>

Note: ** p<0.01; * p< 0.05
**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)
### 2019 PRELIM FINDINGS: Correlations

New Table: Means, standard deviations, and correlations of incoming survey data ($N = 76$)

<table>
<thead>
<tr>
<th>Questions</th>
<th>M</th>
<th>SD</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1.29</td>
<td>0.99</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>2.83</td>
<td>0.96</td>
<td>0.08</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>2.43</td>
<td>1.06</td>
<td>0.03</td>
<td>0.28*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>2.89</td>
<td>1.07</td>
<td>0.21</td>
<td>0.64**</td>
<td>0.35**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>3.04</td>
<td>0.97</td>
<td>0.28*</td>
<td>0.71**</td>
<td>0.35**</td>
<td>0.64**</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>3.20</td>
<td>0.91</td>
<td>0.38**</td>
<td>0.68**</td>
<td>0.24**</td>
<td>0.55**</td>
<td>0.81**</td>
</tr>
</tbody>
</table>

Note: **$p<0.01$; *$p< 0.05$
2017 & 2018 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”)
2019 PRELIM FINDINGS: Qualitative Results

1. Responses were largely consistent so far, although much fewer students are having issues with the ballast tanks after redesigns.

• 2 students suggested improving the graphics
  • (e.g., “It will sound silly, but watch some clips from GTA 5 and try to match the same graphics style”),

• 1 student suggested changes to the ballast-tank interface
  • (e.g., “Easier access to water tanks under the ship.”)

• 6 students requested more missions
  • (e.g., “I would recommend to add more ship models and different missions”)

• Educator Surveys (N=22) need more analysis because of missing data.
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. Plan and execute **pre- and post-test** intervention evaluation.
2. **Continue refining** educational curricula.

JOIN US

3. You can download **FLEET** at fleetengineering.org
4. You can email the **FLEET** team at fleet@navalengineers.org
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!

FLEET Summary

www.fleetengineering.org
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)
### Teaching **FLEET** & The CCCs

<table>
<thead>
<tr>
<th>Activity</th>
<th>Cross-Cutting Connection</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Hands-on Tall Boat Challenge</strong></td>
<td>Structure and Function</td>
<td>Boats need sturdy bases, just like trees have roots and buildings have foundations, ships require a sturdy base that can support tall structures.</td>
</tr>
<tr>
<td><strong>Hands-on Strongest Boat Challenge</strong></td>
<td>Cause and Effect</td>
<td>Student-made boats that can support a brick require iterative design processes. Students must analyze why the boat sinks or flips over when trying to support the weight and then try new designs to address that issue.</td>
</tr>
<tr>
<td><strong>Hands-on Stable Boat Challenge</strong></td>
<td>Structure and Function</td>
<td>A boat that can hold two containers when the water is wavy will need to have a system that holds the containers and another system that mitigates the waves.</td>
</tr>
<tr>
<td><strong>Fastest FLEET Boat</strong></td>
<td>Energy &amp; Matter</td>
<td>In the FLEET simulator, various engines are used to convert fuel into speed. Students will investigate which engine generates the most power and how they can adjust the weight of their ship to maximize speed.</td>
</tr>
<tr>
<td><strong>Highest FLEET Search &amp; Rescue score</strong></td>
<td>Systems and Systems Model; Scale, Proportion and Quantity</td>
<td>Search &amp; Rescue missions require ships to be fast, maneuverable, and good at rescuing people in the water. Students must design solutions to these competing needs while staying within budget. Groups will need to collect data over multiple days in order to be successful and this data will include information about ships that weigh over one-million pounds.</td>
</tr>
</tbody>
</table>