Novel Engineering:

An Integrated Approach to Teaching Engineering and Literacy

Elissa Milto, Kristen Wendell, Mary McCormick, Lija Yang

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What is Novel Engineering?

An approach that uses classroom literature as a starting point for open-ended engineering design challenges.

Turtle Protector with a Pulley
To kids, Engineering Design may appear to be sequential – another set of steps. Mass. STE Frameworks, 2006

The Engineering Design Process

1. Identify the Need or Problem
2. Research the Need or Problem
3. Develop Possible Solution(s)
4. Select the Best Possible Solution(s)
5. Construct a Prototype
6. Test and Evaluate the Solution(s)
7. Communicate the Solution(s)
8. Redesign

Engineering Is Elementary, Museum of Science Boston
Engineering Patterns of Thought and Action

Curiosity

Optimism

Creativity

Ethical thinking

Optimization

Iterative reasoning

Systems thinking

Collaboration

Communication
Why Integrate?

Complex, rich problems

Characters with needs, attitudes, and abilities

Situational context with resources and constraints
Typical Novel Engineering Flow

1. Choose a book
2. Identify problems
3. Understand the clients
4. Design a Solution
5. Feedback
6. Improve design
7. Present solutions
Student-generated Problems from: 
**The Mixed-up Files of Mrs. Basil E. Frankweiler**

As we read, think about...
What are some problems in the book that an engineer might be able to help us solve?

- Claudia feels left out - injustice
- No pictures
- Hide from museum workers
- Angel - who sculpted her?
- Getting through crowd of people
- Janitor sees Jamie hold/fake fountain
- Cannot communicate when hiding
- Information about Angel, but library is closed
- Wake up late
- Help recognize style of Angel being carved

- Fad parents as long as possible
- Inconspicuous
- Jamie's noisy & problem-heavy
- Hide from museum workers
- How to get the NNT
- Angel - who sculpted her? How to see Angel
- Getting through crowd of people
- Janitor sees Jamie hold/fake fountain
- Cannot communicate when hiding
- Information about Angel, but library is closed
- Wake up late
- Help recognize style of Angel being carved

Who are the main characters?
- Claudia
- Jamie
- Mrs. Frankweiler

What problems do you think?
- Noisy money
- Winning or losing
- Only kids need to be inconspicuous
- Letter might not arrive
- TVS might be called
- What to sleep...
Planning: Identifying Criteria & Constraints
Framing the problem

...it would take longer.

But how would they get the wood?

I don’t think it would be like, they have to pay for it.
Problem A: Jamie and Claudia are running low on money. Jamie has discovered that there are coins in the museum fountain.

Challenge A: Engineer a way to retrieve coins from the fountain.

Problem B: Need a way to communicate with each other while the guard makes his rounds. During this time, they hid in the bathroom.

Challenge B: Engineer a way for them to communicate from different stalls.

Design Criteria/Constraints: Functional, materials from museum or cheap, inconspicuous, useable for 10 year old
Do As We Say NOT As We Do

- Facilitate discussions
- Work in small groups
- Read and Reread the text
- Share-Outs/Feedback
- Writing
An example of fourth grade

- Suburban Boston school
- Student-generated solutions
- Groups of 2 to 3 students
- Each group designed for a different problem
- Written components of task
A few student solutions

Money Filter backpack

Guard Distractor

Communication devices
A design for Claudia:
# Table of Books

<table>
<thead>
<tr>
<th>Book Title</th>
<th>Grade</th>
<th>Description</th>
<th>Example Item</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pop's Bridge</td>
<td>3rd</td>
<td>Two boys watch their fathers build the Golden Gate Bridge and experience</td>
<td>Backpack that becomes a <strong>bungey</strong> cord</td>
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<tr>
<td></td>
<td></td>
<td>positive and negative aspects of working on the bridge</td>
<td>Parachute with parts that span the bridge</td>
</tr>
<tr>
<td>If You Lived in Colonial Times</td>
<td>3rd</td>
<td>Expository book describing the lives of people in the English colonies</td>
<td>Garden watering system using central place to dump buckets of water and tubes</td>
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<tr>
<td>Ann McGovern</td>
<td></td>
<td>before the Revolutionary War</td>
<td>for distribution</td>
</tr>
<tr>
<td>The Mixed-up Files of Mrs. Basil E.</td>
<td>4th</td>
<td>Claudia and Jaime run away from home and stay at the MET in NYC. They face</td>
<td>A backpack with a padded false bottom to hide money and muffle the sound</td>
</tr>
<tr>
<td>Frankweiler &amp; E.L. Konigsburg</td>
<td></td>
<td>challenges such as a shortage of funds, avoiding detection, and the desire</td>
<td>A scooter made from found materials with a wheel system created from rows of</td>
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<tr>
<td></td>
<td></td>
<td>to learn about a mysterious sculpture that may have been created by</td>
<td>ping pong balls</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Michelangelo.</td>
<td>A telescoping periscope with adjustable mirror flaps</td>
</tr>
</tbody>
</table>
2nd Grader’s Discussing Problems in a Text
Another genre: Hugo Cabret
The text helped support rich problem-framing.

Problem-framing supported digging into the text.

Engineering prompted exploration of vocabulary.

In this exploration, kids are also redefining the problem space.
Interested in Learning More about Novel Engineering?

www.novelengineering.org

Attend Novel Engineering Professional Development
Are they engineering?

- Agentively frame and solve an ill-structured problem
- Navigate uncertainty by negotiating assumptions, reflecting and gathering knowledge from lived experience and character experiences
- Iteratively design, construct, and test a functional prototype
- Balancing criteria and constraints (time, materials, feasibility, functionality, client’s needs) for optimal design
Engineering task can also be a literacy task

Potential for:
• Text-based criteria for design and evaluation
• Considering character/client needs & traits
• Considering plot and setting constraints
• Spontaneous re-reading and writing
• Support for (or bridge between) reading comprehension and writing
• Exploring themes, concepts and vocabulary