Flipping the Classroom, the Laboratory and Social Media with First Year Engineering Students

Dr. Russ Meier
Oscar Werwath Distinguished Teaching Professor
Milwaukee School of Engineering
EDUCATIONAL APPROACHES

- **Traditional Classroom**
  - Passive Lectures
  - Mentored Lab

- **Active Learning**
  - Active Lectures
  - Mentored Lab

- **Distance Learning**
  - Recorded Content
  - Mentored and Virtual Lab

- **Flipped**
  - Hybrid Lectures
  - Hybrid Laboratory
EDUCATIONAL QUESTIONS

Flipped Classroom
- Do flipped classroom harm knowledge acquisition?
- Do flipped classrooms diminish mentor authority?

Flipped Laboratory
- Does the ownership model improve design results?
- Can remote equipment improve design creativity?

Social Media
- Does crowdsourcing harm or improve retention?
- Can social media use result in design creativity?
MSOE

U.S. News and World Reports

15th Best University - Midwest
5th Most Innovative - Midwest

Quick Facts

- Residential campus
- 2950 students
- 12 engineering degrees
- Average class size of 20
- 96% placement rate
Quick Facts

- Biomedical Engineering
- Computer Engineering
- Electrical Engineering
- Software Engineering
- 800 students
- 600 lab hours over 4 years
FIRST YEAR COURSES

Digital Logic

CE-1901
4 cr

CE-1911
4 cr

CE-1921
4 cr

SE-1011 or experience with procedural programming language
FIRST YEAR COURSES

CE1901
- Combinational
- Logic Gates
- Gate Circuit
- Timing
- VHDL

CE1911
- Sequential
- FSMs
- Datapaths
- VHDL

CE1921
- Architecture
- Organization
- Assembly Lang.
- Microprocessors
INSTRUCTIONAL SCAFFOLDING

CE1901
- Hybrid Classroom - Flipped + Traditional
- Traditional Mentored Laboratory

CE1911
- Hybrid Classroom - Flipped + Traditional
- Flipped Laboratory

CE1921
- Flipped Classroom
- Flipped Laboratory
- Remote Equipment
FLIPPED CLASSROOM

• Lecture video
• Active learning
• Guided Mentorship
• Constructivism

Week 1

Week 10

Evaluation
Synthesis
Analysis
Application
Comprehension
Knowledge
FLIPPED LABORATORY

Ownership Model
- Week Project
- Experiential
- Constructivist

CE1911
- EFI Control
- Traffic Control
- Vend Control
- Seatbelt Control
- PWM Control
- Data Control
REMOTE EQUIPMENT

ROBOTIC ARM

- Modified a $45 kit
- Four motors
- DC ↔ Stepper
- DE0 Nano SOC+LT24
REMOTE EQUIPMENT

Software Support

- Linux (Angstrom)
- SSH server
- Robot API
- ARM Assembly
<table>
<thead>
<tr>
<th>DAY</th>
<th>LEVEL</th>
<th>TWEET</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>K</td>
<td>#FACT PWM duty cycle controls speed of DC motor and position of stepper motor.</td>
</tr>
<tr>
<td>2</td>
<td>K</td>
<td>#FACT ARM assembly provides direct access to CPU and IO registers. Assembly programmers are close to the hardware.</td>
</tr>
<tr>
<td>4</td>
<td>C</td>
<td>#DESCRIBE how ARM assembly uses move instructions to control data flow.</td>
</tr>
<tr>
<td>8</td>
<td>S</td>
<td>#DESIGN an ARM main program that creates a two parameter stack frame and calls a subroutine named RELEASE-GRIP</td>
</tr>
<tr>
<td>16</td>
<td>S</td>
<td>#DESIGN an ARM main program that uses the robot API to move block in grasper six inches right. Robot on 5-10 pm.</td>
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</table>
REMOTE EQUIPMENT

- Move robot ARM
- Grasp objects
- Move objects
- Draw shape
## EDUCATIONAL EFFECT

### Problem 1: Moore Finite State Machine Model

<table>
<thead>
<tr>
<th>Criteria</th>
<th>B</th>
<th>Y</th>
<th>N</th>
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</thead>
<tbody>
<tr>
<td>Constructs next state logic block, memory register block, and output logic block.</td>
<td>S</td>
<td></td>
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<tr>
<td>Uses input, feedback, and output signals.</td>
<td></td>
<td>A</td>
<td></td>
</tr>
<tr>
<td>Labels CLK, RST, inputs, and outputs with appropriate names.</td>
<td>K</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Organizes inputs, outputs, and feedback correctly in Moore Machine format.</td>
<td>S</td>
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### Problem 2: State Machine Bubble Diagram

<table>
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<tr>
<th>Criteria</th>
<th>B</th>
<th>Y</th>
<th>N</th>
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<tbody>
<tr>
<td>Constructs a five state machine with states S0, S1, S2, S3, and S4.</td>
<td>S</td>
<td></td>
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<tr>
<td>Uses outputs that reflect the state name (S00, S01, S10, S11, and 100).</td>
<td></td>
<td>A</td>
<td></td>
</tr>
<tr>
<td>Adds a reset into state S0.</td>
<td></td>
<td>A</td>
<td></td>
</tr>
<tr>
<td>Adds a self-loop link in state S4.</td>
<td></td>
<td>A</td>
<td></td>
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### Quarter Quiz Average

<table>
<thead>
<tr>
<th>Quarter</th>
<th>W12</th>
<th>W13</th>
<th>W14</th>
<th>W15</th>
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</table>

### Quarter 2 Year to Year Quiz Performance

![Chart showing quiz performance over quarters](chart.png)
STUDENT COMMENTS

• “Love doing my labs at home. I explore more.”
• “Videos make it easy to review something I miss.”
• “Sometimes I don’t watch the videos but I learn through classroom practice.”
• “The social media thing is different.”
• “The robot task was fun!”
• “Wow. That was really hands-on.”
• “I can’t believe what I can build after just 20 weeks.”
THANK YOU

Questions?