M-Power Tools: Using Power-Tools to Enhance STEM Self-Efficacy in Middle School-Aged Girls

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M-Power Tools: using power tools to enhance STEM self-efficacy and identity in middle school-aged girls.

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With thanks to:
Stanley Black & Decker
M-Power Tools Summer Program
Summer 2019
Research Indicates:

● Middle school is a critical time for identifying career aspirations.

● The greatest decline in science and engineering interest among girls happens in middle school.

● Middle school-aged girls become disinterested in STEM resulting from lack of confidence and diminished STEM identity.

● Girls and women gravitate toward careers that have a clear link to service with others.

● Opportunities to learn and enhance technical skills are not equitable among women and men (and boys and girls).
Primary and Secondary Goals

Primary Goals of M-Power Tools:

● Enhance STEM self-efficacy through building independence and confidence.

● Build enthusiasm in the possibility of pursuing a career in engineering.

Secondary Goals of M-Power Tools:

● Provide mentorship and role models to middle school-aged participants.

● Teach girls to safely and effectively use power tools to accomplish project goals and demystify the process of building and fabrication (male dominated fields of engineering).

● Strengthen teamwork skills.

● Illustrate that engineers are vital contributors to the betterment of society.
Curriculum

**Phase One:** Teach power tools safety and rules of operation through the design and construction of an individual project (picture frame).

**Phase Two:** Participants work collaboratively to design and build a group project (Free Little Library), which they present on the last day of the program.

**Phase Three:** Participants “present” final project to community partner.
M-Power Tools Team Project Details:

- Teams of 4 participants were tasked with designing and building a Little Free Library for 1 of 4 “community partners.”
- “Community Partners” included two local schools, one performing arts education center, and a county-run museum.
- With support from staff and current engineering students, teams spent 3 days using power tools (drills, miter saws, circular saws, nail guns, etc) building LFLs.
- On the last day of the program, participants traveled from one location to another where they installed the LFLs.
- Participants stocked the LFLs with books to inspire “girls and women in STEM.”
Assessment

M-Power Tools assessment data collected:

- Demographic Information (race & name of middle school)
- Previous exposure to engineering
- Previous experience with power tools
- STEM Self-Efficacy (specifically regarding math and engineering)

# of pre-assessment participants: 17
# of post-assessment participants: 11

Limitation: Only 11 out of the 17 participants completed the post-assessment. Because the assessment was anonymous, it is not possible to link individual pre- and post-tests.
### Participant Data

#### M-Power Tools Participants by Race:

<table>
<thead>
<tr>
<th>Race</th>
<th># of participants</th>
</tr>
</thead>
<tbody>
<tr>
<td>American Indian/Alaska Native</td>
<td>1</td>
</tr>
<tr>
<td>Asian</td>
<td>2</td>
</tr>
<tr>
<td>Black/African American</td>
<td>9</td>
</tr>
<tr>
<td>Hispanic/Latino</td>
<td>1</td>
</tr>
<tr>
<td>White</td>
<td>6</td>
</tr>
<tr>
<td>Choose not to disclose</td>
<td>1</td>
</tr>
</tbody>
</table>
Pre-Assessment

17 respondents:

- I have used power tools a lot! = 0
- I have used some power tools = 12
- I have never used power tools before = 5
Confidence using power tools to complete a project increased.

**Pre-Assessment:**

How confident are you in your ability to use power tools to complete a project?

- Very confident: 35.3%
- Somewhat confident: 23.5%
- Somewhat hesitant: 35.3%
- Very hesitant: 10.8%

17 responses

**Post-Assessment:**

After attending the M-Power Tools camp, how confident are you in your ability to use power tools to complete a project?

- Very confident: 81.8%
- Somewhat confident: 18.2%

11 responses
Pre-Assessment: STEM Self-Efficacy

- I am confident that I can do an excellent job on math tests:
  - Strongly Agree: 64.7%
  - Somewhat Agree: 32.3%
  - Somewhat Disagree: 3.0%
  - Strongly Disagree: 0.0%

- I am certain that I understand the most difficult material presented in the textbook used in my math class:
  - Strongly Agree: 47.1%
  - Somewhat Agree: 33.3%
  - Somewhat Disagree: 11.8%
  - Strongly Disagree: 7.8%

- I am confident that I can do an excellent job on assignments in my math class:
  - Strongly Agree: 53.3%
  - Somewhat Agree: 37.6%
  - Somewhat Disagree: 9.1%
  - Strongly Disagree: 0.0%

- I am certain that I can master the skills taught in my math class:
  - Strongly Agree: 56.2%
  - Somewhat Agree: 38.2%
  - Somewhat Disagree: 4.8%
  - Strongly Disagree: 0.0%
Post-Assessment: STEM Self-Efficacy increased.
Pre-Assessment

STEM Identity

Pre-Assessment:

I see myself as a "math person"

- Strongly Disagree: 23.5%
- Somewhat Disagree: 32.5%
- Strongly Agree: 55.2%

Others see me as a "math person"

- Somewhat Disagree: 47.1%
- Strongly Agree: 35.3%

I see myself as an engineer

- Somewhat Disagree: 17.6%
- Strongly Disagree: 5.9%
- Somewhat Agree: 23.5%

Others see me as an engineer

- Somewhat Disagree: 27.7%
- Strongly Agree: 33.3%
Pre-Assessment

**STEM Identity increased.**

Post-Assessment:
If learning to safely and effectively use power tools:

- Increases STEM self-efficacy
- Strengthens STEM identity
- Builds confidence

Then learning to safely and effectively use power tools may:

- Encourage girls to enroll in the high level math courses required for admission into undergraduate engineering degree programs.
- Enhance interest in pursuing a career in engineering during an age when many girls lose interest at a critical time.
- Develop senses of independence and self-assurance during a stage when many girls lack confidence.
Program Operation and Implementation:

- Choose a simple and manageable project that is relevant to middle school-aged girls.
- Prototype and test all projects prior to the start of the program to identify potential problems, issues, and challenges.
- Spend only partial day doing the hands-on build and the other portion of they day doing interactive, “fun” and educational activities. An all-day build is too intense for middle school-aged girls.
- Spend significant time assessing, mitigating, and managing risk (this is a high-risk program!)
- Bring in engineering professionals who can speak to the benefit of knowing how to use power tools. This gives a deeper sense of meaning to the activity.
- Implement a prototyping and design review process so that participants feel confident and secure in final build.
Future Research

Details for summer 2020 program:

- Project will be smaller in scale and better suited for the length of the program (though it will continue to be “community partnership” based)
- There will be a maximum of 20 participants to manage risk and ensure safety.
- Pre- and post-assessments will be linked per participant so that we can track individuals and discard data that does not include a pre- and post-assessment.
- Daily schedules will include partial day design-build and partial day “engineering exploration” activities to give students a clearer understanding of the field.
M-Power Tools is evolving and developing.

Suggestions? Comments? Questions?
Thank You!

With thanks to:

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