

## **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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# M-Power Tools Summer Program

Summer 2019



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# Research Indicates. . . .

## 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.



# Project Details

## 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:

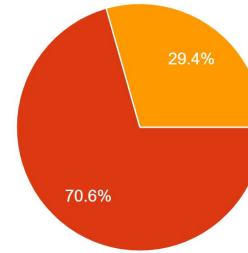
Race	# of participants
American Indian/Alaska Native	1
Asian	2
Black/African American	9
Hispanic/Latino	1
White	6
Choose not to disclose	1



# Pre-Assessment

To what extent have you used power tools in the past?

17 responses



- I've used power tools a lot!
- I've used some power tools in the past
- I've never used power tools before

## 17 respondents:

I have used power tools a lot! = 0  
I have used some power tools = 12  
I have never used power tools = 5

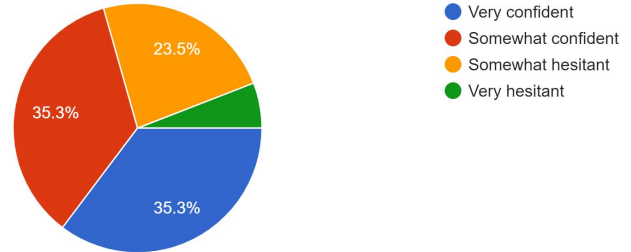


*Confidence using power tools to complete a project **increased.***

## Pre-Assessment:

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

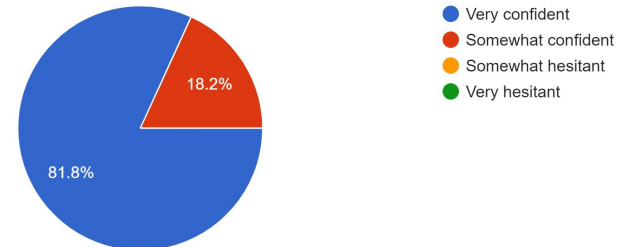
17 responses



## Post-Assessment:

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

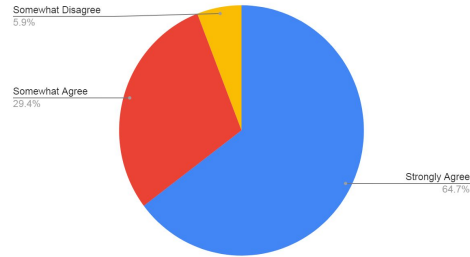
11 responses



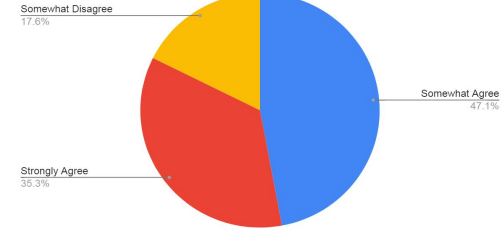
# Pre-Assessment: *STEM Self-Efficacy*

## Pre-Assessment:

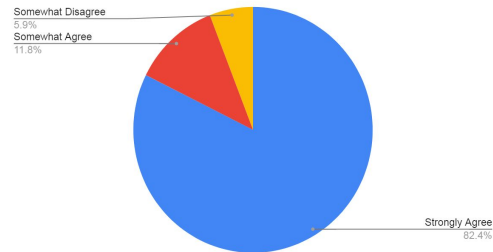
I am confident that I can do an excellent job on math tests



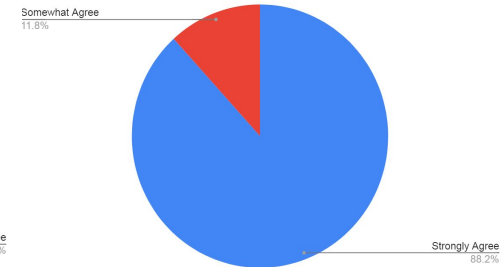
I am certain that I understand the most difficult material presented in the textbook used in my math class



I am confident that I can do an excellent job on assignments in my math class.



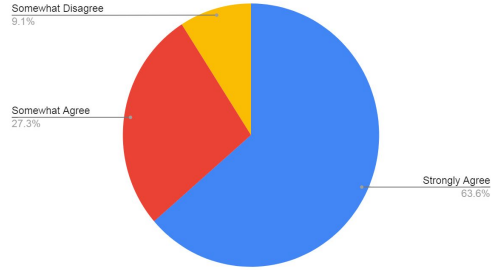
I am certain that I can master the skills taught in my math class



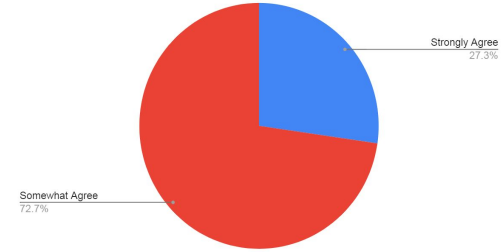
# Post-Assessment: *STEM Self-Efficacy* increased.

## Post-Assessment:

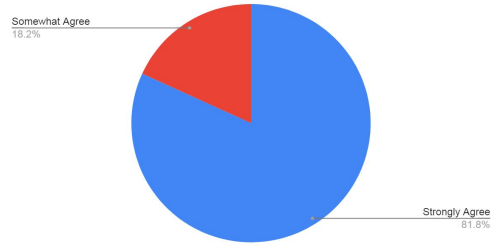
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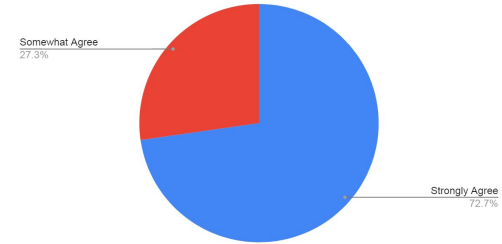
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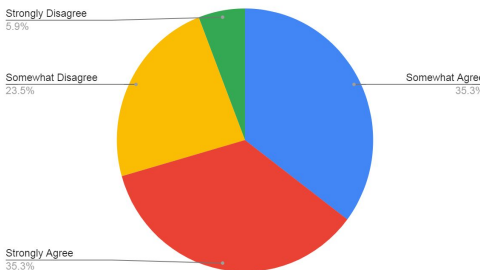
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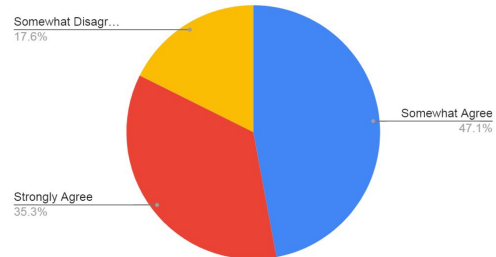
# Pre-Assessment *STEM Identity*

## Pre-Assessment:

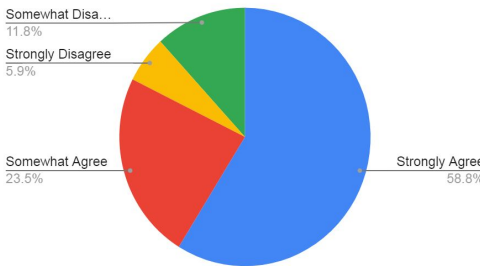
I see myself as a "math person"



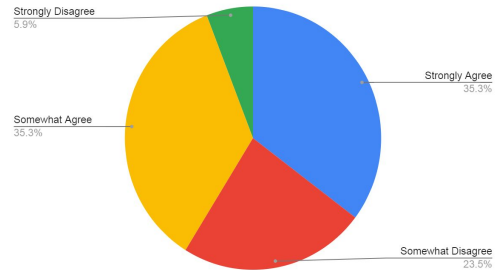
Others see me as a "math person"



I see myself as an engineer



Others see me as an engineer



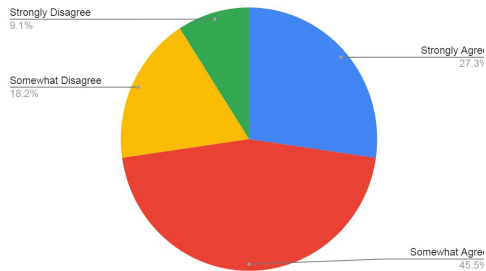
# Pre-Assessment *STEM Identity* increased.



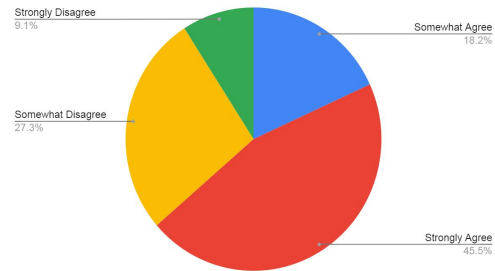
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## Post-Assessment:

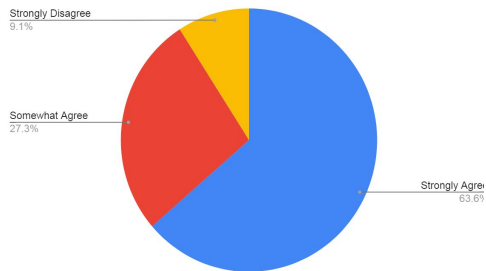
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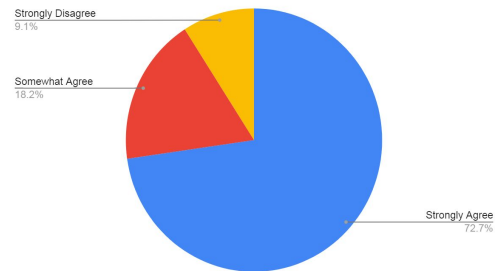
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Others see me as an engineer



# If-Then Statement

**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.





# Lessons Learned

## 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 the 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.

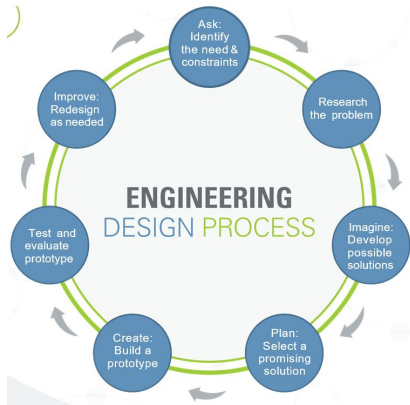




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# M-Power Tools is evolving and developing.



Suggestions? Comments? Questions?



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# Thank You!

*With thanks to:*

***StanleyBlack&Decker***

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