WHAT DO FAMILIES LEARN IN 6-10 HOURS: A STUDY OF CURIOSITY MACHINE'S ENGAGEMENT WITH FAMILIES AND COMMUNITIES

Richard Jung and Tara Chklovski, 2017

What effect does depth of learning (as measured in hours) have on creativity, curiosity, persistence and self-efficacy?

2017 was the first year we systematized data collection, analysis and reporting on **learning gains** for Curiosity Machine participants. We engaged ~700 parents and 900 students in Curiosity Machine programs, across 21 sites in Washington, Chicago, Los Angeles, New York, Alabama, Virginia and the United Arab Emirates. Of the sites, 76% were elementary schools, 10% were middle schools, and 14% were libraries:

- Woodmoor Elementary – Northshore School District, Washington
- Echo Lake Elementary – Shoreline School District, Washington
- Briarcrest Elementary – Shoreline School District, Washington
- Spruce Elementary – Edmonds School District, Washington
- Woodside Elementary – Everett School District, Washington
- Albert Einstein Elementary – Lake Washington School District, Washington
- College Place Elementary – Edmonds School District, Washington
- Pinewood Elementary – Marysville School District, Washington
- Kellogg Marsh Elementary School, Marysville, Washington
- Evergreen Middle – Everett School District, Washington
- Chicago Public Library- Toman Branch, Chicago, IL

- Chicago Public Library- West Englewood, Chicago, IL
- Chicago Public Library- Albany Park, Chicago, IL
- Los Angeles Elementary School, Los Angeles CA
- 10th St. Elementary School, Los Angeles
- 20th St Elementary School, Los Angeles
- Magnolia Elementary School, Los Angeles
- Morris Elementary, Huntsville, Alabama
- Herndon Middle School, Fairfax, Virginia
- MS 394, Brooklyn, New York
- Khalifa School, Abu Dhabi, UAE

We are trying to answer the question::
"What is the dosage and type of learning experience needed for children from underserved communities to develop a resilient sense of self-efficacy as innovators, entrepreneurs, and leaders through learning and using engineering and technology?"

In the past, we have done some external longitudinal evaluations of our Curiosity Machine Family programs, in partnership with the Center for Children and Technology. Through that evaluation, we found that the 5-week program is effective in changing parents' at-home behavior—inspiring them to do more hands-on engineering projects at home.

With this analysis, we wanted to drill deeper into the connection between dosage and change in curiosity, creativity, and persistence as well as a sense of self-efficacy as an innovator.

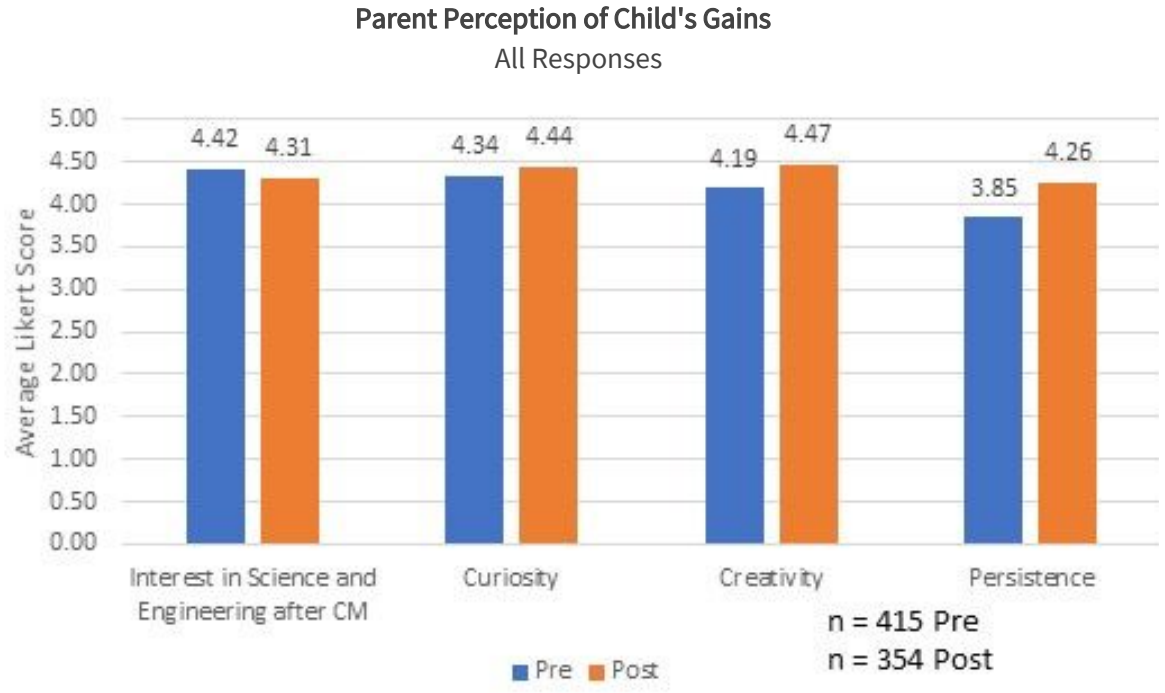
A typical Curiosity Machine implementation consisted of 5 weekly sessions held at the school or library. Across the 19 sites, ~1680 parents and children were engaged in hands-on engineering design challenges during which they learned about engineering and physics topics such as aerodynamics. Partner site staff introduced a real world problem and technology/engineering application by playing a Curiosity Machine Inspiration Video. Following this they introduced the design challenge for the evening. Design challenges this cohort completed include:

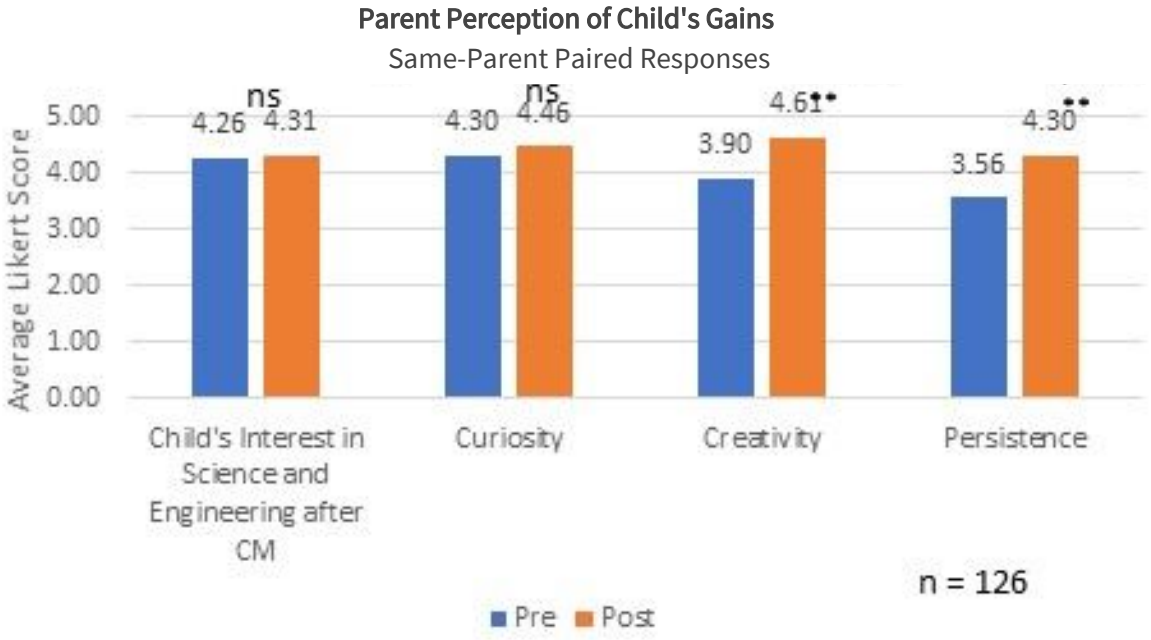
- Engineer a Communication Network
- Build a Long Spanning Wing
- Design a Robotic Arm
- Deploy a Satellite

The families spent an hour planning, designing, building and testing their prototypes. Industry mentors had the opportunity to walk around the room and help families troubleshoot. After the test and redesign stages, partner staff led a reflection session and encouraged families to keep improving their prototypes at home.

Pre-surveys were given to participants at the first session and post-surveys were given at the last session. We analyzed 769 surveys out of which 126 were paired. On average, participants attended 3

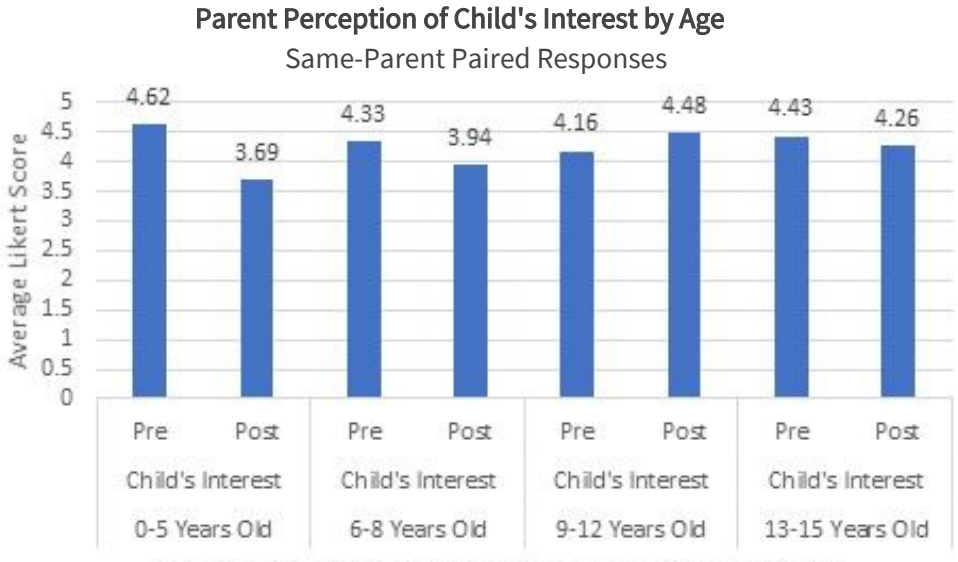
out of the 5 sessions. Overall we found significant increases in creativity and persistence in students (as reported by parents) after ~6 contact hours.

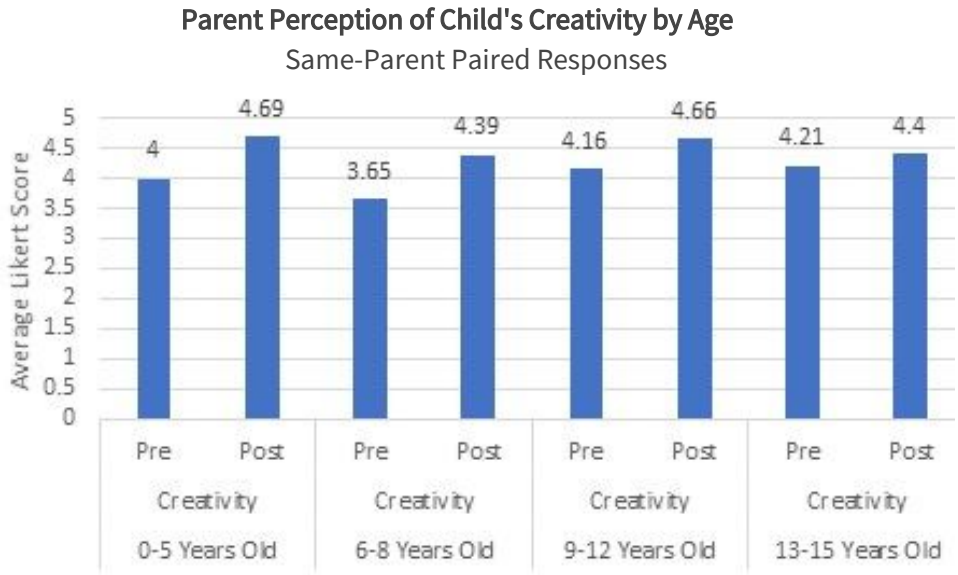




In the paired comparisons, it was interesting to see that parents see increase in creativity across all (elementary and middle school) ages, increased persistence across elementary school aged students, but not in the 13–15 year age range. We also find increased curiosity across ages 0-8, but not from

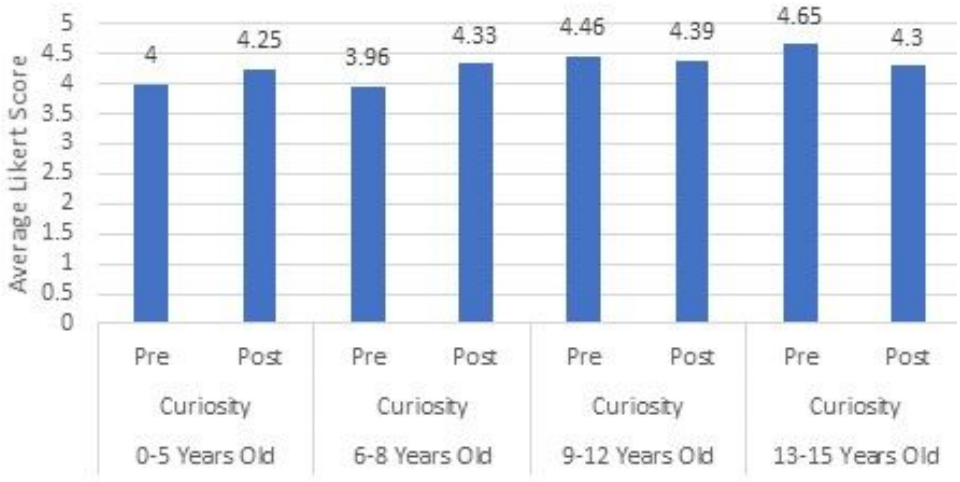
9-15. Parents also reported that interest in science and engineering increased for children aged 9-12, but not for the other age range





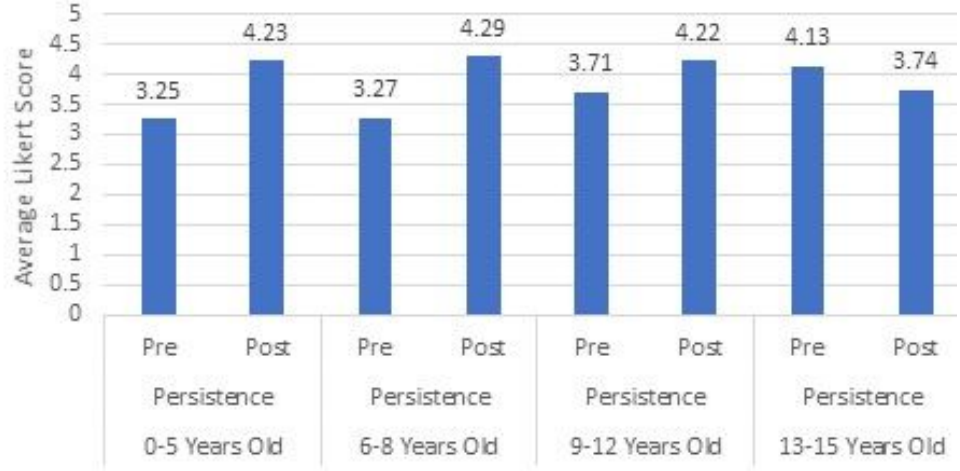
Parent Perception of Child's Curiosity by Age

Same-Parent Paired Responses



Parent Perception of Child's Persistence by Age

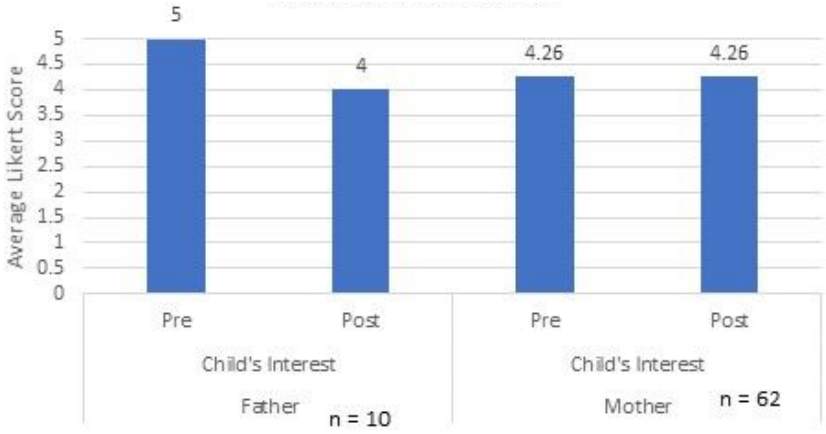
Same-Parent Paired Responses



86% of parents who attended the session were mothers, and interestingly there were differences in how mothers and fathers perceived their children were learning. Overall mothers perceived their children to be learning more than fathers.

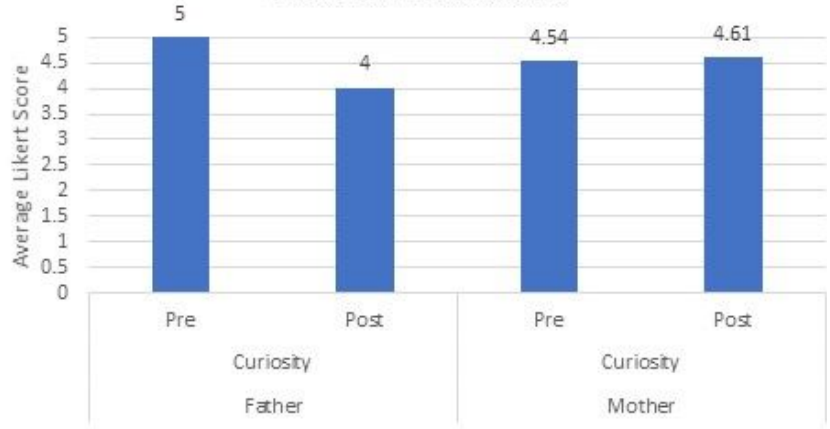
Parent Perception of Child's Interest by Mothers and Fathers

Same-Parent Paired Responses



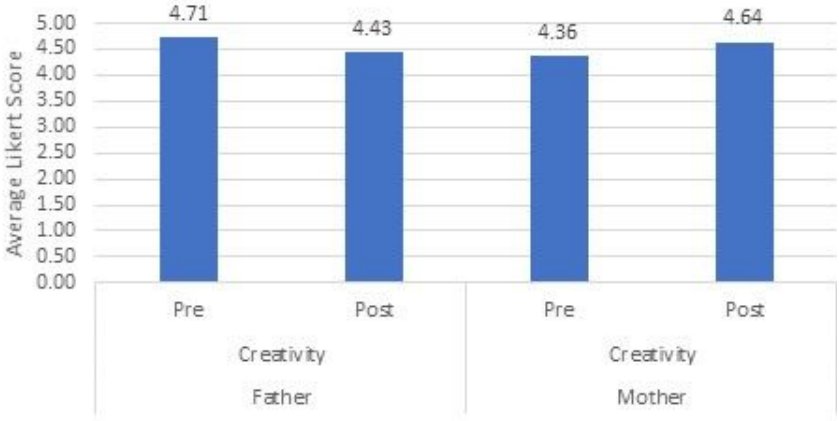
Parent Perception of Child's Curiosity by Mothers and Fathers

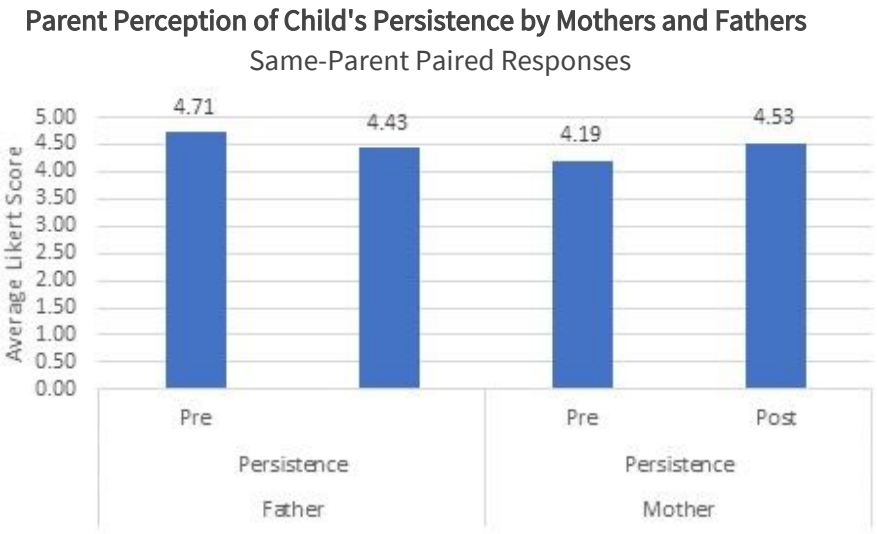
Same-Parent Paired Responses



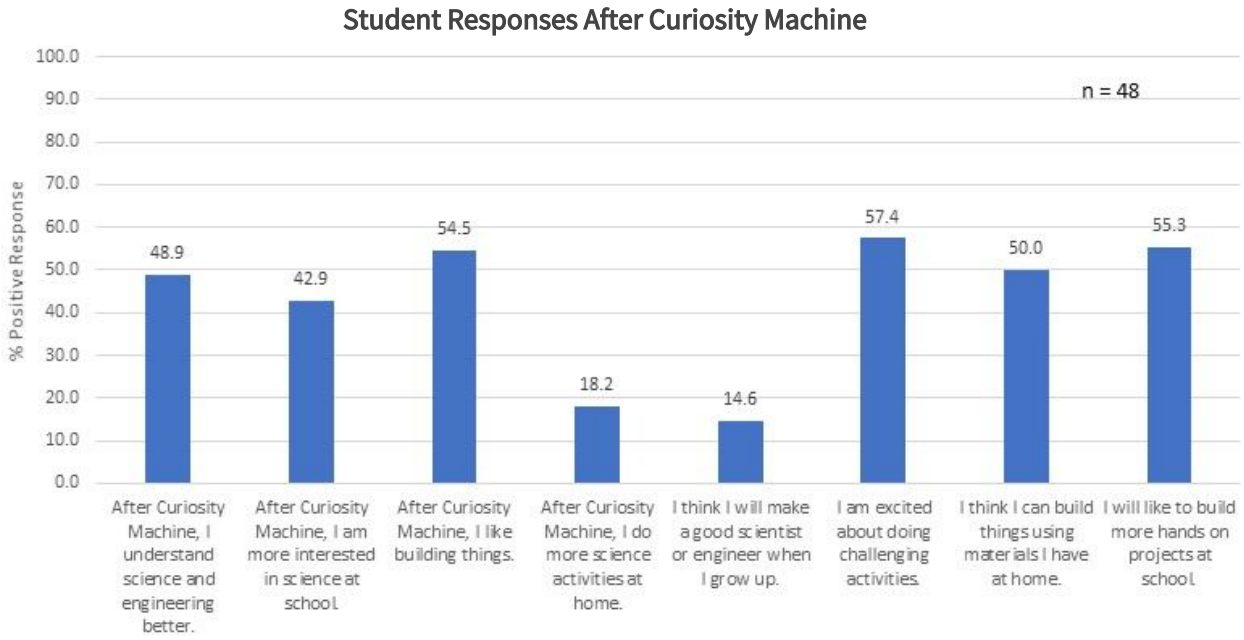
Parent Perception of Child's Creativity by Mothers and Fathers

Same-Parent Paired Responses





The figure below shows the post-responses of 48 middle school students at MS 394, NYC. Almost 3 of 5 students expressed a greater understanding of and interest in science and engineering—more excitement about doing challenging activities and building things using materials at home—after CM. Interestingly, this did not translate into students thinking that they could become a good scientist or engineer when they grew up.



We are excited that we have a system in place now to collect data from program implementation, analyze it, and share results with partners. Our goal for 2018 will be to turn around survey results in a more agile way with partners so we can collectively learn and improve in time for the next implementation.

Future Work

Areas of further investigation include better understanding how children develop their identity as a scientist or engineer, how they see engineering/scientific skills being connected to a career, understanding more deeply the difference in interest and learning gains with children's age, as well as better understanding the differences between mothers and fathers in how they perceive children's learning.