

Background

Ignite Mission

- Encourage creative problem-solvers to utilize engineering design while fostering global citizenship, community-involvement, and improving self-perception, resilience, and attitudes in STEM.
- Collaborate with The Museum of Life and Science to increase interest in STEM and STEM retention for young students in North Carolina by pairing undergraduates, Trainers, with middle school mentees, Learners, and high school mentees, Makers.

Previous Bass Connections Teams

- Research study examining Ignite's impact on Learner attitudes towards community-driven problem solving and their STEM-identity.

Project Overview

Goal 1 - Data Preparation

- Clean, scrub, and de-identify raw data from multiple program iterations to establish a comprehensive database for systematic analysis and trend identification.

Goal 2 - Exploratory Data Analysis

- Conduct slope graph analysis of pre/post survey scores across math, engineering, community, STEM, grit, and science domains
- Examine how demographics affect learning outcomes
- Analyze correlations between student improvement and attendance/engagement metrics to identify performance predictors
- Create heat maps visualizing weekly engagement patterns to identify high/low-focus curriculum components

Goal 3 - Predictive Learning Model Development

- Develop predictive model to forecast student learning and growth patterns based on attendance and engagement score data.
- Establish a statistical analysis framework for continuous program improvement and evidence-based decision making.

Learner Results

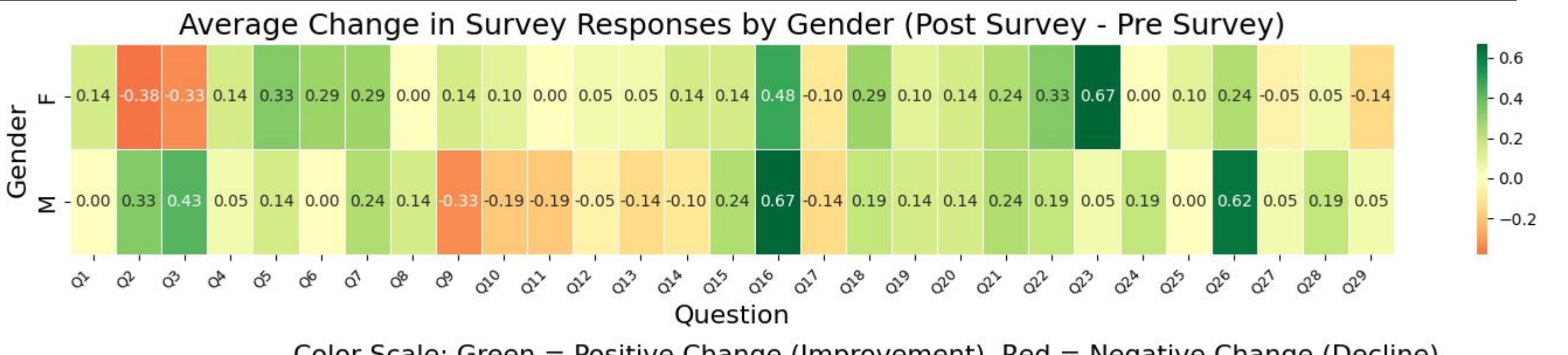


Figure 1. Pre/post survey changes in STEM attitudes by gender. Females showed decreased math confidence but increased engineering interest, while males showed the opposite pattern ($p < 0.05$).

Cumulative Engagement Distribution: Zoom vs. In-person Sessions

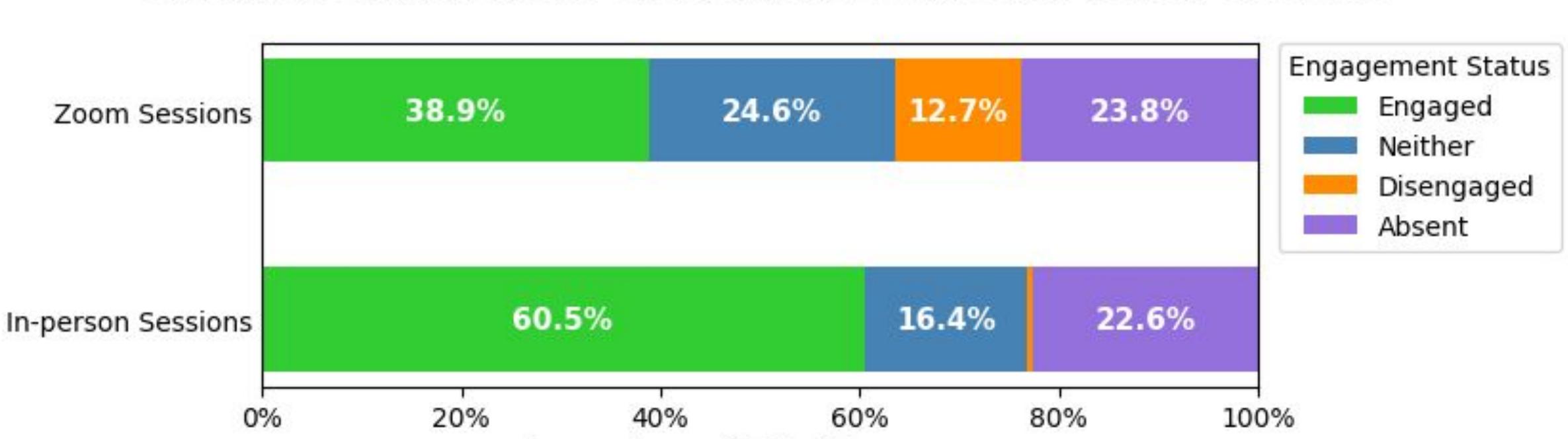


Figure 2. Distribution of student engagement by session format. A significantly greater percentage of students were 'Engaged' during in-person sessions ($p < .001$).

Learner Results



Figure 3. Correlation between pre/post improvement and engagement/absences. Demonstrates the importance of community engagement, professional mentorship, and structured thinking processes.

Maker Results

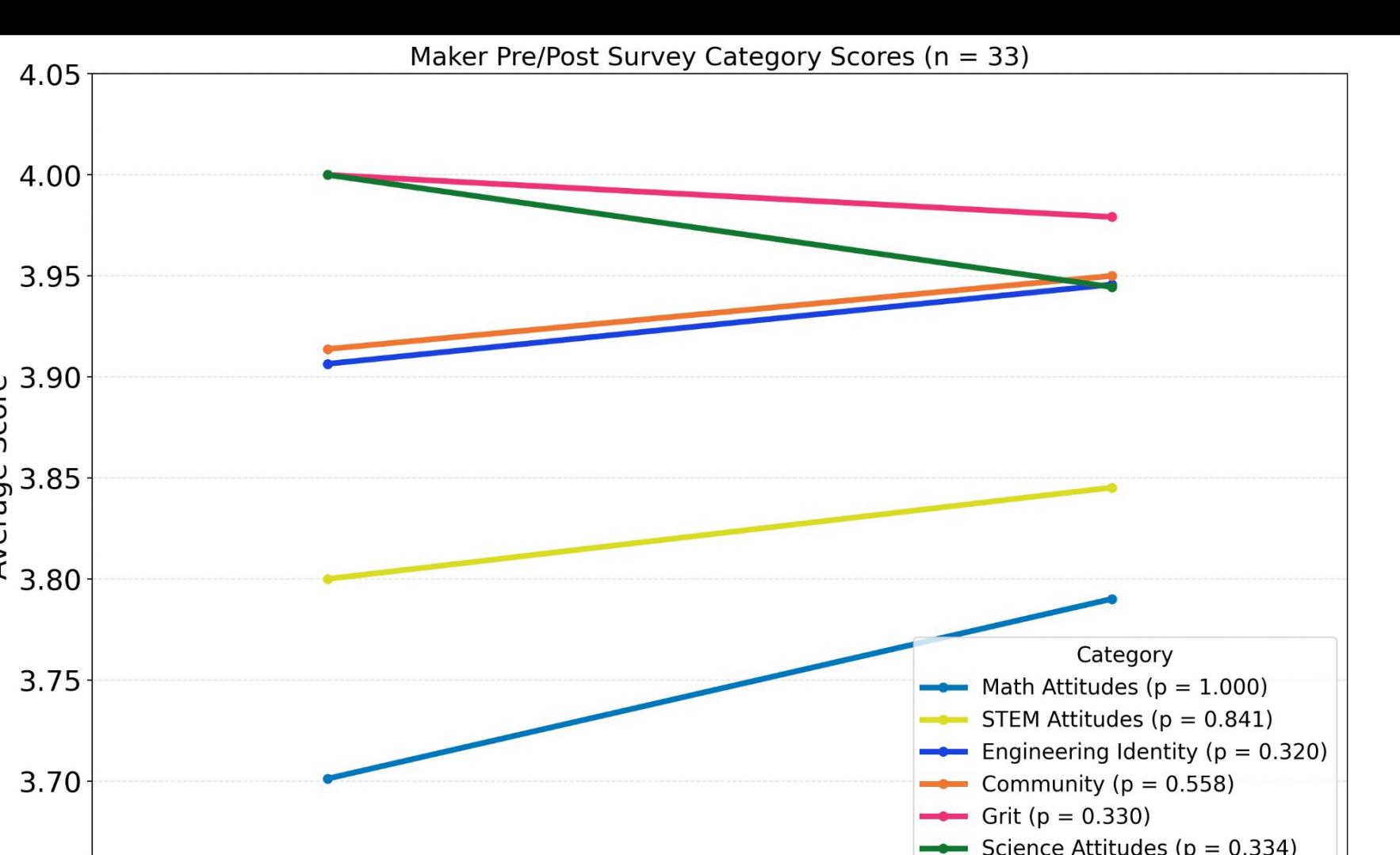


Figure 4. Maker Pre/Post Survey Category Trends (5 pt Likert scale).

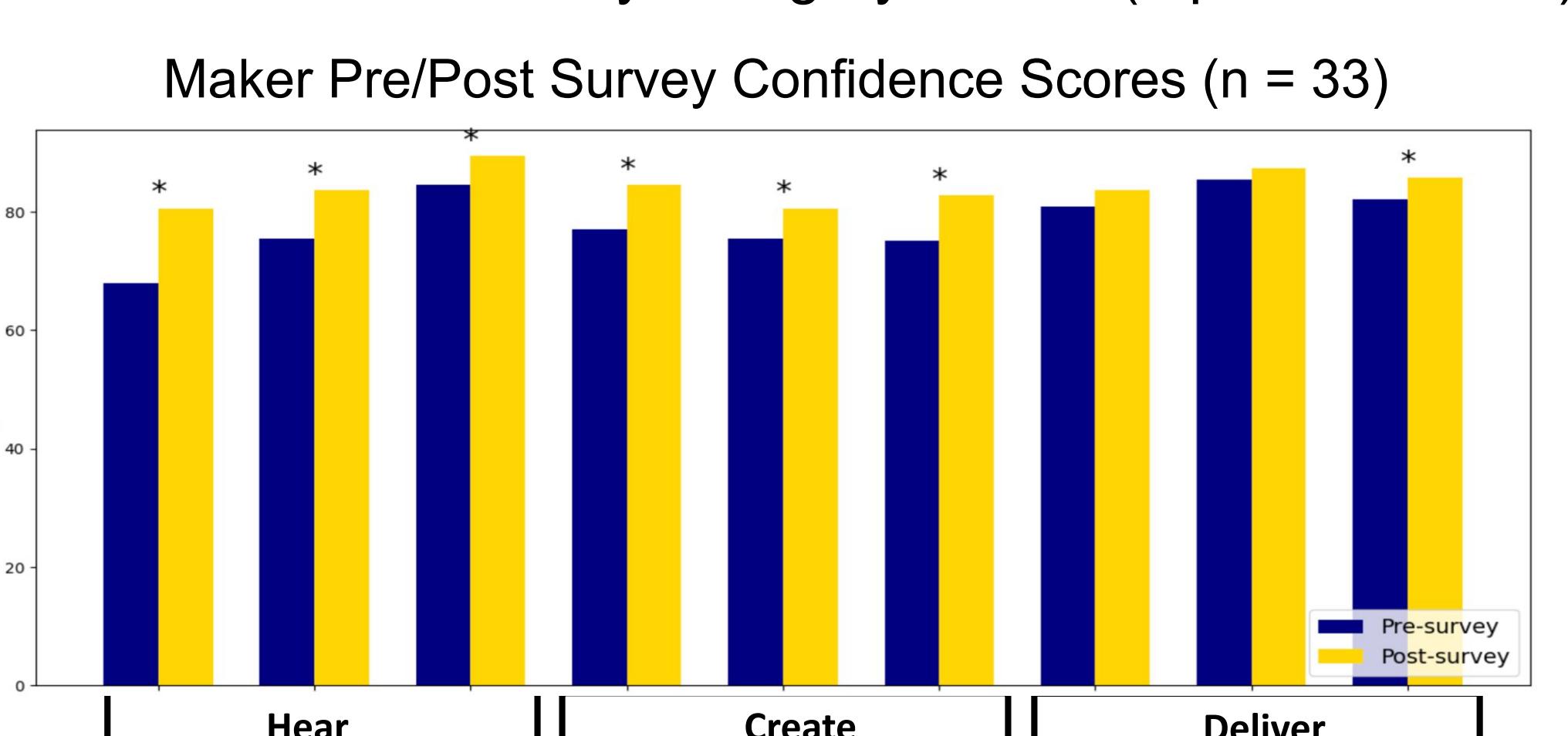


Figure 5. Maker Pre/Post Confidence Scores by Human-Centered Design Phase (100-pt scale). An asterisk (*) denotes a statistically significant paired t-test with $p < 0.05$.

Predictive Model

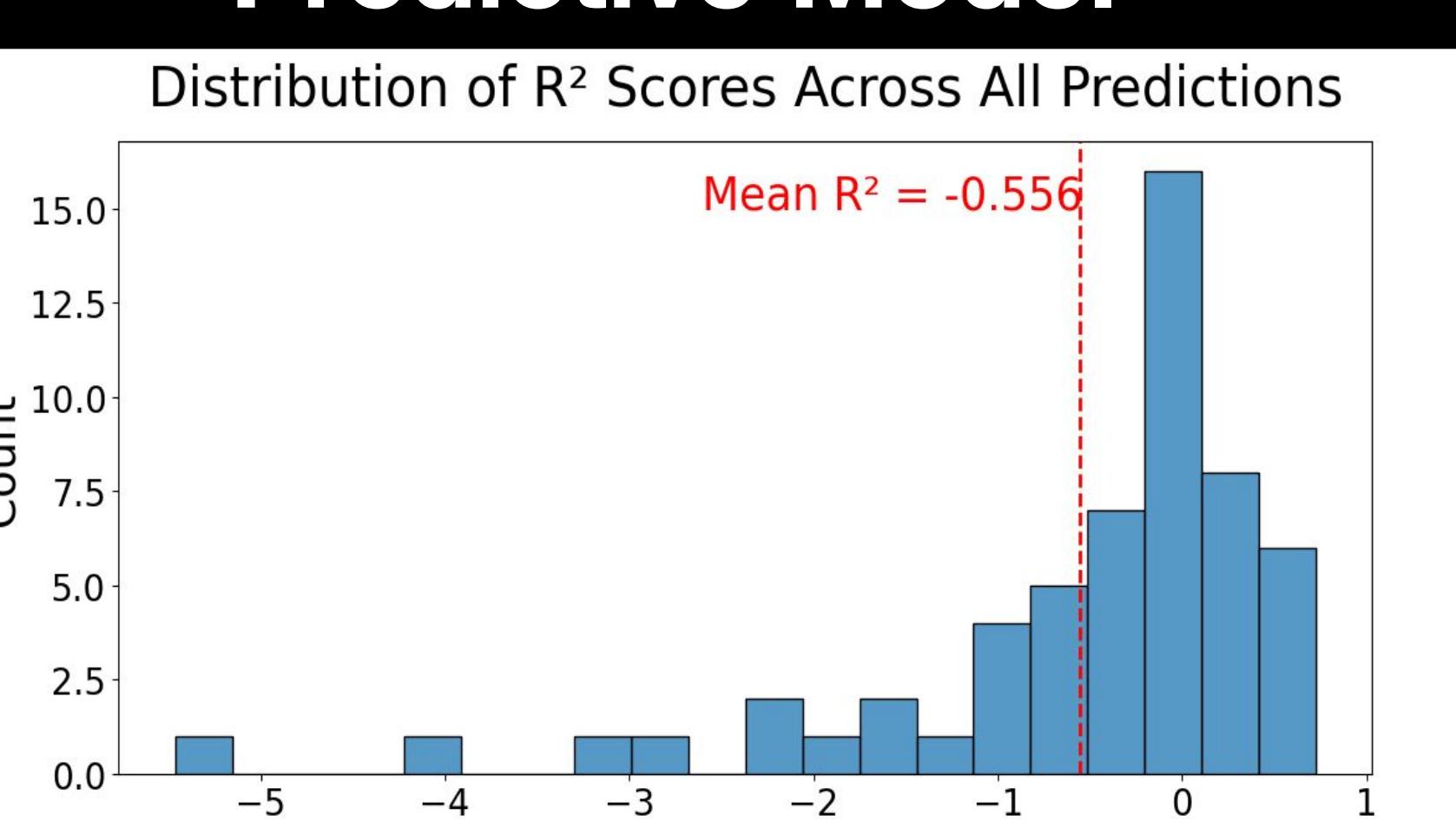


Figure 6. Distribution of R^2 scores across all predictive models.

- We used a random forest regressor with 100 estimators to create a predictive model for student outcomes in the post-survey using pre-survey responses and aggregated engagement data.
- Used mean, max, min and standard deviation for engagement.
- Best R^2 values included 0.72 (community attachment) and 0.57 (ability to solve difficult problems).

Feature Importance Highlights

Pre-Survey Question	Post-Survey Question	Correlation	Interpretation
I have overcome setbacks to conquer important design challenges.	I would like more opportunities to take engineering courses	0.51	Overcoming adversity is important for the students—if they know they can do difficult things, it can improve their engineering identity and enthusiasm.
I can work with tools and use them to assemble and disassemble things.	I can master the content in the engineering-related course I am taking with Ignite	0.72	Using tools helps students to develop a concrete sense of mastery that translates to other engineering work.
I would consider a career related to math.	I feel that I am capable of building prototypes or designing things that help my community	-0.46	Having a bent towards a math career can predispose students against more hands-on work.
I am motivated to solve problems that help my community and the world	I can always manage to solve difficult problems if I try hard enough	0.57	Tying problems to students' communities and the wider world can improve grit.
In the future I would consider getting involved in more STEM opportunities	My STEM education will help me get a good job	0.80	Getting students involved in more STEM opportunities makes them more enthusiastic about future STEM jobs.

Top 5 Most Predictive Features - I have a strong attachment to my community

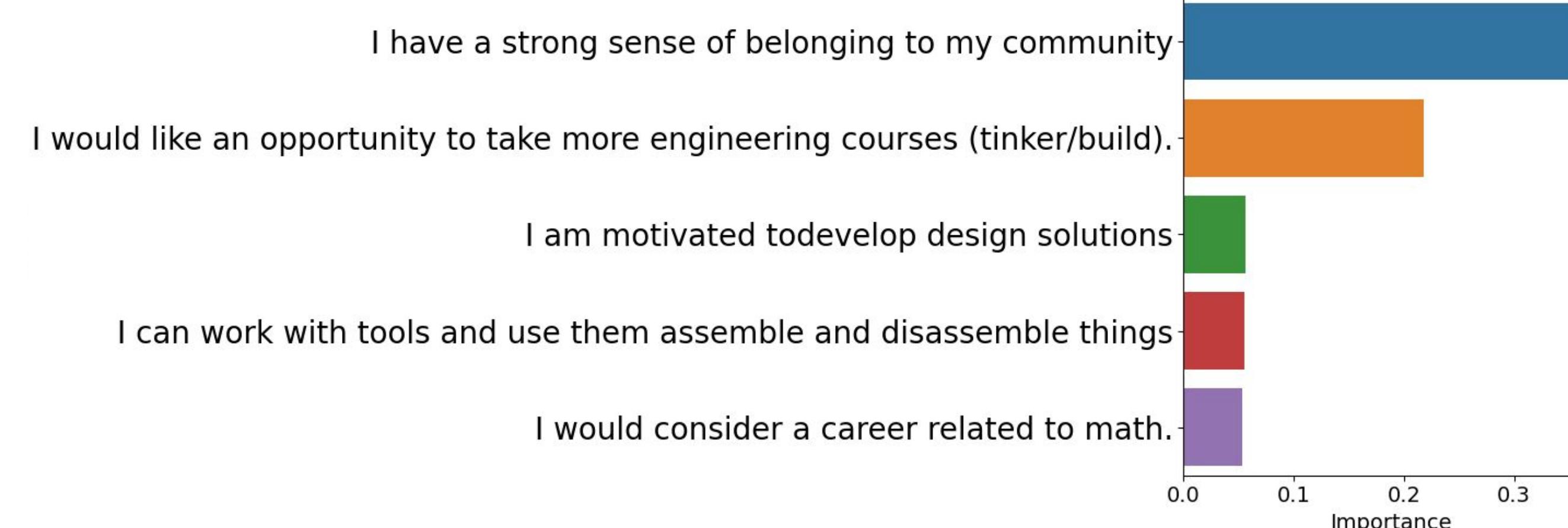


Figure 7. Predictive features for students' community attachment post-survey responses. The 5 most important pre-survey features used by the prediction model are shown here—similar models were made for every outcome metric.

Conclusions

- Ignite affects students from different demographic backgrounds differently; for example, Ignite positively impacted female students' interest in engineering and ability to recognize design needs, while male students saw increases in math confidence and interest in math.
- The 2025 Ignite program positively impacted students' engineering identity, community engagement, and confidence in math and STEM.
- We can predict up to 72.2% of the variance in students' outcomes for each post-program metric using pre-survey and engagement data.

Next Steps

- 2025-2026 Bass Connections Team: Improving Students' STEM Identity Through Design and Tinkering**
 - Implement improvements and collect more data for analysis.
 - Compare to the 2025 data baseline.

Acknowledgements

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