Evaluating the impact of professional science involvement on students at the Marine Academy of Science and Technology at Florida International University (MAST @ FIU)

Bridgette K. Gunn, MPS, MAST @ FIU, Miami, FL
Montana State University, Master of Science in Science Education Program, Bozeman, MT

Introduction

- The demand for professionals in science, technology, engineering, and math (STEM) is expected to increase and have a significant impact on our nation's economy (Obama, 2011)
- STEM education at K – 12 levels plays a critical role in promoting matriculation in post-secondary STEM programs and increases the likelihood of participation beyond college (National Economic Council, 2011)
- Incorporation of community partnerships, interdisciplinary approaches, and collaborative learning opportunities are essential to foster 21st century skills for success within STEM (Eguchi, 2016)
- Osborne, Simon, and Collins (2003) argue that student attitudes influence their behaviors and are a part of cognition
- While conventional teaching methods seldom lend the opportunity for students to participate in relevant, real-world science, citizen science projects offer students the chance to collaborate with professional scientists

Purpose

- The purpose of this research is to evaluate the impact of professional science involvement on student attitudes, academic performance, and STEM retention at MAST@FIU

Table 1. Data Triangulation Matrix

Focus Question: How does professional science involvement impact honors bioscience students?			
1. Student attitudes?	Pretreatment/post--treatment: Professional Science Involvement Impact Instrument to monitor changes in attitudes owed to treatment	Pretreatment/post - treatment: Student Interest Inventory to allow students to self-identify attitudes/ perceptions toward STEM content	Pretreatment/ posttreatment: Teacher field notes
2. Student academic performance?	Pretreatment/post-treatment: Science Concept Quiz to evaluate learning gains owed to treatment	Pretreatment/post-treatment: Student work samples to demonstrate concept application	
3. Retention in STEM-programs?	Pretreatment/post-treatment: Student Interest Inventory to allow students to self-identify STEM career options of interest		

Figure 1. Top to bottom, left to right. NASA scientists, Gioia Massa, presenting at the Fairchild Challenge; the GBE plant atrium; student recording growth conditions; student presenting primary literature on plant cultivars

Methods and Materials

- **Treatment**: Students participated in the 2016-2017 David Fairchild Environmental Challenge, *Challenge 5*, between September to February
  - *Challenge 5*, "Growing Beyond Earth," conjoint citizen science project offered in partnership with NASA
  - 90 day growth trial of tomato and pepper cultivars using a flexible protocol that students could adapt, provided by the Fairchild Challenge
  - Apparatus set-up, maintenance, and breakdown, biometric and plant health monitoring, plant watering and nutrient regimes, and data life cycle management and interpretation were all carried out by students
  - Two original student proposals were submitted at the end of the trial for evaluation by Fairchild and NASA scientists
- **Evaluation**: Students were evaluated before and after participation in treatment using three original instruments designed for use in this action research project:
  - The *Professional Science Involvement Impact Instrument*- 11 Likert items; assessed student attitudes toward professional science involvement
  - The *Student Interest Inventory*- 15 open-ended questions; gauging student interest in STEM careers and learning preferences
  - The *Science Concept Quiz*- four open-ended questions; assessed processed-based skills in experimental design

Results

- *Professional Science Involvement Impact Instrument*-
  - Students believed that they would take projects more seriously if they knew they were a part of professional science and that such opportunities make learning more exciting
  - Students felt instruction would be more meaningful with the opportunity to participate in professional science
- *Student Interest Inventory*-
  - ~ 7% more students were interested in pursuing a STEM career following participation in treatment
  - ~ 14% less students were undecided about their enthusiasm toward STEM posttreatment
- *Science Concept Quiz*-
  - Combined class average (*N=83*) pretreatment was 64.82%, posttreatment 79.64%
  - Wilcoxon Signed-Rank analysis of posttreatment SCC scores at $p \leq 0.01$ were found to be statistically significant

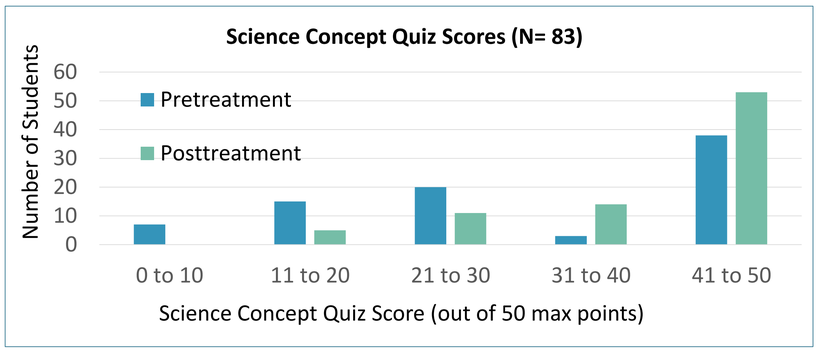

Figure 2. Wilcoxon-Signed Rank analysis yielded a Z value of-5.6925 at a $p \leq 0.01$

Conclusions

- Student academic performance, attitudes, and retention in STEM were all positively influenced by participation in the Fairchild and NASA "Growing Beyond Earth" Challenge.
- Students reported "excitement" and "eagerness" to participate due to the professional science component and many said that they would happily participate again.
- This research best supports the claim that professional science involvement in the classroom can positively influence academic performance, as verified through Wilcoxon-Signed Rank analysis.

References

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Contact

Bridgette K. Gunn
MAST @ FIU's BBC
Email: bridgettekgunn@gmail.com
Phone: 305-546-0198