Eguchi, A. (2016). Students believed that they would take projects more seriously if they combined class average. The four open-ended questions; gauging student interest in STEM careers and learning preferences 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.

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-4 open-ended questions; assessed processed-based skills in experimental design.

Table 1. Data Triangulation Matrix

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

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 ≤ 0.01 were found to be statistically significant.

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

Figure 2. Wilcoxon-Signed Rank analysis yielded a Z value of 5.6925 at a p ≤ 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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