Instructional Resources to Teach Science Concepts While Promoting Careers in Horticulture

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Context

• Limited awareness of horticulture and its diversity of careers (Meyer, 2015)

• 59,700 agriculture sector job openings annually, 35,400 U.S. students will graduate with a B.S. or higher to fill them (Goecker et al., 2015)

• Decline of students enrolled in horticulture baccalaureate programs across US (Dole, 2015)
Introduction

• Our SPECA Project
  • Secondary Education, Two-Year Postsecondary Education, and Agriculture in the K-12 Classroom Challenge Grants Program
  • Creation of web based online instructional units focusing on STEM and encouraging careers in horticulture
    • Science and Technology in Horticulture
    • Hydroponic Food Production
    • Light Quality and Plant Responses
  • Support high school Science and Agriculture teachers
• Assessing teachers’ likelihood to adopt curriculum
• Assessing youths’ understanding and enthusiasm for STEM and careers in horticulture
Project Goals Support National Initiatives

• Supports national initiative *Promoting Horticulture in the United States*
  • *Seed Your Future*
    • ASHS
    • AHS
    • APGA
    • NJHA
    • Longwood Gardens
    • AmericanHort

• Online national survey showed 54% of respondents consider Horticulture Education/Awareness the biggest challenge facing the horticulture industry (Meyer, 2015)
Project Scope

- Survey Agriculture and Science teachers
  - Also surveyed FFA youth who competed in State Floriculture CDE

- Develop content for instructional units
  - Science and Technology in Horticulture
  - Hydroponic Food Production
  - Light Quality and Plant Responses

- Implement pilot testing with a select number of high schools

- Release and promote web-based units for national use

- Follow-up and evaluation
Surveyed User-Groups

• Students (n=30 pre and post)
  ▪ Kansas FFA Floriculture CDE
  ▪ Additional Career Development Activity
  ▪ Toured hydroponic systems at KSU greenhouse

• Educators (n=75)
  • Agriculture Teachers (n=62)
    ▪ Kansas Association of Agricultural Educators Winter Conference
    ▪ Pre-existing interest in horticulture, tasked with teaching agriculture/horticulture concepts
  • Science Teachers (n=13)
    ▪ Kansas Association of Teachers of Science (KATS) Kamp
    ▪ Presented workshop on Hydroponics and Light Quality
    ▪ Not specifically interested in horticulture
    ▪ Queried barriers and incentives to adoption of learning units
<table>
<thead>
<tr>
<th>Statement (n=30)</th>
<th>Pre-Survey Mean&lt;sup&gt;1&lt;/sup&gt;</th>
<th>Post-Survey Mean</th>
<th>Significant Change&lt;sup&gt;2&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interested in career in horticulture</td>
<td>3.47±0.94</td>
<td>3.87±1.01</td>
<td>**</td>
</tr>
<tr>
<td>Understand skills in <strong>mathematics</strong> required</td>
<td>3.73±1.05</td>
<td>4.17±0.91</td>
<td>**</td>
</tr>
<tr>
<td>Interest in <strong>learning mathematics</strong></td>
<td>3.80±1.19</td>
<td>3.83±1.12</td>
<td>NS</td>
</tr>
<tr>
<td>Understand skills in <strong>engineering</strong> required</td>
<td>3.37±0.96</td>
<td>4.37±0.72</td>
<td>***</td>
</tr>
<tr>
<td>Interest in <strong>learning engineering</strong></td>
<td>3.20±1.13</td>
<td>3.53±1.04</td>
<td>NS</td>
</tr>
<tr>
<td>Understand skills in <strong>technology</strong> required</td>
<td>3.77±1.07</td>
<td>4.33±0.80</td>
<td>***</td>
</tr>
<tr>
<td>Interest in <strong>learning technology</strong></td>
<td>3.56±1.14</td>
<td>3.60±1.10</td>
<td>NS</td>
</tr>
</tbody>
</table>

<sup>1</sup> 1=Strongly disagreed, 6=Strongly agreed.  
<sup>2</sup> NS = Not significant;  ** P < 0.01;  *** P < 0.0001
# Teachers’ Interests

<table>
<thead>
<tr>
<th>Statement</th>
<th>Response Mean</th>
<th>Response Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Currently teach...</td>
<td></td>
<td></td>
</tr>
<tr>
<td>...about careers in horticulture</td>
<td>5.03±1.13</td>
<td>3.90±1.14</td>
</tr>
<tr>
<td>Ag Teachers (n=63)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Science Teachers (n=12)</td>
<td>3.10±1.29</td>
<td>2.70±1.49</td>
</tr>
<tr>
<td>Instructional activities most likely to use...</td>
<td></td>
<td></td>
</tr>
<tr>
<td>...Hands-on Activities</td>
<td>5.67±0.54</td>
<td>5.31±0.84</td>
</tr>
<tr>
<td>Ag Teachers</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Science Teachers</td>
<td>5.82±0.40</td>
<td>5.64±0.50</td>
</tr>
</tbody>
</table>

1=Strongly disagreed, 6=Strongly agreed.

• All teachers “somewhat to strongly agreed” that they’d be interested in teaching about the use of drones, artificial intelligence, and robots
### Teacher Comfort Levels

<table>
<thead>
<tr>
<th>Statement</th>
<th>Agriculture Teachers Response Mean(^1) (n=63)</th>
<th>Science Teachers Response Mean (n=12)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Familiar with greenhouse operations</td>
<td>4.52±1.25</td>
<td>3.83±1.47</td>
</tr>
<tr>
<td>Confident about building a hydroponic system</td>
<td>4.15±1.22</td>
<td>4.33±1.56</td>
</tr>
<tr>
<td>Confident about teaching students how to manage nutrient solutions in hydroponic systems</td>
<td>3.87±1.18</td>
<td>3.82±1.66</td>
</tr>
<tr>
<td>Know a few different ways in which color of light affects plant growth</td>
<td>4.00±1.08</td>
<td>4.67±1.30</td>
</tr>
<tr>
<td>Would like to incorporate the use of LED lights into instruction</td>
<td>4.48±0.98</td>
<td>5.17±1.03</td>
</tr>
</tbody>
</table>

\(^1\) 1=Strongly disagreed, 6=Strongly agreed.
Science Teacher Motivators

<table>
<thead>
<tr>
<th>Statement (n=12)</th>
<th>Science and Technology in Horticulture¹</th>
<th>Hydroponic Food Production</th>
<th>Light Quality and Plant Responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>The proposed instructional unit would be innovative and novel</td>
<td>5.18±0.60</td>
<td>5.27±0.65</td>
<td>5.50±0.52</td>
</tr>
<tr>
<td>Easy to adopt</td>
<td>4.40±1.51</td>
<td>4.36±1.50</td>
<td>4.92±1.16</td>
</tr>
<tr>
<td>Fit well with the Next Generation Science Standards</td>
<td>5.18±0.98</td>
<td>5.36±0.67</td>
<td>5.50±0.52</td>
</tr>
<tr>
<td>Relevant to students’ everyday lives</td>
<td>5.55±0.52</td>
<td>5.36±0.67</td>
<td>5.42±0.51</td>
</tr>
</tbody>
</table>

¹ 1=Strongly disagreed, 6=Strongly agreed.

- Science teachers somewhat agreed (4.52±1.25) that they were familiar with careers in horticulture in which the knowledge of STEM concepts is critical
Science Teacher Barriers

• Workshop presentation appeared to increase teachers’ perception of barriers as to whether or not they could adopt this content (pre: $3.88 \pm 0.22$ and post: $4.63 \pm 0.16$; NS)

• Barriers participants listed on surveys include:
  • Space
  • Money
  • Teachers’ time
  • Time needed to get results with plants
  • Equipment
  • Natural light
Conclusion

• Science and agriculture teachers have different:
  • Content knowledge bases
  • Motivators to adopt instructional units
  • Barriers to instructional unit adoption

• Team needs to consider:
  • How youths’ desires to learn technology, math and engineering mesh or don’t mesh with instructional units’ content
  • Differences and similarities among teachers
  • How to thoughtfully and strategically address science teacher barriers to adoption

• Two especially important takeaways:
  • Moving from module or unit design to resources that support standards for science and agriculture teachers
  • Need solid strategy to reduce barriers for science teachers