Effects of informal versus school-based field experience on elementary preservice teachers’ self-efficacy for teaching science

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Greenhouse Project

Background

• Joint venture of the Engineering and Education departments at a mid-sized liberal arts college in south central Pennsylvania

• An internal grant largely funded the building of an automated greenhouse at a local K-8 school in a nearby urban district

• Additional funding was granted by a local non-profit organization

• Two overarching pieces
  • Construction of the greenhouse by senior-level Engineering students
  • Creation of accompanying curriculum by junior & senior-level Education students
Goals of the Greenhouse Project

• Broaden the type of capstone experiences for Engineering students
• Provide training for preservice teachers in the Education department
• Address a pressing social & educational need within a local, urban school district
Dorchester Elementary

- One of eight K-8 schools in nearby urban school district
- Student population
  - 655 students total
  - 90.5% of the students come from low-income families
  - 26.9% are English language learners
  - 24% receive special education services
  - 47.6% Hispanic; 27.6% Black
- Dorchester’s population mirrors that of the district overall
Courtyard prior to greenhouse
Greenhouse construction in progress
Completed greenhouse interior
Engineering Side

• All US based engineering programs accredited by ABET must include a culminating capstone experience.

• Typically, students at our college participate in capstones that are more traditional, focusing on designing and competing an engineered system that may not be connected to solving a human problem (like building a racecar).

• Recent trends push capstones to be more connected to service learning that solves a real life problem.

• Our greenhouse project fell under this project-based serving-learning model.
Education Side

• All students preparing to be elementary educators (grades PK-4) take ECH 330, a science teaching methods course

• Prior to fall 2017, preservice teachers (PSTs) enrolled in ECH 330 completed their field experience hours in mostly informal science settings (libraries, local state park)

• Beginning in fall 2017, all PSTs enrolled in ECH 330 completed their field experience in a formal classroom setting, mostly at Dorchester Elementary

• Initial study set out to compare informal settings to formal settings, using the greenhouse. However, construction delays formed a third group – formal settings without using the greenhouse
  - This study compares Cohort A (informal settings) to Cohort B (formal without the greenhouse)
Existing Literature Says….

• STEM education in the US is lacking
• We should be starting STEM education in elementary schools (but largely are not)
• Many elementary level PSTs have a low self-efficacy for teaching science
  • This is linked to their own anxiety around science/math
• Feelings of low self-efficacy and high anxiety lead to an avoidance of teaching science – which leads to negative feelings among K-8 students, who grow up to avoid science and STEM careers
• To increase self-efficacy, PSTs need positive exposure to science teaching (from teacher educators in methods courses or student teaching)
Research Questions

• Does the type of field experience placement, formal or informal, have an impact on overall self-efficacy for teaching science among elementary preservice teachers?

• Does the type of field experience placement, formal or informal, have an impact on self-efficacy for teaching science among elementary preservice teachers in two sub-categories: Personal Science Teaching Efficacy Belief (PSTE) and Science Teaching Outcome Expectancy (STOE)?

• What role does the type of field experience placement, formal or informal, have on elementary preservice teachers’ perceptions about their self-efficacy for teaching science?
Methods

• Data collection began in Fall 2016 and includes data through Spring 2019
  • Data collection will continue through Spring 2021 and compare Cohort C (formal with the greenhouse) with Cohorts A and B

• Every semester, PSTs enrolled in ECH 330 were asked to complete the STEBI-B at the beginning of the course and again at the end of the course
  • The STEBI-B is a measure of self-efficacy for teaching science in preservice elementary teachers (Bleicher, 2004)

• Alpha-numeric codes were used for anonymity but still allowed for tracking

• STEBI-B pre and post scores were compared using various analyses on SPSS (more on this later)
Methods, cont.

• A random subset of participants every semester was invited to participate in a focus group
• In fall 2017, students were asked to voluntarily submit responses to a set of questions about their field placement
• In fall 2019, some students mentioned Dorchester as part of another assignment and were asked for permission to use their comments
• Focus group transcriptions and written assignments were coded for patterns by the lead author and a student assistant.
## Participants by Semester

<table>
<thead>
<tr>
<th>Semester</th>
<th>STEBI-B $n$</th>
<th>Focus Group $n$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fall 2016 – Cohort A</td>
<td>24</td>
<td>6</td>
</tr>
<tr>
<td>Spring 2017 – Cohort A</td>
<td>15</td>
<td>4</td>
</tr>
<tr>
<td>Fall 2017 – Cohort B</td>
<td>26</td>
<td>6</td>
</tr>
<tr>
<td>Spring 2018 – Cohort B</td>
<td>24</td>
<td>5</td>
</tr>
<tr>
<td>Fall 2018 – Cohort B</td>
<td>9</td>
<td>8</td>
</tr>
<tr>
<td>Spring 2019 – Cohort B</td>
<td>12</td>
<td>5</td>
</tr>
<tr>
<td><strong>TOTAL Cohort A</strong></td>
<td><strong>39</strong></td>
<td><strong>10</strong></td>
</tr>
<tr>
<td><strong>TOTAL Cohort B</strong></td>
<td><strong>71</strong></td>
<td><strong>24</strong></td>
</tr>
<tr>
<td><strong>OVERALL TOTAL</strong></td>
<td><strong>110</strong></td>
<td><strong>34</strong></td>
</tr>
</tbody>
</table>
Question 1: Does the type of field experience placement, formal or informal, have an impact on overall self-efficacy for teaching science among elementary preservice teachers?

• An independent samples *t*-test compared the difference in means of pre- and post STEBI-B results for Cohort A and Cohort B

• *p* value = 0.002, rejecting the null hypothesis
### Average difference in overall means for Cohorts A & B

<table>
<thead>
<tr>
<th>Measure</th>
<th>n</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cohort A</td>
<td>39</td>
<td>0.229</td>
</tr>
<tr>
<td>Cohort B</td>
<td>71</td>
<td>0.402</td>
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</table>

**Independent-sample t-test comparing overall scores for Cohorts A & B**

<table>
<thead>
<tr>
<th>Measure</th>
<th>df</th>
<th>MD</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cohorts A + B Overall Scores</td>
<td>108</td>
<td>-0.174</td>
<td>-3.215</td>
<td>0.002</td>
</tr>
</tbody>
</table>
Question 1: Does the type of field experience placement, formal or informal, have an impact on overall self-efficacy for teaching science among elementary preservice teachers?

• A paired sample t-test compared the collective difference pre and post STEBI-B results for all participants
• Three t-tests were run – overall scores, PSTE, and STOE
• Highly significant differences were found on all 3 (all $p$ value = 0.000) signifying a rejection of the null hypothesis
<table>
<thead>
<tr>
<th>Measure</th>
<th>df</th>
<th>Mean</th>
<th>SD</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall Pre-Post</td>
<td>109</td>
<td>-0.341</td>
<td>0.282</td>
<td>-12.660</td>
<td>.000</td>
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<tr>
<td>PSTE Pre-Post</td>
<td>109</td>
<td>-0.455</td>
<td>0.325</td>
<td>-14.684</td>
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<tr>
<td>STOE Pre-Post</td>
<td>109</td>
<td>-0.173</td>
<td>0.446</td>
<td>-4.076</td>
<td>.000</td>
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</tbody>
</table>

*Paired sample t-test comparison of pre and post-course overall and subscale scores*
Thanks for coming!

Questions can be directed to Nicole Hesson – nhesson@ycp.edu
Completed greenhouse interior
Lab Safety Begins Before You Go to the Lab!

• (Use this space to list two things you should do before going to the lab.)
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• (Use this space to list two things you should do before going to the lab.)
In the Event of a Lab Accident…

• (Use this space to discuss procedures to follow in the event of a lab accident.)
At the End of Your Lab Time…

• (Use this space to discuss what should be done at the end of your lab time.)