Effects of STEM Guest Speaker Sessions on Student Interest in STEM
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Introduction
The most in-demand technical skills in the modern job market are in STEM (science, technology, engineering, and math) (Noonan, 2017; Smithsonian, n.d.). A major reason for the STEM labor shortage is declining student interest in STEM (Kim, 2018). However, common types of STEM education fail to teach passion in addition to content. This research is a case study in Putnam County, Tennessee, of the effectiveness of STEM guest speakers at increasing student interest in STEM and STEM careers.

Benefits of Guest Speakers
Traditional classroom instruction is too standards-focused to foster enthusiasm for STEM, while nontraditional forms of STEM education, such as extracurriculars and field trips, can be exclusive or costly. The literature reveals the following benefits guest speakers bring to students:

- Networking and role modelling (Kamoun & Selim, 2007)
- Exposure to “real-world” applications of content (Kamoun & Selim, 2007)
- Nonroutine teaching style (Leor, 2015)
- Increased confidence in the speaker’s field (Kamoun & Selim, 2007)

Many students are disinterested in STEM due to common misconceptions. Guest speakers can easily dispel (implicitly and explicitly) the following myths:

- STEM is “too hard” (Kim, 2018)
- STEM careers always require higher education (Kim, 2018; Noonan, 2017)
- STEM is not altruistic (Kim, 2018)
- STEM is “boring” (Kennedy, Helferan, & Funk, 2018)

Research Questions
Much previous research has been done on guest speakers in the college classroom, but my research focuses on the Pre-K–12 classroom and examines on benefits to teachers and speakers as well as students. It also judges effectiveness based on interest rather than on academic outcomes. My research questions are as follows:

1. How effective are STEM guest speaker sessions at improving student attitudes toward STEM, STEM careers, and their relation to them?
2. Are teachers and speakers empowered by speaker sessions?
3. Do results depend on demographics: student grade level, school poverty rate, STEM opportunities at the school, or speaker’s area of STEM?

Methodology
All data comes from pre- and post-intervention questionnaires by voluntary response samples of Putnam County teachers (N=8) and area STEM professionals (employees and university students) (N=5). All recruitment materials included a link to a website (Figure 1) that walked participants through the steps of the study and provided teachers with a list of a session. It was participants responsibility to complete all study tasks by the study deadline.

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Limitations
Due to short study duration, only three teachers were able to host a speaker and fill out the post-session survey. No speakers filled out the post-session survey.

The teacher sample is also very homogenous. Seven of the eight – and all three who filled out both surveys – teach grades 2–4 at a high-poverty rural school with no STEM-related clubs or electives.

Due to these limitations, I cannot analyze results based on Demographic items and cannot generalize the results beyond the student and teacher demographics in the study.

Results
Student Attitudes
The following Teacher Questionnaire Student Attitude items show a statistically significant increase (p=0.005) in mean Likert rating from the Pre-Session to Post-Session Teacher Questionnaire:

- The students are interested in STEM as a discipline (p=0.029).
- The students are aware of many STEM careers (p=0.029).
- Many of the students want to enter a STEM career (p=0.019).

The following Student Attitude item shows a significant decrease in mean:

- The students believe stereotypes about STEM (p=0.029).

Teacher and Speaker Empowerment
The Pre-Session Speaker Questionnaire Speaker Attitude questions suggest little room for speaker attitude improvement: all means are above the assumed average of 3. Speakers’ passion for STEM education is also seen in their above-average rating for the following Student Attitude questions:

- Students believe stereotypes about STEM (p=0.0081) and their below-average rating for the following:
  - Students are aware of many STEM careers (p=0.011).

The only evidence for teacher empowerment is the above-average ratings for all Session items.

Discussion and Conclusion
The results of this case study suggest that for students in grades 2–4 at high-poverty rural schools with few STEM opportunities, STEM guest speaker sessions are effective at increasing their interest in STEM and STEM careers. However, the statistically significant improvements in student attitude could result not from students’ improved attitudes, but from the teachers’ noticing students’ interest in the session. Regardless, the results suggest that a greater partnership between the Putnam County School System and passionate area STEM professionals can bolster STEM education by improving student attitudes and empowering teachers. Future studies with larger samples or samples with different demographics are also suggested.

The author would like to acknowledge Dr. Jennifer Meadows for her advisement during this study.

Table 1
<table>
<thead>
<tr>
<th>Question type</th>
<th>Pre-Session</th>
<th>Post-Session</th>
<th>Difference in mean Likert ratings pre-versus post-session</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Student Attitude</td>
<td>Likert questions about student perceptions of STEM, STEM careers, and students’ relation to them.</td>
<td>Teacher: 7–14 Speaker: 6–13</td>
<td>Teacher: 14–20 Speaker: 15–20</td>
<td>The students believe stereotypes about STEM.</td>
</tr>
<tr>
<td>Teacher/Speaker Attitude</td>
<td>Likert questions about teacher and speakers’ relations toward STEM education and their role in it.</td>
<td>Teacher: 4–8 Speaker: 2–7</td>
<td>Teacher: 11–15 Speaker: 9–14</td>
<td>“I believe STEM education is important.”</td>
</tr>
<tr>
<td>Demographic</td>
<td>Student, student’s, and speaker characteristics.</td>
<td>Teacher: 1–3 Speaker: 1</td>
<td>N/A</td>
<td>Depending on demographics, analysis of Likert questions yields different results.</td>
</tr>
<tr>
<td>Session</td>
<td>Likert questions about the quality of the speaking session.</td>
<td>N/A</td>
<td>Teacher: 1–10 Speaker: 1–8</td>
<td>High mean ratings.</td>
</tr>
</tbody>
</table>

Notes: “All mean ratings should increase except ‘Students lack confidence in their STEM abilities’ and ‘Students believe stereotypes about STEM.’”