Engineering Challenges Faced by Elementary Education Majors

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Introduction

It is essential that elementary students are exposed to engineering at an early age to help build a base of knowledge that they can expand on later in their schooling. With the world constantly advancing in terms of technology, Elementary Education (ELED) teachers are not well equipped to teach engineering to elementary students. With this in mind ISU has offered a course, Toying with Technology (TwT), for the past two decades for ELED majors which addresses the issue at hand. The course not only teaches basic engineering but also trains the students in building lesson plans and teaching it to elementary students. The goal of the research is to identify the challenges faced by ELED majors when learning these new concepts.

Research Design

Research Question

What are the challenges encountered by ELED students while learning about engineering in TwT course?

Sample Codebook

Question 2: When you hear the word “engineering,” what do you think of?

Q2T1: Engineering concepts
- Responses which relate to knowledge, skills and applications pertaining to engineering. These include problem solving, inventing, creating, making objects
- “I think about how to make stuff or make new things.”

Sample Matrix

<table>
<thead>
<tr>
<th>Question 2: When you hear the word “engineering,” what do you think of?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q2T1: Engineering concepts</td>
</tr>
<tr>
<td>- science</td>
</tr>
<tr>
<td>- designing, uh, coming up with solutions</td>
</tr>
<tr>
<td>- math</td>
</tr>
<tr>
<td>- how stuff works, making stuff work</td>
</tr>
<tr>
<td>- problem solving and programming</td>
</tr>
</tbody>
</table>

Demographic Information

28 Total Students: 23 Female and 5 Male
5 Focus groups of 5-6 students each

Procedure

Preparation
- IRB Training
- Develop interview questions
- Mock interviews
- Revise interview questions

Pre-interview
- Divide TwT class into focus groups
- Record the interviews

Transcription
- Transcribe interviews
- Organize responses into matrices (example above)

Coding
- Create initial codebook (example above)
- Look at individual responses for each question
- Look for patterns
- Draw connections
- Make predictions

Analysis
- Develop new questions
- Revise previous questions
- Use same focus groups
- Record the audio

Post-interview
- Organize responses into matrices
- Connect responses in mind-map

Conclusion
- Were our predictions supported?
- Impact of course

Share Findings
- Present at Honors Poster Presentation
- Discuss with staff potential changes to TwT

Findings

Lack of basic understanding of engineering concepts
- “This is our first time really doing engineering”
- “I feel uncomfortable when I hear the word”
- “challenging”
- “intimidation”

No experience in design and text-based programming
- “I don’t know what [CADD] means”
- “I haven’t really dealt with any of this type of stuff before”

Inadequacy to teach engineering concepts
- “I did very basic programming and a lot of it was just dragging symbols”
- “definitely how to teach kids like about engineering because most of us don’t have very much experience with it”

The map above shows all responses can be broken into two primary challenges.
- Thinking about engineering negatively can build a mental block for ELED majors
- Insufficient understanding of engineering concepts means ELED majors haven’t had experience with 3D design and/or text-based programming.

Future Directions

- Many non-engineering majors find engineering intimidating, time-consuming, and strenuous. These attitudes and ideas formed before being introduced to the topic makes learning the material difficult.
- Research also showed where students identified strengths: soft skills. The biggest challenges they predicted to face were technical. Ability to code was low due to lack of experience or a negative attitude towards it. They felt uncomfortable with this new material and not confident in teaching it.

Conclusions