Ed+gineering

An Interdisciplinary Partnership Integrating Engineering into Elementary Teacher Preparation Programs

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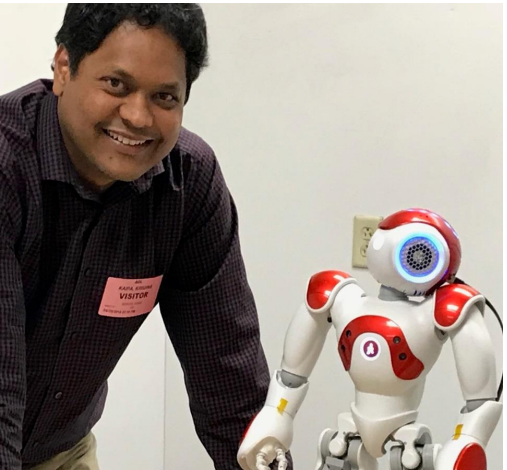

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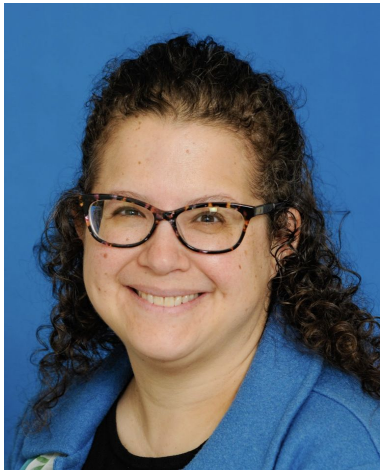

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Challenge: New Nationwide Curricular Demands for Engineering and Computer Science in K-8 Education

- NGSS and Virginia science SOLs call for new emphasis on Engineering education
- In Virginia, Computer Science K-8 (mandatory) standards, including coding, are designed to be integrated into instruction

NEXT GENERATION SCIENCE STANDARDS

SOL Virginia Standards of Learning Program

Despite New Demands…

- Few preservice teachers are exposed to engineering and/or coding in their coursework (Rose, Carter, Brown, & Shumway, 2017)
- Consequently, PSTs lack confidence in these areas (Mesutoglu & Baran, 2020)

Introducing Ed+gineering: a Mutually Beneficial Partnership

EDUCATION

Preservice Teachers Need:

- Exposure to Engineering

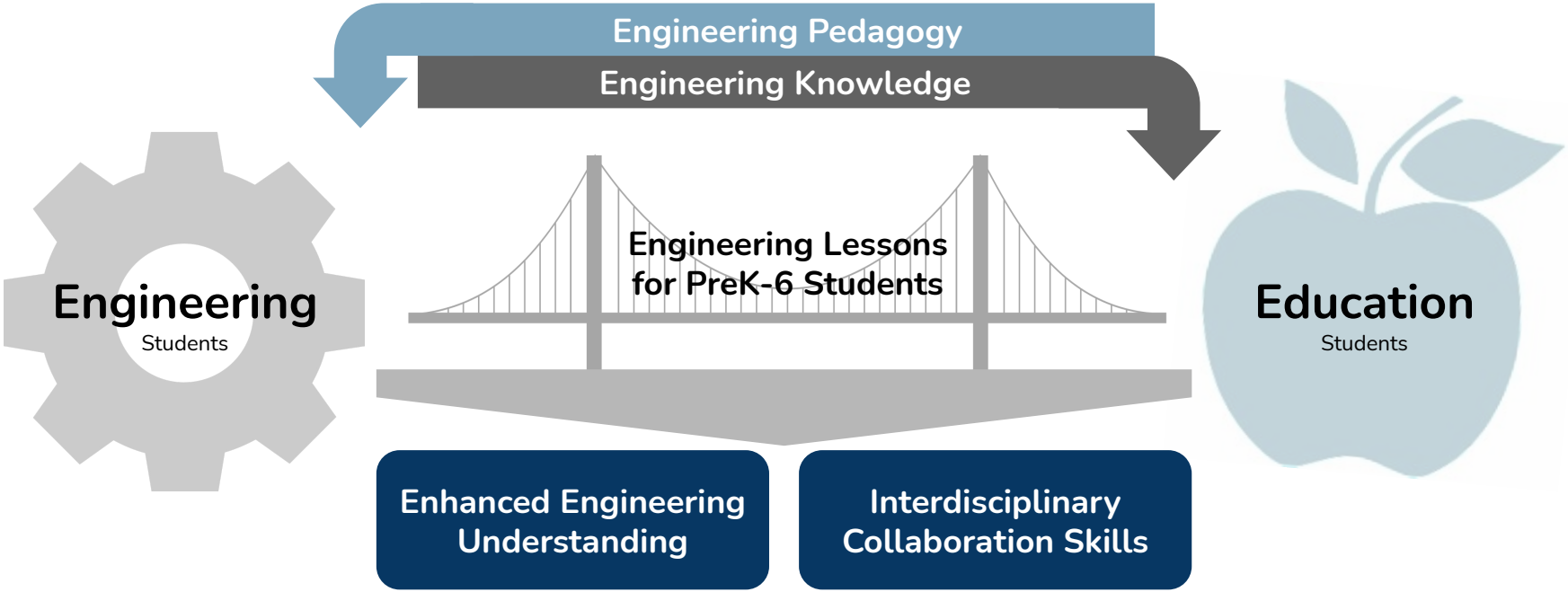
ENGINEERING

Engineering Students Need:

- Experience working in interdisciplinary teams

Cross-disciplinary Collaborative Learning

Education and engineering students learn from and with each other as they develop and deliver engineering lessons for elementary school students



3 (PST + Engr Student) Collaborations

PSTs have three opportunities to partner with engineering students as part of their coursework to teach an engineering lesson to elementary students during their Teacher Preparation Program

Collaboration 1

Educational Foundations
(1st education course)

+

Information Literacy for Engineers
(100 level course)

Collaboration 2

Instructional Technology
(2nd education course)

+

Computing/Electromechanical Systems
(300/400 level courses)

Collaboration 3

PK-6 Science Methods
(middle-level education course)

+

Fluid Dynamics
(300 level course)

Field-trip Model:

4/5th graders visit campus for a 1 hr lesson

After-school Onsite Model

PSTs lead a tech club for 5th graders; Engr Students join the main project, engineering a bio-inspired robot

Field-trip Model:

4/5th graders visit campus for a 1 hr lesson

Project-based Learning

-authentic task
-real audience
-adds value and motivation

Social Constructivism

-cross disciplinary collaboration leads to new perspectives & knowledge

Ed+gineering Model

Education & Engineering students collaborate to teach engineering lessons to elementary students

Service Learning

-enhances persistence for female and minority engineering students

The Ed+gineering model, rooted in constructivism, leverages high impact practices to engage education and engineering students in impactful, memorable learning experiences.

On the next slide, watch a 3-minute video to hear about the project in our students' own voices.

Ed+gineering - Student Voices: (3 mins)

RIGHT CLICK to open in a new tab!

This video is also accessible in Files and on YouTube: https://www.youtube.com/watch?v=eW-ywhJ-CsU&t=4s

How did Ed+gineering Adapt during COVID?

Spring 2020

Collab 1 & 3: Students produced interactive virtual lessons (slideshows) for their 4th/5th grade partners

Collab 2: Students met with their 5th grade partners via Zoom to design and build their robots

On the next slide, watch a 3 min video of Team Dolphin as they collaborated to engineer robotic dolphins that could help combat ocean pollution

Spring 2021

Students taught interactive, hands-on lessons via Zoom to elementary students

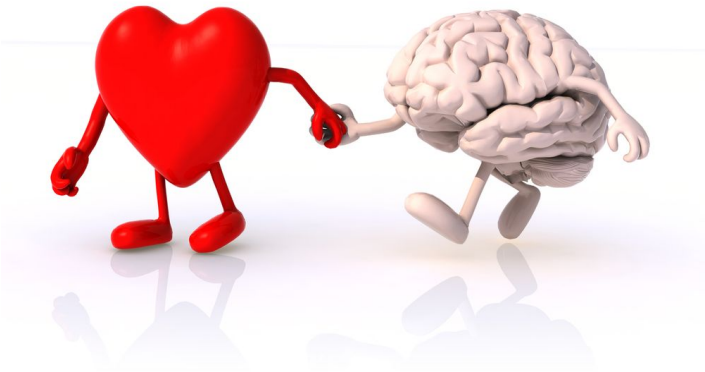
Team Dolphin:
(3 mins)

RIGHT CLICK to open in a new tab!

This video is also accessible Files and on YouTube: https://www.youtube.com/watch?v=CzdAIu5brY0

DRK-12

Research



Changing the hearts and minds of Preservice Teachers

Purpose. The purpose of Ed+gineering is to develop, refine, and evaluate an innovative instructional model to integrate engineering into P-6 teacher preparation.

RQ 1. How does Ed+gineering influence P-6 PSTs' a) knowledge of engineering practices, b) knowledge of engineering pedagogy, c) beliefs about engineering integration, d) self-efficacy for engineering integration, and e) intention to integrate engineering into classroom instruction?

RQ 2. How do P-6 PSTs' knowledge, beliefs, and self-efficacy for engineering integration influence their intention to integrate engineering into their instruction?

RQ3. What are the barriers and enablers of engineering integration in the P-6 context identified by PSTs who did and didn't participate in the intervention?

RQ4: To what extent do Ed+gineering graduates integrate engineering into P-6 instruction in their first year of teaching? What are the barriers and enablers of engineering integration in the P-6 context identified by Ed+gineering graduates?

RQ5: How does the availability of resource and support incentives, including an engineering education workshop, impact Ed+gineering graduates' integration of engineering into P-6 instruction?

Collaboration 1

Ed Foundations + Engr Info Literacy

1hr lesson "field trip" model

Collaboration 2

Ed Tech + Electromechanical Systems

After-school club (5 week project)

Collaboration 3

Science Methods + Engr Fluid Mechanics

1hr lesson "field trip" model

- Knowledge of engineering practices (IUSE)
- Knowledge of engineering pedagogy
- Beliefs about engineering integration
- Self-efficacy for engineering integration

Intention to Integrate Engineering PreK-6 (PSTs)

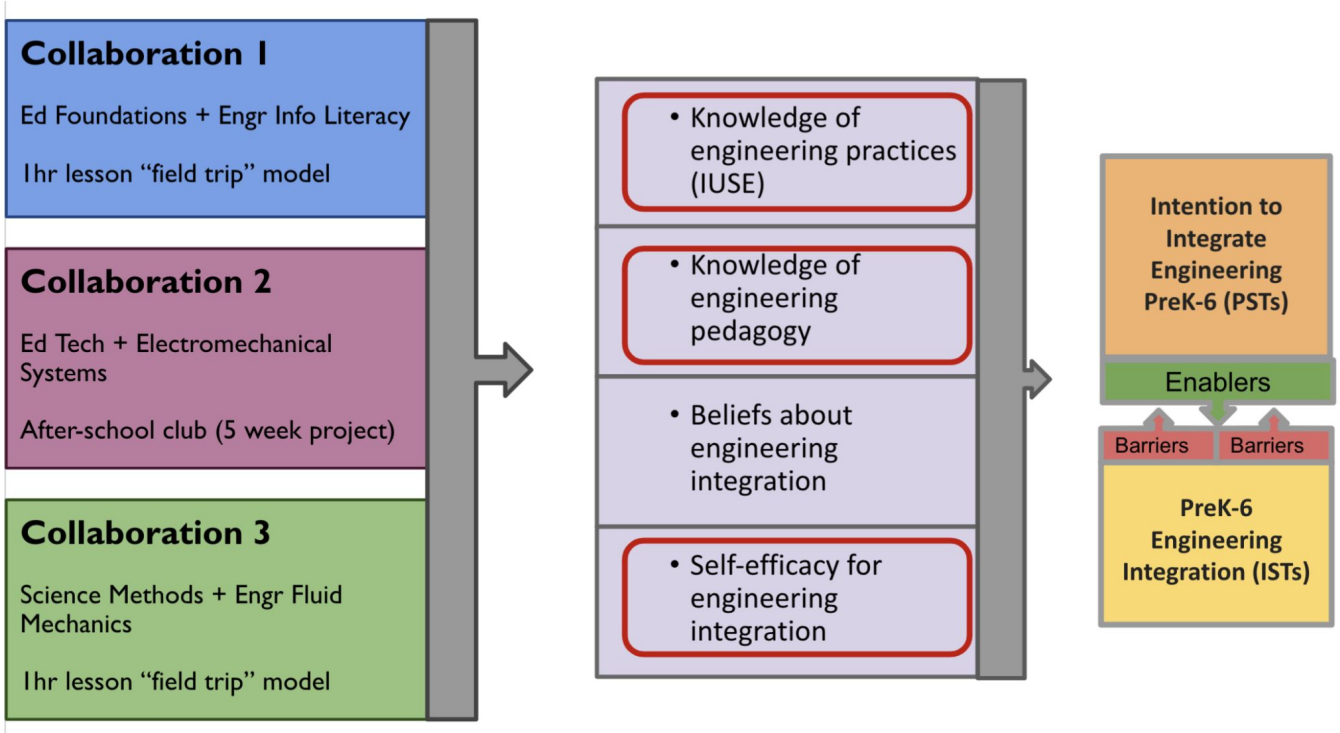
Enablers

Barriers | Barriers

PreK-6 Engineering Integration (ISTs)

Results thus far have focused on RQ1

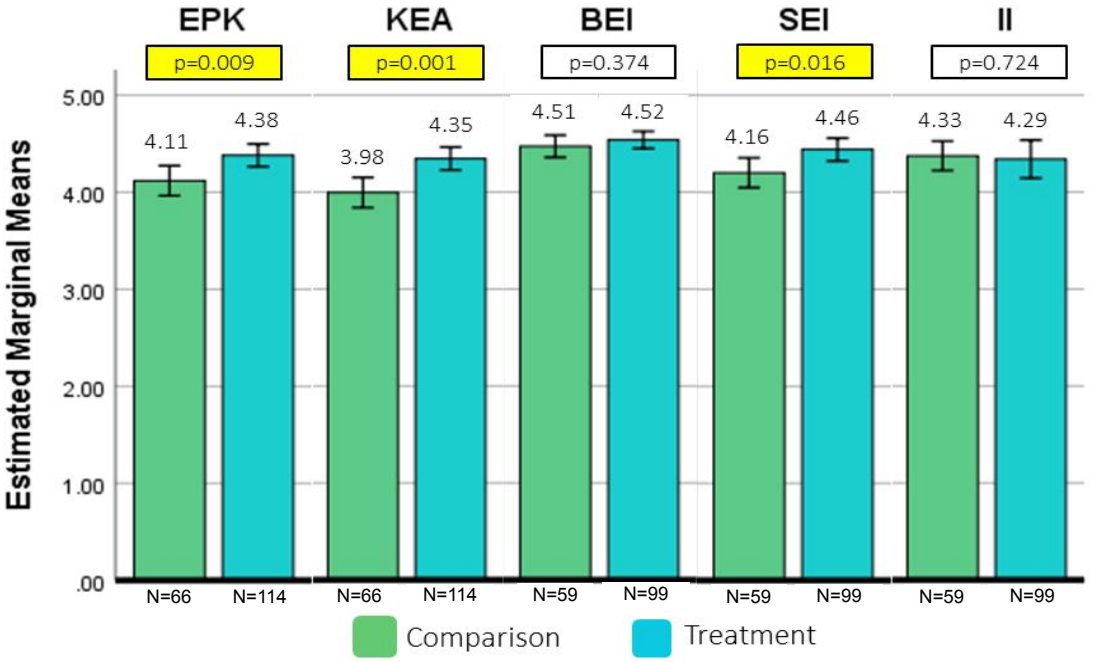
Ed+gineering has had a positive impact on engineering knowledge and self-efficacy



RQ1- How does Ed+gineering influence PSTs:

- **EPK**- Engineering pedagogical knowledge
- **KEA**- knowledge of engineering applications
- **BE**I- Beliefs about engineering integration
- **SEI**- Self efficacy for engineering integration
- **II-** Intention to integrate

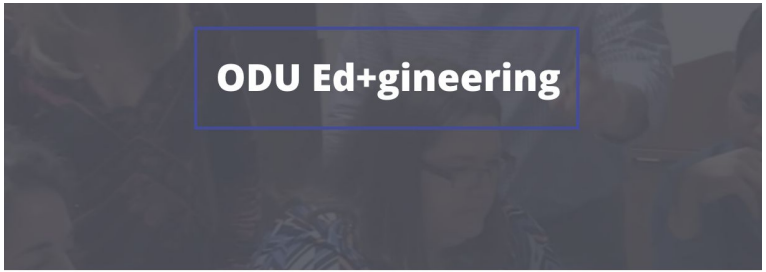
Fall 2019
&
Spring 2020
DATA



Project Summary

Though elementary educators recognize the importance of integrating engineering in their classrooms, many feel challenged and unprepared to teach engineering content. The absence of effective engineering instruction in teacher preparation programs leaves future educators unprepared for this challenge. Ed+gineering is an NSF-funded partnership between education and engineering aimed at increasing preservice teacher (PST) preparation, confidence, and intention to integrate engineering into their teaching. Ed+gineering partners education and engineering students in multidisciplinary teams within the context of their respective university courses. As part of their coursework, the teams plan and deliver culturally responsive engineering lessons to elementary school students under the guidance of one engineering and one education faculty. Our research investigates the impact of Ed+gineering on PSTs' knowledge of engineering practices, engineering pedagogical knowledge, self-efficacy to integrate engineering, and beliefs about engineering integration. The impact of Ed+gineering on participating PSTs was assessed using three collaborations involving students in engineering and education during Fall 2019 and Spring 2020. Preliminary results suggest that the Ed+gineering partnership positively impacted engineering-pedagogical knowledge, knowledge of engineering practices, and self-efficacy for integrating engineering.

If you'd like to learn more, visit our website:

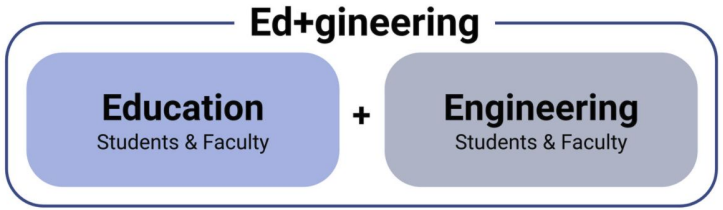


The Origin Story...

"Engineering is so hard. It's for the boys!"

This comment was made to Dr. Stacie Ringleb, Professor of Mechanical and Aerospace Engineering, by a female elementary education student who was babysitting her children. This all too common sentiment made us realize that engineering and education faculty have to work together if we want to broaden participation in engineering. From this distressing remark, Ed+gineering was born.

ODU Ed+gineering is a collaborative partnership between education and engineering students and faculty at Old Dominion University. The project partners more than 500 education and 300 engineering students to teach engineering lessons to over 1,600 elementary school students.



https://www.oduedgineering.com/

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