Adding Local Cultural Relevance to Engineering Exploration Lessons for Middle School Students

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Dr. Holly M. Matusovich is an Associate Professor in the Department of Engineering Education. She is current the Assistant Department Head for Undergraduate Programs and the former Assistant Department Head for Graduate Programs in Virginia Tech's Department of Engineering Education. Dr. Matusovich is recognized for her research and practice related to graduate student mentoring. She won the Hokie Supervisor Spotlight Award in 2014, was nominated for a Graduate Advising Award in 2015, and won the 2018 Graduate Student Mentor Award for the College of Engineering. Dr. Matusovich has graduated 10 doctoral students since starting her research program in Spring 2009. Dr. Matusovich co-hosts the Dissertation Institute, a one-week workshop each summer funded by NSF, to help underrepresented students develop the skills and writing habits to complete doctorate degrees in engineering. Across all of her research avenues, Dr. Matusovich has been a PI/Co-PI on 12 funded research projects including the NSF CAREER Award with her share of funding be ingnearly $2.3 million. She has co-authored 2 book chapters, 21 journal publications and more than 70 conference papers. She has won several Virginia Tech awards including a Dean's Award for Outstanding New Faculty, an Outstanding Teacher Award and a Faculty Fellow Award. She holds a B.S. in Chemical Engineering from Cornell University, an M.S. in Materials Science from the University of Connecticut and a Ph.D. in Engineering Education from Purdue University.

Dr. Cheryl Carrico P.E., Cheryl Carrico Consulting, LLC

Cheryl Carrico is owner of Cheryl Carrico Consulting, LLC. Her current research focus relates to STEM career pathways (K-12 through early career) and conceptual understanding of core engineering principles. She is currently a Member-at-Large for the Pre-college Division of ASEE. Dr. Carrico's consulting company specializes in research, research evaluations, and industry consulting. Dr. Carrico received her B.S. in chemical engineering from Virginia Tech, Masters of Engineering from North Carolina State University, MBA from King University, and PhD in Engineering Education from Virginia Tech. Dr. Carrico is a certified project management professional (PMP) and licensed professional engineer (P.E.).

Ms. Karen J Gilbert, Virginia Tech

Karen J. Gilbert is a Doctoral Candidate in Higher Education Administration within the Department of Higher Education of the College of Liberal Arts and Sciences at Virginia Tech. She is currently serving as a Graduate Research Assistant for Dr. Holly Matusovich, Assistant Department Head of Undergraduate Programs for Engineering Education in the College of Engineering. Karen previously worked as a Graduate Assistant for Dr. Rachel Holloway, Vice Provost for Undergraduate Academic Affairs at Virginia Tech and conducted research related to student success for three years on topics such as mentoring, tutoring, student athlete academic support, internships, student academic centers, and transfer students. Karen was the inaugural Coordinator of the Transfer Student living learning community created to support new transfer students, as part of this graduate assistant role. She holds a B.S. in Business Administration and a Master's in Public Administration from Southern Illinois University at Edwardsville, IL. Karen previously was employed for over twenty years in the career areas of regional planning, economic development, public relations, and community engagement. She worked for Virginia Tech in the College of Engineering and the Center for Student Engagement and Community Partnerships for 11 years. Her research focuses on fostering and sustaining a specific type of cross-sector partnership, campus community partnerships.

Karen's dissertation in progress is on the topic of Leader Perceptions of Campus Community Partnerships in a Community College Setting, focusing on the formation process and the value created.

Adding Local Cultural Relevance to Engineering Exploration Lessons for Middle School Students (Resource Exchange)

Helping middle school students to "see what they can be" based on the culture they are surrounded by is the basis for this small group activity featuring a local interactive approach to instructional design and delivery. This approach was used in a study of rural Appalachian middle school students conducted at a major university in the United States for the purpose of assessing how their conceptions of engineering might be impacted after participating in multiple classroom interventions related specifically to their culture. The study revealed a positive change in the understanding and conception of the field of engineering by students who participated in the culturally relevant classroom interventions. As a basis for this study, ample literature was found to describe middle school students' conceptions of engineering but there was limited available research on the value of relating the field of engineering to a student's local culture.

This session introduces the approach of designing and using classroom engineering exploration activities directly connected to the students' local environment, featuring the types of engineering work performed in the area and local problems related to engineering. An example of an actual lesson will be shared and expanded upon where students explored potential and kinetic energy by designing and building mountain roads out of simple hardware store materials. This activity allowed students to make connections between the roads they built in the classroom and the geography of their local mountainous, rural area. Industry partners participated in this intervention by offering insights from their technical backgrounds and company practices and assisted with the hands-on lessons in the classroom. This was one of six culturally relevant engineering activities provided to 757 sixth-grade students at seven Appalachian middle schools.

After presenting and discussing this sample classroom activity, we will ask participants to **share their experiences** partnering with local business and industry to expose students to STEM fields and careers in K-12 classrooms, as well as what was learned from these experiences for future use. A list of these suggestions will be compiled and shared electronically with all session participants. The session facilitator will offer **key tips for partnering** with business and industry in the classroom. The session facilitator will also provide examples of how partnering with local business and industry can help to **increase diversity** in the K-12 classroom setting. A second example of a classroom activity to promote careers in STEM will be shared if time permits or will be available electronically.

Sample Classroom Activity

Positively impacting culturally relevant conceptions of engineering for young students

The project below is a **sample** for you of a middle school classroom engineering exploration activity that incorporates the students' **local culture** in Appalachia and the types of engineering practices and challenges faced in this region.

TEAM MOUNTAIN ROAD BUILDING PROJECT

After related lessons, students explored **potential and kinetic energy** by designing and building mountain roads out of simple hardware store materials, as displayed. This intervention allowed students to **make connections** between the roads they built in the classroom and how the geography of their local mountainous, rural area affects projects such as road construction.

SAMPLE STUDENT INSTRUCTIONS:

1) You **MUST DRAW** your road first and label the potential and kinetic energy points. If you alter your design during the building of your road, you must alter your drawing to reflect the change.

2) Your road must start at the top of the highest point on the mountains and **AT LEAST** 50% of your road must be on the mountains.
3) Your road must include **AT LEAST 3 TURNS** (a loop around the mountain can count as 2 turns) **AND 1 UPHILL** section.
4) Your vehicle (marble) **must not leave the road or stop** during the drive down the mountain.
5) Your vehicle (marble) **must land safely in the cup** at the end of the road.
6) You may use **UP TO 3 LENGTHS** of road material. You may use the other materials provided responsibly and cooperatively as needed.
7) You will have **30 MINUTES TOTAL** to build your road and a timer to do 10-minute time checks throughout the building. **TAKE TURNS** with the jobs of holding, building, taping, and supply gathering.
8) Place a 1 next to a point in your road where cars will accelerate.
9) Place a 2 next to a point in your road where cars decelerate.
10) Place a 3 next to the point(s) where cars have the greatest potential energy.
11) Place a 4 next to the point(s) where cars have the greatest kinetic energy.

KEY POINT: Industry partners **participated** in this intervention by **offering insights** from their technical backgrounds and company practices and **assisted** with the hands-on lessons in the classroom.

FOR DISCUSSION:

A. What can you share about **your experience partnering with business and industry** in the K-12 classroom to expose students to STEM fields and/or careers in STEM? What did you **learn from the experience**? What would you **do differently** next time?

B. What other **types of information** would help you **design** a culturally relevant classroom lesson to promote careers in STEM?

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