Curriculum Exchange: Integrating STEM with Local Community Needs

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William (Bill) Oakes is the Director of the EPICS Program and one of the founding faculty members of the School of Engineering Education at Purdue University. He has held courtesy appointments in Mechanical, Environmental and Ecological Engineering as well as Curriculum and Instruction in the College of Education. He is a registered professional engineer and on the NSPE board for Professional Engineers in Higher Education. He has been active in ASEE serving in the FPD, CIP and ERM. He is the past chair of the IN/IL section. He is a fellow of the Teaching Academy and listed in the Book of Great Teachers at Purdue University./ He was the first engineering faculty member to receive the national Campus Compact Thomas Ehrlich Faculty Award for Service-Learning. He was a co-recipient of the National Academy of Engineering's Bernard Gordon Prize for Innovation in Engineering and Technology Education and the recipient of the National Society of Professional Engineers' Educational Excellence Award and the ASEE Chester Carlson Award. He is a fellow of the American Society for Engineering Education and the National Society of Professional Engineers.

Mrs. Jean M. Trusedell, EPICS

Jean Trusedell is a Nationally Board Certified Teacher with extensive experience working with K-12 Educators and students. Her current project is working with the EPICS at Purdue University to create curriculum that can be used with students to integrate best classroom practices with engineering design. Previously, she was the Science and Technology Coach for MSD of Decatur Township in Indianapolis, IN. Ms. Trusedell is pursuing a PhD in Curriculum and Instruction with an interest in formative assessment and its relationship to student achievement.

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Grade Level: Middle School and High School

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Abstract: Modern design methods emphasize a human-centered approach where designers must understand the users of a product and those it may impact as well as the design itself. Lessons and activities to teach human-centered design can be developed with materials found in most classrooms without expensive equipment and are an easy way to engage practicing engineers. This interactive and fun session will engage participants in activities used to teach human-centered design through the EPICS design model and introduce teacher participants to the resources available through EPICS.

Curriculum Summary: Integrating engineering practices into service-learning is the focus of the EPICS Program. Its goal is to engage high school and middle school students in the fields of engineering and technology while connecting the critical educational requirements of providing hands-on engineering and technical design opportunities while meeting needs of community members.

Key elements of the program include: teacher professional development; engineering mentors and support; and STEM and computer science content (EPICS Program students apply their knowledge to meet authentic issues that are limiting the quality of life for community members). The EPICS Program has the potential to play a prominent role in addressing many current issues facing today's communities by providing not-for-profit organizations—such as community service agencies, schools, museums, and local government offices—the creation, implementation, and delivery of technology resources needed to improve services.

Session Goal- In this session the participants will be exploring the newly created curriculum that is based on the award winning EPICS College Engineering Program at Purdue University. The EPICS program's Engineering Design Cycle creates a framework for students to empathize with potential stakeholders, determining their needs and create a prototype that would be used as a discussion tool to further determine the needs of the engineering design. The participants would have the opportunity to explore projects created and implemented by high school and middle schools students throughout the country through the use of the curriculum. This will be accomplished through the use of personas and scenarios an essential component of the Engineering Process.

Learning Goals: Teacher participants will experience the use of scenario and persona along with using a prototype as an interactive tool with the potential community partners to develop service-learning projects within their communities.

Session objectives: Through this experience the teacher participants will be able to:

- Identify situations that impact the standard of living in the community by using the prototype as a communication tool.
- Utilize the feedback from the stakeholders to redesign the prototype of the project.
- Explore Scenarios and Personas to personalize stakeholders within the community.

Example Standards related to NGSS and ELA (Science, Technical writing and Mathematics)

ITEEA's Technological Literacy Standards:

- Standard 8: Students will develop an understanding of the attributes of design
- Standard 9: Students will develop an understanding of engineering design

(NGSS) National Generation Science Standards

HS-ETS1-2. Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.

HS-ETS1-3. Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts.
National Standards for ELA related to Science and Technical Writing
ELA/Literacy – SL.11-12.1d- Respond thoughtfully to diverse perspectives; synthesize comments, claims, and evidence made on all sides of an issue; resolve contradictions when possible; and determine what additional information or research is required to deepen the investigation or complete the task.
National Standards related to Mathematics
MP.2 Reason abstractly and quantitatively
MP.4 Model with mathematics

Essential Questions: What are scenarios and personas and how are they used to help my students understand a need within the community? How does the EPICS curriculum give guidance to the engineering process and how could this program be implemented within my school community.

Content Overview- The participants will explore the use of scenarios and personas as a way of personalizing and empathize with stakeholders along with creating and using a prototype as a discussion tool with the potential clients.

Materials- Overview of the EPICS Engineering Design Curriculum, Scenario cards, craft supplies

Time Required- 60 minutes for class session.

Workshop Procedures- Use of Scenario Cards to walkthrough the design process-
This activity is design as a quick overview of the design process from project identification to prototyping and redesign. The participants will select a scenario card that represents current projects in the EPICS Program. In the design process, one of the most difficult pieces is determining a project that would be successful that would: a) meet the needs of a group in the community, b) pique the interest of the students and c) deliver the academic content that will fulfill educational requirements. As the teacher participants are working to create a needs assessment for their community they will explore your community in detail to bring enough information to be able to make a qualified decision about how to proceed with a given project. This activity is used as a preliminary challenge to get the students to understand needs within the community and explore the use of scenarios, personas and prototypes as communication tools.

Teacher Participants will be using the Scenario cards as a way to empathize with their stakeholders and visualize the potential project. The teacher participants will be creating their own personas and scenarios to put a face with the project. The teachers will read through the scenarios, discuss the information that they have been given and sketch out a preliminary design. The teachers will then work to build a solution to the scenario using materials provided and discuss the prototype with a partner and team to determine how effectively the prototype meets the needs of the stakeholder. The teacher participants will then explain the solution to the scenario to the group and how this prototype will meet the needs of the stakeholders.
Reflection- Reflection is an essential part of the educational process not only with students but with instruction. The teachers will reflect using the following questions.

- How would this process help identify potential projects and the critical thinking associated with delivering a possible engineering solution in your community?
- How are the discussions that the prototype facilitates helpful for understanding more about the stakeholder and the situation?

Resources: Additional information and curriculum resources are available www.epicsk12.org and https://engineering.purdue.edu/EPICSHS resource page along with information about how to become an EPICS school and join the network.