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School of Teaching, Learning and Curriculum Studies

College of Education, Health and Human Services

KENT STATE UNIVERSITY

College of Education, Health and Human

Services

DOCTORAL DISSERTATION DEFENSE

of

Karen B. Plaster

For the degree of

Doctor of Philosophy

Curriculum & Instruction

IDENTIFYING HIGH SCHOOL  
MATHEMATICS THAT REFLECTS THE  
ENGINEERING PROFESSION

March 14, 2024

3:30 pm

408 Dean's Conference Room

White Hall

Teams Meeting ID: 284 153 418 116

Passcode: sWgTDp

Karen B. Plaster

M.S., Integrated Mathematics with Licensure (Grades 7-12)  
The University of Akron, 2010

B.S., Industrial & Systems Engineering  
The Ohio State University, 1993

Karen is a Professor of Practice at The University of Akron in the Lebron James Family Foundation School of Education. Her primary area of expertise is working with K-12 pre-service teachers to develop their STEM teaching, with a focus in mathematics and engineering. She has created and taught various instructional courses, including Instructional Design & Assessment, Engineering for Educators, Teaching Math in a Primary Inclusive Setting, and Building Understanding in an Early Childhood Setting. Karen uses a combination of research and current teaching methods to provide hands-on, engaging lessons for her students.

In addition, Karen is a leader of the Urban STEM Center at the University of Akron. Currently, she is working on the Ohio Department of Education Statewide Mathematics and Literacy Tutoring Grant. She will begin work on the Ohio Department of Education Statewide Computer Science Endorsement Grant this summer. Karen has presented at national, state, and local conferences on various topics, including engineering and entrepreneurship, engineering in primary education, and grading with equity in mathematics.

## Identifying High School Mathematics that Reflects the Engineering Profession

This explanatory sequential mixed-method study explores how practicing engineers, engineering professors, and mathematics teachers identify how mathematics is used in engineering. Using engineering problems created by mathematics pre-service teachers, the Engineering Profession in Mathematics (EPM) questionnaire was developed to collect data from 92 participants. Afterward, six questionnaire participants were interviewed, two from each participant category, to gain further detail on responses.

The following research questions guided this study: 1) What high school mathematics prepares students for the engineering profession? 2) How do current engineering problems designed for high school mathematics students compare with the work that engineers perform? 3) What mathematical characteristics (e.g., topics, content, processes) do engineers, engineering professors, and math teachers each identify as relevant to engineering problems? 3a) How do these mathematical characteristics (as identified by engineers, engineering professors, and math teachers as relevant to engineering problems) compare and contrast?

This study provides evidence that the mathematics engineers primarily use are proportional relationships, area and volume, statistics, and functions. Two of the 24 engineering problems were identified as good engineering problems, involved statistics and functions. Finally, after conducting qualitative interviews, five key themes emerged in engineering mathematics problem characteristics: relevance, interest, challenge, engineering attributes, and teaching methods.