

# Department of Industrial Engineering

## Spring 2021 Seminar Series

Friday, March 12<sup>th</sup> 1:25-2:15pm EST via Zoom

Open to the public

Please contact Dr. Emily Tucker (etucke3@clemson.edu) for log-in information

**Speaker:** Dr. Karina Liles

**Affiliation:** Claflin University, Dept. of Mathematics and Computer Science

**Title:** Ms. An (Meeting Students' Academic Needs):  
A Socially Adaptive Robot Tutor for Student Engagement in Math Education



### Abstract:

The goal of this research was to develop a socially adaptive robot tutor to actively engage students in mathematics education. Student engagement influences student motivation and progress in learning. Of the many facets of engagement as it relates to education, we investigated the robot's ability to promote intellectual engagement (representing a student's cognitive advancement while learning) and emotional engagement (representing a student's affective state while learning). To assess our research goal, we explored the following questions: 1) How do students perform academically by studying with a socially adaptive robot tutor? and 2) How do students respond emotionally by studying with a socially adaptive robot tutor?

For this study, we developed Ms. An (Meeting Students' Academic Needs). Ms. An is a NAO humanoid robot that is an ideal platform for delivering education because of its multimodal capabilities such as speech and gesture. Twenty 4th and 5th grade students in rural South Carolina participated in a between subjects study with two conditions: A) with a non-adaptive robot (control group); and B) with a socially adaptive robot (adaptive group). Students engaged in two one-on-one tutoring sessions to practice multiplication per the South Carolina 4th and 5th grade mathematics state standards. The content of the lessons spanned across the different ways in which multiplication can be described (i.e., equal groups, area arrays, and comparison). Students practiced multiplication with Ms. An with problems that included multiplying whole numbers by up to four digits and one digit and multiplying two-digit numbers by two-digit numbers. To ensure record of a wholistic multiplication experience, students solved problems with different combinations of multiplication question and answer types.

We administered pre-/post-tests and documented results throughout the study to evaluate intellectual engagement. To evaluate emotional engagement, we asked students to best describe their emotions (i.e., happy, angry, sad, surprised, neutral) using emojis at the beginning, in the middle, and at the end of each session. From the results of the research study, we found that the socially adaptive robot tutor successfully engaged students both emotionally and academically as they practiced multiplication. Students in the adaptive group had higher significantly different learning gains than students in the control group, and their scores tended to be higher in the subsequent session than the control group. Furthermore, students in the adaptive group showed higher gains for identifying the different ways to represent multiplication problems than those in the control group. Lastly, students showed a slight trend to report happiness in the adaptive condition more than the control condition. Overall, students in both groups mostly exhibited positive emotions. It is likely that we did not see any huge differences between the two groups because of the novelty of the robot for students. The results of this study provided insight in students' interaction with Ms. An and their levels of engagement while learning with the robot. By identifying the factors that contributed to student engagement, we developed preliminary recommendations for the design of a socially adaptive robot tutor for mathematics education.

### **Bio:**

Dr. Karina Liles an assistant professor in the department of Mathematics and Computer Science at Claflin University. Her research interests are robotics, educational robotics, and artificial intelligence. She is also the director of the Social Technologies and Robotics (STAR) Lab. The goal of the lab is to conduct innovative, multidisciplinary research using robotics and other technologies the positively impact at need populations.

Prior to employment at Claflin University, Dr. Liles taught computer science courses at University of South Carolina. She has also worked for Pacific Northwest National Lab (PNNL), AT&T, and Merrill Lynch as a technology analyst. She has worked at Northeastern Technical College as a Research and Statistical Analyst and adjunct professor. Dr. Liles has also served as a Science Technology Engineering and Math (STEM) consultant for K-12 school districts and currently owns a STEM Truck, a mobile STEM classroom that visits rural areas and provides STEM resources to students and educators.