Callie Womble E...: Greetings. My name is Dr. Callie Womble Edwards, and I am the Associate Director of program evaluation and education research at the Friday Institute for Educational Innovation at North Carolina State University. I am one member of a three person research team consisting of Dr. LaTricia Townsend and Dr. Tameshia Ballard Baldwin, both listed on this slide. In this presentation, I will describe our results from a case study we conducted during the 2020-2021 academic year. The title of this presentation is They Become the Lifeline, An Instrumental Case Study of Engineering Design Course Implementation in Rural North Carolina during COVID-19. I have also listed my contact email address on this slide should you wish to contact the team, and there will be more contact information provided at the end of this presentation.

Dr. Townsend, Dr. Baldwin, and myself are all a part of project DeSIRE. DeSIRE is an acronym for Developing STEM Identity in Rural Audiences Through Community-based Engineering Design. DeSIRE is a four-year project funded by the National Science Foundation that began in early 2020. It represents a collaboration between NC State College of Engineering, NC State Friday Institute for Educational Innovation, NC Mathematics and Science Education Network Pre-College Program, Edgecombe County Public School System, Strategic Twin Counties Education Partnership, and local industry partners in the food, pharmaceutical, and energy systems industries, which are the largest employers in the particular region of North Carolina that the project targets.

DeSIRE has several goals. First, our hope is that student participation in the project will increase their knowledge of STEM content as well as their interests in STEM careers. To accomplish our goal, we work with the teachers and principals at two middle schools in Edgecombe County, a rural county in North Carolina, as well as our industry partners to create real world STEM design experiences within the context of advanced manufacturing. In addition, through this program, we hope to increase student awareness of the career opportunities available in STEM in their hometown and beyond. Our goal is to help these rural middle school students begin to see themselves as scientists and engineers, and to consider those as viable career options.

As a part of the DeSIRE program, we will create three STEM focused elective classes for grades six through eight. In these classes, students will learn about STEM and advanced manufacturing in the food, pharmaceutical, and energy systems industries. Students will have the opportunity to use Lego robotics, Raspberry PIs, and Arduinos to design and build simulated manufacturing lines. In doing so, students will apply the engineering design process through hands-on STEM project-based learning. Students will also get a chance to meet and interact with STEM professionals and be mentored by college students in the Minority Engineering Program at NC State. Once we get past COVID and the world opens back up again, we hope to set visits to our industry partners, advanced manufacturing facilities.

As a part of the larger research plan for the project we conducted a case study. Case study approaches enable researchers to examine in depth a program, event,

activity, process, or one or more individuals using a variety of data collection procedures over a sustained period of time. This case study was inspired by the implementation pivots that were necessary due to the unprecedented global health pandemic and staffing turnover among school partners. I will report on findings related to one specific teacher's implementation. We conducted semi-structured virtual interviews and focus groups with the teacher and three project team members who worked closely with the teacher during the pilot year, two professional development coaches, and one STEM program administrator. Interviews and focus groups were conducted via Zoom, which were then recorded, transcribed, and analyzed by the research team.

Three interrelated themes emerged from the data, contextual factors, predispositions, and teacher support. I will discuss each finding in detail now. The first theme, contextual factors, underscores how the rural geographic backdrop of the collaboration provided foundational challenges and opportunities for growth when implementing the design course. Examples of contextual factors include response to the COVID-19 pandemic, access to technology and broadband connectivity, staffing concerns, such as turnover or ability to recruit high credential candidates, and school building infrastructure concerns. As the teacher navigated each of these issues, they altered the method of course delivery, which raised some questions about implementation fidelity. The challenges faced by the teacher led to increased communication between all project partners.

The second theme, predispositions, outlines significant aspects of the teacher's background that uniquely ready them for implementing the design course. Exemplar characteristics include the teacher's preparation, experience, and content knowledge as a former's school level administrator and history teacher. These assets allowed the teacher to be a critical thought partner when identifying ways to respond to unforeseen barriers. It should also be noted that non-cognitive predispositions, such as work ethic, enthusiasm, willingness to collaborate, and ability to be resourceful were all keys to the teacher's success.

The third theme, teacher support, identifies support necessary for teacher growth. Buy-in from school level administrators, content specialists, and professional development coaches, as well as student mentors in the classroom where all paramount to this teacher's growth. Other programs might incorporate similar support structures to assist their teachers with developing and sustaining course efforts.

In conclusion, the following quote from an interview with a STEM program administrator succinctly summarizes the main takeaways from this case study. With rural counties in Northeastern North Carolina, turnovers are high, and it's always challenging. With a person like this teacher, they become the lifeline. They're really the core of our program because their success determines our success. And typically, those type of people, they build. They have the relationships with the parents and the kids, and that really builds the program. Ultimately, the research findings elucidate, how teachers were the core of the implementation process in

the inaugural year of DeSIRE.

We would like to thank the National Science Foundation for their generous financial support of this work. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the authors, and do not necessarily reflect the views of the national science foundation. If you want to learn more or have questions about the case study, please feel free to reach out to me. My contact information is provided here. I have also listed our project website on this slide for you to take a look at as well. On behalf of the entire project DeSIRE team, thank you so much for your time and attention to this presentation.