

Retention Transcript:

Narrator: Solving today's problems requires diverse and creative ideas from a diverse and creative workforce. Women are underrepresented in the engineering workforce and efforts are being made to attract them to the field.

However, that is just the first step; keeping them on a path to success and retaining them in the engineering field often poses a larger challenge.

To increase diversity in the engineering field, it is important to understand what factors sustain young women's interest in the field at every level of education.

The National Science Foundation found that one-third of the students surveyed reported that competition, lack of support and discouraging faculty and peers drove them away from engineering studies. The research also revealed that many students made career choices based on the value they placed on social contributions.

As a result, student retention can improve when the students have the details they need to make informed judgments on how their studies will shape their daily lives in the future.

Susan Metz, Stevens Institute of Technology: I think if you ask students a question: 'how do you think engineering has touched you today?' And just go through from the time they wake up until the time they even get to school, how many points have they crossed where engineers have had an impact? From the alarm clock, from the microwave oven that made their breakfast, from they check their telephone and their cell phone and their text messages, and get on a bus and use the roads and bridges to get to school, and sitting at a desk. So, there's nothing anyone does, we're sitting right here and we can name 50 things that engineers have had an impact on.

Narrator: Students need to see tangible value in what they are learning. Enhancing the learning environment begins with talking about how the skills obtained in math and science show up in everyday life through engineering.

Susan Metz, Stevens Institute of Technology: It's a matter of exciting them, you know even in kindergarten, and possibly some of this is labeling, but you see kindergarteners build with blocks. Well, that's engineering at the kindergarten level. So, it's important to create that excitement and continue that design hands-on kind of activity and not relegate math and science activity to you know a blackboard, paper and formulas. So, the idea of relevance, how often do kids say, 'Why do I have to learn this math, or what good will it ever do me in life?' It's a teacher's role to make those connections.

Narrator: Showing the relevance of academic work to daily life is just the beginning of the learning environment transformation that will keep young women on a pathway to an engineering career.

Studies have shown that any student can fall prey to stereotypes about their abilities. However, concerns are often greater with women of color or those with disabilities. Social stresses may undermine their performance in testing environments.

Pressure to succeed or expectations to fail interfere with young women's motivation and achievement. In these cases, simple encouragement can make all the difference. One success can help overcome stereotypes that suggest persons from a given demographic group will perform less well academically.

Rose Marra, University of Missouri: I just completed a study on engineering self-efficacy. So, the concept of the belief in one's abilities to accomplish studying engineering, and there have been past studies that have showed that those kinds of beliefs about a particular task, and that's what self-efficacy is, can really positively impact one's ability to accomplish that task like, quit smoking or stick to an exercising program. So, we wanted to take a look at how self-efficacy in engineering impacts women engineering students' beliefs and future actions in studying engineering. We've found that it's positively related to their plans to persist, and we've found that longitudinally over a couple years, some aspects of self-efficacy in engineering actually get better and some aspects get worse.

What we're trying to do is take those results and say to faculty, 'these are the kinds of things you can do in your classroom that can positively impact self-efficacy which can in turn help keep these students that we want to keep, studying engineering.' Things about providing great diverse examples of how all different kinds of people can succeed and be an engineer.

Narrator: Cultivating an equitable learning environment is one of the first steps to encouraging women to stay in engineering. But what is an equitable learning environment?

It is characterized by:

- An inclusive climate and visual environment.
- Multicultural curricula and materials.
- Use of outside resources and role models.
- Availability of extracurricular activities to enrich the curriculum and provide multicultural experiences.
- Active outreach to and involvement of parents.
- Recognition of student strengths through academic opportunities, honors, leadership roles and creative options.

Creating an equitable learning environment involves using a variety of instructional strategies to reach different learning styles and backgrounds.

For example, collaborative learning engages groups of students working together to gain understanding or to create a solution. These are integral elements of actually working as an engineer.

Stephanie Adams, Virginia Commonwealth University School of Engineering: Definitely. There's been a tremendous push and increase for students to work together. Because when students graduate and go in the workplace, by and large, they are working with other people. So, the knock that education got from industry was that students didn't know how to work together with other people. They were so used to working in silos or working by themselves that they just had no interpersonal skills for engineering. So, there is this push of trying to incorporate more teaming into the engineering classroom.

Narrator: Contextual learning places problems into a setting students can understand through their experiences.

Experiential learning has students solve problems by actually working through them.

Rose Marra, University of Missouri: Engineering applications can work the same way. You can ask students to build bridges out of toothpicks and then ask them to speculate on which bridge design is going to hold and support more marbles. And again, hypothesize and predict what's going to happen.

Narrator: And, holistic learning uses a mix of activities that help students experience new things, put those experiences into context and work together.

Karen Tonso, Wayne State University: Out-of-school learning is absolutely essential for students to have an appreciation of the world and the way that math and science and engineering principles are in the world. They come from the world, they're not just in the vapor or something, they are really there.

Narrator: Local science centers and children's museums are great teaching resources. There are also engineering awareness events like National Engineers Week and Discover Engineering. Through these activities students and their families can meet professional engineers and see how basic math and science principles translate to real-world engineering applications.

Opportunities outside the classroom can also keep young women on a pathway to engineering. Internships, local chapters of engineering professional societies, research assistantships, and community service activities all provide structured programs where students can explore engineering options.

Socially relevant out-of-classroom work complements lessons learned in the classroom. They also expand young women's perspectives.

Reaching students often requires recognizing their different backgrounds. Tailoring lessons to pique particular interests can aid efforts to retain students.

For example, students in a class near farming operations may be familiar with the large irrigation structures that hover over the fields. That local context can provide practical examples in mechanical and chemical engineering. Educators can highlight the knowledge necessary for the design and operation of irrigation pumps and sprayers, as well as how engineers manage the chemical processes used to ensure the quality of

runoff water. These examples can help capture students' attention by relating engineering to the world around them.

Retention in math, science, and engineering study often depends on developing persistence.

Students who assume responsibility for their learning tend to better develop the diverse skills they need for careers in engineering. Instilling students with a drive to succeed and a desire to achieve greatness produces a sense of self-determination and personal responsibility that can propel them to success.

Karen Tonso, Wayne State University: Teaching is knowing when to get beyond that, to let students work with problems they make up, with issues that just arise. Teaching is just so much more than simply training somebody. Teaching is getting children and youth to depend on themselves, to believe in themselves, to take risks, to be willing to fail because they know the world is not going to come to an end if they do. So, good teachers just know how to do those.

Narrator: Supporting students' goals also offers the opportunity to connect those goals with the work of engineers. Otherwise, students may not see the relevance of preparatory study and lose focus.

Not every student is motivated by the challenge of tough coursework. A high school student might fall off the engineering pathway because she is frustrated with classroom exercises and formal coursework. Scenarios like these give teachers a chance to step in and change the conversation to great effect by using examples that put lessons into practice. Teachers can show how calculus predicts change, how geometry pictures space, or how algebra forecasts variables.

Keeping students on the engineering pathway can require additional support. Sometimes students ask questions about the field educators cannot answer. Or, students might want to hear directly from an engineer about their work.

Mentoring programs can be a great resource for students and educators. While the classroom will always be the center for learning, mentoring can play a critical role in retention of students.

Mentors might seem hard to find, but there are numerous mentoring resources available. The trick to finding mentors is to identify a range of individuals who represent the diversity of the field and the varied career choices available in engineering.

Alumni and engineering faculty from local colleges, as well as engineers from local utilities, manufacturers, or government agencies can be mentors. Mentors need not be female to be effective; but they must be sincere and well informed.

Stephanie Adams, Virginia Commonwealth University School of Engineering: If you're a K-12 teacher, I think there is still a big disconnect between K-12 and universities. Even if you're 45 minutes away from a college campus, you should still go over if you're a high school science or math teacher and get to know the university science and math teachers, and university science and math teachers should get to know the K-12 teachers. Then, you can bring in people who speak the language that you speak or who can help with problems that you have. I think also the same thing with

students. As students leave your high school and they go off to college in a math or science area, invite those students back because you're close in age to the people that you're working with right now.

Narrator: Regardless of approaches used to retain young women in engineering, it is important to define success and set goals.

Benchmarking and setting goals allow educators to track progress and evaluate whether or not an approach is working. Some approaches aimed at improving retention will work for one group of students, but not another.

Assessing efforts allows educators to tailor or refine their efforts to focus on what works.

Assessment might be as simple as reaching out to students for feedback or encouraging students to speak for themselves. These efforts help to create an inclusive atmosphere and healthy learning environment.

Evaluation forms can be effective tools to learn how a class is perceived or to understand what students appreciate in formal or informal settings. One-on-one conversations give students an alternative platform to express themselves. Self-expression supports retention by improving student awareness.

Evaluation and improvement do not begin or end. The ethic of continuous improvement will lead to success for educators and students alike.

Educators have a special role in retaining young women who are interested in math, science, and engineering courses. With educators' help, it becomes easy to see that along the pathway to success, there are many different routes to accomplishing great things in engineering.