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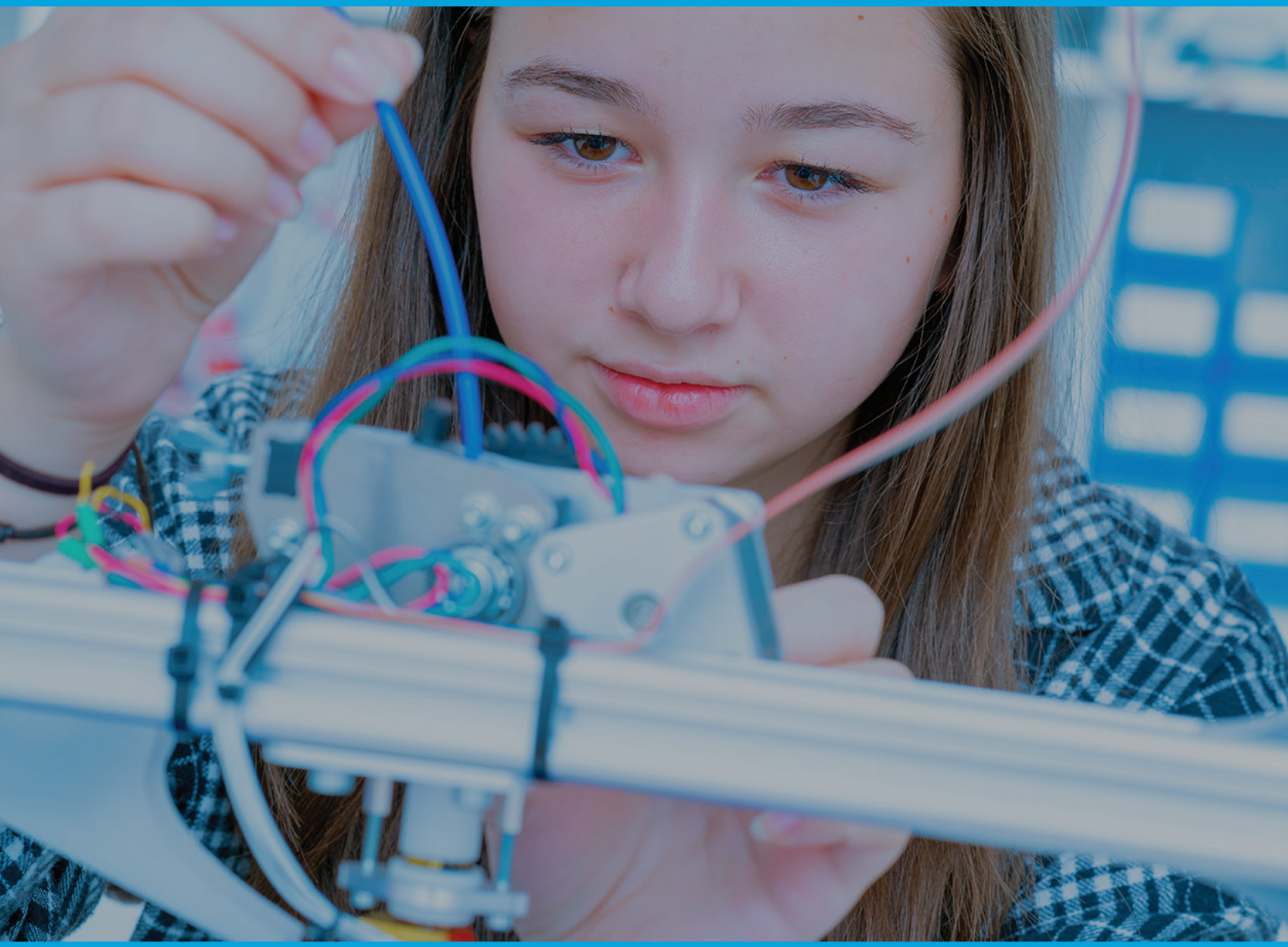

Dr. Cristal Sanchez

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With women and girls making up roughly 50% of the global population, women should be equally represented at the highest levels of education, government and business. You might find it alarming that men far outnumber women engineers, innovators and technologists in their respective fields. Men outnumber women CEOs at an even greater rate. If these are the jobs and skill sets of the future, then this is a dire situation for women. And while the interest in STEM, science, technology, engineering and math has increased over the past 20 years, it's surprising to note that the STEM career gap has also widened.

Before letting a sense of defeat wash over you, know that there's hope for your daughters, sisters and women. I myself am an outlier, as a Hispanic female scientist and technologist in mechanical engineering, and I have found myself asking, why are there so few women in technology and entrepreneurship, and what can we do to start to close the gap of inequality?

I realized that even before girls enter school, and are shown what girls "should" or "shouldn't" do, girls need to learn that they can succeed in these fields. Social cues shape girls' views beginning at a very early age, from gender roles observed at home, cultural iconography, or classroom gender bias. To correct this, and to foster a greater sense of empowerment among girls and young women, I founded VentureLab, an academy that develops project-based technology entrepreneurship programs that prepare K–12 students with 21st century skills.

My passion is teaching and encouraging girls to pursue science, technology, engineering and math—STEM. In this paper I will share my key discoveries for educating and encouraging girls to become STEM industry leaders.

WHERE ARE ALL THE GIRLS?

STEM is losing girls at every stage. Why? What can we do?

"More than ever before, girls are studying and excelling in science and mathematics. Yet the dramatic increase in girls' educational achievements in scientific and mathematical subjects has not been matched by similar increases in the representation of women working as engineers and computing professionals," writes Catherine Hill of the American Association of University Women (AAUW), in *Solving the Equation: The Variables for Women's Success in Engineering and Computing*, a report she co-authored. "Just 12 percent of engineers are women," she writes, "and the number of women in computing has fallen from 35 percent in 1990 to just 26 percent today."

STEM is losing girls at every stage. In elementary school, about 74% of girls are interested in science and math and they excel at these. Often when a girl performs poorly in math she is steered away from it, maybe because her parents, her teachers, or her counsellors have told her that math was not for her. As a result, many girls in their teens lack the confidence to push forward in math and science. They are not encouraged, they lack mentors, and chances are they have never met a woman CEO or a woman in technology. The body language of these girls is hesitant, and when they raise their hand it's with timidity, so they don't get called on to respond. By now there are fewer of them and they don't feel like they belong. By the time we get to high school and college, we find that only 14% of girls are interested in pursuing STEM careers. All around us we see young women who have nurtured an apprehension to standing up and starting up. Meaning, they

are reluctant to raise their hand and speak up in class, as well as lack the confidence to enroll in or continue in STEM courses. Instead of giving girls the confidence to pursue their interests in STEM, girls have been taught to drop out of these subjects.

If we are to close the gap of inequality, we must begin with how and what we teach our daughters. I believe we can make a change. It starts with inspiring girls to stand up and to start up. This is what I set out to do when I founded VentureLab. My main goal in starting VentureLab was to change the reality surrounding females in STEM. After years of teaching at the university level and now teaching K through 12, I have come to identify three keys to building our pipeline of women engineers and innovators!

3 KEYS TO ENGAGING GIRLS IN STEM

Shattering Stereotypes, Redefining Failure & the Entrepreneurial Mindset

1. Break Free From Stereotypes.

First and foremost we need to teach our girls to break free of stereotypes. Girls are set on a certain path when they are given Barbies or when they see mostly boy heroes and science whizzes on cartoons. An antidote to so many of the prevailing images targeted at children—in popular culture, media, cartoons, and fairy tales is working with girls as young as five to teach them about the possibilities that exist for women, and the female heroes and science whizzes in real life. An entire industry has been built around princesses and the princes who rescue them—toys, costumes, posters, decor, and bedroom furniture. But nothing about girls who become self-reliant problem-solvers.

Many fairy tales would have us believe that girls are delicate and sensitive. In *The Princess and the Pea*, the royal princess is disturbed because she can feel a pea beneath her mattress, and her devoted, hapless father piles mattress upon mattress—twenty in all—until his daughter is high in the air. Yet the sensitive princess still feels that annoying pea. Can you imagine tennis superstar Serena Williams being disturbed by a tiny pea? Or Facebook financial chief Sheryl Sandberg? Or Spanx creator Sara Blakely? If they were, you can bet they'd lift the mattress with one hand and flick the pea out of the way with the other hand.

How about counterbalancing the princess stories with a gritty alternative? One of my favorite children's books is *The Paper Bag*

Princess. Instead of being a helpless princess who waits to be rescued by a prince, the Paper Bag Princess fights off a dragon and saves them both, but her finery is scorched and her skin made sooty by the dragon's fiery breath. Being resourceful, the Paper Bag Princess cuts openings in a brown paper bag and wears it. This turns off the prince, who cannot even acknowledge that this resourceful princess had saved his life. But by then she sees him for what he is—a nitpicking, entitled, ungrateful coward—and she goes off happily on her own.

Which story do you like better? Honestly, it's fine with me if someone prefers The Princess and the Pea. It's a beloved classic. You can't but laugh at the situations in it, and my daughter enjoys the tale. But let's balance it with a story that encourages girls to dream of a future in which they can become whatever they put their minds to, a future in which they're gritty, independent and resilient, a future where it's okay to wear a paper bag if you've torn your clothes after having killed a dragon and rescued a prince.

So early stereotypes matter and we as parents and educators have the opportunity to filter these. Studies of the brain show that specific neural pathways are created at early ages and affect the way that children perceive the world. Encourage young children, particularly girls, to be curious, and expose them to stereotypical "boy" activities such as Legos, building models, coding, mechanics and more. Instead of Barbies and princess outfits, give girls toys that require them to use logic and to engage in problem-solving.

Set them up with messy science experiments and tricky puzzles so that they discover how things work.

Girls need to learn—even before they enter school and are shown what girls "should" and "shouldn't" do—that they can succeed in STEM fields.

Social cues, such as gender roles observed at home, cultural iconography seen everywhere around them, or classroom gender bias, all shape girls' views beginning at a very early age.

2. Teach our Girls to Redefine and Embrace Failure

Studies show that many girls self-select out of things that are difficult or risky, because they fear they might fail and won't be perfect.

Let's encourage our girls to get out of their comfort zone and do things that they think are difficult or beyond their reach. If a girl does poorly on a test, or her idea fails, let's teach her to think of failure as a *process*, as a natural part of learning that yields information. Failure means learning what doesn't work. Failures means believing that you have the potential to overcome obstacles. Failure means you persist until you achieve your goals. Let's teach our girls they can have failures without going on to define themselves as failures!

I've designed VentureLab camps to be fun and friendly environments where it's safe for students to try new things, and to fail, but to learn from their failures. We teach girls in particular 3D modeling, creating a website, and the steps involved in building a product based on an an idea. We teach girls to stand up and present themselves and their products in front of people.

In the girl-only classes, the girls are so much more talkative and creative, and speak up more than in the mixed ones. They really get into their projects and are fearless. In many of the coed courses, the boys are more boisterous and the girls tend to be a bit more subdued. I think for young girls, and especially ones who may be shy, the girls-only programs are a more comfortable environment for them to let loose.

The goal is to give girls the confidence to believe that they could do anything, and this pays off as they grow into adulthood. For example, when these girls are in junior high and are exposed to peer pressure, they can look back and say, "Hey, I did 3D modeling or I made a website or sold a product when I was 5 or 7, so there is nothing I can't do!" It is really about giving them this confidence early on, and instilling in them a growth mindset.

Here's the big discovery, after years of teaching at a university level and trying and failing to get girls into tech and entrepreneurship I found that the secret is to teach young girls to think like entrepreneurs.

3. Teach Girls to be Entrepreneurs

In an entrepreneurial classroom, STEAM learning, which includes art in addition to science, technology, engineering and math, feels like hard-working, joyous play, creating possibilities for thousands of sparks. Entrepreneurial learning amps up all of the other elements of STEAM.

For these reasons, STEAM needs a new letter—an "e" for entrepreneurial skills. eSTEAM (pronounced "esteem") encompasses success as learning, developing and testing new ideas, solving problems creatively and collaboratively, persevering through setbacks, building grit, gaining deep knowledge, and—most especially for girls—developing confidence. It is less about filling in the correct bubbles on a standardized test, and more about developing students who could write a better test.

Any way you come at the problem of women underrepresented in eSTEAM, the solution involves starting young.

Among the higher echelons of corporate management or in capital markets, when it comes time to raising money for women-led companies, women face further obstacles because the whole ecosystem accommodates the male design and way of looking at things. This is despite women driving the majority of consumer purchases. Many subtle barriers still exist for women entrepreneurs, and women entrepreneurs (and girls who want to

become entrepreneurs) don't have a lot of women to speak with about their goals.

As a result, it's essential to get the entrepreneurial pipeline going, starting with kindergartners. You have to plant the entrepreneurial spark in kindergarten through sixth grade, you have to show these young girls your passion. Middle school is a real problem for girls because they find that it's suddenly no longer cool to be a nerd or a geek, or even to be smart. There's so much pressure on girls to be submissive that it's disheartening. At a very young age girls need the confidence and awareness and support to be self-directed so that they have the strength and tenacity going forward to make it through the bumpy waters. If you show little girls that technology and science are so much *fun*, and that there is so much *opportunity* for them, then they can get to the other side of what society prescribes for them and arrive at incredible STEAM careers.

If we want more women innovators and CEOs then we need to teach girls to observe the opportunities that arise and to anticipate their needs. We need to teach them to innovate and to create and to take calculated risks. No girl is too young to learn these skills.

I once asked a 5-year-old student of mine if she had any problems around her. She replied that she always got in trouble for eating her Play-Doh. So we brainstormed and came up with the idea of edible Play-Doh. The thinking behind this, of course, was that

if you made Play-Doh out of food you wouldn't get in trouble for eating it. This little girl and some of the other students in her class actually did market research, and surveyed other students about their favorite flavor and favorite color. They came up with chocolate chip and pink strawberry. We helped the girls make their Play-Doh and create a website where they put up their pricing online. They came up with the name Tasty-Doh. At the end of the class these girls pitched their product and plan to an audience and each of the girls left with $20. These were 5-year-olds who otherwise would have been watching TV shows with boy superheroes and science whizzes rather than becoming science whizzes and entrepreneurs themselves.

What I see is that entrepreneurship for girls brings science and technology to life.

THE VENTURELAB DIFFERENCE

Our unique eSTEAM framework connects with girls.

What makes VentureLab different from other entrepreneurial programs is that our STEM curriculum is based on the eSTEAM framework. eSTEAM, as I mentioned before, is like STEM, but better. It includes Entrepreneurship, Science, Technology, Engineering, Arts and Mathematics. eSTEAM emphasizes entrepreneurship and arts, in addition to STEM education.

We recognize that having a strong foundation in the arts enables young people to become more creative, motivated and focused. Arts programs have also been found to improve students' ability to work in teams and to think critically. Research shows that excelling in the arts often correlates with greater success within the other disciplines. True innovation and discovery happen at this intersection of multiple disciplines. In addition, the eSTEAM framework introduces STEM concepts in a way that makes them more fun and relatable to younger audiences.

Our current education systems are great at teaching concepts like those necessary for STEM fields. But we don't teach kids how to apply their learning.

It is great to know and understand technology, but it is also important to know how to apply it in the real world, by creating products or services that will benefit society. Students need to know how to observe needs and create their opportunities. Even artists, or doctors, or lawyers may start their own gallery or practice and should understand basic entrepreneurial principles.

The unique VentureLab classes and programs allow girls to take what they learn in their classes and apply them to real-world problems or needs that they see. By learning entrepreneurial skills, girls gain the ability to shape and realize their future.

With an entrepreneurial mindset, girls have a competitive advantage which is the key to survival in our current world economy.

SKILLS FOR THE FUTURE

Why girls need to learn and excel in STEM.

Entrepreneurship changes lives, and diversity is good for business. As Catherine Hill of AAUW concluded in her co-authored report, *Solving the Equation*, "the representation of women in engineering and computing matters. Diversity in the workforce contributes to creativity, productivity, and innovation. Everyone's experiences should inform and guide the direction of engineering and technical innovation. In less than 10 years, the United States will need 1.7 million more engineers and computing professionals. We simply can't afford to ignore the perspectives or the talent of half the population."

VentureLab's approach to entrepreneurship, tech, and innovation develops collaborative, project-based curricula to prepare K-12 students with the skills they need to excel in 21st century careers. With programs that focus on topics like film production, 3D printing, robotics, and the basics of launching a startup, the primary goal of VentureLab is essentially to create next generation innovators and entrepreneurs through education, mentorship, and inspiration.

CONCLUSION

Investing in your daughter's entrepreneurial education is a smart strategy for equipping her for future successes. There are few far better ways to empower girls than investing in their education. It's not enough today for girls to be educated in the traditional education system. Girls must be engaged and encouraged through entrepreneurial frameworks to develop a growth mindset. From growth comes confidence and self-awareness that a girl can excel at eSTEAM and anything she puts her mind to!

About the Author

Luz Cristal Glangchai, Ph.D., is a scientist, entrepreneur, and mentor with a passion for teaching and engaging girls in technology and entrepreneurship. She has been featured in the Wall Street Journal, the TODAY Show, NPR's The TakeAway, and Mashable. She is the Founder/CEO of VentureLab, an academy that develops project-based technology entrepreneurship programs that prepare K-12 students with 21st century skills. Dr. Sanchez's innovative curriculum boasts 60% female participation, with three student companies having raised $240K in funding. Previously, she was the director of the Center for Entrepreneurship and Innovation at Trinity University. Prior to joining Trinity, Dr. Glangchai managed the Idea to Product Program at UT Austin, and was the founder of NANOTaxi, a drug-delivery company that developed disease-responsive nanoparticles to target tumor tissues. She holds a Ph.D. in biomedical engineering from UT Austin, as well as doctoral certificates in Cellular and Molecular Imaging for Diagnostics and Therapeutics, and in Nanoscience and Nanotechnology. She holds an M.S. in biomedical engineering, a B.S. in Mechanical Engineering and a B.A. in the Plan II Honors Program from UT Austin.