

# ICT Educator Webinar Series

Exploring the ICT Disciplines:  
Which ICT Career is for You?

November 8, 2019

# Table of Contents

Welcome .....	4
An Introduction .....	6
Overview .....	7
Defining the Problem.....	8
Professional Differences.....	9
Advanced Placement Differences.....	10
Bachelor’s Degree Differences.....	11
Underrepresented Population Differences.....	12
Women’s Attitudes about STEM.....	13
Defining Computer Science.....	15
Math is a 4-Letter Word .....	16
Computer Science is Only One of the Computing Disciplines.....	17
What is Computer Science? .....	18
Information Systems.....	19
Information Technology .....	20
Computer Engineering .....	21
Software Engineering .....	22
Mixed Disciplinary Majors.....	24
Cybersecurity .....	25
Data Science/Data Analytics.....	26
Not About Math! .....	27

The Solution ..... 28

- 1. Think Beyond Computer Science ..... 28
- 2. Tackle Gender Issues in the Classroom ..... 29
- 3. Inform and Encourage Counselors ..... 30
- 5 Things Companies Can Do to Attract Diverse Talent ..... 32
- 5 Things Colleges Can Do to Attract Diverse Students ..... 32
- 3 Things You Can Do to Keep Diverse Students in Computing ..... 33

Wrap Up ..... 35

Additional Resources ..... 41

[00:00:00]

## Welcome

**STEVE WRIGHT:** Well, good morning, everybody. I'm Steve Wright. I'm the Statewide Director for the ICT Sector Team, and if you get a chance to visit our website, you can see our Regional Directors and our support team, which includes Nicole Sherman, who is the producer of this weekly ICT webinar series every Friday at 10:00—except, well, we have a couple of days we're not going to have it because of the calendar... It doesn't work well for the academic world.

We started this series because, originally, we used to give big conferences and spend a lot of money doing all that. We just thought, "Well, let's really optimize this whole video conferencing capability here and see if we can do a good job bringing people state-of-the-art information that they would get at a conference, but make it every Friday at 10:00." And we've done that—I think it really helps. People do need to register in advance and then get your little reminder call.

### Posted Webinars

#### Top IT/Cybersecurity Webinars of 2019

- Cloudification of the IT Model Curriculum
- Cisco Update: A New Streamlined Certification Program
- Choosing the Right Cyber Activities for Your Campus
- Completing a 4-Year Degree in Cybersecurity Through the CA Community Colleges
- Cybersecurity Dual Enrollment Pathway at Cypress College
- Digital Credentials in the California Community Colleges
- NETLAB+ User Group: Capture the Flag Competitions, Summer Camps & More
- Promoting Community College Programs Through Cyber Competitions

**STEVE WRIGHT:** We've had some really great webinars. Some of the ones that have gotten a lot of attention so far in the past year: Cloudification of the IT Model Curriculum, the Cisco update was

a big one with people from all over the western United States attending that one, Choosing the Right Cyber Activities for Your Campus, 4-Year degree articulation we have with various private colleges right now in IT. These are just some of them, and there are a lot more on our website.

Each and every single one of these is recorded, chapterized by video, completely transcribed, and all the relevant materials that were presented referred to during the webinar are on our website for you to find and use—and hopefully, efficiently. We get a lot of people that like to go back and use our stuff afterwards.

### Upcoming Webinars

- **November 15** – BIW Dual Enrollment at Cerro Coso College
- **December 13** – Virtual Labs Update: Practice Labs

**STEVE WRIGHT:** Coming up in the next two, we have the Business Information Worker Dual Enrollment at Cerro Coso College, and then we'll have a Virtual Labs update by Practice Labs on December 13. We're working on a lot of new titles for the new year, and any ideas that you guys have out there that you would like to see or hear more about, or if you think there's something really special happening in ICT, go ahead and let us know.

### Webinar Presenter



#### **DR. MARKUS GEISLER**

Markus Geissler, PhD currently serves as the Regional Director, Industry Engagement for Information & Communication Technologies and Digital Media (ICT/DM) for the Greater Sacramento Region where he coordinates regional efforts, including the development of educational pathways and education-industry partnerships, on behalf of the California Community Colleges to help build the number of qualified professionals in the ICT and DM sectors.

Having served the students of Cosumnes River College in Sacramento, CA as a Professor of Computer Information Science since 1998, Dr. Geissler continues to enjoy teaching transfer-oriented and career education courses in Information Technology. He enjoys creating educational media to enhance student learning in his courses.

**STEVE WRIGHT:** This week, we'll be focusing on exploring ICT disciplines. Now, for those of you out there, ICT does include Business Information Worker and Digital Media and Entertainment, but in this particular case, we're talking more about the IT, Computer Science, Cloud, and Cybersecurity realm of ICT.

And with that, let us welcome Dr. Markus Geissler to share his screen and take us through a talk that he's been giving for a while and has decided to share it with us. Take it away, Markus!

## **An Introduction**

- Professor
- Regional Director, Employer Engagement, Information & Communication Technologies/Digital Media, Greater Sacramento Region
- Chair, C-ID Information Technology/Information Systems Faculty Discipline Review Group
- Member, ACM Committee for Computing Education in Community Colleges (CCECC)

[00:02:44]

**DR. MARKUS GEISSLER:** All right, thank you very much. Good morning, everyone. I look forward to sharing with you some things I've been very passionate about, and I've been passionate about ICT for about 22 years. As you can see, I am not only the Regional Director for Employer Engagement for Information & Communication Technologies and Digital Media for the Greater Sacramento Region, but I've also been a professor of Computer Information Science at Cosumnes River College in beautiful Sacramento for the last 23 years.

So, I do know my way around the various disciplines. In addition to that, I have been serving as the Chair for the C-ID Information Technology and Information Systems Faculty Discipline Review Group, so any of you who submitted courses towards the IT/IS descriptors, I have seen the curriculum that you have submitted and passed it on to some of our core evaluators.

I also was appointed about 3 years ago to be a member of the ACM, the Association for Computing Machinery's Committee for Computer Education in Community Colleges, and the primary goal of that committee is to build curriculum guidance for the various disciplines in Information Technology, Computer Science, anything around ICT.

So, that is the expertise that I bring to the table, and regarding Steve's comments about the balance, this is balance that you're going to get with my mug because I think that the information I'm going to be presenting to you is more important than my smiling face.

## Overview

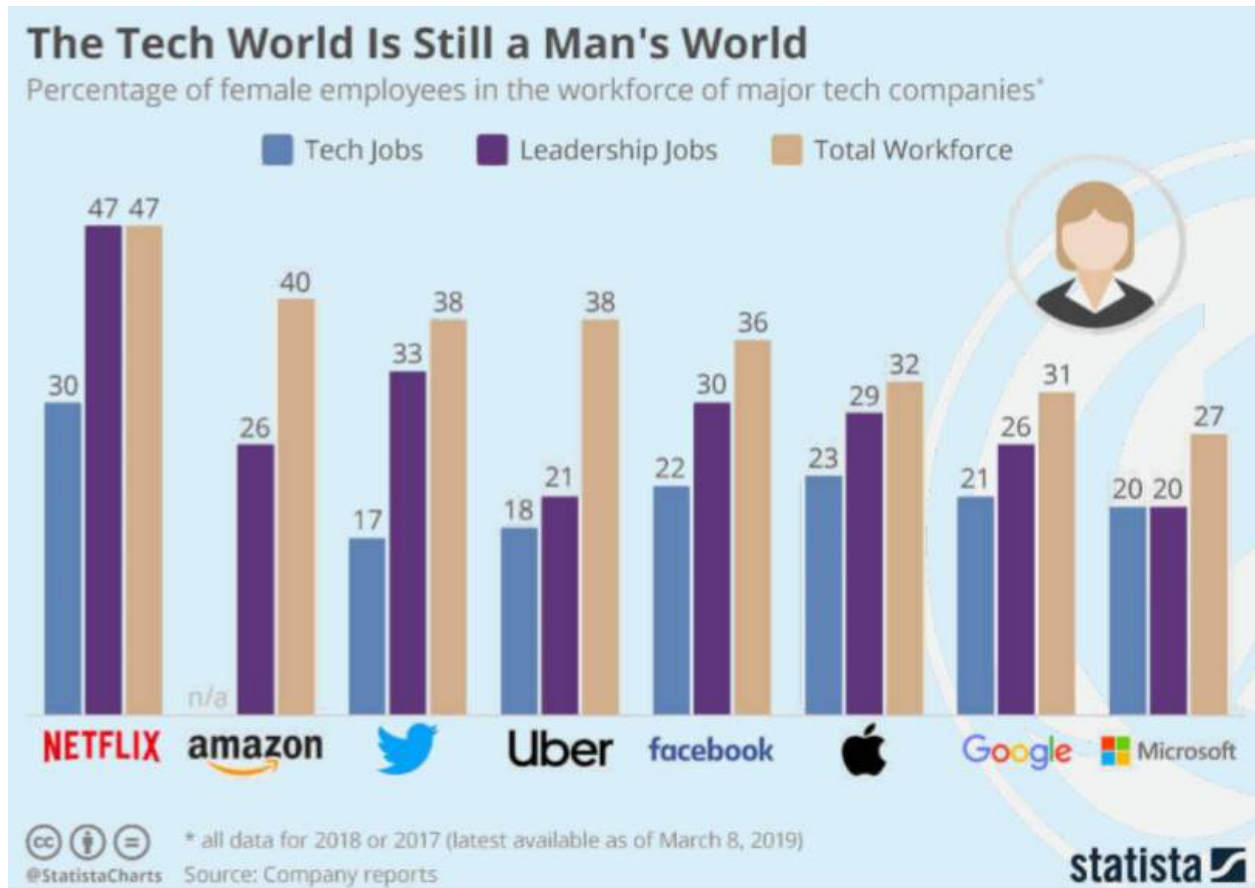
- Defining the problem
  - ICT workforce characteristics
- Defining the ICT disciplines
- For many students Math is a four-letter word.
- You ~~can should~~ *need* to be part of the solution.
  - And so do your Counselor colleagues!

[00:04:30]

**DR. MARKUS GEISLER:** So, let's talk about the problem, and that's what we're going to do initially. 'Computer Science' is just too easy—we'll call it that. We understand it's around computers, and it's science, but there's more than that, so we need to take a look at some of the other IT disciplines that are out. We also need to address our customers on the student side, for many of whom math is a four-letter word—which, in fact, it is—and we'll give you some ways in which you need to be part of the solution. If there are any counselors watching right now, this is very much also aimed at you and some of the treasure chest of knowledge you can impart upon your students, so I hope this will be of use to you as we go.

[00:05:26]

## Defining the Problem



**DR. MARKUS GEISLER:** Now, let's define the problem. It's relatively obvious that, in the tech world, it's still a man's world. For the percentage of women workers that we're seeing here, that is lower in many, many of these companies than it could be.

Now, are we ever going to reach paradise where we've got the same number of women in the field? I don't know. I don't think so, and maybe we don't need to, but we certainly need more women than we have because the expertise that they bring and the approaches that they bring to the ICT sector make the sector better, and if we don't have a lot of women in the sector, we are going to be at a disadvantage as our sector serves all the other sectors of which we are a part.



As we discussed just before things got live here this morning, there are IT workers in all sectors, and I believe the number that Steve mentioned was 85% of all ICT workers don't work in the ICT sectors—they work in other sectors across. So, what we're not doing by not producing a lot of graduates in the ICT sectors for women is we're not enabling the rest of those other sectors to perform at their optimum level, in my opinion.

## *But what about the other (non-Tech) companies that employ Computing professionals?*



- National Center for Women & Information Technology (NCWIT)
- Lots of great materials for faculty and administrators at [www.ncwit.org](http://www.ncwit.org)

**DR. MARKUS GEISSLER:** Much of the information that I'll be presenting here for the first five or ten minutes or so comes from the National Center for Woman & Information Technology, also known as NCWIT, and they do have a lot of great materials for faculty, for administrators, and for counselors at NCWIT.org, and as you're looking at that slide, let me take it apart and let's guide us through what some of the issues are within our field.

### **Professional Differences**

- Percent of **professional occupations** in the 2018 U.S. workforce held by women
- Percent of **professional Computing occupations** in the 2018 U.S. workforce held by women
- Percent of Fortune 500 **Chief Information Officer (CIO)** positions held by women in 2018

[00:07:31]

**DR. MARKUS GEISSLER:** Let's talk about professional differences, and I've got some statistics for you, some of which you might go, "OK, this is pretty good," some of which, in my opinion, is scary and certainly worthy of improvement.

So, let's talk about the percentage of professional occupations held by women in the U.S. workforce in 2018. That number, you would be positively surprised, is 57%.

Now, let's move that into the computing world, and the number is going to be lower, you would think, and you'll be right, but by how much lower? If you actually take a look at that number, it's 26%. 26% of folks in professional computing occupations are women. That number is too low for a couple of reasons. First of all, we don't have a lot of folks within our field to fill the positions that are available, and again, the contributions that women make by the way that oftentimes they think differently are invaluable and, at this point in time, not achieved because we don't have enough of them within our field.

Now, let's talk about leadership, and that number, as you might expect, is even lower with only 20% of the Fortune 500 CIOs being women in 2018.

### **Advanced Placement Differences**

- Percent of **Advanced Placement (AP)** test-takers in 2018 who were female
- Percent of **AP Calculus** test-takers in 2018 who were female
- Percent of **AP Computer Science** test-takers in 2018 who were female

[00:09:03]

**DR. MARKUS GEISSLER:** Now, how do we get people there, or how do we not get people there? Let's take a look at where it's almost too late to start in high school, but those are the best numbers that we have to see how some of those tendencies are leading to some of the shortages we're experiencing.

The number of AP test-takers—this is all AP exams—in 2018 who were female is 56%. Yes, there are more women (or girls) taking AP exams than men (or boys in high school). So, that's a great start, you would think, but then let's take a look at calculus.

You would think that number would be substantially lower, and frankly, it's not. If you take a look at AP Calculus test-takers in 2018, 47% of those were female. Now, some of the underrepresented populations, that's a different story—I'll get there in just a second—but when it comes to gender distribution, we're actually relatively even.

Now, let's translate that to Computer Science. This is, by the way, not just the actual Computer Science exam but also things like Computer Science Principles. That number drops to 28%, and that is, again, one of the reasons that we are not able to continue to have women within our collegiate programs and then within our industry.

### **Bachelor's Degree Differences**

- Percent of 2017 **bachelor's degree recipients** who were women
- Percent of 2017 **Computer and Information Sciences** bachelor's degree recipients who were women
- Percent of 2017 Computer Science bachelor's degree recipients at **PhD-granting universities** who were women
- Percent of **1985 Computer Science** bachelor's degree recipients who were women

[00:10:44]

**DR. MARKUS GEISLER:** Bachelor's degrees! Of course, you know 'bachelor's' is such a male-oriented term, but let's go with that for a second. This is all, again, information from NCWIT and some of their sources. In 2017, the bachelor's degree recipients who were women was 57%—more women get bachelor's degrees than men.

In the Computer and Information Sciences, which is what we're dealing with, what do you think that percentage was? Scarily, that percentage is 19%. Only 19% are women who have baccalaureate degrees in Computer and Information Sciences.

At PhD-granting institutions, that number doesn't change—it's still 19%—and in 1985, way back when, what do you think the number was of Computer Science bachelor's degree recipients who were women? That number was 37%. Notice how we have cut that almost in half between 1985 and 2017. That means we can do better. We've obviously done better, but that's where we are at this point in time, compared to where we've been.

## **Underrepresented Population Differences**

- Percent of **Computing** workforce who were women in 2018
- Percent of Computing workforce who were **African-American women** in 2018
- Percent of Computing workforce who were **Asian women** in 2018
- Percent of Computing workforce who were **Hispanic women** in 2018

[00:12:03]

**DR. MARKUS GEISLER:** One more slide with statistics, again, from NCWIT, and let's talk about underrepresented populations.

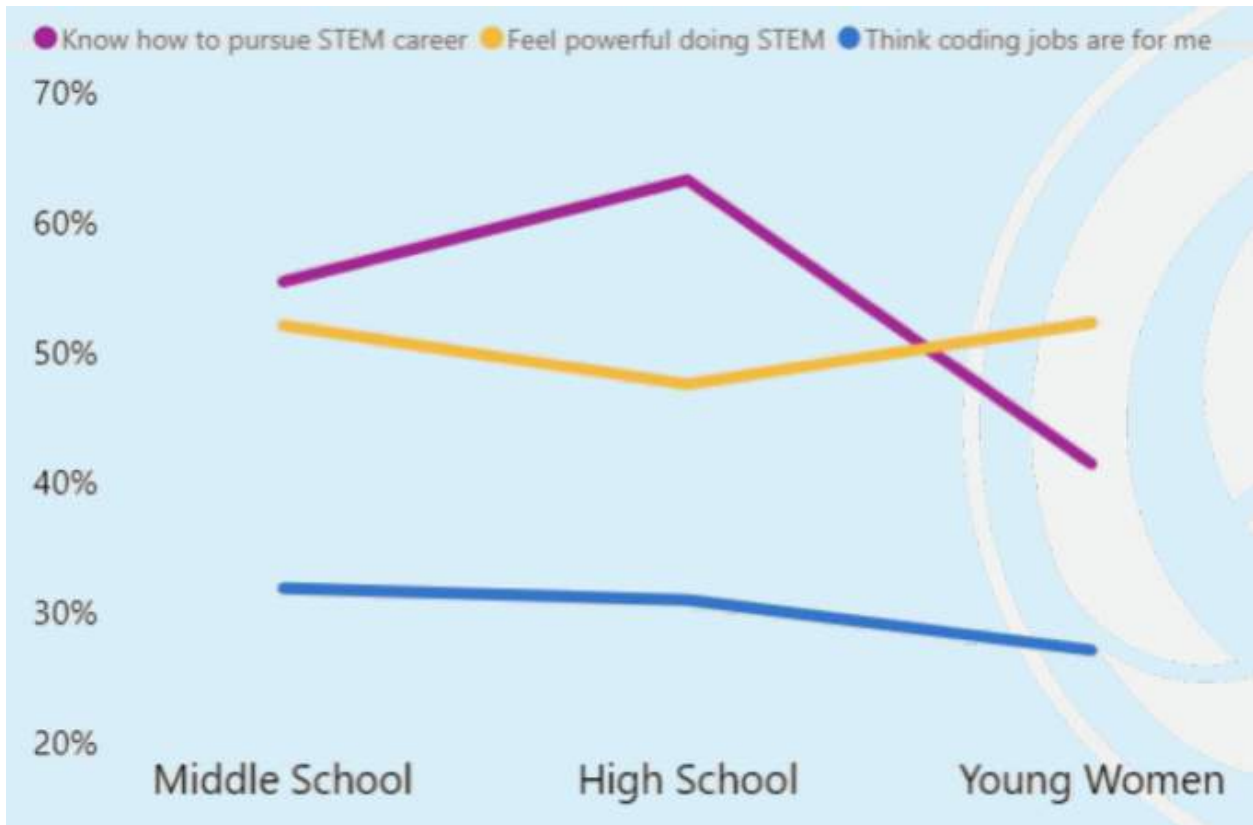
Computing workforce who were women in 2018. We've looked at that, and that was at 26% rate—again, very low.

African American women is a scary 3%.

Asian women, even though Asian race is very much well represented within the technology fields, when it comes to women, we've got a very low 6%.

And I'm not sure about you, but I am very happy to have seen the number of Latino students go up in my classes over the last 20 years, and that's great to see. However, we're not reaching the women at this point in time quite yet, with a measly 2% of the Computing workforce.

## Women's Attitudes about STEM



[00:13:04]

**DR. MARKUS GEISSLER:** So, what happens? Why aren't we doing this? Let's take a look at some attitudes about STEM (Science, Technology, Engineering, and Math). They asked women:

- Whether or not they knew how to pursue a STEM career—that is the fuchsia line
- Whether or not they feel powerful doing STEM—that is the yellow line
- Whether or not they think coding jobs are for them—that is the blue line

It's interesting how, in high school, women understand how to pursue a STEM career, and that during or after high school, that number drops as it does, relatively rapidly. When it comes to being enabled and empowered to do STEM, we're staying relatively consistent, and when it comes to coding, we're doing something along the way to cause young women to think less positively about coding jobs or coding in general. I think I may have a couple of answers to why that is.

So, that defines the problem as to what the situation is currently holding for women and underrepresented minorities, and this presentation certainly isn't all about women and underrepresented minorities, but what is about is how we can get more people into the ICT field. To me, these populations are the first place where we should look, but there are other reasons. Let's move on to those.

[00:14:51]

## Defining Computer Science

- Overarching term used to identify Computing-related disciplines
- Good news
  - One clear term is used to identify all Computing-related efforts!
- Bad news
  - Computer Science is only one of several Computing-related disciplines
- Students often don't hear about Information Technology, Information Systems, etc. until after they finish high school.

**DR. MARKUS GEISSLER:** Computer Science... Now, a disclaimer—I personally do not hold any Computer Science degrees. My associate degree is in French and Spanish. My bachelor's degree is a Business Administration degree with a concentration in MIS (or Management Information Systems—we'll get there). I have an MBA, which really should have been called a techno-MBA, except they didn't call those that in the early 1990s—it was a bit early. And my PhD is in Organization and Management with a specialization in E-Business.

So, I've always gone more pragmatically at technology, so I'm not a traditional Computer Scientist, and that might explain some of my bias, but I've worked with the various disciplines for long enough where I understand what Computer Science does, what it is, where it's good, and where it's bad. So, let's talk about that good and that bad.

First of all, it's an overarching term. If you are talking to kids in high school who are interested in technology, the first term that they will be faced with is Computer Science. And it's easy, right? We're dealing with computers, and it's science. From a political perspective, we can justify that, maybe for the college-going crowd, it's not so much CTE (or Career and Technology Education for those of you who may not be familiar with the educational terminology).

So, it works—the good news is we can identify the Computing-related efforts with the term ‘Computer Science’, so we’ve got things like CS for All or Computer Science Education Week. All that makes sense, and I consider that good news.

The bad news, however, is that a lot of young people, apparently, don’t think beyond ‘Computer Science’ and that they believe that it’s the only discipline that’s out there, and they don’t understand that there are other disciplines that may meet their needs that may be more interesting to them and for which they may be better qualified. So, the good news is we can call it ‘Computer Science’. The bad news is, if that’s all we call it, then we’re not addressing many of the other disciplines that are out there.

### **Math is a 4-Letter Word**

- Computer Science, Software Engineering, and Computer Engineering transfer programs typically require multiple semesters of Calculus.
  - Many CS departments use Calculus to teach Logic.
    - Students need to understand Logic, but most CS and SE graduates will never use Calculus on the job!
- Many high school graduates are NOT Calculus ready.
  - Their (logical!) conclusion: Computing careers are not for me! 😞

[00:17:15]

**DR. MARKUS GEISLER:** Why is Computer Science potentially not a good thing to do? One, because to many students, math is a 4-letter word, and when we’re dealing with transfer programs of Computer Science, Software Engineering, and Computer Engineering, those do require multiple semesters of Calculus.

Why Calculus? Of course, it’s computing, and we came from the Math department, and we still, to this point, use Calculus to teach Logic. It’s tradition, it’s been done that way, and students certainly need to understand Logic. But that said, most Computer Science and Software Engineering graduates will never use the Calculus that they’ve learned on the job.



In fact, until recently—and it was, interestingly, a Regional Director colleague of mine who broke that streak, but I used to ask every Computer Science grad I met how much they used their Calculus on the job, and the answer I very consistently got was “never.” It was Duane Rinehart out of San Diego, one of our colleagues, who actually did use it in a, I believe, data analysis kind of job that he had at some point in time, so he is my notable exception, and I will point him out as such, but again, for many reasons, Logic does not need to be taught via Calculus, but it is. And since many high school graduates are not Calculus ready, their very logical (no pun intended) conclusion is that Computing careers may not be for them.

### **Computer Science is Only One of the Computing Disciplines**

- Computer Science
- Information Systems (Management Information Systems)
- Information Technology
- Computer Engineering
- Software Engineering
- Mixed Disciplinary Majors
  - Bioinformatics, Gaming and Animation, Medical (or health) Informatics, etc.
- Cybersecurity (Statistics) – CSEC2017
- Data Science/Data Analytics (Statistics) – Coming soon!

[00:19:02]

**DR. MARKUS GEISLER:** So, let’s talk about some of these other disciplines. In addition to Computer Science, you will find many universities out there offering degrees in Information Systems (sometimes known as Management Information Systems). You will find degrees in Information Technology, in Computer Engineering, Software Engineering. There are quite a few mixed disciplinary majors that have been popping up over the last 10 years or so, such as Bioinformatics, Gaming and Animation. You will know that the Computer Science community has defined Cybersecurity as a discipline—you will find more programs there that are using Statistics rather than Calculus. And of course, with Data Science and Data Analytics becoming increasingly popular, Statistics is also more likely the approach that folks will take. You're going to see, again, other

options for students who may not necessarily be the greatest math wizzes when it comes to Calculus or who just may not be interested and who believe that they can make a contribution to the field without necessarily knowing math.

## **What is Computer Science?**

- Study of both computer hardware and software design
- Encompasses both the study of theoretical algorithms and the practical problems involved in implementing them through computer hardware and software
- Typical Math requirement
  - Calculus series
  - Discrete Mathematics/Discrete Structures

[00:20:22]

**DR. MARKUS GEISSLER:** So, let's talk about Computer Science. Techopedia gives a good definition in that it provides the study of both computer hardware and software design, that includes the study of theoretical algorithms and practical problems involved in implementing those algorithms through computer hardware and software.

So, it's the grandparent of them all, and the typical Math requirement is the Calculus series as well as another course called Discrete Math, and at the opposition of some Math departments, that course is called Discrete Structures at many institutions.

And let me give you an example of my alma mater here at Cal State Sacramento—they offer that baccalaureate in Computer Science. Notice that the units required are 129 still at this point, and with the increase and push, of course, to reduce that number. They've been doing some work, but they're still at 129.

Specifically, looking at the lower division, you'll find the typical ACM structure—Programming Concepts. There's the Discrete Structures Math course, and then, at the bottom, you've got two semesters of Calculus. So, the Math foundation is very much provided in this Calculus-based Computer Science Degree.

There are a couple of exceptions in California where Computer Science programs are not located within the College of Engineering, such as at [inaudible 00:22:04] State University, for example, where the Math requirements aren't that high, but this is very typical, what I'm mentioning here, when it comes to the Math requirements for Computer Science.

## **Information Systems**

- Information systems are complex systems requiring both technical and organizational expertise for design, development, and management.
- Sometimes called "Management Information Systems"
- Typical Math requirement
  - Business Calculus
  - Statistics

[00:22:18]

**DR. MARKUS GEISLER:** The second discipline that I'd like to discuss is called Information Systems or MIS, and what this discipline does is it takes complex systems and make those usable and useful, particularly in business applications, and students learn how to do that in an MIS program. It is often embedded in a Bachelor of Science in Business Administration degree.

Therefore, it is typically accompanied by the Math requirements for that B.S. B.A. in Business Administration with Business Calculus and Statistics. Notice it says 'Business Calculus', and that's different from the Engineering-style Calculus. In fact, Cal State Sacramento—I'll get there in a second. We'll get a good chuckle out of this one.

So, again, Sacramento State, and I've got some other examples from other universities as well, but just because this is where I graduated, way back when, I figured this one would be a good one to include. It is, again, a concentration within Business Administration, and if you take a look at the Lower Division requirements, you've got STAT 1 at the bottom, Introduction to Statistics, and then MATH 24, which is Modern Business Mathematics.

With the C-ID changes, that is going to be aligned eventually, but the reason that they changed the name of the course to 'Modern Business Math' is because they were told that some students were afraid of the word 'Calculus', so they renamed 'Business Calculus' to 'Modern Business Math', just to take some of that edge off, and students felt more comfortable with that, even though the content didn't really change of the course. Sac State was a little bit alone by doing that, and again, with the C-ID curriculum alignment for Business Administration, the Business Calculus course is going to fall back in place there. Again, Business Calc is different from Engineering Calculus.

## **Information Technology**

- Computer Science is more about developing new types of technology, while Information Technology courses are more about learning how to take computer technology and put it to use in commercial environments.
- Typical Math requirement
  - Statistics
  - Discrete Math

[00:24:09]

**DR. MARKUS GEISLER:** All right, the next discipline is IT or Information Technology. If you think about it, if we're in the field, we don't say, "I work in Computer Science." You say, "I work in IT," right? So, this is the overarching term, even though ICT or Information & Communication Technologies is the more international term, but when you work in technology around computers, you say, "I work in IT." You don't work in Computer Science.

So, it's interesting how, on the business end, we've moved to that updated technology, but in academia, we're still dealing with CS only. But as a comparison from GetEducated.com, Computer Science is more about developing new types of technology, while IT courses are more about learning how to take computer technology that, if I may editorialize, currently exists and put it to use in commercial requirements.

And per the new definition of the IT curriculum by the ACM that was done with IT 2017, they are requiring Statistics and Discrete Math (again, or Discrete Structures, depending on the university).

And within California, we have a great example of that at Cal State University San Bernardino, which offers a Bachelor of Science in IS and Technology, and as part of their requirements, they, notice, have a good portion of the business core still, with Business Systems, Business Law, etc. And if you take a look at the Math, down below, they're basically saying, "OK, we'll take Pre-Calc, we'll take college Algebra." They will also take Calculus if somebody has maybe gone that route and then wants to transfer into IT, but notice the Math requirement is a whole lot less stringent in the B.S. IST at Cal State San Bernardino and other similar programs. Then it would be at a Computer Science level. And up at the top, you'll notice also Applied Business Statistics as one of the requirements.

So, we have an example a less Math-heavy IT degree. Now, there are also relatively Math-heavy IT degrees. If you look at Cal State Northridge, for example—I didn't copy a slide down for them—their IT degree is similar to the Computer Science degree and, therefore, also requires a lot of the Mathematics, even though oftentimes the differentiator between IT and CS is that Math requirement.

## **Computer Engineering**

- Computer Engineering is a branch of engineering that integrates several fields of Computer Science and Electronic Engineering required to develop computer hardware and software.
- Typical Math requirement
  - Calculus series!

[00:27:24]

**DR. MARKUS GEISLER:** Now, Computer Engineering is the fourth discipline that I'll discuss, but Computer Engineering, if there's one place that Math is required, this is it. OK, so the integration

of CS (of Computer Science) and, doubly, Electronic Engineering is where Computer Engineering requires the Calculus series.

And at one of the premier programs in the state for Computer Engineering, based at least in part on its location, at San Jose State University, we do have a lot of Math in Computer Engineering.

Now, what does a Computer Engineer do? They build the hardware oftentimes with associated software to make the hardware run that is used in various technological tools, and in order for them to be able to understand how some of the physical electronics work and how they behave in different conditions, Calculus is certainly needed, so you're not going to get an argument from me here that...

Notice they have Calculus I, II, III, they do have Discrete, and they also have Differential Equations and then the Algebra. That's a lot of Math. I would daresay that if you're going to be a Math major somewhere, you're probably just short of that Math major if you are fulfilling the requirements for this Computer Engineering degree, and this is a relatively typical one when it comes to curriculum at San Jose State.

## **Software Engineering**

- Software Engineering is the systematic application of engineering approaches to the development of software.
- Typical Math requirement
  - Calculus

[00:29:11]

**DR. MARKUS GEISSLER:** Now, a discipline that we don't see very often on the West Coast is Software Engineering. Now, Computer Science and Software Engineering are relatively similar. In fact, a lot of Software Engineering programs are at the master's level because it is an extension of the more general approach that students would learn in a Computer Science degree that, again, covers both hardware and software pieces, but there are some undergraduate programs in

Software Engineering on the West Coast as well, and we're once again dealing with the Calculus requirements, partially due to the relationship with Computer Science.

And this one here happens to be at Cal Poly San Luis Obispo, where they do have a Bachelor of Science in Software Engineering, and where you do have a Math foundation that is required. Let me zoom in a little bit right here, and actually, let me go ahead and go down.

MAJOR COURSES	
<a href="#">CSC/CPE 101</a>	Fundamentals of Computer Science
Select from the following:	
<a href="#">CSC/CPE 108</a>	Accelerated Introduction to Computer Science
<a href="#">CSC/CPE 202</a>	Data Structures
<a href="#">CSC/CPE 123</a>	Introduction to Computing <sup>1</sup>
<a href="#">CSC/CPE 203</a>	Project-Based Object-Oriented Programming and Design
<a href="#">CSC 225</a>	Introduction to Computer Organization
<a href="#">CSC 300</a>	Professional Responsibilities
or <a href="#">PHIL 323</a>	Ethics, Science and Technology
<a href="#">CSC 305</a>	Individual Software Design and Development

DR. MARKUS GEISSLER: See, you've got a lot of Computer Science at the top, and then, down below, you've got Discrete Structures or Discrete Math.

<a href="#">CSC/CPE 101</a>	Fundamentals of Computer Science
Select from the following:	
<a href="#">CSC/CPE 108</a>	Accelerated Introduction to Computer Science
<a href="#">CSC/CPE 202</a>	Data Structures
<a href="#">CSC/CPE 123</a>	Introduction to Computing <sup>1</sup>
<a href="#">CSC/CPE 203</a>	Project-Based Object-Oriented Programming and Design
<a href="#">CSC 225</a>	Introduction to Computer Organization
<a href="#">CSC 300</a>	Professional Responsibilities
or <a href="#">PHIL 323</a>	Ethics, Science and Technology
<a href="#">CSC 305</a>	Individual Software Design and Development
<a href="#">CSC 308</a>	Software Engineering I
<a href="#">CSC 309</a>	Software Engineering II
<a href="#">CSC 348</a>	Discrete Structures
<a href="#">CSC 349</a>	Design and Analysis of Algorithms

**DR. MARKUS GEISLER:** And notice there isn't a whole lot of Math here at first look. Sadly, once you go to the support courses, here is the rest of your Calculus series, and it goes all the way through Calculus IV at this quarter school, and all the way to Linear Analysis, so you still have a lot of requirements on the Math side in Software Engineering. Again, Software Engineering and Computer Science are relatively similar, with a software focus, obviously, in Software Engineering, whereas with a more general focus in Computer Science.

### **Mixed Disciplinary Majors**

- Bioinformatics
- Gaming and Animation
- Medical (or Health) Informatics
- Many more
- May require closer coordination between transfer institutions
- Math requirement depends on major

[00:31:08]

**DR. MARKUS GEISLER:** Now, this is an eyeopener for many people who think that these disciplines I've talked about up until now (and I've got a couple more to go) would be comprehensive because there are other approaches, and it would only make sense, since computing is spread throughout all the other sectors, that there would be hybrid programs where students need to pick up a certain degree of ICT knowledge in addition to the other subject matter knowledge, Bioinformatics being a great example and, of course, the gaming industry. It's not all about just programming—there's the storyboarding and other components, like the graphics, that are part of that. Health Informatics are certainly—there's a big need for that as well, lots of jobs that are going unfilled because companies can't find those skillsets.

But there are majors at different universities that implement those hybrids. I don't have any particular examples for California to bring to the table, but where those examples are popping up, it would, of course, then require a closer coordination between the community colleges and



the 4-year institutions or even with high school for students to be successful in making it through those programs as quickly as possible.

Now, what I always recommend to my students when they come talk to me about transfer is to try to make a decision regarding the transfer institution as soon as possible and then work with the requirements of that transfer institution. I wish I could tell you that all CSUs have the same Lower Division requirements for a Computer Science degree. Now, we do have a transfer model curriculum for Computer Science that, due to the high number of units in Math and CS classes, it has been difficult to implement by a lot of community colleges, but we pretty well know what comes across from the ACM requirements if we are an Upper Division program. We have a good idea of what students will pick up.

But still, again, San Jose State being an example, where Computer Science is not in the College of Engineering. If a student wants to go there, then they need to be aware of what San Jose State requires rather than, say, Cal State Sacramento, for example. And again, with the depth of that hybrid major, the Math requirement will change as well.

## **Cybersecurity**

- Cybersecurity is a computing-based discipline involving technology, people, information, and processes to enable assured operations in the context of adversaries.
- Typical Math requirement
  - Statistics

[00:33:53]

**DR. MARKUS GEISLER:** Cybersecurity—this is the hot topic these days, and for good reason, because the need for graduates in this field is absolutely huge as well. Academia has a problem in hiring faculty in Cybersecurity because anybody who has got some good skills will get a job relatively quickly.

But when it comes to Math requirements, Statistics will typically allow students to analyze the reports that they would see—log files, etc. There, in many cases, is no need for Calculus—in most cases, I would dare say—within the Cybersecurity discipline.

And from the community college perspective, we've been working with one of our private partners, National University, and they're certainly not the only ones. We're also dealing with Western Governors and Southern New Hampshire, and those folks will take programs based on the IT Model Curriculum for California Community Colleges and implement those, and then they will focus on Cybersecurity and not much else.

Again, they do have some Math requirements as part of the general education, but if you take a look at the degree requirements beyond that, they're really not asking for a whole lot of Math, and that opens doors for students, again, who would like to make a difference in helping keep our country safe, our infrastructure safe, without necessarily knowing Calculus to do that.

### **Data Science/Data Analytics**

- Combines domain expertise, programming skills, and knowledge of mathematics and statistics to extract meaningful insights from data.
- Typical Math requirement
  - Statistics
  - Some Calculus

[00:35:33]

**DR. MARKUS GEISSLER:** Finally, another discipline—or some people would dare say these are two separate disciplines that are coming up around the ICT sector are Data Science and Data Analytics. Those disciplines are currently being fought for by the field of Statistics, by certainly Computing. So, it's an indicator that we're dealing with a lack of silos but with integrated learning across multiple disciplines, but who is actually going to find what's going to be taught in those eventually as a standard remains to be seen.

That said, a lot of information has been brought across by the various universities that are offering programs in those fields, and some do require Calculus that are a bit more Computing/Math heavy, but in many of these programs, students will, once again, be able to succeed with a good knowledge of Statistics. By the way, some of the Statistics courses are taught both at Upper and Lower Divisions, so students may even get a couple of Statistics courses as they go through.

### **Not About Math!**

- Each Computing discipline has its own qualities.
  - Some are more applied.
  - Some are more suited for collaboration.
  - Some are more suited for creative minds.
  - Some allow you to make a difference in society.

[00:36:46]

**DR. MARKUS GEISSLER:** But it's not all about the Math! And if it didn't come across when I talked about the different disciplines, you should know that some of those disciplines are more applied, such as IT or Information Systems, for example. Some are more suited for collaboration. There is teamwork in many areas, especially when it comes to Cybersecurity, where it's typically not just one person—you'll have a team of folks who are collaborating. Some are more suited for creative minds, and some people would say, "Well, Computer Engineering and building new devices certainly requires a degree of creativity. Looking at data in different ways would require some of that as well." And some of those disciplines allow you to make a difference—Cybersecurity is the first one that comes to mind for me there.

And the reason I mention these properties, especially towards the end, that's where some of our millennials have certain degrees of interest. They want to be creative. They want to make a difference. And you can certainly do that with a Computer Science degree, but you can also do that with an Information Systems degree, with a Cybersecurity degree, with a Data Science degree.

[00:38:00]

## The Solution

### Be Part of the Solution by Using a Multi-Pronged Approach

1. Think beyond Computer Science
2. Tackle gender issues in the classroom
3. Inform and encourage counselors

**DR. MARKUS GEISLER:** So, how can you be part of the solution? I recommend a multi-pronged approach that I will talk about here in detail in just a second.

### 1. Think Beyond Computer Science

- Get out the word about ALL Computing disciplines
  - High school and college counselors
  - Parents
    - Especially important when working with underrepresented populations
  - Students

[00:38:14]

**DR. MARKUS GEISLER:** Think beyond Computer Science being the first point—I think I've brought that across, but to help our students and their parents think beyond Computer Science, we need to have our counselors on board. That is, to me, one of the biggest opportunities to inform students who are interested in IT at whatever level they may approach it, as long as our counselor colleagues (as well, of course, as our faculty colleagues) are informed about some of the alternatives that are out there. The more we can get those folks current...

And I know—how could you possibly know about every major, right? I get it. I understand, and I don't envy our counselor colleagues because, not only are they dealing with a lot of different requirements, but they're dealing with changing requirements. So, please don't get me wrong, but

if we want to make sure that we get more people into the ICT disciplines, we need to make sure that we can tell them about the various opportunities and, yes, some of the roadblocks of which there are some in some areas, including Math, along the way.

But if we don't know what those opportunities and what those disciplines are, then it's going to make it harder for us to recommend some good pathways, and I'm happy to see, personally, the concept of guided pathways because that will allow some of my counseling colleagues, as it's happening at Cosumnes River College, to focus more specifically on ICT and some of the related majors and allow them to gain more knowledge about all the various disciplines that are out there.

Especially when we're dealing with underrepresented populations, we need to talk to the parents. The likelihood that a student in an underrepresented population is going to make an independent decision about which career they're going to embark on is lower just because the families are more important. They listen to the parents. They listen to the extended family, and we need to make sure that those folks are, in whichever way we can, informed as well.

And then, of course, we need to let the students know that there are multiple different opportunities for them to pursue careers in technology.

## **2. Tackle Gender Issues in the Classroom**

- Instructors should address the problems head on
  - Proactively talk about the diversity needed in the Computing fields
    - Use resources provided by NCWIT ([www.NCWIT.org](http://www.NCWIT.org)), etc.
  - Ensure that student teams operate inclusively
- Invite both men and women guest speakers

[00:40:40]

**DR. MARKUS GEISSLER:** The second is that we need to tackle some of the issues that may be preventing women from joining our field, directly in the classroom. Having gone to several conferences and quite a few different talks about this topic, I've come to the conclusion that the

best approach is for instructors to address the problems head on. We need to let our students know as faculty that the field requires a diversity of folks, and even though many of our classrooms with the more advanced classes may not look like it, we need to start in our introductory courses to let people know that there is a need for these various disciplines to be filled and, again, that there are different options available.

We also, from a faculty perspective, need to ensure that the teams in which we have our students work are formed and operate inclusively, meaning that those teams have members that aren't just men, that aren't just Asian, that provide a great diversity because that's what students are going to find when they graduate, and if we don't start encouraging and, to an extent, maybe even forcing that at the educational level, then we're going to have a harder time getting those folks into the field.

There's one more statistic that I'll talk about that I didn't include on this slide specifically, and that is that a relatively high number of women—I don't have specific numbers at this point in time for you—go through all of the education, enter the field, and then drop out within a year because they just don't like the climate that they're encountering. If we can proactively take everybody who is going to be in the field and let them know that we do need folks of all convictions within the sector, then that may help address some of those issues.

And if instructors don't want to do it by themselves, then they may certainly invite some guest speakers in to make that point and to talk about some of those issues as they are found within the job market eventually and, of course, on the way there in the academic world. But that's something that we as educators can fix and, frankly, again, something that we need to fix.

### **3. Inform and Encourage Counselors**

- Computing ≠ Mathematics
- Encourage your CIS/IT/CS faculty to do their part
  - Communicate success stories at counselor meetings
  - Highlight the various Computing programs available at your institution
  - Help counselors understand that ALL are welcome in ICT!

[00:43:16]

**DR. MARKUS GEISSLER:** And I'm going to come back to the counselors because, even though I put it in the form of an equation or a non-equation (I couldn't resist), Computing does not equal Mathematics. Yes, we have the historical connections, and that's where Computing came from, right? Early computers were fancy calculators, but we've gone beyond. At this point in time, those computers aren't just calculators—they're communication devices. They are used for analysis. They're used to produce things, to produce media, to work with images. They're not just calculators anymore. Therefore, we need to separate those two.

If we have some success stories, we need to communicate those. I personally see our counselors once a year as a faculty member. I will invite myself to a counselor meeting. And frankly, that sounds like I'm imposing, but they're usually happy to have somebody speak. They give me 10 to 15 minutes, which isn't much, but it allows me to drive home the point that we do have multiple Computing programs available, not only here at Cosumnes River College but also at some of the transfer institutions where our students end up.

And as part of that, I also try to help my counseling colleagues understand that all are welcome in ICT. Even though all of us have a work to do to get folks into our classes, to keep them there, and to keep them going and keep them within the field, we need to start somewhere, and as long as we understand that, at the end of the day, when it comes to earnings, there are differences, but the differences certainly aren't very large between what people end up making in the field.

That's another indication that the opportunities aren't just there for males or whites or Asians. They're there for everyone. And again, those differences, to me, are sad. We should be paying folks the same amount of money for the same job that they do, but it's the reality at this point in time. But in this case, take a look at the numbers—it's a good reality. So, the folks who are in this scale on this slide, even the lowest bar is higher than \$70,000 for the median job. Of course, if you're in the San Francisco Bay Area, it's going to be more than that. If you're going to be in

Sacramento even, we're a little bit more than that. So, there are opportunities no matter what you look like.

## **5 Things Companies Can Do to Attract Diverse Talent**

- Blind resume screening
- Have a diverse talent acquisition team
- Ensure inclusive wording in job descriptions
- Emphasize (company) value-based hiring
- Seek out candidates where they are

[00:46:07]

**DR. MARKUS GEISSLER:** What are 5 things that companies can do to attract diverse talent? This is for our industry partners—I'm not going to spend a whole lot of time, but if you talk with them, make sure that the folks that go out and market on their behalf (and yes, these companies are looking for IT skills) that those folks present to diversity. Ensure inclusive wording in your job descriptions and go out and go beyond just the traditional recruiting avenues. Go beyond a little bit, and you will probably be happy with what you find.

## **5 Things Colleges Can Do to Attract Diverse Students**

- Accept everyone who applies
- Have a diverse student acquisition team
  - Including Outreach Specialists with Computing interests
- Ensure inclusive wording in catalog descriptions and syllabus
- Teach and practice inclusive values
- Meet potential students where they are
  - Consider level of Math ability and interest

[00:46:41]

**DR. MARKUS GEISSLER:** What can we do as colleges? One, the community colleges do that already—accept everyone who applies. Again, do the same thing with student acquisition. Make



sure that you've got a diverse workforce who goes out and presents your college. Teach and practice inclusive values—and this is not just as a college but specifically as ICT faculty, we're called upon to do that. And then meet potential students where they are—we always say that, but consider that when it comes to the level of Math ability and interest. Oftentimes the ability is there. We can see that from the AP exams that we saw earlier, some of those numbers. It's the interest that we need to work on, and letting folks know what's out there is part of that.

### **3 Things You Can Do to Keep Diverse Students in Computing**

- Provide community via a student organization
  - Serve as an advisor for an ACM Student Chapter
  - <https://www.acm.org/chapters/students>
- Integrate competitions into the curriculum
  - Serve as a CyberPatriot/NCL/ACM-ICPC coach or mentor
- Adjust Math requirements where possible
  - Do assignments prepare students for the workplace?

[00:47:30]

**DR. MARKUS GEISLER:** And more specifically, 3 things that you can do to keep diverse students in Computing... One, provide community, and you can do that via a student organization. You can serve as an advisor for an ACM Student Chapter or another Computing-style club. That's a strategy that works, especially for women who seek out that community. There are ACMW chapters specifically for women, typically at the professional level but also at the college level. So, if you have opportunities there to contribute, please do that.

Integrate competitions into the curriculum wherever possible, and part of that is serving as a coach or as a mentor for competitions such as the National Cyber League or even CyberPatriot at the high school level.

And take a look at your Math requirements—do the assignments that you give prepare students for the workplace? Or do they allow you as an instructor to keep on making history by having a lot of Math level. Again, what we're after is not Math. What we're after is Logic, so can

we adjust the Math requirements and focus on the Logic when we teach it to properly prepare students for the workplace? That's where we, in my opinion, need to aim as individuals.

[00:48:53]

## Wrap Up

**DR. MARKUS GEISSLER:** This concludes my journey through the various disciplines in ICT, and as a quick review, we started with Computer Science, we moved through Information Systems and Management Information Systems, we moved to Information Technology, Software Engineering, Computer Engineering, Cybersecurity, then Data Science/Data Analytics, and those mixed majors, those hybrids with Computing Technologies and others.

I hope that opened your mind a little bit, but looking at our own front door, there's some work that we need to do. Take a look at this slide...



**DR. MARKUS GEISSLER:** This is the color scheme from the California Community Colleges. Notice the dark blue. How much are we really attracting females with dark blue?

*Markus Geissler, PhD*

*Professor and Regional Director, Employer Engagement,  
Information & Communication Technologies/Digital Media  
Greater Sacramento Region*

## *Exploring the ICT Disciplines - Which ICT Career is for you?*



**DR. MARKUS GEISSLER:** Wouldn't it make a whole lot more sense if we took some of the colors that we use in some of our presentations and... OK, this is a guy applying what he thinks are neutral colors—and I may be out in left field with that, but I'm going to say that the colors that you're seeing right here are more attractive to underrepresented populations and females than a navy blue would be.

So, with that, I would like to thank you very much for your time, and if there are any questions that you would like to ask or any success stories that you might have, this might be a good time to bring those across or to ask those. But thank you very much for your attention.

[00:50:33]

**STEVE WRIGHT:** Wow, Markus, that was fantastic. This is one for the archives, obviously, and one that will be shared widely. So much insight! I really appreciate it. We're going to get to these questions here, but I'm curious what color is that? Is that teal or aqua?

[00:50:47]

**DR. MARKUS GEISSLER:** It's a teal that I chose. I didn't really look at the name for it either, but I was like, "OK, let me pick something neutral that, from my perspective with my cultural biases, that might work for everyone." So, that's what I came up with—no science behind this one, just a feeling and, I think, just to raise an awareness.

[00:51:08]

**STEVE WRIGHT:** One more question—I mean, you're obviously very articulate about this, and your knowledge is just self-evident. Now, you've been working nationally with the computer standards groups and everything. So, what you've been sharing with us is not just a California situation; it's pretty much nationwide. **Do you see people resolving or dealing with these issues nationwide in some interesting ways that we should adopt? What are your findings?**

[00:51:35]

**DR. MARKUS GEISSLER:** Yeah, some of these aren't California specific, although most of them are national. We are in California. Where we are lagging behind much of the rest of the country is in the implementation of programs in Information Technology, specifically. Because of the historical situation of Computer Science and Information Systems, we've not been able to move as quickly in implementing specifically that discipline in California as in many other parts of the country. So, you'll see IT programs in many other places that you're not seeing here. So, there are a couple of things for us to focus on, but overall, it's a national picture that I presented here.

[00:52:19]

**STEVE WRIGHT:** Oh, so looking at the questions that are appearing online, one of them is **what would inclusive wording look like in a catalog description?** Have you got any ideas on that? It's a great soundbite, but what does that look like in practicality?

[00:52:31]

**DR. MARKUS GEISSLER:** Yeah, I don't have anything specific for you, but this is where organizations such as NCWIT have been doing work where, if you take a look at a typical course description for a Computer Science course, it oftentimes sounds very math-y and very male engineering oriented. If you could... I'm going to say 'soften', and I don't want it to come across as we're dumbing things down because that's not what we're doing. We're just making things more approachable. So, I guess, rather than having computer folks write those course descriptions, maybe having someone look over them who has got a bit of a marketing background—that might be helpful.

[00:53:20]

**STEVE WRIGHT:** We might have a resource in our statewide marketing campaign that hired Ogilvy to do their work before, and that's the reason we changed 'Career Technical Education' to 'Career Education', because part of the focus group found that just using the word 'technical' scared people off. So, I'm guessing this math anxiety is pretty deep rooted. I like what you shared about the fact that it really doesn't need to be that heavily math focused for a lot of these insularly things outside of the main hardcore Computer Science, and we need to open those up because we're losing people, and you think due to that math fear—is that correct?

[00:53:55]

**DR. MARKUS GEISLER:** Yeah, I think that's it, and frankly, I think counselors who, again, make such a big difference oftentimes see where a student is, and they're trying to best serve that student by assessing whether or not it's... I don't think it's a fear as much as, to an extent, it's a level of interest, and if we're not redirecting those students properly into the disciplines that don't require the heavy-duty math but allow students to have more practical math approaches, I think that would solve it. There may be some fear involved, but I think it's otherwise just a lack of interest.

As we see by the AP exam results, the women can certainly have the skill to do just fine in the Calculus pieces. It's where we don't redirect them or we don't direct them properly into Computing careers. For many women, we are a career of second choice. They go into the workplace with other degrees. They find an interest and an ability in ICT, and then they come back to the community college oftentimes, which is where I see them, and they do just fine, but those women at that point in time are in their mid to upper twenties, low thirties, and I think we've lost them for the first part of their career, partially because we've never really made them our own. We've never really told them that they're welcome and that there are programs that allow them to implement their interests.

[00:55:17]

**STEVE WRIGHT:** I like your analysis in beginning. Rather than just say, “We need to have more diversity because diversity is good,” you're basically saying, “We’re turning off half of the population here.”

**DR. MARKUS GEISLER:** Yes.

**STEVE WRIGHT:** “Why?” And I think that helps us really focus on the opportunity in terms of getting more people. Because of all these H-1B visas and everything else, we seem to have a shortage, and the industry is expanding. Thank you. Any other questions out here? I see that, I believe, Donna asked a little bit about the AI (artificial intelligence) and where that seems to fit into the scheme of things these days.

[00:55:54]

**DR. MARKUS GEISLER:** Yeah, that’s an interesting one because you will see artificial intelligence in many of these programs. You’ll see it in Computer Science, you’ll see courses in Information Systems, and you’ll see it in Cybersecurity, where I believe it’s going to increase in dominance because you are going to have AI systems attacking targets, and we’re going to build similar AI resources to analyze those attacks and then respond—in intrusion detection systems, for example.

So, the skillset is more of an analysis skillset, and then various different levels of implementation within the various disciplines. So, I don’t think with AI that that would necessarily send students to one specific discipline but to kind of look around at some of the programs that offer specific coursework in AI.

[00:56:43]

**STEVE WRIGHT:** Did I miss any questions? I don’t see any more. That’s good. Well, wow, Markus! It’s really nice to hear you talk.

**DR. MARKUS GEISLER:** Oh, well, thank you very much. Again, for those of you on the call and who are viewing this, I think the biggest contribution that you can help make is to spread the word. Let people know what's out there, and if you have a chance to do that, then you're helping our field attract a more diverse audience, and you're helping, again, businesses all over the place to be more successful and to work more optimally because they've got the right people in the right places.

[00:57:31]

**STEVE WRIGHT:** And to that, Nicole usually has these things packaged and ready on our website, usually in less than a week, so that would mean the video recording of what we just saw chapterized, so you can go ahead to certain pieces of it, and a complete transcript as well as any other links that Markus has shared with us. I believe there's a link to a video that's a positive for women that we didn't show because we had a hard time getting the sound to work. So, there will be a lot of resources there as well, so check back, and we'll send out a note saying when it's available.

Thank you all very much, and thank you, Markus, especially, for all the work that you've done and how you've been able to articulate this very clearly. It's confusing for a lot of people—thank you for shedding light. Thank you all. We'll see you again, I believe, next week at 10:00 on Friday for the ICT webinar series. Take care.



## Additional Resources

- National Center for Women & Information Technology – [NCWIT.org](https://www.ncwit.org)
- Serve as an advisor for an ACM Student Chapter <https://www.acm.org/chapters/students>