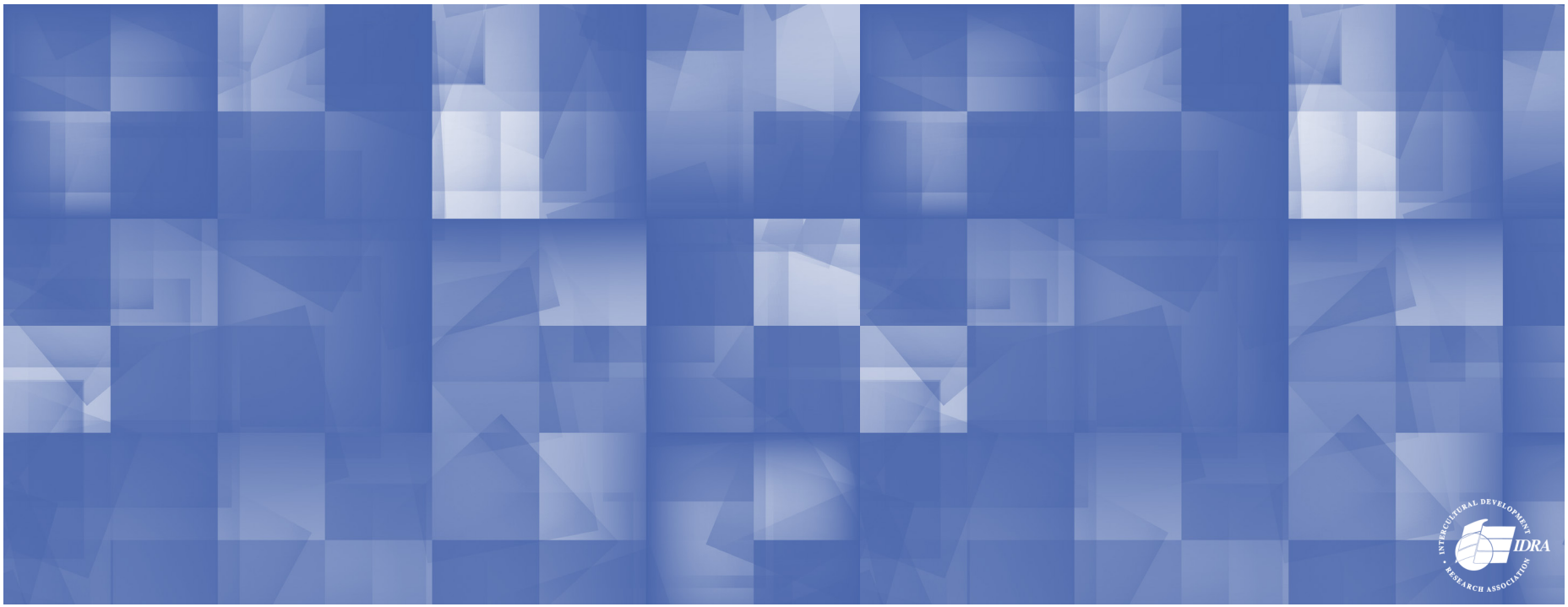
Girls and STEM Education
Research Overview and Resources



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Developed with assistance from Sarah Bishop.

The purpose of this eBook is to explore the intersection between science, technology, engineering, and math (STEM) fields, particularly computer science, and girls. Historically, women and other minority students have been largely absent from STEM fields and classes (Girl Scout Research Institute, 2012; Anderson, 2018). This eBook covers statistics for girls and minority students in STEM, the growing technology-dependent labor market, current initiatives and organizations encouraging STEM, literature on how to support these promising students, and resources.

Contents

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School-Based Strategies for Supporting Girls in Technology – With Perspectives from a 14-Year-Old Coder

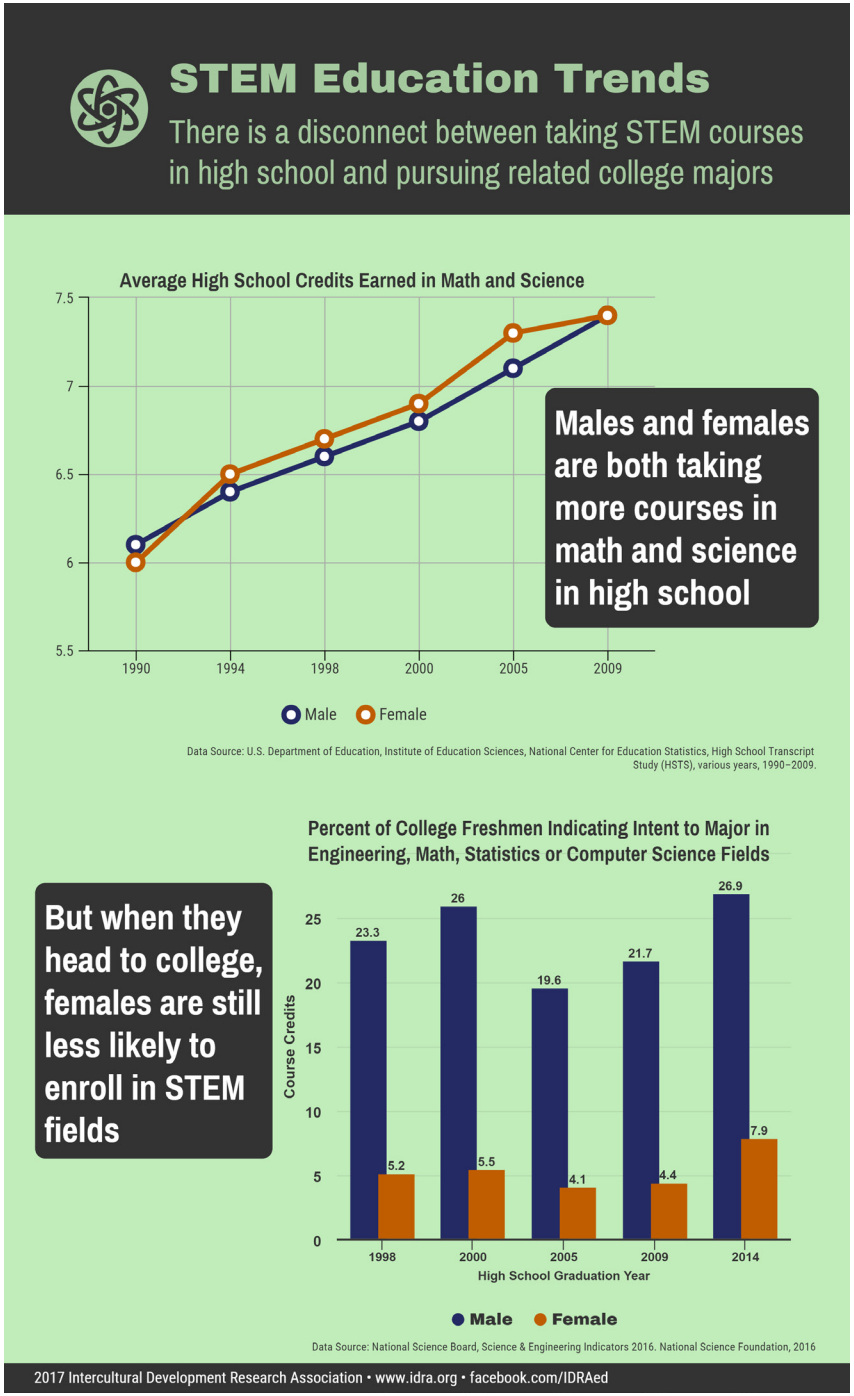
by Christie L. Goodman, APR

https://budurl.me/IDRAnlFeb18b

Currently, the interest girls have shown in computer science does not match up with the number of female who are enrolled in computer science classes (Anderson, 2008).

Forty-five years ago, Congress passed Title IX, a policy that prohibits sex-based discrimination in federal-funded education programs. The National Coalition for Women and Girls in Education just released a report on the impact of Title IX in multiple areas, *Title IX: Advancing Opportunity through Equity in Education.* It states: "Simply by creating the same opportunities to learn for all students, K-12 schools and higher education institutions have paved the way for new levels of achievement."

However, the report also points to areas where gender bias persists and contributes to gender gaps in some areas, including STEM education.



Major contributing factors to the overall lack of women and girls in the STEM pipeline are gender barriers, access and expectations (Girl Scout Research Institute, 2012).

Despite the strides made by women in non-traditional fields, gender stereotyping continues to limit opportunities for women and men alike in career and technical education. Women especially face hurdles in STEM fields, such as computer science and engineering. Sexual harassment and assault are issues that permeate the field across the education spectrum (NCWGE, 2017). These issues must be addressed to open the field to all talented men and women.

The NCWGE report outlines research-based suggestions for encouraging girls in math and science in middle and high school as well as ways colleges and universities can ensure gender equity in their STEM programs.

See the NCWGE report, *Title IX - Advancing Opportunity through Equity in Education.*
https://www.ncwge.org/TitleIX45/Title%20IX%20at%2045-Advancing%20Opportunity%20through%20Equity%20in%20Education.pdf

Labor Statistics and the Future of Computer Science

The labor market in the United States will increasingly be reliant on jobs in STEM fields. Unfortunately, “the STEM workforce is no more diverse than it was 14 years ago, and it may be because… kids with STEM interests can only go so far as their resources and support allow them” (Lou, 2015).

Equally important to note is that 99 percent of computer science jobs require some sort of postsecondary education (Fayer, Lacey & Watson, 2017).

According to the National Center for Women & Information Technology,

- 57 percent of 2015’s bachelor’s degree recipients were women.
- 18 percent of 2014’s computer science bachelor’s degree recipients were female.
- Women hold 57 percent of professional occupations, yet only hold 26 percent of professional computing occupations.
- Only 34 states and the District of Columbia allow computer science to count as a math or science graduation requirement.

Computer science jobs will continue to be in demand, and they also will provide opportunities for higher wages. According to the Bureau of Labor Statistics, the median annual wage for computer science occupations was $82,860 in May of 2016, which was higher than the median annual wage for all occupations of $37,040 (2018). In 2015, seven of 10 of the largest STEM occupations were computer-related (Fayer, Lacey & Watson, 2017).

Recruiting Girls to STEM Fields

Despite their underrepresentation in STEM careers and classes, girls have a strong interest in STEM education. According to the Girl Scout Research Institute, 74 percent of teen girls are interested in STEM subjects and fields of study because of the inherent hands-on and creative aspects of these disciplines (2012).

Girls who are interested in STEM like to understand how things work, solve problems, do hands-on activities, and ask questions (Girl Scout Research Institute, 2012). They also have higher aspirations and tend to be supported by adults in their lives.

Parents, educators and advocates for STEM education can do their part to encourage girls and minority students to pursue STEM fields, especially when they show an active interest. The Girl Scout Research Institute provides some helpful tips, to include (2012):

- Do not assume girls are uninterested in STEM. Talk to them like they are.
- Encourage girls to ask questions and problem-solve. This will encourage developing assets to foster their STEM skills.
- Be aware of STEM opportunities and show girls that they can achieve their goals through STEM careers.
- Introduce girls to experts and mentors in STEM fields.
- Develop girls' confidence and initiative so that they will be able to pursue STEM careers and become experts.

We also need to create awareness of the multitude of career opportunities today and coming soon. STEM is varied and creative, it is not limited to programming and source codes. Simple exposure and awareness to STEM fields and encouraging the development of academic and personal skills that are useful to the field can increase interest and confidence in historically underrepresented students.

Organizations Actively Helping Girls and Students of Color Succeed in STEM

There are plenty of organizations working to tackle the issue of helping minority students enter STEM fields and careers that interest them.

Boys & Girls Clubs of America – Recently rolled out an organization-wide computer science initiative developed in partnership with Microsoft (Schwartz, 2017). It focuses on bridging the digital divide, opening access to computers and the Internet, and has widened to include teaching digital competencies that will prepare youth for the future, competitive workforce.

Girl Scouts of the USA – Recently launched five additional badges and journey curricula in STEM areas. Girl Scouts can create algorithms, design robots and race cars, go on environmentally conscious camping trips, collect data in the great outdoors, try their hand at engineering, etc.

4-H – Has teamed up with Google.org to reach communities where youth traditionally have limited access to computers, Internet or computer science training. The program will equip community educators with new funding, curriculum, training, devices and the support of Google computer science experts.

National Action Council for Minorities in Engineering (NACME) – A non-profit seeking to increase the number of successful students of color in STEM education and careers.

TechHive – A 10-week program that works with teenage girls and minorities, providing the resources to allow students to build and design STEM works for industry and community projects.

We Tech Science – Connects students in California and Texas with STEM mentors and tutors.

Maker Ed – STEM education projects, including hands-on workspaces for students who are traditionally underrepresented.

Girlstart – A program in Texas for girls of color and from low-income backgrounds. They attend the Girlstart summer camp and the STEM conference.

Computational Thinking for Girls (CT4G) – A year-long colloquium course that, unlike traditional coding introductory courses, introduces underserved populations to computer science with the full array of computing in the 21st century (Brady, et al., 2017). Girls work with varied projects, such as physical computation devices, 3-D printing, and simulations using open-hardware programmable badges.

Supporting Underserved Students in STEM Education

Various factors influence the overall lack of students of color in the STEM pipeline, to include the struggles faced by low-income students in underfunded schools to societal expectations that discourage interest in STEM for these young men and women (Lou, 2015).

Title IX can be a useful resource for helping girls and women succeed in and pursue STEM fields (NCWGE, 2017). Solutions include:

- Ensure equal access to STEM courses and activities. Outreach and retention programs are encouraged.
- Safeguard equity in academic admissions and employment.
- Expose girls to female role models who have succeeded in STEM occupations.
- Provide spatial skills training.
- Ensure that all stakeholders are aware of the "purpose and provisions" of Title IX.
- Schools must improve their data collection and reporting of how students are faring on their campuses.
- Title IX must be properly enforced and coordinators must be in place to investigate any claims.
- School administrators should be proactive in setting rules and regulations that go beyond Title IX provisions to ensure the rights of LGBTQ students and restrict the usage of single-sex programming.

It is vitally important to acknowledge that increasing the flow of women into STEM occupations does not come at the expense of men – it will instead increase the overall pool of talented workers for employers to choose from and help address the incredible gap between the number of students graduating in computer science and the ample employment opportunities in the future (NCWGE, 2017).

Access to computer science education is still not universal. This is especially true for disadvantaged populations (Google & Gallup, 2016). Educators must understand the barriers students face to computer science and create learning opportunities for students to maximize their potential for growth in this area. Google & Gallup's 2016 poll of educational stakeholders found:

- More than 90 percent of parents feel opportunities to learn computer science are a good use of school resources.
- 40 percent of K-12 principals say their school offers at least one computer science course, including coding or programming.
- 84 percent of parents, 71 percent of teachers, 66 percent of principals, and 65 percent of superintendents say that offering computer science is more important than or just as important as required core courses such as math, science, history and English.
- U.S. students need more support for parents to advocate for computer science in the classroom.
- U.S. schools need STEM prepared teachers and better funding to increase the quality and likelihood of advancing computer science education at the rate needed to keep up with career demands.

It's critical to increase opportunities for female students to connect with their peers and build support. Classroom and group opportunities allow female students to have intellectual conversations with their peers, and eventually build support groups and networks. Exposure to role models and underrepresented students having intellectual conversations about STEM subjects pushes back against stereotypes (NCWIT, 2015).

Students with disabilities are equally vulnerable to a lack of confidence in STEM, but there are plenty of steps that can be taken in the classroom to maximize learning. These steps include (NCWIT, 2015):

- Providing assistive technology to meet the needs of all students.
- Having flexibility in meeting with students to discuss any accommodations.
- Ensuring that workspaces minimize distraction and maximize safety and efficiency.
- Speaking directly to disabled students, not through their companion or interpreter.
- Offering directions in numerous ways.

Concerned stakeholders across the educational spectrum are working to assist students of color in pursuing STEM classes and occupations. Currently, an expansion of AP computer science classes are drawing more underrepresented students into these fields (Anderson, 2018). Testing for female, Black and Latino students doubled in 2017 following the debut of a national course for computer science.

Though these imbalances persist, the data show an advance in battling the stereotype that coding is primarily for White or Asian American men (Anderson, 2018). About 27 percent of roughly 100,000 AP computer science test-takers in the spring of 2017 were girls. Collage Board data show that 20 high schools in Maryland, Virginia and the District of Columbia had 2017 gains of at least 50 students in AP computer science testing (Anderson, 2018).

Title IX also plays a major role in helping encourage girls to pursue STEM education. Research shows that girls have the same potential to succeed in STEM fields as their male counterparts. Opportunity in this area will benefit both sexes; by encouraging women to enter STEM, we can also collectively encourage men who are interested in female-dominated fields to enter careers in these areas (NCWGE, 2017). All students should be encouraged to develop skills and confidence in the subjects they want to pursue and have the support and resources they need to succeed.

Resources and Websites with Tools

1,000 Girls 1,000 Futures – An initiative designed to engage young women interested in science, technology, engineering, and math, and advance their pursuit of STEM careers through mentoring and 21st-century skills development. Provides online mentoring meetings, coursework and networking. Part of the Global STEM Alliance.

https://www.nyas.org/programs/global-stem-alliance/1000-girls-1000-futures/

Black Girls Code – A non-profit organization focused on increasing the number of women of color in the digital space by empowering girls of color ages 7 to 17 to become innovators in STEM fields, leaders in their communities, and builders of their own futures through exposure to computer science and technology. Since launching in 2011, Black Girls Code has hosted multiple hackathons and learning expos across the country.

blackgirlscode.com

Code.org – A non-profit dedicated to expanding access to computer science in schools and increasing participation by women and underrepresented minorities. Code.org organizes the annual Hour of Code campaign which has engaged 10 percent of all students in the world, and provides the leading curriculum for K-12 computer science in the largest school districts in the United States. Code.org has one-day trainings for elementary school teachers to bring computer science to their classrooms.

https://code.org/

Code2040 – A community of Black and Latinx technologists and their allies who are diversifying tech to create a more equitable, inclusive and prosperous economy. Through high-impact direct service programs, robust in-person and online community engagement, and dynamic storytelling and knowledge sharing, Code2040 empowers and mobilizes diversity champions across the industry.

http://www.code2040.org/

Design Squad Global – Has hands-on activities and videos for classrooms, afterschool programs, libraries and museums and for use at events and at home, along with Design Squad Global Clubs that connect 10- to 13-year-olds in out-of-school programs around the world. Created by PBS Kids.

http://pbskids.org/designsquad/

Girls Who Code – A non-profit organization that aims to support and increase the number of women in computer science. Provides free summer programs and after-school clubs for teen girls. Girls Who Code's curriculum is designed for students with a wide range of computer science experience, including activities for girls with no computer science experience all the way up to activities that introduce college-level concepts.

https://girlswhocode.com/

Iridescent – A non-profit that trains professional engineers, scientists and parents to deliver cutting-edge STEM education to underserved girls, children and their families. Two flagship programs are the Technovation (technology entrepreneurship program for teams of middle and high school girls) and Curiosity Machine (original, hands-on, engineering design curriculum for students in K-12 and their families).
http://iridescentlearning.org/

Made with Code – Initiative launched by Google in 2014 to help empower young women in middle and high schools with computer programming skills. It is designed to inspire teens by celebrating women and girls who are using code to do great things; to engage teen girls to try coding through introductory projects and resources; and to sustain their interest by creating alliances and community. Includes a Party Kit for advice and resources on how to have an informed discussion about code.
https://www.madewithcode.com/

SciGirls – Educational materials provide gender-equitable teaching strategies and hands-on inquiries based on the concepts modeled in SciGirls' videos. The SciGirls approach is rooted in research on how to engage girls in STEM. Includes a SciGirls Club Kit. Created by PBS Kids.
http://pbskids.org/scigirls/home

SciStarter – Provides a place to find, join and contribute to science through more than 1,600 formal and informal research projects, events and tools. Its database of citizen science projects enables discovery, organization and greater participation in science. It is also the place to track your contributions, bookmark things you like, and access the tools and instruments needed to get started.
https://scistarter.com/

STEM Learning Ecosystems – Provides the architecture for cross-sector learning, offering all young people access to STEM-rich learning environments so they can develop important skills and engagement in science, technology, engineering and math throughout preK-16.
http://stemecosystems.org/

Youth Code Jam – Inspires kids to tell a computer what to do by learning to code. With a focus on parent engagement, Youth Code Jam works to connect the dots from playing online to creating online to real world jobs. It fosters an interest in technology by introducing upper elementary through high school students to computer science. Based in San Antonio, Youth Code Jam gets kids excited about programming, builds their confidence in their skills, and inspires them to imagine themselves in the emerging technology-driven jobs of tomorrow. She Code Connect is a program of Youth Code Jam.
https://www.youthcodejam.org/

Gadgets, Kits and Tools

App Lab – Programming environment at Code.org where you can make simple apps. Design an app, code in JavaScript with either blocks or text, then share your app in seconds.
https://code.org/educate/applab

Arduino – Open-source electronic prototyping platform enabling users to create interactive electronic objects.
https://www.arduino.cc/

Finch Robot – Small robot designed to inspire and delight students learning computer science by providing them a tangible and physical representation of their code. The Finch has support for over a dozen programming languages, including environments appropriate for students as young as five years old.
https://www.finchrobot.com/

Lego Engineering – Website for educators and kits developed by the Tufts Center for Engineering Education and Outreach (CEEO), with the support of LEGO Education and teachers from around the globe, including the Engineering Design Group Educators (EDGErs), to inspire and support teachers in bringing LEGO-based engineering to all students.
http://www.legoengineering.com/

littleBits – Makes a platform of easy-to-use electronic building blocks, empowering everyone to create inventions, large and small.
https://littlebits.cc/

PocketLab – A wireless sensing and analytics platform for science experiments. A portable, inexpensive, and easy-to-use science laboratory for students, educators and citizen scientists.
http://www.thepocketlab.com/

StemBox – Delivers monthly hands-on STEM learning to girls 8-13. Girls also receive exposure to some of today's most inspiring women in STEM through educational videos and interviews.
https://www.mystembox.com/

Tinker Crate – Hands-on kids' projects emphasizing STEM learning.
https://www.kiwico.com/

Other Resource Suggestions

Getting Started with Coding in the Classroom, Common Sense Education
https://www.commonsense.org/education/teaching-strategies/get-started-with-coding-in-the-classroom

15+ Ways of Teaching Every Student to Code (Even Without a Computer), Edutopia
https://www.edutopia.org/blog/15-ways-teaching-students-coding-vicki-davis

Coding in the Classroom: 10 Tools Students Can Use To Design Apps & Video Games, Teach Thought
https://www.teachthought.com/technology/coding-classroom-10-tools-students-can-use-design-apps-video-games/

Coding in the Classroom: 16 Top Resources, Edudemic
http://www.edudemic.com/coding-classroom-16-top-resources/

Top 5 Free Coding Tools for Teens, Teacher Vision
https://www.teachervision.com/top-5-free-coding-tools-teens

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