A Content Analysis: Girls and Young Women in Computer Science

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A Content Analysis: Girls and Young Women in Computer Science

by

Wilma Ann Anderson

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A dissertation submitted in partial fulfillment of the requirements for the degree of
Doctor of Education
Department of Education Leadership, Management and Policy

Seton Hall University

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Wilma Ann Anderson has successfully defended and made the required modifications to the text of the doctoral dissertation for the Ed.D. during this Spring Semester.

DISSEPTATION COMMITTEE
(please sign and date)

Dr. David Reid
Mentor

Dr. Renee N. Richardson Rose
Committee Member

Dr. Dönnie R. Johnson
Committee Member

The mentor and any other committee members who wish to review revisions will sign and date this document only when revisions have been completed. Please return this form to the Office of Graduate Studies, where it will be placed in the candidate’s file and submit a copy with your final dissertation to be bound as page number two.
Dedication

This is for my first and forever love, my dear mother, Erin (“Erie”) Lucretia. Your love, wisdom, faith, humor, resilience, grace, and prayers will continue to sustain me for my entire life. You told me I am special and I believed! You told me I am intelligent and I achieved! Thank you for being my best friend. You always wished for me to be a doctor. Well, looks like we made it!

Your Little Willy loves you FOREVER!!
Acknowledgements

I thank and praise God from whom all blessings flow. God is the source of my strength.

My sincere gratitude goes to Dr. Richard Blissett for assisting me with honing in on a topic that matters to me, exposing me to methods of research that were new to me, and for assistance with framing my study in a design that has reach to a wide audience. Thank you to Dr. Eloise Forster for always showing up for me. Dr. Alexandra Freidus, you were a bridge when I needed one! Dr. David Reid, your guidance, feedback, and overall investment in assisting me with reaching this milestone were invaluable.

Innumerable thanks go to my sister Debra who “sees” me, loves me, encourages me, affirms me, supports me, and lets me be me as I learn-grow-teach. That’s IT!! I did it!!

I thank my dearest friend-turned-sister, Penelope Joy, for showing me what true friendship is. I am so blessed to have you in my life. Let’s be brave and bodacious together!

Thank you to my children, Dawson Dean Armand, Eden Ann Jewel, Giovanna Ariella Belle, and Cheyne Ali Phoenix Hero, for being simply AWESOME. I am so proud to know you and so happy for the blessing of being called your mother. You show me what unconditional love is. I absolutely adore you. Let’s keep learning and growing. I pray you are inspired by the steps you’ve seen me take and by the ones we take together. You are doing an amazing job at taking your own steps. Be empowered to use what you learn and achieve to positively affect others and contribute meaningful and beautiful offerings to the world. Have lots of fun, too! Do your work, then go PLAY!!! You are special and blessed. Let your Light shine.

To me, myself, and I. I am so proud of us. WilPower up. There is no box.
Abstract

The national conversation about STEM education continues. While math and science have been a constant in K–12 and higher education, curriculum in technology and engineering have not been consistently part of the tapestry of American education. As such, there is a dearth of qualified candidates for the ever-growing number of computer science and engineering career opportunities. Prevailing stereotypes that depict the typical workforce in these industries as White and male contribute to the lack of representation of other groups. This study focused on the representation of girls and young women in computer science between the years of 2005–2018. Data tracking on Advanced Placement (AP) computer science enrollment started in 2005, making this an optimal year to start data collection. The researcher ended collection of articles in 2018. Using 47 articles from one of the country’s newspapers with the highest readership and with wide-reaching influence, The New York Times, a variety of concepts were coded and analyzed in a mixed-method design. Overarching themes emerged and formed a narrative about girls and young women in computer science. Within the text of the articles, causes for the disparity and solutions were explored. There was little conversation about policy changes. Various stakeholders who influence education pathways can use the findings of this study to craft solutions to what The New York Times chronicled as a national crisis.

Keywords: computer science, girls, young women, women, technology, STEM
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Chapter I

A Content Analysis: Girls and Young Women in Computer Science

Science, Technology, Engineering, and Math (STEM) majors and degree conferrals have been dominated by men (Perez, 2017). STEM degrees only account for about 5% of all undergraduate degrees (National Center for Educational Statistics [NCES], 2018). When undergraduate degree recipients are broken down by gender and discipline, women make up only 0.8% of engineering degree recipients (Perez, 2017). The outcomes of STEM degree conferrals to women at the graduate level do not increase greatly. According to the National Science Foundation (NSF, 2014), there has been a steady decline in women enrolling in graduate-level STEM programs and obtaining full-time academic positions in STEM fields. The preparation and encouragement of women in STEM fields has not been as comprehensive as for men (Association of University Women [AAUW], 2010). Yet, the demand for STEM professionals has grown more than in other fields (Marra et al., 2012; Perez, 2017).

There has been insufficient research regarding possible reasons women do not pursue majoring in STEM programs overall. While there are some fields in STEM (i.e., nursing or medicine) that have substantial rates of women involved (NCES, 2018), there are other STEM fields which have noticeably few female participants (Perez, 2017).

While research exists on the rates of degree completion of women in comparison to men in STEM fields, little exploration has been done on the impact print news media have had on the discourse about women in STEM fields, specifically, computer science. Print news media provides fertile ground for rich and meaningful dialogue regarding prevailing ideas and concepts in society (Potter, 2004). As such, conducting a content analysis on print news media, specifically newspapers, may provide some insight as to the public discourse regarding women in STEM fields in general and computer science, in particular. There is an underrepresentation of
women in the computer science field (Margolis et al., 2000). The need to understand possible causes for the low participation of women in computer science is vital to reversing the outcomes. As such, exploring print news media via content analysis offers a unique approach to understanding the computer science education of girls and young women.

Statement of the Problem

The problem presented by print news media discourse is that there are not enough females in computer science and other STEM fields resulting in a “gender gap” (Fisher & Margolis, 2002; NSF, 2016). Media portrayal of computer scientists and policy surrounding the education of girls in the discipline of computer science are at the root of this gap (Margolis et al., 2000). Understanding the role print news media play in the discussion and dissemination of information around this perceived gap will be useful in identifying possible ways to increase female participation in the field of computer science. Further, this content analysis will help policymakers, school districts, teachers, parents, young women, technology companies, and other interested parties understand the dynamics and challenges associated with preparing and educating girls and young women for positions in computer science.

The Topic

The focus of this dissertation study was to conduct a content analysis of print news media from 2005–2018 regarding women and computer science preparation and education. This study explored the influence of print news media in the form of articles published by The New York Times and its related publications from 2005–2018. This dissertation study sought to understand the narratives published in print news media regarding women in STEM fields, specifically, computer science and the influence those publications may have had on educational policies and programs geared towards women in STEM. This research study examined published articles over a 13-year period.
Significance of the Study

Employment in the United States within the last 20 years has steadily moved to becoming more technology based (Scott et al., 2008). New technological advancements have created a plethora of employment opportunities for emerging graduates who complete STEM programs. However, men have overwhelmingly comprised the majority of the graduates in STEM programs (Perez, 2017). In order to develop more national and global leaders, America must make a concerted effort to develop the computer science skills of the female population (Women in STEM, 2012). There has been some inquiry into the achievement rate of female students who pursue STEM-related degree programs (AAUW, 2010; Marra & Bogue, 2006; Perez, 2017). Investigation into STEM outcomes by gender has been limited in many cases to completion rates and academic preparedness in the form of standardized testing (Marra & Bogue, 2006). However, standardized testing is not the only means to understand the lack of females pursuing education and careers in computer science.

Figure 1 indicates the rate of undergraduate degree conferrals for women in engineering. Computer science is housed in the discipline of engineering. As indicated in Figure 1, within the discipline of engineering, computer science has one of the lowest degree attainment levels by women at 17.4% (Roy, 2019). Based on the data reported by Roy (2019), men account for 82.6% of computer science within the engineering discipline undergraduate degree attainments. Outside of the engineering discipline, the computer science degree attainment numbers increase only slightly with women earning 18.5% of awarded degrees. Men are eight times more likely to obtain a bachelor’s degree in computer science as compared to women (Perez, 2017). Perez (2017) also reports that “Of the universities that granted the most degrees to women, by percentage, only three are public, land grant universities” (p. 6). This is important to note as socioeconomic factors, as well as gender, may likely play a part in degree completion.
The outcomes at the graduate and professional level are more promising. The AAUW, (2010) reports only 9% of doctorate degrees conferred in engineering were earned by women in 2006. Employment in engineering for women amounted to only 10% (Marra et al., 2012). Perez (2017) reports that, “women comprise 13.8% of engineering faculty” (p. 6). Conversely, women only account for 7% of full-time faculty in engineering (AAUW, 2010). Data from 2009 presented in Figure 2, indicate degrees conferred at the undergraduate, graduate, and
postgraduate levels in engineering for both males and females (Lichtenstein et al., 2014). Figure 2 shows that the gender gap between men and women persists beyond the undergraduate level (Lichtenstein et al., 2014). Women continue to be outpaced by men in fields of STEM (Nager & Atkinson, 2016). The gender gap is most pronounced at the professional level, where women only account for 11.5% of tenure track and workforce positions (Lichtenstein et al., 2014).

Figure 2

*Engineering Degree and Professional Attainment, by Gender*

![Bar chart showing gender differences in engineering degrees and professional attainment.](image)

Background and Justification

The research on outcomes for women in STEM focuses primarily on quantitative methods (Perez, 2017). Using quantitative and qualitative methods, this dissertation research will complete a content analysis on print news media to better understand the public discourse on policymaking and educational initiatives influencing the outcomes of women in computer science. A content analysis offers a viable approach to understanding the role print news media have had in shaping the conversation around computer science. St. Clair (2015) argued:

Ultimately, meaning is implicit—it is not enough to look at a text at face value. Even at the most basic level—lexically—it is critical to understand what is and what isn’t said, and what it means in relation to the larger networks of meaning and mythologies in which the words used (or not used) exist. In this way . . . context matters, and the importance of interpretation matters . . . This is particularly true when looking at news coverage. (p. 62)

“Texts are a pervasive and naturally occurring feature of everyday and institutional life. From diaries to newspapers, medical records and e-mail discussions . . . ” (Potter, 2004, p. 613). Chiang (2009) contended, “Power in discourse may not be directly encoded in the semantic system of language. Rather it is in the process of communication that power gets exercised often in a quite inferential fashion” (pp. 255–256). Understanding why the gender gap in the field of engineering exists is an important topic and worth a critical inquiry. Qualitative research is effective when examining contemporary events because it adds two sources of evidence (Yin, 2009). Perez (2017) suggests,

[Exploring the public discourse on] women in undergraduate engineering programs [helps to better understand how] universities and the field can make steps to alleviate the discrepancy in attainment rates between men and women and broaden participation. The use of a critical lens and qualitative methodology will allow for a basis of understanding
from which leaders in the field can examine their own practice, and authentic, deep, meaningful discussion can follow. (p. 8)

Research Questions

1. How did the print news media cover the education of girls and young women in computer science from 2005–2018?
   Sub-question: How, if at all, did the print news media cover computer science-related policies?

2. How, if at all, did the focus of print news media coverage about the education of girls and young women in computer science evolve from 2005–2018?
   Sub-question: How, if at all, did the print news media coverage of computer science-related policies evolve from 2005–2018?

Purpose of the Study

This dissertation study completed a content analysis within print news media on girls and young women in computer science. The focus of this dissertation study was to conduct a content analysis of print news media from 2005–2018, regarding girls and young women and computer science preparation and education. This study explored the influence of print media in the form of a major newspaper published from 2005–2018. This dissertation study sought to understand the narratives published in print news media regarding women in STEM fields; specifically, computer science and the influence those publications had on educational policies and programs geared towards women in STEM. This research study sought to examine publications over a 13-year period. As career perceptions are often shaped by the public presentation of said career and those employed within it, this study is important to further understand the factors that affect the end of the computer science education pipeline.
Definition of Terms

**Girl, Young Woman:** A student or degree completer who is identified as female

**Man:** A student or degree completer who is identified as male

**Undergraduate:** Bachelor level education

**Graduate:** Master level education

**Post-Graduate:** Doctoral level education

**STEM:** Science, Technology, Engineering, and Math

**Engineering:** Degree programs in aerospace, civil engineering, electrical engineering, environmental engineering, computer science engineering, industrial engineering, manufacturing engineering and mechanical engineering

**Computer Science:** a program of study located in the STEM field, will be used synonymously with engineering periodically

**Print Media:** Nationally publicized newspapers and magazines i.e., *The New York Times,* *Washington Post,* *Discover Magazine,* *Science Nation*

**Public University:** College that receives the majority of its funding from a state budget

**Content Analysis:** Content analysis may be briefly defined as the systematic, objective, quantitative analysis of message characteristics. It includes both human-coded analysis and computer-aided text analysis. Its applications can include the careful examination of face-to-face human interactions; the analysis of character portrayals in media venues ranging from novels to online videos; the computer driven analysis of word usage in news media and political speeches, advertising, and blogs; examination of interactive content such as video gaming and social media exchanges; and so much more (Neuendorf, 2016, p. 1).
Chapter II

Review of Related Literature

Girls learn about STEM through family, community, schools, and media (Chavatzia, 2017). They choose to follow a STEM path because of who and what they have been exposed to. STEM learning in K–12 schools is the entrance to the pipeline for girls who have the interest, potential, and capabilities to become women in STEM (AAUW, 2010). Along the pipeline, young women face “chilly climates” in classrooms that may deter some, and negatively affect others—a phenomenon that maintains the gender gap in STEM fields (Britton, 2017). Another significant deterrent and factor that enables the gender gap is the media’s overarching portrayal of STEM workers, computer scientists in particular, as white, male, and bent toward a “geek” culture (Cheryan et al., 2013). A critical analysis of the national discourse presented by the media, The New York Times newspaper in particular for this study’s scope, revealed that media portrayal of STEM workers informs perspectives and actions of media consumers and affected STEM education stakeholders.

STEM and Schools

There is still not a national consensus on what STEM looks like in schools and how we should “do STEM,” but the federal government and the majority of states agree that we must improve efforts to train educators to prepare children for the changing workforce (CSTA, 2018). STEM is an acronym for Science, Technology, Engineering, and Math. Ostler (2012) places the coining of the term in the late 1990s. According to Christenson (2011), it is a term coined by Winona State University President Judith Ramaley. In 2001, Ramaley was director of the National Science Foundation's education and human resources division, working to develop curriculum that would enhance education in science, mathematics, engineering, and technology. Those terms spell out SMET. Ramaley changed it to “STEM” and the new acronym persisted.
The subjects that contribute directly to the acronym are defined in a National Research Council report (Katehi, et al., 2009) as: Science—the study of the natural world; Technology—the study of the human-made world, its artifacts and processes; Engineering—creating the human-made world, the artifacts and processes that never existed before; and Mathematics—the study of patterns and relationships among quantities, numbers, and shapes.

Ostler (2012) posits that the concept of subject matter integration dates back to the late 1800s, but the current iteration of STEM originally had a focus only on the individual subject matters “without the intent to formally integrate the subjects in schools” (p. 29). Efforts to integrate the subjects in schools persist because there is still a national shortage of STEM workers (Brown et al., 2011) and the United States needs to educate and train students to address the shortage.

Growth of STEM jobs in the United States is steady and increasing with STEM jobs outpacing non-STEM jobs at triple the rate (Langdon et al., 2011). A growing number of jobs require a growing talent pool. The United States is low on the totem pole when it comes to science and engineering degrees awarded nationally. The Organization for Economic Cooperation and Development (OECD) conveyed: 16% of all degrees awarded in the United States were science and engineering degrees; Korea awarded science and engineering degrees totaling 38% of all its degrees; Germany awarded 33% of its country’s degrees to science and engineering students; and 27% of all degrees awarded in the United Kingdom were science and engineering degrees. Despite the Innovate to Educate initiative launched by President Obama in 2009, and its goal of inspiring a “more diverse STEM talent pool” (Chu et al., n.d.), females are still not comparable to males in the area of degree attainment. The United States has a shallow K–12 talent pool that feeds the computer science pipeline leading to higher education in the
subject matter, degree attainment, and employment in technology fields (Pollacia & Lomerson, 2004).

Discussions about STEM among politicians have never resulted in consensus—at least not on how to effectively help America reach the level of being on par with international peers, but strides have been made since the nation first realized the disparities. The *A Nation at Risk Report* (1983) revealed that students in the United States were behind their peers from other developed nations. The 1990–2011 National Assessment of Educational Progress (NAEP) standardized measures revealed that American students still fall short in the STEM areas. The data released put a microscope on how America educates its children and what subjects need more focus. Initiatives to improve funding towards improving education in subjects that fall under the STEM umbrella, such as computer science, proliferated.

In 2015, the Department of Labor (DOL) reported a surge in computer science-related jobs and projected continued growth. The national dilemma of students not being exposed early enough to computer science and facing significant barriers to computer science degree-track courses in high school has led educators and policymakers to collaborate toward leveling the playing field for all students. This leveling comes by way of increased access and instruction by well-trained educators (Change the Equation, 2016; Nager & Atkinson, 2016). Education policies that do not support vetted STEM education (for teachers and students) practices that are consistent nationwide are also a challenge to closing the gap. Though high school graduation requirements have changed since 2012 when only 13 states and the District of Columbia allowed computer science to count toward graduation (Change the Equation, 2013), standardized policies across the nation do not exist. Code.org suggests nine policies to make computer science fundamental:
1. Create a state plan for K–12 computer science
2. Define computer science and establish rigorous K–12 computer science standards
3. Allocate funding for rigorous computer science teacher professional learning and course support
4. Implement clear certification pathways for computer science teachers
5. Create programs at institutions of higher education to offer computer science to pre-service teachers
6. Establish dedicated computer science positions in state and local education agencies
7. Require that all secondary schools offer computer science with appropriate implementation timeline
8. Allow computer science to satisfy a core graduation requirement
9. Allow computer science to satisfy an admission requirement at institutions of higher education (State of CS Education: Policy and Implementation, pg. 4)

In order for STEM to find a permanent, standardized place in schools, the national discussion must culminate in policies being created and implemented with fidelity. With effective implementation in schools must come effective teacher preparation, but this is still a challenge for teacher education programs and districts. Though STEM jobs will see an increase by 8.9% (between 2014 and 2024), according to 2017 data generated by American College Testing (ACT), the number of students on track to fill STEM jobs is disproportionate. There are not enough trained STEM teachers to meet the demand of school districts. According to The U.S. Department of Education (2011), “Many STEM programs have mushroomed in K–12 educational settings throughout the United States, but many teacher programs often do not respond to school district needs for teachers prepared to teach in high-need subjects like science,
technology, engineering, and math” (pg. 5). Furthermore, teachers need to be properly trained to be STEM teachers who are able to integrate the disciplines; ample professional development needs to be provided (Greenfield et al., 2017). As burgeoning curricula for computer science have long been non-standard from state to state and district to district, formal teacher preparation and professional development will need to increase (Greenfield et al., 2017).

As the field of STEM Education evolves, the structure and content of the training for educators is still developing. Sanders (2009) said that STEM Education and STEM content are not the same. Preparation of teachers as specialists in a STEM discipline requires a focus on that discipline, while STEM Education requires broader knowledge and integration training. The training would also look different for different grade levels and there is not yet consensus on how to educate the educators. STEM courses were not originally meant to be taught as part of a package (Ostler, 2012), therefore training and education, and branding schools as proficient in this specialty area of teaching and learning, has been a challenge. Goode (2007) reported on three high school cases where intervention by trained computer science teachers increased enrollment of female students, specifically Blacks and Latinas. Computer science is only one component of STEM Education so a standard, more comprehensive level of training is still required.

Women and STEM

Women have been present in STEM fields for as long as women have been allowed to work in industry. Their roles were those of military mathematicians, nurses, mathematical “computers,” and coders. If women in STEM could help get a man on the moon—a feat widely analogized to be the pinnacle of success—why are there so few women in STEM now? The fact is that there are many more women in some pockets of STEM than in others. Nager and Atkinson (2016) explain in their report detailing high school course taking that chemistry and
physics courses were greatly attended after the NSF’s post-Sputnik warning about the nation’s need for more math and science trained workers—but “computer science was the only math or science field to lose ground” (pg. 10) during the 1990–2009 surge.

Computer science falls under the Technology and Engineering arms of STEM, and teaching and learning of it can be considered a movement. With calls to action by two consecutive presidents (Obama and Trump), it has been highlighted as a field that requires attention, funding, and progress in order to level the playing field within our nation and globally. The traction computer science has gained is notable, but this was not always the case. Computer science became its own academic discipline in the 1960s, but the bursting of the tech bubble in 2003 caused a rapid decline (Nager & Atkinson, 2016). Computer science is often translated into “coding” because of big pushes from organizations such as Code.org. This organization and others such as Girls Who Code, Black Girls Code, and Girl Develop It (to name a few), have led a movement to introduce computer science to K–12 students through in-school curricula, after-school enrichment programs, and community-based organization initiatives. Learning environments affect girls’ interest in computer science. Horting (2016) posits that stereotypes that favor male participation in tech industries are the cause of this. Horting surmises that an increase in the high school offering of introduction to computer science will change the ratios of gender interest and participation in computer science.

The traditional route along the computer science educational pipeline ends with a higher education degree in computer science. Young women who take AP computer science are 10 times more likely to pursue a computer science degree than young women who do not take AP computer science (Morgan & Klaric, 2007). But the number of degrees earned by women in the fields of computer and information science is only 18% of all of those awarded (Koch & Gorges,
2016). When young women embark upon the study of computer science in college, there are barriers encountered that may affect whether young women stay in the program or not and how they fare while there.

Low enrollment and attrition will continue to be a direct byproduct of the chilly climate—the environment of the classrooms that seems to be unwelcoming to females—that Hall and Sandler (1982) posit women experience. At institutions of higher education, women do not feel like they belong (Wasburn, 2004), do not have female computer science faculty members as role models, and do not feel supported. According to the National Science Board (2010), bachelor's degrees awarded to women were significantly fewer than the 81% awarded to males.

An investigative study of computer science majors and non-majors by Beyer et al. (2003) led researchers to believe that low confidence and perceptions of lack of support significantly affect attrition and dropout rates. Biggers, et al. (2008) conducted a study comparing the experiences of graduating computer science students and students who left the major (“leavers”) and found that women’s top reasons for leaving included “‘I did not feel as if I belonged,’ unhappy with grades, curriculum flexibility, curriculum difficulty, unfriendly classes and poor teaching by faculty or teaching assistants and loss of interest in a computing career” (p. 404). The chilly climate contributes to women’s negative academic experience and fosters the gender gap in computer science.

Changing the environment, changes the outcomes. Ramsey, et al. conducted a 2013 study of two groups of women, one with STEM support and the other without, and showed that the supported STEM group showed more outward expression of association with their major. The environment that was less chilly fostered a feeling of being welcomed and the participants reported having more role models that were their peers.
The concept of experiencing a feeling of fitting into a place based on the elements of the surroundings can be termed “ambient belonging.” This feeling of fitting in is affected by physical structures, objects, and people (Cheryan et al., 2009). If the environment is decidedly masculine or not decidedly neutral and women do not see a natural fit for themselves, they can feel that the climate is chilly and be deterred from that environment. Nosek, et al. (2002) report that if women are relating negatively toward a domain, those who identify as women may have a negative relationship with the domain. This can lead to attrition for women already studying computer science and determent for those who may have continued through this educational pipeline.

Figure 3 shows a sharp decline in the 2003–2008 span and a leveling from 2008–2010 with the numbers dropping in 2011–2015. Table 1 conveys that computer science bachelor’s degrees awarded to women from 2008–2016 decreased, master’s degrees awarded increased by 3%, and doctorate degrees awarded decreased by 2% (National Science Board, 2016).

**Figure 3**

*Women's Share of Science and Engineering Bachelor's Degrees, by Field: 2000–15*

**Table 1**

*Women’s Share of Computer Science Degrees and Percent Distribution: 2008–16*

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<td>Degrees Awarded to Women</td>
<td>% of Total Awarded to Women</td>
<td>Degrees Awarded to Women</td>
<td>% of Total Awarded to Women</td>
<td>Degrees Awarded to Women</td>
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<tr>
<td>Bachelors</td>
<td>736,460</td>
<td>57.3%</td>
<td>792,611</td>
<td>57.3%</td>
<td>875,590</td>
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<tr>
<td>Masters</td>
<td>285,296</td>
<td>61.6%</td>
<td>319,944</td>
<td>61.7%</td>
<td>352,511</td>
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<tr>
<td>Doctorate</td>
<td>19,844</td>
<td>50.4%</td>
<td>23,213</td>
<td>51.5%</td>
<td>26,552</td>
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<td>% of Total Awarded to Women</td>
<td>Degrees Awarded to Women</td>
</tr>
<tr>
<td>Bachelors</td>
<td>5,114</td>
<td>17.6%</td>
<td>5,343</td>
<td>17.6%</td>
<td>6,416</td>
</tr>
<tr>
<td>Masters</td>
<td>2,861</td>
<td>26.7%</td>
<td>2,968</td>
<td>27.1%</td>
<td>3,384</td>
</tr>
<tr>
<td>Doctorate</td>
<td>220</td>
<td>22.5%</td>
<td>242</td>
<td>22.4%</td>
<td>247</td>
</tr>
</tbody>
</table>

Note. The table is limited to Clearinghouse degree records with a reported field of study, which represent approximately 87% of all degrees reported to IPEDS (Integrated Postsecondary Education Data System). Excludes degrees where gender could not be determined. Adapted from Science & Engineering Degree Attainment – 2017, https://nscresearchcenter.org/snapshotreport-science-and-engineering-degree-completion-by-gender/. Copyright 2024 by the National Student Clearinghouse Research Center.
Many well-intentioned STEM programs suffer from lack of efficacy due to programs not knowing how to “do STEM” well. Even when essential elements (funding, trained staff, and standards-aligned curricula) exist, there may not be expert managers to ensure the programs are executed effectively enough to produce STEM-literate students and/or continue in subsequent years. Zinth and Goetz (2016) say, “In many states, STEM policymaking efforts have not achieved their intended return on investment because programs lack one or more of statewide coordination, adequate funding and evaluation” (pg. 1). School districts have a Technology Plan that reflects the goals of the state and supports national policies. These plans mimic federal plans such as the Goals 2000: Educate America Act. In this Act, the Secretary for the U.S. Department of Education was directed “to develop a long-range technology plan for actions promoting higher student achievement through the use of technology in education” (Rand Corp., et al., 1996, p. 3). The disconnect across states is that “use of technology” means different things to different people. Initially, just having computing devices in the classroom constituted “using technology.”

The expectation has evolved from students simply using calculators and word processing machines to learning to “speak technology” through coding language acquisition; learning computer science at some level is becoming necessary. With the surge in computer science degree enrollments on the post-secondary level comes the same challenge as at the elementary and secondary levels—not enough qualified educators are on staff. The number of students may have stayed the same in K–12, but the demand for courses and instruction has increased. On the post-secondary level, there is an increase in the number of students enrolling for the major or minor, but lack of professors and Teachers Assistants (TAs) to support the increase of students (Camp et al., 2017). Though computer science is becoming necessary, support on the journey
through the computer science pipeline to becoming a viable part of the field's workforce remains a challenge.

**Feminism**

After 19th-century college matriculation restrictions gave way under burgeoning feminist protests, women with financial means and status were allowed to enter colleges. Such a woman was Ada Lovelace, the daughter of a mathematician (Gürer, 2002). Women like her had options of teaching and being a “computer” (Rossiter, 1982). Patitsas et al. (2014) posited that focus on STEM giants such as Ada Lovelace and Grace Hopper may well serve to position these pioneering role models for today’s women in STEM, but it does not give a lens to the historical context and the struggles within.

Workforce participation for women has evolved from “running numbers,”—otherwise known as computation. This was once solely “women’s work” (Rossiter, 1982). From assisting male scientists as “computers” and calculating the efficacy of military artillery in war to literally solving the mathematical problems of the space race, women have indeed been present in STEM fields. The presence was slow-growing due to the norm of women caring for the children and the home. As good as progress was after the surge of wartime employment during which women held jobs in factories and shipyards, Kimble (2017) asserted, “There are indications that, for their part, Rosie the Riveter and Wendy the Welder struggled against their postwar disempowerment and eventually—at least in many cases—made it back into the workforce."

Feminists propose varying reasons for the disparity in technology (Rosser, 2005). Social feminists believe that there exists a social construct that reinforces masculine roles in the workplace and in the home—and they seek to deconstruct this paradigm. Instead of solely being the “assistants” and “computers,” women must contribute to technology by being tech start-up creators (Rosser, 2005), creators of technologies, and managers (Ramilo, 2006). Social feminists
rally for a shift in the social disparity that affords those highest on the economic totem pole the rights to wield taxpayers’ money to pay for high-stakes technology initiatives, in a manner that does not necessarily meet the needs of all taxpayers (Rosser, 2005). “Liberal feminists seek no special privileges for women and simply demand that everyone receive equal consideration without discrimination on the basis of sex” (Rosser, 2005, p. 2). Liberal feminist STEM gender gap critics purport that acknowledging a gender gap and creating initiatives specifically for females reinforces patriarchy.

There is consistent support for the idea of an existing gender gap and its causes. Societal influences and biases, school education, and workplace biases are the three reasons Ashcraft (2012) of The National Center for Women & Information Technology offers for the gender gap. Wang and Degol (2017) offer six: (a) cognitive ability, (b) relative cognitive strengths, (c) occupational interests or preferences, (d) lifestyle values or work-family balance preferences, (e) field-specific ability beliefs, (f) and gender-related stereotypes and biases. Stereotypes and biases arguably make every list of reasons for the disparity of women in computer science. The media plays a large role in creating and perpetuating the stereotypical ways computer scientists are portrayed and subsequently, a large role in the choices women make when it is time to choose a college major and career (Steinke, 2017).

Women in STEM and Media Portrayals

Hidden Figures is a 2017 film that highlights women’s contribution to NASA’s space missions. Its plotline was notable for being based on a true story and for illuminating the plight of Black women in STEM. This film prompted a resurgence of energy around gender and race diversity in STEM.

People learn much of what is going on in the world through news media. Film and TV make statements and have the power to create and perpetuate stereotypes. The general populace
takes cues on what to think about a topic and how to make meaning of it from media discourse (Richardson, 2007). The national discourse about girls and women in STEM, computer science in particular, is occurring via media outlets.

Mass media is said to have started with the distribution of the Federalist Papers in the 18th century. The purpose was to garner support for the Constitution. Print media was used for political influence via narratives that those controlling the media wanted to imprint upon the minds of the masses. Media messages in the minds of the masses will shape the views of the masses. Media plays a significant role in shaping viewpoints about specific groups. The emphasis given to certain groups through frequency of stories published, time slot of highest viewership, and distribution field of theaters and broadcasted stations all factor into what is consumed by the masses (McCombs, 1972).

The relationship between reported statistical information and media content is often interdependent. Media has the power to craft personas and perpetuate stereotypes (Cheryan et al., 2013). Media stereotypes depicting computer scientists as White and male prevail. A 2012 report by the National Science Board indicated that 70% of the nation’s 3.5 million scientists and engineers are White. Mercier et al. (2006) asked middle schoolers about their perceptions of computer scientists and students drew White, pale, thin males. Beyer et al. (2003) reported the stereotype college students accepted as truth was that computer scientists are overwhelmingly male. Additionally, results of a 2016 survey conducted by Wang et al. reported the majority of middle school student respondents perceived computer scientists as White, male, and smart.

With journalistic media affecting the public’s views on the world (McCombs, 1972), it is critical to pay close attention to how information is presented. McCombs (1972) contends that placement of text, size, and length of a journalistic piece all shape perception of the value of the
content. News stories discussing girls and women in computer science have headlines that often blatantly state that there is a gender gap or allude to changes in the dynamic of representation of girls and women in degree attainment programs or in the professional field. Richardson (2007) said,

> Journalism has social effects: through its power to shape issue agendas and public discourse, it can reinforce beliefs; it can shape people's opinion not only of the world but also of their place and role in the world; or, if not shape your opinions on a particular matter, it can at the very least influence WHAT you have opinions on; in sum, it can help shape social reality by shaping our views of social reality. For these reasons, and many more, the language of the news media needs to be taken very seriously. (p. 13)

Media, news journalism in particular, have a tendency to discuss policy with bias. This is because there is a domino effect at play. The information delivered to journalists is often well massaged to take a shape that is favorable to certain parties or it is deliberately neutral. Decided neutrality can also lead the masses to form an opinion based on information presented or omitted and thus be socially unjust (Richardson, 2007). Richardson (2007) highlights the position that “academic neutrality contributes to the perpetuation of such injustice” (p. 2). Strömberg (2004) illustrates the relationship between media and policy as an interdependent and biased one. Media outlets are driven by advertising dollars, and advertising power buys advertisers the eyes and ears of the selected target market. These consumers of the messages form opinions and biases and eventually vote toward policies and politicians based on the information they received through the news outlet.

If news media expresses and/or discusses any type of bias in detail or remark upon the policy (or effect of the policy) surrounding the computer science education of girls and young
women, perception will be affected. The importance of the content of these public conversations is grave and the effect is monumental.

Summary

In conclusion, the review of literature fell into three categories: STEM and schools, Women and STEM, Feminism, Women in STEM and Media Portrayals. Chapter III discusses the method by which the researcher collected data for the study.
Chapter III

Methodology

Aim of the Study

This dissertation study completed a content analysis of print news media from 2005–2018 regarding girls and young women and computer science preparation and education. This study explored the influence of print news media in the form of a major newspaper and its related publications published from 2005–2018. This time period was chosen because the 2009 CSTA (Computer Science Teachers Association) National Computer Science Survey tracked AP computer science enrollment starting in 2005 and showed a decline in high school computer science courses offered and student enrollment. The study was funded by Google and was conducted under the direction of the Association for Computing Machinery (ACM), in partnership with the CSTA, Google, Microsoft, the National Center for Women and Information Technology, and the National Science Foundation. Due to the attention this national study—which highlighted a national deficit—may have garnered, the researcher found 2005 to be a valid year as a starting point because consistent data would be available. It was also supposed that media coverage of the topic might commence within the year of the release of the study or shortly thereafter. The year 2018 is when the researcher gathered the articles. This dissertation study sought to understand the narratives published in print news media regarding women in STEM fields, specifically, computer science and the influence those publications had on educational policies and programs geared towards women in Technology.

1. How did the print news media cover the education of girls and young women in computer science from 2005–2018?

Sub-question: How, if at all, did the print news media cover computer science-related policies?
2. How, if at all, did the focus of print news media coverage about the education of girls and young women in computer science evolve from 2005–2018?

Sub-question: How, if at all, did the print news media coverage of computer science-related policies evolve from 2005–2018?

Content Analysis

Berelson (1952) defines content analysis as: “. . . a research technique for the objective, systematic and quantitative description of the manifest content of communication.” According to Carley (1990), though content analysis focuses on the frequency with which words in a text appear, it goes beyond a word and phrase tally. Colorado State University (Busch, et al., 2005) contends that this research tool uses the quantitative results to analyze relationships and societal/cultural trends. “Content-analytic procedures are appropriate and work well at macro levels where the interest is in broad cultural concepts” (Carley, 1993, p. 90).

Freitas (1998) characterizes content analysis as a technique that embodies rigidity in its process after categories are set and coding rules are determined. While this is true, Freitas also encourages researchers to exercise patience when interpreting results as there are word/phrase meaning nuances that inform inferential conclusions.

Content analysis allows for a textual analysis in the following ways:

1. Texts are naturally occurring and by their very nature tend to be available. Texts are, after all, designed for reproduction, storage and circulation.

2. Texts come already turned into words on the page, which is the central currency of analysis. They do not require recording or lengthy processes of transcription.

3. Some phenomena only exist in this form—novels, newspapers . . .

Machin and Mayr (2012) hold the “view of language as a means of social construction; language both shapes and is shaped by society . . . power is transmitted and practiced through discourse” (p. 4). The current research examining women’s preparation, education, and completion in computer science programs is limited. As such, this research sought to provide an alternative look at how public discourse influences educational policy for computer science programs. Further, it discusses the impact and engagement of women in these programs. Hall et al. posited that the media is a powerful voice in social institutions and yields sociopolitical and ideological power (1980).

**Design**

Van Dijk argues that sociopolitical and ideological power yields control (2001). As such, the public discourse influences and is influenced by the levers of control. This dissertation research identified publications over a 13-year period that have influenced the public discourse on the preparation, educational training, and degree attainment of women in computer science programs. Other researchers have used this method to trace continuity and change over time. Freyenberger (2013) conducted a content analysis of the media’s framing of Amanda Knox using newspapers around the world. Gándara and Ness (2019) used content analysis to chart think tank website content about U.S. college affordability. Additionally, Hogan (2013) used content analysis of how U.S. newspapers framed public schools since the No Child Left Behind law was initiated. The researcher identified one of the nation’s top newspapers that has published articles on the topic of girls and women in computer science by completing a preliminary search of the highest ranked national publications, both newspapers and magazines. *The New York Times* newspaper (and its related publications) was chosen because it is ranked as having one of the
highest readerships and is believed to influence the public discourse on various matters, including education and educational policy.

There is a deficit of historical research on content analysis of print news media as it relates to the computer science education of girls and young women, but this study addresses the deficit to inform the field of education by providing an account of the discursive contexts and content about computer science education and related policies. To complete this research project, the researcher established an article collection and coding protocol (Saldaña, 2014) and collected data gleaned through Google Scholar searches using the terms “computer science,” “national print news media,” “girls,” “young women,” “education,” “education policy”; journals; studies; current articles; and aggregated databases including LexisNexis University searches employing the use of Boolean techniques, as shown in Figure 4. In addition, the researcher employed databases within the Seton Hall University library system.

Figure 4

Boolean Search Techniques for the Study

"Computer Science"

"Women" and "Girls"

"Education" and "Education Policy"
Articles that contain the key terms: “computer science,” “women,” “girls,” “education,” and “education policy” within the headlines were used in the analysis for this study. Full article searches were conducted as well to collect additional data.

**Data Collection**

This dissertation study is exploratory in nature. As such, the researcher attempted to capture all articles that pertain to the central topic of this research study. The researcher, upon conducting a literature search of all articles published between 2005–2018, began to sort each piece by category. Miles et al. (2014) discuss a priori coding (or deductive coding) as a starting point to developing a list of terms to conduct a search. This method involved selecting coding concepts the researcher had identified during the literature review process. The researcher was familiar with the topic of this study due to prior research and this familiarity also informed the formation of the initial list of codes. The researcher identified “education” and “educational policy” as key terms within this study. Therefore, article headlines that mention “education” or “education policy” along with “girls” or “women” and “computer science” or “STEM” were sorted for review and analysis. The researcher suspected other key terms may have been captured during the data collection phase. For example, “completion,” “preparation,” and “training” may have been used as key concepts to fully capture published articles on the topic of girls and young women in computer science education. Potter (2004) mentions two main challenges when conducting analysis:

1. One of the difficulties in dealing with texts is their designed mobility encourages the analyst to treat them in a decontextualized manner which is inattentive to the practices that they are part of. At the same time, working with decontextualized texts provides a temptation to speculate . . .
2. A related temptation is to attempt to consider texts in terms of their (putative) relation to what they describe, as if what they describe can be simply and independently captured by the research. This can generate all sorts of confusion (p. 614).

In order to avoid the challenges identified by Potter (2004), this researcher formally categorized the articles gathered for this study primarily by terms listed in the headline or terms that summarized the articles. Though education and education policy are the primary foci of this research study, additional categories were utilized to determine whether an identified article fit the criteria for this study. This study attempted to limit newspaper publications, for example, to the “education” section, but found that other sections contained relevant content. Editorials and commentaries were included for analysis. However, commentaries or reviews of books related to women and computer science were not included as part of the analysis. Articles identified as a reproduction or republished for correction were not included in the analysis. If an article provided no context of information related to the primary topic of girls and/or young women and computer science, then it was not included in this sample. The total sample was categorized by year (see Figure 5).

**Figure 5**

*Total Sample Size of Articles Analyzed: 2005–2018*

<table>
<thead>
<tr>
<th>Year</th>
<th>Number of Articles</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>2005</td>
<td>1</td>
<td>c</td>
</tr>
<tr>
<td>2006</td>
<td>0</td>
<td>—</td>
</tr>
<tr>
<td>2007</td>
<td>1</td>
<td>b</td>
</tr>
<tr>
<td>2008</td>
<td>4</td>
<td>c, e</td>
</tr>
<tr>
<td>2009</td>
<td>0</td>
<td>—</td>
</tr>
<tr>
<td>2010</td>
<td>1</td>
<td>c</td>
</tr>
</tbody>
</table>
Note. Categories: (a) Curriculum (b) Efforts to Address the Gap by Academic Institutions and Organizations (c) Diversity Issues and Stereotypes (d) Existing Inequity / Sexism (e) Industry Efforts to Address the Gap (f) The Myth of Sexism (g) Policy. The absence of relevant articles is represented by (—).

Coding is essential to data analysis. The units of meaning within categories included coding for specific concepts, words and phrases, and the frequency with which words and phrases appeared. The researcher also used the unit of whether certain concepts appeared in the headline of articles or not. Placement in the headline and frequency can connote importance and relevance and can affect reader perception.

The level of analysis encompassed coding for concepts that are single words or phrases. Initially, eight concepts were coded: “at a disadvantage,” “better,” “chilly climate,” “deficiency,” “deficit,” “disparity,” “gap,” and “worse.” The researcher found a dearth of articles using only these codes and modified the code list to the following: “belonging,” “better,” “bias,” “curriculum,” “decrease,” “degree,” “enrollment,” “exposure,” “increase,” “inequity,” “interest,” “policy,” “progress,” “recruit,” “role model,” “stereotype,” and “worse.” Coding for these single
ideas revealed the essence of sentiments and positions presented that form the composite message of news accounts and in turn addressed the research question of how print news media covered the education of girls and young women in computer science.

The data was coded for frequency. Frequency with which the word or phrase appears does not change the value of words. For example, the appearance of the word “deficiency” 50 times cannot further decrease the amount of the concept “deficiency” refers to, but it may impress upon the reader an increased significance of connoted meaning. Additionally, accounting for frequency certainly assisted in determining a shift in coverage over the bounded news coverage span of 2005–2018. If coding for existence, the mere presence of a word and/or phrase about girls and young women in computer science was enough to characterize the role they play in the phenomenon, but not enough to determine how media coverage changed over the bounded 13-year period.

Concepts were coded to allow for subtle differences. The rigidity of coding exactly as words and phrases appear may exclude valid forms of words, synonymous phrases, jargon and euphemisms (CSU, 1994–2012). The researcher analyzed each instance to determine suitability for inclusion in the quantification process. This coding choice allowed the level of generalization that permits coding for words that are implied.

According to Carley (1992), the coding choices the researcher makes can prevent the skewing of the data. The coding rules must allow for reliability, reproducibility, and accuracy. Conceptual analysis does err on the side of subjectivity due to its inferential nature, but careful coding choices give the resulting inferences credible validity. The researcher developed rules for consistency and coherence and constructed a set of coding rules that are reproducible for
validity. Interpretations would be more valid if other researchers can find what the researcher found and interpret the data to come to similar conclusions.

Irrelevant information is considered to be text that does not have a bearing on coded units, and was not used for data analysis. Weber (1990) suggests avoiding the use of irrelevant information because irrelevant words will not assist the researcher in interpreting the data and addressing the research questions. To code the text, the researcher used Quirkos. Quirkos is a computer application used for analyzing qualitative research with text. The use of this automated process significantly reduced time in identifying coded units. The use of automation did not preclude review by the researcher. It was essential that this review was done to determine presence of word nuances that may have skewed the results.

**Data Analysis**

Upon completion of coding, the researcher drew conclusions and generalizations by looking closely at the frequency with which units appeared. Comparing and contrasting frequency results across the bounded time frame allowed the researcher to chart how the focus of news coverage about the education of girls and young women in computer science and related policies changed. The results were then reexamined for validity and the code scheme altered as deemed necessary to ensure the process can be replicated.

Conducting a deductive analysis approach for this dissertation study was comprehensive and exhaustive. The researcher first used existing theory and research to understand the complete coverage of the data (print news media) and how it had been utilized by the publisher. A coding structure was created to help with identifying the categories necessary for each published article utilized in the sample. Part of the analysis for this dissertation study included a “lexical analysis.” Freitas (1998) lauded the use of software tools to perform a three-tiered analysis:
The statistical lexical and the data analysis methods.

The syntactic analysis

The lexical surfing and the reading assisted by computer (p.12).

St. Clair (2015) posits, “the words used, the words not used—also discussed as ‘suppression’ or ‘lexical absence’—the stories told, and how they are told (or not told) are all important to analyzing the text and understanding its meaning” (p. 60).

The content analysis approach served two purposes for this dissertation study: (1) understand to what extent the national conversation (via print news media) focused on girls and young women and their involvement with computer science exists (2) understand the influence print news media has had on the educational preparation and policy related to increasing the visibility of women in the computer science field.

A content analysis approach encouraged a more comprehensive inferential understanding about contemporary narratives published by major publications and their influences on the decision of women to enter the computer science field, thereby making coding of the data essential to the analysis. Potter contends, “Coding is not a discrete stage of research, but a process that is ongoing from the point where materials start to arrive to the point where academic writing is completed” (2004, p. 615). The data for this research project was analyzed both categorically and contextually. Carley (1993) contends the researcher must be aware that coding may come with biases whether computer aided or done by human hand; the meanings attributed to the words/phrases are made based on the experiences and/cultural influences of the coder. The researcher coded the data from the articles using a directed content analysis method conducive to conceptual analysis. Hsieh and Shannon (2005) state that in directed content analysis “the researcher uses existing theory or prior research to develop the initial coding scheme prior to
analyzing the data.” Carley (1990) defines conceptual analysis as a qualitative research technique that “focuses on the frequency with which words occur in texts or across texts.” Carley’s (1986) definition of concept is “a single idea, or an ideational kernel.” Deductive (a priori), focused, and axial coding were used.

**Ethical Considerations**

The researcher is an instrument in qualitative research (Creswell, 2009; Dancy, 2007). The researcher put aside pre-judgments, biases and preconceived ideas as well as maintained transparency throughout the research process. Journals were maintained to document the researcher’s thoughts separate from the articles collected and used in this sample (Dancy, 2007; Moustakas, 1994; St. Clair, 2015).

**Limitations of the Study**

This dissertation research sought to complete a content analysis of print news media from 2005–2018. Due to the time frame, this study did not review print material published before or after the years identified. Further, this study sought to review publications during this time period that published articles on the educational preparation and educational policy related to girls and young women in the computer science field. The study examined only a limited number of publications—the articles of other publications, which were tangentially related to this study’s research questions, were beyond the scope of this study. A limited number of print news media sources were chosen for efficiency purposes, but the researcher recognizes that others exist. Articles from the International Edition of the *The New York Times* were not included in an attempt to filter the corpus to American-centered data. The study was also limited by the use of computer-automated software if human coding was not also done. Implicit meaning of coded text may be extrapolated by hand, but with a greater error rate due to omissions, biases, and human judgments (Krippendorf, 1980).
Summary

In Chapter III, the method used to conduct research was discussed. The researcher collected articles regarding girls and young women and computer science preparation and education from the 13-year period of 2005–2018. A conceptual content analysis of the narratives published in print news media regarding women in STEM fields, specifically computer science and the influence those publications had on educational policies and programs geared towards women in STEM are discussed in Chapter IV.
Chapter IV

Summary

Introduction

The findings of the content analysis will be conveyed in this chapter. The findings suggest a consistent conversation about the gender inequity that exists in computer science. The text within the titles of the articles suggest an aggregated positive tone, while the body text had a predominantly negative tone. The purpose of this qualitative content analysis study was to determine how females were framed in The New York Times articles from 2005–2018. Data from 47 articles were aggregated—two of these articles were the same article published on different days. Though the content is the same, the headlines did vary. The researcher found it valid to include both of the latter because the audience was likely different, producing additional exposure of the content. The main focus for this study was to determine the tone of newspaper articles that mentioned girls and young women and their study of computer science and/or coding or their work in related industries, not how the articles impacted the readership.

The discussion section, subsequent to presenting the results, will explore potential methodological limitations that could have influenced the outcomes.

Media Coverage of the Education of Girls and Young Women in Computer Science

In reference to the first research question—How did the print news media cover the education of girls and young women in computer science from 2005–2018?—the researcher found that the articles in the sample presented the topic as a national crisis. Content of the articles fell into seven main categories: articles that focused on (a) Curriculum (b) Efforts to Address the Gap by Academic Institutions and Organizations (c) Diversity Issues and Stereotypes (d) Existing Inequity / Sexism (e) Industry Efforts to Address the Gap (f) The Myth of Sexism (g) Policy. Articles frequently shared statistical information, supported by anecdotes
and testimonials about the state of girls and women in computer science; possible causes; and remediation efforts. In reference to the sub-question—How, if at all, did the print news media cover computer science-related policies?—the researcher found only one article that focused on policy about improving computer science education and another that mentioned policy. The content of the first article was based on President Obama’s 2016 CS4All proposal to fund teacher training and the increase of computer science instruction for girls and minorities. The second mentioned his 2015 TechHire proposal to hire more individuals to fill technology jobs. Other articles that mentioned national pushes through computer coding organizations to improve computer science education spoke in an encouraging manner rather than a compulsory manner. It was not clear whether or not the organizations were government partners or not. Individual states make the decisions about changing what were once elective courses—like computer science—to required courses. No individual states and their related policies were reported on during the 2005–2018 period.

For this research, the researcher used the LexisNexis database to retrieve the newspaper articles used for this study. Nearly 100 articles were found, but the initial search query of “education + girls + coding” did not show up in the titles as anticipated so the search was amended to “. . . within the titles AND/OR body of the article.”

Data were collected from January 1, 2005 to December 31, 2018. The use of a priori codes generated from a review of literature started the list of terms to code. The researcher noted recurring themes and thus decided on the remaining code words. The unit of analysis for this study was each headline mention of “code/coding”—mentioned in eight articles; “computer / computer science”—mentioned in nine articles; “girl/girls”—mentioned in nine articles; “tech/technology”—mentioned in five articles; and “woman/women”—mentioned in eight
articles. Instances of “bias,” “belonging,” “better,” “curriculum,” “decrease,” “degree,” “enrollment,” “increase,” “inequity,” “interest,” “policy,” “progress,” “recruit,” “stereotype,” and “worse” were tabulated from within the body of the article.

Collected data about the frequency of coded concepts across unique articles revealed “enrollment,” “inequality,” “interest,” “recruit,” and “stereotype” as the five most prevalent concepts.

**Table 2**

*Unit of Analysis in Body of Article*

<table>
<thead>
<tr>
<th>Coded Concept</th>
<th>Number of Unique Articles in Which Concept Occurred</th>
<th>Aggregate Number of Mentions Across All Articles</th>
</tr>
</thead>
<tbody>
<tr>
<td>belonging</td>
<td>16</td>
<td>56</td>
</tr>
<tr>
<td>better</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>bias</td>
<td>9</td>
<td>20</td>
</tr>
<tr>
<td>curriculum</td>
<td>10</td>
<td>23</td>
</tr>
<tr>
<td>decrease</td>
<td>14</td>
<td>28</td>
</tr>
<tr>
<td>degree</td>
<td>15</td>
<td>30</td>
</tr>
<tr>
<td>enrollment</td>
<td>21</td>
<td>47</td>
</tr>
<tr>
<td>exposure</td>
<td>27</td>
<td>56</td>
</tr>
<tr>
<td>increase</td>
<td>10</td>
<td>15</td>
</tr>
<tr>
<td>inequity</td>
<td>31</td>
<td>71</td>
</tr>
<tr>
<td>interest</td>
<td>19</td>
<td>28</td>
</tr>
<tr>
<td>policy</td>
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<td>2</td>
</tr>
<tr>
<td>progress</td>
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<td>5</td>
</tr>
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<td>recruit</td>
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<td>55</td>
</tr>
<tr>
<td>Role model</td>
<td>18</td>
<td>37</td>
</tr>
<tr>
<td>stereotype</td>
<td>21</td>
<td>48</td>
</tr>
<tr>
<td>worse</td>
<td>7</td>
<td>8</td>
</tr>
<tr>
<td>Total</td>
<td>248</td>
<td>533</td>
</tr>
</tbody>
</table>
Dependent variables for this study included frequency and story placement (section of the newspaper) of the article. Using LexisNexis, the researcher implemented the inclusion and exclusion criteria (see Figure 6). The final inclusion search items and phrases were chosen after searching various configurations because they yielded the most relevant results relating to the goal of this study. Further LexisNexis search specifications included sections of *The New York Times* and countries to exclude.

**Figure 6**

*Inclusion and Exclusion Criteria: LexisNexis*

<table>
<thead>
<tr>
<th>&quot;computer science&quot; and &quot;girls&quot; or &quot;women&quot;</th>
<th>Narrow By</th>
</tr>
</thead>
<tbody>
<tr>
<td>&quot;girls&quot; or &quot;women&quot; and &quot;computer science&quot;</td>
<td>The New York Times</td>
</tr>
<tr>
<td>girls or women and &quot;computer science&quot;</td>
<td>Jan 01, 2005 to Dec 31, 2018</td>
</tr>
<tr>
<td>girls or women and &quot;computer science&quot;</td>
<td>NOT international</td>
</tr>
<tr>
<td>EXCLUDE boys and men</td>
<td>NOT global</td>
</tr>
<tr>
<td>&quot;computer science&quot; and &quot;girls&quot; or women</td>
<td>North America</td>
</tr>
<tr>
<td>EXCLUDE boys</td>
<td>NOT Canada</td>
</tr>
<tr>
<td>&quot;computer science&quot; and &quot;girls&quot; or women</td>
<td>NOT &quot;travel desk&quot;</td>
</tr>
<tr>
<td>EXCLUDE men</td>
<td>NOT &quot;house &amp; home/style desk&quot;</td>
</tr>
<tr>
<td>&quot;computer science&quot; and &quot;girls&quot; or women</td>
<td>NOT &quot;society desk&quot;</td>
</tr>
<tr>
<td>EXCLUDE boys and men</td>
<td>NOT &quot;metropolitan desk&quot;</td>
</tr>
<tr>
<td>&quot;computer science&quot; and &quot;girls&quot; or women</td>
<td>NOT &quot;book&quot; PRE/1 &quot;review&quot;</td>
</tr>
<tr>
<td>EXCLUDE boys or men</td>
<td></td>
</tr>
<tr>
<td>&quot;computer science&quot; and &quot;girls&quot; or women</td>
<td></td>
</tr>
<tr>
<td>EXCLUDE boys and/or men</td>
<td></td>
</tr>
<tr>
<td>girls or women and &quot;computer science&quot; and &quot;education policy&quot; or &quot;education&quot;</td>
<td></td>
</tr>
</tbody>
</table>
Note. The left side of the figure lists all the inclusion phrases, when coupled with all the exclusion specifications on the right, used to yield articles. The two bolded phrases yielded the most articles. Articles were further reviewed to ascertain relevancy to the study’s topic.

The researcher examined The New York Times newspaper for those mentions between the specified dates. After searching the terms, the LexisNexis search found 47 articles that contained the units of analysis and relevance to the research topic. The number of mentions that were analyzed in this study totaled 533. No article contained fewer than two coded concepts and 13 articles contained 10 or more.

The articles were collected from 21 varied sections of The New York Times and its related publications. The majority of the articles fell into the Business/Finance section. Four sections had similar section names; Business and Business Finance; Editorial and Editorial Desk; National and National Desk; Style and Style Desk, but were tallied as individual sections. The Business Finance section yielded the most articles (15), with the Opinion and Science sections each yielding the second-highest number of articles, five each (see Table 3).

Table 3

Article Placement and Related Statistics

<table>
<thead>
<tr>
<th>Article Number</th>
<th>The New York Times Section</th>
<th>Gender of Author</th>
<th>Day of the Week</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Business</td>
<td>F</td>
<td>F</td>
<td>2013</td>
</tr>
<tr>
<td>2</td>
<td>Business Finance</td>
<td>M</td>
<td>M</td>
<td>2012</td>
</tr>
<tr>
<td>3</td>
<td>Business Finance</td>
<td>F</td>
<td>M</td>
<td>2013</td>
</tr>
<tr>
<td>4</td>
<td>Business Finance</td>
<td>F</td>
<td>T</td>
<td>2017</td>
</tr>
<tr>
<td>5</td>
<td>Business Finance</td>
<td>F</td>
<td>M</td>
<td>2012</td>
</tr>
<tr>
<td>6</td>
<td>Business Finance</td>
<td>F</td>
<td>F</td>
<td>2013</td>
</tr>
<tr>
<td>7</td>
<td>Business Finance</td>
<td>F</td>
<td>T</td>
<td>2007</td>
</tr>
<tr>
<td>8</td>
<td>Business Finance</td>
<td>F</td>
<td>M</td>
<td>2018</td>
</tr>
<tr>
<td>9</td>
<td>Business Finance</td>
<td>F</td>
<td>M</td>
<td>2014</td>
</tr>
<tr>
<td>10</td>
<td>Business Finance</td>
<td>F</td>
<td>W</td>
<td>2014</td>
</tr>
<tr>
<td>11</td>
<td>Business Finance</td>
<td>F/M</td>
<td>Su</td>
<td>2008</td>
</tr>
</tbody>
</table>
The researcher collected data on the number of articles written per gender of the writer and found that 38 articles were penned by a woman—with 11 of those articles being written by
the same woman. An analysis of article publication dates revealed that Tuesday was the day of
the week where the most articles on the topic of this study were printed.

The dependent variables were tone, frequency, and story placement. For the purpose of
this study, tone is defined as the journalist’s view toward the subject matter. Story placement
refers to the section of the newspaper where the article was placed. Positive mentions included
those that gave the sense that there was either a hopeful shift away from the disparity of women
in computer science that exists and/or a conveyance that initiatives and programs exist to remedy
the comparatively low number of women in computer science.

Negative mentions are associated with coded phrases that suggest the disparity exists and
either nothing is being done to remedy the situation or girls and young women in computer
science are not experiencing their education or careers in a supportive environment. For
example, the headline “Colleges Chip Away at a Barrier Built on Gender” (Cain Miller, 2015, p.
A3), was coded as positive. The headline “Tech's Man Problem” (Cain Miller, 2014, p. BU1)
was coded as negative. There were 27 positive headlines, six neutral, and 14 negative.

The article body phrase “. . . diversify the images of scientists they see in the media . . .”
(Pollack, 2015, p. SR 3), was coded as positive. The body phrase “. . . pop culture depictions of
programmers – think Mr. Zuckerberg in “The Social Network” – have not helped dispel the
image of the typical coder as a “freakish, white boy genius stuck in a basement” from “Building
Careers in Programming,” (Wingfield, 2013, p. B4) was coded as negative.

Analysis of the frequency data produced an overview of the tone of articles about girls
and or young women, and computer science. As shown in Table 4, from the articles, 294
mentions of the coded concepts were negative and 239 were positive.
Table 4

*Code Frequency and Tone Within Articles*

<table>
<thead>
<tr>
<th>Concept/Code Word Within Body of Article</th>
<th>Frequency: Total Number of Mentions</th>
<th>Negative Tone</th>
<th>Positive Tone</th>
</tr>
</thead>
<tbody>
<tr>
<td>belonging</td>
<td>56</td>
<td>36</td>
<td>20</td>
</tr>
<tr>
<td>better</td>
<td>4</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>bias</td>
<td>20</td>
<td>20</td>
<td>0</td>
</tr>
<tr>
<td>curriculum</td>
<td>23</td>
<td>5</td>
<td>18</td>
</tr>
<tr>
<td>decrease</td>
<td>28</td>
<td>28</td>
<td>0</td>
</tr>
<tr>
<td>degree</td>
<td>30</td>
<td>19</td>
<td>11</td>
</tr>
<tr>
<td>enrollment</td>
<td>47</td>
<td>24</td>
<td>23</td>
</tr>
<tr>
<td>exposure</td>
<td>56</td>
<td>9</td>
<td>47</td>
</tr>
<tr>
<td>increase</td>
<td>15</td>
<td>0</td>
<td>15</td>
</tr>
<tr>
<td>inequity</td>
<td>71</td>
<td>65</td>
<td>6</td>
</tr>
<tr>
<td>interest</td>
<td>28</td>
<td>7</td>
<td>21</td>
</tr>
<tr>
<td>policy</td>
<td>2</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>progress</td>
<td>5</td>
<td>5</td>
<td>0</td>
</tr>
<tr>
<td>recruit</td>
<td>55</td>
<td>10</td>
<td>45</td>
</tr>
<tr>
<td>role model</td>
<td>37</td>
<td>7</td>
<td>30</td>
</tr>
<tr>
<td>stereotype</td>
<td>48</td>
<td>48</td>
<td>0</td>
</tr>
<tr>
<td>worse</td>
<td>8</td>
<td>8</td>
<td>0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>533</strong></td>
<td><strong>294</strong></td>
<td><strong>239</strong></td>
</tr>
</tbody>
</table>

Phrases in the body of the articles were generally negative. The prevailing tone was positive when headlines were analyzed (see Figure 7).
Media Coverage of the Computer Science-Related Policies

In reference to the second research question—How, if at all, did the focus of print news media coverage about the education of girls and young women in computer science evolve from 2005–2018?—the researcher noted that, as shown in Figure 7, coverage of the topic saw a gradual increase from one article in 2005, no articles in 2006, and one article in 2007 to a spike to four in 2008. The years that saw the most coverage were 2013 and 2014, with eight and nine articles published respectively. The majority of these articles were about the effects of efforts made by academic institutions and computer science / coding organizations toward computer science education. After this, there was a sharp decline in the number of articles in 2015–2017 to six, three, and two, respectively. The year 2018 saw an upturn with seven articles published about girls and young women in computer science. One article in 2015 mentioned policy about computer science hiring and one article in 2016 was dedicated to education policy.
In reference to the second research question sub-question: How, if at all, did the print news media coverage of computer science related policies evolve from 2005–2018?—the researcher noted that there was no attention given to policy until 2015. The attention was short-lived; The two articles that mentioned policy were written in 2015 and 2016. Though a small number of articles were yielded given the search terms, the researcher found it relevant to present these limited findings as they may have valuable implications.

In reference to this study’s first research question—How did the print news media cover the education of girls and young women in computer science from 2005–2018?—the researcher identifies various narratives about efforts toward addressing the topic of the gender gap in computer science that fell into the categories of (a) Curriculum (b) Efforts to Address the Gap by Academic Institutions and Organizations (c) Diversity Issues and Stereotypes (d) Existing Inequity / Sexism (e) Industry Efforts to Address the Gap (f) The Myth of Sexism (g) Policy.

In general, articles (a) stayed the narrative that “there is a gender gap with clear causes and parents, teachers, guidance counselors, school districts, states, and the Tech industry need to do something about it” and (b) infrequently presented an opposing narrative suggesting that labeling the gap—caused by what some say is girls’ and women’s lack of interest in computer science—as a disparity caused by inequity undermines girls’ and women’s ability and right to choose what suits them best.

**Belonging**

Articles addressing the concept of belonging with statements such as: “The contributing factors are many, including a culture inside companies that makes women feel unwelcome” (Cain Miller, 2014, para. 19) highlight a critical issue within the computer science industry concerning the experiences of women and the workplace culture within technology companies. This sentiment is also echoed by girls in K–12 classrooms as evidenced by the testimonial of a
student who was interviewed for Natasha Tiku’s 2014 article “How to Get Girls Into Coding.” The student said, “I was one of two girls in the [after-school robotics] class. We kind of had to fend for ourselves” (p. SR4).

A young woman interviewed for Cain Miller’s 2015 article “Making Computer Science More Inviting: A Look at What Works” reflected, “Before, I kind of thought computer science was potentially an isolating field where I’d work by myself all day, but actually you get to work with other people and get exposed to different ideas” (para. 15). These articles reinforce the notion that lack of a sense of belonging has the long-term effect of low enrollment rates and attrition, which negatively affect the number of women who hold computer science jobs. Addressing the sense of a lack of belonging with a concerted effort has benefitted institutions and workplaces. In the articles that mention the sense of lack of belonging, the authors reveal lack of a sense of belonging as one of the reasons girls and young women do not choose to take classes in computer science and why there is attrition in colleges/universities. The narrative is that a sense of lack of belonging is intricately tied to the male-dominated culture and climate of classrooms and workplaces that keep girls and women on the outside.

Better

The researcher expected that this code would emerge many more times. The concept of “better” is woven throughout every notation of percentage growth, enrollment boost, degree attained, and technology industry position secured—as long as those figures are higher than a prior measurement. “Better” can also be used in a negative phrase and when this occurs, the meaning of the message changes as well. For example the Editorial Board of The New York Times wrote the article “Silicon Valley's Diversity Problem” (2015) and stated, “. . . the proportion of women and minorities in these types of [computer science and engineering] jobs is not much better than the proportion in technical positions” (p. SR10). While this code either
echoed the sentiment of the disparity or showed an improved state of girls and women in computer science, the researcher found that it did not yield enough results to stand alone with distinct value.

**Bias**

In this study, the concept of bias addressed in the articles presented as societal attitudes and perceptions that influence how individuals such as parents, teachers, and guidance counselors, perceive the capabilities and interests of girls and boys differently. Gardiner’s 2013 article with the headline “Computer Coding: It’s Not Just for Boys” stated, “Subtle, even unconscious bias can prompt parents, teachers and guidance counselors to give the sexes different study and career advice” (para. 19). Articles echoing this sentiment suggest that these biases may not be overt or intentional, but can manifest in subtle ways, such as steering girls away from computer science-related fields based on gender stereotypes or assumptions. Bias can perpetuate gender disparities and contribute to the underrepresentation of women in classrooms and in the workforce. The narrative of print news media is that addressing these biases promotes diversity and inclusion in the field.

**Curriculum**

In “Making Computer Science More Inviting: A Look at What Works,” (2015) Cain Miller highlights The University of Washington's efforts to “make computing more accessible and inviting to a broader range of people” (para. 10). The university, like others mentioned in the article, made concerted efforts to break down the barriers to computer science—one effort in particular at this university was giving the curriculum a “makeover.” The author does present a one-liner that opposes the idea of modifying curriculum: “The focus on recruiting and retaining women might increase their numbers but also singles them out, say some critics of programs that
change curriculum to attract more women or offer classes specifically for women. Students often say they want to be seen as a computer scientist, not a female computer scientist.”

Dean (2007, p. 17) presented an opposing opinion about the lacking relevance of the computer science curricula at The University of Washington in her article “Computer Science Takes Steps to Bring Women to the Fold.” One faculty member shared his view, saying the criticism about the introduction to computer science course was unfair because high school computer science courses mimic the traditional college computer science courses that favored the teaching of the programming language Java. Harvey Mudd College’s chairman of the computer science department held a similar perspective about changing the programming language from Java [to Python] and about making course material more accessible. In Hafner’s 2012 article “Giving Women the Access Code,” the department chairman was quoted as saying, “We realized that we needed to show students computer science is not all about programming. It has intellectual depth and connections to other disciplines” (p. D1).

Articles overall promoted either revamping existing computer science courses, expanding offerings, or offering introductions to computer science-related topics via K–12 after-school programs or camps. The print news media expressed that paying particular attention to curriculum and implementing modifications makes this entry point more accessible. Girls Who Code and Code.org are pro-computer science organizations collectively highlighted in three articles. One of the other points made about curriculum is that many K–12 schools lacked courses due to the lack of qualified and trained teachers available to teach the courses. Though this need was highlighted, Computer Science Education Week was not mentioned in any of the articles.
Decrease

In Rampell’s 2013 article “I Am Woman, Watch Me Hack,” she underscored the glaring statistics and the state of computer science when she reports, “The share of women in computer science has fallen over the years. In 1990–91, about 29 percent of bachelor’s degrees awarded in computer and information sciences went to women; 20 years later, it has plunged to 18 percent” (p. 14). This decline in the share of women earning bachelor’s degrees in computer science over the years reflects the persistent gender disparities within the field. Despite advancements in technology and increased awareness of diversity issues, women continue to be underrepresented in computer science education and careers.

Lost potential and innovations when there is a decrease in the presence of women is the concurrent narrative expressed across various news articles. The decreasing representation of women in computer science means that a significant portion of talent and potential contributions to the field is being underutilized. Diversity in perspectives and experiences fosters innovation and creativity, and the absence of women in computer science limits the industry's ability to address complex challenges and develop inclusive solutions. The economic implications of this on both the individual and societal levels are significant. Though the print news media did not explore the individual level of potentially lost lucrative opportunities, it did present the notion that society as a whole misses out on the benefits of a diverse and inclusive workforce.

Degree

In 2007, Dean wrote “. . . graduate degrees in computer science, only 17 percent of the field’s bachelor’s degrees in the 2003–4 academic year went to women.” Her article “Computer Science Takes Steps to Bring Women to the Fold” (p. 17) explores what educational institutions are doing to change the landscape of the amount of female computer science matriculants and graduates.
The New York Times frequently mentioned degree attainment of women in computer science to illustrate that women are earning less degrees than men. Fewer graduates has historically meant fewer members of the computer science-related workforce who are women. Though the vast majority of mentions were negative, when covering individual colleges and universities that have computer science initiatives in place, decrease was not highlighted. The gender disparity is emphasized with the statistics that show that women have changed positions when it comes to computer science. The articles do not explore the history of computer science by explaining that “computers” were once women who served as human calculators.

The print news media paints the picture that there has been a decline but does not state women’s position in the field before the decline. In “How to Get Girls Into Coding,” Tiku (2014), when referring to coding literacy, wrote, “Last year, girls made up 18.5 percent of AP computer science test-takers nationwide, a slight decrease from the year before. In three states, no girls took the test at all” (p. SR4). The article attempts to explore this decrease and its possible causes such as lack of interest, lack of palatable computer science education delivery methods such as gaming, and bias.

Enrollment

A core causal component of the gender gap expressed during 2005–2018 articles is the declining enrollment of girls in AP computer classes and young women in college-level courses. Pollack (2015) writes, “Female college students are four times less likely than men to major in computer science or engineering, even though they test extremely well in math” (p. SR 3). The writer goes on a mission in “What Really Keeps Women Out of Tech” (2015) to figure out why females are not studying computer science. Enrollment disparities are closely linked with whether or not girls and young women feel comfortable in the classrooms where they sit for class. The chilly climate of male-dominated spaces is often a deterrent and affects enrollment.
The disparity in college majors represents a leakage in the STEM education pipeline for women. Even though female students may excel in math and science, they may encounter barriers or lack encouragement to pursue advanced studies and careers in computer science and engineering. Educational institutions have tried a few things to positively affect enrollment such as starting after-school activities and camps; taking students on college tours with tours hosted by females; including female faces on brochures; and revamping college courses to make them more accessible to those who have limited or no experience.

**Exposure**

The issue of lack of exposure is expressed as a narrative across many articles. Without the opportunity to try coding for themselves, many girls will never be exposed to computer science. “Most young people . . . simply don’t come into contact with computer scientists and engineers in their daily lives,” writes Rampell in “I Am Woman, Watch Me Hack” (2013, p. 14). Her article highlights the benefit of a female teenager attending an eight-week computer science program with the nonprofit organization Girls Who Code; the program led to her aspiration to major in computer science. Rampell surmises that exposure via computer science courses, out-of-school programs, and movies and TV shows impact career choices. This conclusion is echoed across all articles that mention media influences.

Lack of exposure means females may not fully understand the breadth of opportunities available in computer science fields. Across several articles, Girls Who Code was mentioned the most of any K–12 focused program. *The New York Times* did not say that any one organization or company needed to do more or less to promote the growth of girls and women in computer science. The newspaper was objective in publishing articles that highlight different vehicles for exposure. Discussions across articles highlighted the need to address the lack of exposure to
computer science and engineering professionals as a critical barrier to increasing diversity and representation in the industry.

**Increase**

“Thirty percent of University of Washington bachelor's degrees in computer science last year went to women. Ed Lazowska, chairman in computer science and engineering at the university, called that share ‘not great.’ Still, it is twice the national average and up from 20 percent in 2010 and 15 percent in 2005” (Cain Miller, 2015, p. A3). Few articles highlighted an increase in enrollment and degree attainment. The articles that did highlight an increase also shared best practices for driving this positive change.

This improvement reflects efforts to address gender disparities and create a more inclusive learning environment within the university. The university's initiatives may be more effective compared to other institutions and as such, these exemplary initiatives are a call to action. Other articles that show universities boasting increases serve as models of progress. Challenges are recognized and this is a demonstration of the growth that is still needed as it regards girls and young women in the field of computer science.

**Inequity**

Inequity is the theme that runs through every article. Cain Miller (2013) wrote, “Even though women represent more than half the overall workforce, they hold less than a quarter of computing and technical jobs . . . ” (p. F10). Across the bounded time frame, the print news media reported the persistently alarming statistics, continued to sound the alarm on this issue, and framed it as a national crisis.

Gender disparity within the computer science industry and broader technology sector was presented as having treatable causes. Once eradicated, these causes would reduce the missed opportunity of having valuable diverse perspectives, talents, and skills utilized in the industry.
While a couple of articles challenged a narrative that painted causes of the disparity as sexist, there was no refuting the accuracy of prevailing statistics that illustrate inequity. The print news media made it clear that inequity for girls and young women meant inequity for society as a whole and reinforced the notion that all stakeholders have a responsibility to remediate this.

The topic of inequity in hiring and promotion was significantly highlighted in two articles. This has not been discussed greatly by the print news media as a cause of the lack of women in computer science. But when a small, opposing voice was amplified, the message was that the sexism-laden plight of girls and young women was limited to outdated data and did not represent the masses. The New York Times article by Williams and Ceci (2014) explained, “That’s not to say that mistreatment doesn’t still occur — but when it does, it is largely anecdotal or else overgeneralized from small studies.” Articles with this narrative pointed to other reasons for the underrepresentation (p. SR12).

**Interest**

Girls’ and young women’s interest in computer science is described by the print news media as one of the causal factors that affect their presence in computer science. If girls and young women are interested, they will pursue the discipline and career, but if there is no interest, they are absent. This interest is cultivated via exposure to computer science and to positive role models in everyday settings. Rampell (2013) shares an anecdote about a 16-year-old girl and her experience with a coding camp. “. . . she was skeptical; she didn’t really understand what computer science was. The [camp] experience, however, got her hooked on coding . . . ” (p. 14). Dean (2007) shares her conversation with a computer scientist who also doubles as dean of sciences at the Radcliffe Institute for Advanced Studies at Harvard. Of bygone days, the dean said, “Students entered college with little idea of what computer science involved, so they would try it and find out how much fun and how interesting it was, women included” (para. 20). This is
in stark contrast to more recent times. Now, because of the media’s large impact, stereotypes and wrong messages can thwart or dampens girls’ interest in computer science. When detailing steps the University of Washington is taking to diversify the computer science student roster, the chairman in computer science and engineering was quoted by Cain Miller (2015) as saying, “The first [step] is to get girls interested in computer science early on, by teaching elementary and high school teachers and students about computing through workshops and field trips” (p. A3).

The lure of lucrative careers has not been enough to combat the dissuasive power of the aforementioned possible causes, but Tiku (2014) reports that “some educators now believe that gaming could be a way to get girls interested in coding” (p. 4). A prevailing supposition is that girls are more likely interested in computer science when there is a link to something familiar and/or comfortable. Pollack (2015) referenced work by Sapna Cheryan, psychology professor at the University of Washington who, along with fellow colleagues, found that a sense of belonging in the physical classroom is also tied to interest.

**Policy**

The only article that focused on national policy about changing the face of computer science instruction from a federal level announced that “President Obama will call for spending $4 billion to help states pay for computer science education in the schools” (Shear, 2016, p. A16). Teacher training within the five-year period was to begin January 2016. No other articles collected from 2015–2018 reported on these efforts.

This signifies a commitment to expanding access to computer science education for all students, which includes girls. Though there was an undercurrent message woven through all articles that girls and young women should be encouraged to pursue and have access to a
computer science education, limitations of socioeconomic status, and geographic location were not addressed toward bridging the gender gap.

Federal policy conversation, as addressed in this article, and changes at individual institutions, which may or may not be considered policy changes, did not permeate *The New York Times* articles. Articles that mentioned or focused on girls and young women were the focus of this study so other articles that painted broad strokes of the need to educate all in computer science were not relevant to include.

*The New York Times* reported that President Obama was “. . . sending $100 million directly to school districts to help start computer science education programs” (Shear, 2016, p. A16) and this was a significant impetus to report on; many other articles pointed to the disparity of girls and young women in computer science, but they did not always point to a solution. Articles that spotlighted programs and institutions that were actively addressing the issue effectively heralded those programs and institutions as champions before the issue attracted federal attention and subsequent funds to support policy changes were allocated.

**Progress**

The concept of progress can be captured through more than one code. For example, increased enrollment, a stronger sense of belonging, and greater exposure to role models can be perceived as progress. The researcher wanted to capture the word to see if articles were using it to describe the improved state of girls and young women in computer science. It was not used many times. In “Opening a Gateway for Girls to Enter the Computer Field” (2013, p. F10), Cain Miller reports on the progress the organization Girls Who Code is making toward recruiting girls for its camps and clubs. Hafner (2012) quotes a professor at Harvey Mudd College as saying, "It [computer science] must be the unique area of science and technology where women have made
negative progress” (p. D1). Similar to the concept of “better,” “progress,” while inherently meant to demonstrate growth, can be used in a negative way and contribute to a negative tone.

**Recruit**

The print news media suggested that recruiting starts early. Articles were laden with narratives about developing interest in computer science through classes offered in grades K–12; exposure through after-school and out-of-school programs; female role models, campus tours, revamping introductory courses, improving media images, and education institutions making concerted efforts to bring young women through the tech pipeline and into the workforce. The print news media presented (and essentially praised) institutions such as Harvey Mudd. “Harvey Mudd revised its recruiting brochures to show photos of women, and it hired women as campus tour guides” (Cain, 2015, para. 9). Apparently, these recruiting efforts converted into higher enrollment and degree attainment numbers. Profiles of colleges and universities coupled with anecdotes from female students and staff members spread across 30% of the articles in this study and were focused on initiatives of schools and organizations to recruit girls and young women into computer science. These articles did not contain the only mention of efforts by academic institutions and organizations. Other articles highlighted that technology companies weighed in on closing the gender gap in computer science.

**Role Model**

The narrative of the gender gap in computer science was supported by journalists reporting that not having role models was cited as one of the causes for the gender gap. Tiku (2014) wrote, “. . . interacting with women who use computer science in their professional lives gives them an idea of something to go after . . . ” (p. SR4). This fact was not reported as the case in many articles. If the article profiled a school or featured expert testimony, having a role model was cited. Cain Miller’s 2015 article profiled a female student at the University of Washington and
on the topic of community building, Cain Miller reported that the student said, “After she took the first introductory class, the professor emailed her to encourage to take the next one” (p. A3). The university revamped its program and “forty percent of the teaching assistants are women” (p. A3). This article also mentioned Carnegie Mellon starting “a formal mentorship for women studying the subject, since they were often excluded from the male students’ informal networks” (p. A3). Other journalists reported on computer science camps and programs that highlight the value of role models and mentors, and on the visual messaging of various programs that featured women. This visibility of role models supported the popular mantra: you can’t be what you can’t see.

**Stereotype**

The conversation in the print news media about stereotypes was constant and the message was a pervasive one. The message was that stereotypes portraying computer scientists as predominantly male, socially awkward, and lacking interpersonal skills can deter girls and young women from pursuing classes and careers in computer science. Pollack (2015) reported, “Cultural stereotypes about computer scientists strongly influenced young women’s desire to take classes” (p. SR3). In another article by Rampell (2013) regarding the factors that create barriers for women, she reported, “A study financed by the Geena Davis Institute on Gender in Media found that recent family films, children’s shows, and prime-time programs featured extraordinarily few characters with computer science or engineering occupations, and even fewer who were female” (p. 14). TV shows and films, as well as video games, perpetuate gender bias within the computer science industry, contributing to the underrepresentation of women in the field. Every article that mentioned the public image of computer scientists, suggested that stereotypes that associate computer science with masculinity can reinforce societal norms and
expectations that discourage girls and young women from pursuing interests and careers in technology.

The print news media presented individual anecdotes from girls who were hesitant to enter the field of study or women who left the field due to not fitting into the male-dominant culture and not feeling they belonged. Stories additionally discussed how stereotypes about who technology business owners and high-ranking executives are can challenge the professional growth of women.

Worse

The narrative of The New York Times is that women’s place in computer science is vastly different now than in 1985, the peak year in the number of computer science bachelor’s degrees being granted to women as per the National Science Foundation (Dean, 2007): “. . . many in the field say, the situation has worsened. They say computing is the only realm of science or technology in which women are consistently giving ground,” wrote Dean (2007, para. 3). The concept of being in a worse position begs a comparison to a time before when there was prosperity or abundance, and/or comparison to another group. In this case, the group is men.

Journalists identify a troubling trend and compare the achievement of girls to that of boys while in K–12 settings, saying that girls do well in math and science, but when it comes to majoring in computer science, things change. Cain Miller (2013) reported, “. . . the need is most urgent for girls, said Reshma Saujani, who founded Girls Who Code last year. Roughly 74 percent of girls in middle school express an interest in engineering, science and math, she said. But by the time they get to college, just 0.3 percent choose computer science” (p. F10).

Women are considered to be in a worse position for thriving in institutions because men have more informal support due to the “bro culture” according to statistics about declining enrollment, attrition at the postsecondary level, and “leavers” of the field (Cain Miller, 2013,
Cain Miller wrote “Tech’s Man Problem” (2014) and reported that “among the women who join the field, 56 percent leave by midcareer, a startling attrition rate that is double that for men, according to research from the Harvard Business School” (2014, p. BU1).

These statistics mute opposing voices that say women leave computer science to a lesser degree when compared to other non-math-intensive fields. Overall, the print news media’s message is that the state of women in computer science has worsened and this suggests: existing efforts to address gender disparity in the industry have not been effective or have not kept pace with the evolving challenges; there is a concerning trend of declining representation of women in the computer science industry; this worsened state underscores the need for concerted efforts to address gender disparity, promote inclusivity, and create opportunities for women to contribute meaningfully to the field.

The Magnitude of Inequity

Overlaps of coded concepts occurred when codes were used on the same passage of text. Codes are displayed as ‘rings’ (see Figure 8) based on how many times their codes overlap with the center code. The closer the code is to the center code, the more times both codes were used to code the same passage of text—indicating that more than one concept is addressed in that passage of text. The more overlaps there are suggests the passage is dense with a message to the reader. For example, “inequity” very frequently overlapped with “degree” and “enrollment.” Within 55 mentions, “exposure” overlapped with “role model.” “Curriculum” did not frequently overlap with other coded concepts. Though “worse” was mentioned significantly lower than a priori coding suggested it would be, it was often mentioned with “enrollment” within the same article.

The finding that “inequity” emerged as the most frequent concept confirms the narrative of The New York Times as it relates to computer science education and girls and young women.
The print news media presented this topic as a national crisis and weaved in other elements of the crisis such as low enrollment in computer science majors and degree attainment. These connections tell the story of the 2005–2018 time period and the messages being transmitted to the public. Expert testimonials and anecdotes of girls and young women experiencing the crisis presented an overall negative tone about the topic. But *The New York Times* sifted in enough of a positive tone to the articles to express that there was hope for remediation of the inequity.

**Figure 8**

*Overlap View: Inequity*
Summary

In Chapter IV, a conceptual content analysis of the narratives about girls and young women published in *The New York Times* was conducted. The chapter detailed how the coded concepts emerged in the articles in terms of frequency and placement, and how they formed a message across all articles within the period of 2005–2018. The tone of the headlines and text in the body of the articles was also tabulated and analyzed as well as other characteristics of the articles. Chapter V contains a discussion of the implications of the findings as well as recommendations for future research.
Chapter V
Discussion

The findings in Chapter IV show how The New York Times covered the topic of girls and women in computer science in a mostly anecdotal manner. The articles provided statistics, but also included quotes from interviews with girls and women and anecdotes of their experiences within classrooms and in workplace settings. Industry professionals and education professionals were also interviewed. The findings showed high frequency of the concept of inequity; positive tone of the article headlines; negative tone of the body of articles; and predominance of the female gender amongst the authors. All of these variables—individually and/or collectively—can affect an audience's perception of the topic.

As newspaper headlines have a communicative function, the tone of a headline may impart a positive, neutral, or negative perspective about the article’s content. This study does not seek to measure the impact of the article headlines for stories, but highlights that there may be an impact on readers, influencing them to think positively, negatively, or neutrally about the subject matter and therefore react to or act on what they have read. The article headlines were largely positive, while the contents were largely negative. Headlines like “Computer Science Takes Steps to Bring Women to the Fold” (Dean, 2007, p. 17) impart a hopeful message about the presence of girls in computer science while headlines like “Microsoft C.E.O. says Tech’s progress on gender equality is ‘not sufficient’ ” highlights a persistent disparity.

Only two articles directly mentioned what translated to a national, government supported initiative regarding computer science. Other articles discussed curriculum and the suggestion that a change in the breadth of computer science course offerings would benefit girls and young women in computer science. Still other articles loosely alluded to the possibility of computer science counting toward high school graduation requirements. There was an uptick of positive
mentions in 2013 and negative mentions in 2014. This finding may be connected to the fact that the organization Girls Who Code started in 2012 and Code.org was founded in 2013. There was a launch of the global Hour of Code in December of 2013. The first Computer Science Education Week (CSEdWeek) was launched by the Association for Computing Machinery (ACM) on December 6–12, 2009, but there was no mention of this initiative in any of the articles.

Implications for Policy

The findings of this study shine a light on the conversation surrounding the education of girls and young women in computer science. The possible effects of the level of attention toward what has been framed as a critical initiative are vast. The print news media says that with concerted efforts, effectively exposing girls to computer science, coding, and computational thinking is an important first step. Highlighting the importance of role models and society’s onus to eradicate stereotypes of computer scientists that discourage girls, *The New York Times* has effectively made the point that underrepresentation of women in computer science is a syndrome that starts at home and in K–12 academic settings. The study found that the print news media spoke in great abundance about the inequity in the field. The print news media presented the voices of girls and young women who have suffered from the lack of computer science curricula and learning environments that cater to their interests and needs during the learning process. The print news media echoed a national call to action to effectively and comprehensively train educators to teach computer science courses across the nation, and in doing so, the United States and the world would benefit from talent that was cultivated on U.S. shores.

But the echo of the call-to-action was faint during the 13-year bounded time frame of 2005–2018. In 2015, President Barack Obama partnered with organizations and institutions to allocate efforts and monetary resources toward the initiative to hire more Tech employees from the U.S. talent pool and to grant access to computer science for all. From 2015–2018, the number
of articles about the education of girls and young women in computer science dwindled greatly and the conversation on this topic by *The New York Times* nearly hushed. It seemed the prior swell in numbers was attached to the presidential mandate and initiative of organizations such as Code.org and Girls Who Code. While those organizations still carried out their missions, the conversation in *The New York Times* quieted. The public did not find out if individual states revamped their education policies and offerings. The public did not hear about policymakers launching new initiatives or continuing to fund past initiatives.

Policymakers and practitioners can use the information in this study to begin the conversation again or continue it more loudly. Communicating the successes of past programs and presenting national goals that were reached would be an effective way to keep the subject top of mind for all stakeholders because computer science has not become any less relevant and marginalized groups still exist. Policymakers and practitioners can continue to reach out to underserved communities and untapped talent to ensure underrepresentation due to lack of access is no longer a cause of the inequity that was unearthed through this study.

**Implications for Research and Practice**

This study was an effort that can be used to conduct continuous research on the education of girls and young women in computer science. The researcher had not found research studies such as this when the study was embarked upon. This study is an example of how looking at the content of print news media is critical to implementing changes in various industries. This research has brought to light that the grand effort of educating this population of the United States is being carried out by non-profit groups as well as for-profit groups. Some believe that it may not be necessary to teach everyone to code and we should teach only those who are interested in it. This study has shown that interest is not always innate—TV and film play a large part in educating youth. Putting sound educational practices in place for students and teachers
must also be linked to responsible representations by our TV and film companies, rather than perpetuating isolating and limiting stereotypes.

**Future Research**

*The New York Times* newspaper (print and online) was the only publication used for this study. Using additional newspapers and other forms of media in future research would capture a broader conversation with the public. Some such additional sources would include radio, magazines, television, or other online news sources. Additionally, the inclusion of International Edition articles may have added to the corpus and may have provided additional relevant data and perspective. Replication of this study on a larger scale with a more diverse body of publications would yield a more diverse sample size, representing more of the public. The coding protocol yielded a small number of articles over the 13 years. This could support the hypothesis that conversation about this subject matter was limited and the disparity of girls and women in computer science is a reflection of this limited conversation. Future studies might remove some of the exclusion criteria. Also, expanding the years in the longitudinal analysis might show more trend data about the subject matter. Additionally, the coding protocol could be refined by coding for additional concepts and the process might benefit from and be improved by including more coders and rounds of trial coding.

Including articles published in languages other than English may have produced a more robust sample size. Future research might also include articles that focused on Black and Latina girls and women. The intersectionality of gender, race, and ethnicity could possibly tell more of the story of the apparent inequity in computer science. Tuesday was the day of the week on which most of the articles were published. It is not clear whether there was a relationship between this fact and the tone of the content of the articles. A future study could examine this relationship.
The researcher has presented the results of researching the media content about the education of girls and young women in computer science. There have been studies covering gender differences, stereotypes, motivation experiences, perceptions, and barriers—all relating to either being female, female and Black, or female and Latina. No studies were encountered that specifically conducted a content analysis about being educated in computer science as a girl or young woman.

The problem presented by print media discourse is that there are not enough females in computer science and other STEM fields—a gender gap exists (NSF, Science & Engineering Indicators, 2016; Fisher & Margolis, 2002). Media portrayal of computer scientists and policy surrounding the education of girls in the discipline of computer science are at the root of this gap. Knowing how the media is discussing this perceived gap, which stems from whether or not girls are being educated in computer science and how they are being educated, is applicable to policymakers, school districts, parents, girls and young women, women who are changing careers, technology companies, and other groups among the masses for varied reasons. All groups are somehow affected by educational policies and how they are acted upon and discussed.

Parents receive cues on education policies and topics from print media (Hobbs, 2004). This content analysis study examined how the public discourse, using print media, possibly influenced the education of girls and young women in computer science. This research will help parents understand the importance of advocating for computer science classes in their child's school and/or seeking outside-of-school opportunities for their girls and young women in the field of computer science. Advocating to policymakers about allowing computer science to count toward graduation credits is another application of this study.
Teachers and staff can benefit from this study because it encourages them to advocate for the inclusion of computer science skills in the curricula and motivates them to become certified in the growing high-needs area of computer science, or simply include computer science in classroom career discussions. Baker et al. (2008) posited that teachers play a pivotal role in the trajectory of students during the formal schooling experience.

Technology in contemporary society is ever-evolving. The developments of and at technology companies inform print media, but it is a symbiotic relationship (St. Clair, 2015). Technology companies often innovate or partner with schools based on what print media is reporting about the activity and partnerships of other companies.

Community members need to know how to fill in the “gender gap” through programming using institutions such as churches and community centers. This research topic is important to educational policymakers and school districts—both of which consider the other in the planning of the best use for state funding toward achieving national educational goals.

This study has an application to government bodies. Governments must continually be aware that the computer science education of diverse groups such as girls and young women positively informs the range of innovation and the depth of inclusion for various populations and relatability of this innovation for various populations. Computer science education requires diverse practitioners, including women (Nadler & Atkinson, 2016). Findings further support funding for computer science education toward preparing students to be globally competitive in job markets and to be participants in global innovation.

This study is applicable to society. It benefits society to care about what the media says about this topic because public discourse influences topics discussed by the media and because the media is directly involved in shaping public perception (St. Clair, 2015). As society becomes
more inclusive, it remains critical that the media is conscientious about how conversations surrounding gender are held. This discourse often leads to local, state, and national changes in existing policies and the establishment of new policies.

Enrollment in computer science classes at the high school level is predicated on computer science course offerings. Research says that as interest in computer science is sparked in lower grades, the taking of formal classes in high school further develops that interest, increasing the chances of young women pursuing computer science degrees after secondary school, thus increasing the probability of young women entering the computer science field (AAUW, 2010). What the media says about computer science affects this probability. As such, exploring print news media via a content analysis offers a unique approach to understanding computer science education of middle and high school girls.

There is an underrepresentation of women in the computer science field. Understanding what is occurring in media discourse about the computer science education of elementary, middle, and high school girls and young women in college due to prevailing policies is critical to understanding how the representation of women in the field of computer science is affected. As career perceptions are often shaped by the public presentation of said career and those employed within it, future research is important to further understand the factors that affect the end of the computer science education pipeline; an increase in the number of women working in the field of computer science.
References


Berelson, B. (1952). Content analysis in communication research.


