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What's in a name? A study of gendered language in IT program and course titles

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Abstract

The issue of gender inequity in STEM-related has been an ongoing problem for many years. Researchers have conducted many studies to determine why the gender gap still occurs in industry and in STEM based academic programs and have proposed many theories on how to fix this problem. Based on the previous research, there was little data found that speaks to the issue of wording used to attract females to STEM programs and courses. In this paper, we seek to determine why the gender gap still occurs in academic programs and courses by investigating Gender Word Preference for Academic Programs and Gender Word Preference for Academic Courses**.** The research included a survey collecting age and gender demographic data, and a series of questions asking about information technology-related programs and courses, focusing on the wording of the program, course titles and asking participants for their opinions and preferences regarding the wording selection. There was a total of 23 questions on the survey. Based on the research conducted, it is believed naming convention of courses and programs can also influence which genders it attracts. These results help to contribute to a greater understanding of the importance of knowing if females will be attracted to technology related fields and academic programs through courses and program descriptions and naming and helping to close the gender gap in STEM fields.

Keywords: STEM, gender equity, gender participation, equity, gender gap, gender inequity, information technology, technology

Introduction

For decades, there has been a gender gap in STEM based fields that have reduced the number of females that register for these courses or complete their affiliated programs. In turn, this gap reduced the population and diversity that is available for STEM based careers which can present an overall burden as organizations grow their staff. Current and past research continuously seeks to focus and understand the issue of gender inequity around STEM. Research conducted by de Las Cuevas, et.al. (2022) validated a decline for women pursuing STEM fields and classes in college. Amongst the multiple findings that was found to contribute to the issue, one that stood out includes "As the courses run, the number of women in technical tracks decreases" (p. 5). Yates et al. (2022) adds that women prefer more communal type classroom environments which may not always be found in a STEM based program. This communal approach to learning is important for women learning STEM disciplines and helps to determine their success in their field. "Another approach focuses on reducing stereotypes and encouraging feelings of identity and belongingness" (Freedman et al., 2023, p.3). So, how does higher education align the correct STEM

programs or courses in order to attract and retain gender equity in STEM programs? One area where there seems to be little research is around the naming of programs and courses. Falkner et al. (2015) investigated the issue of diversity in computer science in academia and how female professors can help guide and attract female students into STEM programs. Vrieler et al. (2022) adds that many instructors of technical disciplines are not fully prepared to adapt to diversity in their field and need to have a better understanding of how to create greater appeal to a more diverse pool of students. "Since the instructors' background in technical education does not prepare them for teaching, they lack training in diversity-conscious pedagogy and critical understanding of how learning communities, regardless of their formal or informal nature, are transmitters of the dominant culture" (Vrieler et al., 2022, p.5). In another study, Varoy et al., (2023) identify the perception of differences in "digital technologies" between male and female students by teachers and their ability to share helpful insight on classroom performance. "Understanding gendered differences in early computing classrooms may help to reveal strategies that mitigate the factors that contribute to gender imbalance" (p.70).

This study investigated the challenges surrounding the gender gap in academic STEM programs with a focus on information technology-based programs and courses. Part of this research considers the naming of programs and courses and how the perception of an information technology-based program or course can deter or attract female students.

Previous studies have found that gendered wording in job advertisements impacts whether women are attracted to a job (Hentschel et al., 2020; LinkedIn, 2019; Gaucher et al., 2011; Newman et al., 2008). Therefore, it stands to reason that gendered wording may also play a role in attracting women to information technology-related programs and courses. In the context of this study, the authors hypothesize that gendered wording in relation to information technology-related programs and course titles could include words such as "science," "cyber," and "computer." This study aims to explore perceptions of gendered wording in information technology-related program and course titles, and proposes two primary research questions:

RQ1: *How does gender impact wording preference for information technology-based programs?*

RQ2: *How does gender impact wording preference for information technology-based courses?*

Literature review

The drawing shown in Figure 1 provides the backdrop to the ongoing discussion about gender disparities in STEM education. "A teacher's drawing of their ideal Digital Technologies student. The depiction of a young girl was chosen by the teacher to highlight the shortage of girls entering Digital Technologies and to encourage girls that this is a possible future career" (Varoy et al., 2023, p.1). In their recent study, Varoy et al. (2023) discuss differences of confidence and risk-taking levels between male and female students with recommendations of developing risk-taking skills through encouragement of accepting failure and building confidence in not only taking risks but creating knowledge in technical skills (p.75). It focuses on teacher encouragement and creating a female perspective around developing these skills as it may be difficult for female students to envision a career in STEM. Even though females are just as capable in technical areas, they may not choose a STEM based career because it may not align with their needs for fulfillment in a career. "Experiences and interactions in these contexts illuminate individuals' personal values, goals, social identities, competence to succeed, and connection to others. Over time, these sociocultural experiences accumulate to inform the development of cognitive ability and motivation, which in turn influence career choices" (Wang et al., 2016, p.120). Focusing on the softer side of a STEM career

by promoting level of enjoyment, creativity, innovation, satisfaction, and community in their career would be helpful in attracting females to STEM disciplines.

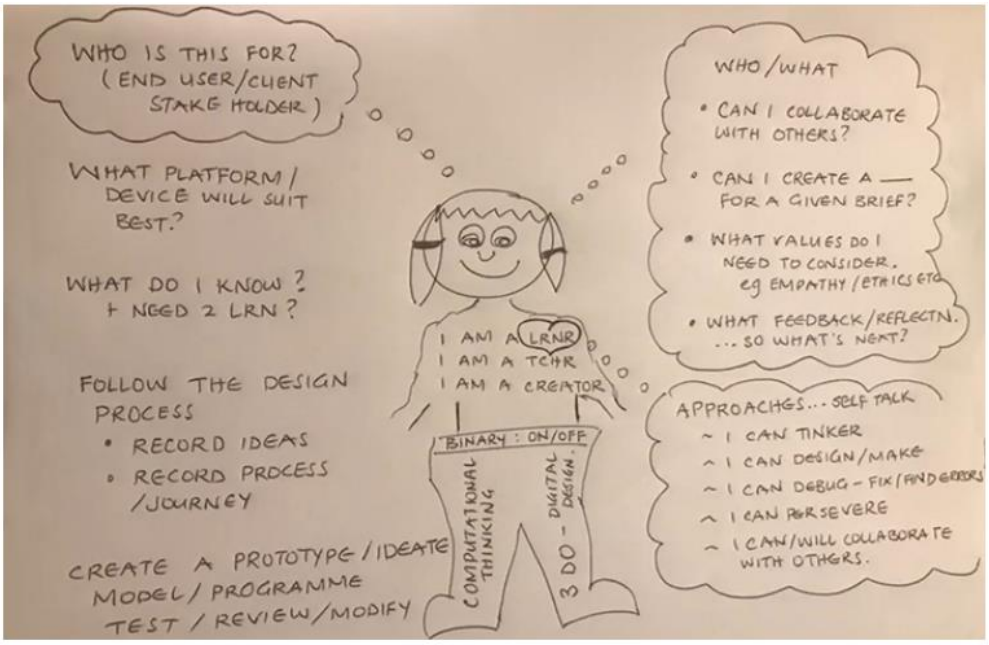

Figure 1: Ideal Digital Technologies Student

A study conducted by Beyer, et.al (2003) surveyed 56 students enrolled in computing courses. The findings revealed that women's computer confidence was much lower than men. Female computing majors had less confidence in their computer skills than did male non-majors. This suggests that low computer confidence affects women regardless of level of computer experience. Low computer confidence among women is a barrier to women's advancement in computing degrees and careers.

Positive self-perceptions of ability are intimately tied to aspirations, educational choices, preference for challenging tasks, intrinsic motivation, and persistence. Females with low computer confidence could decrease the likelihood that women will choose to major in computing and increase the likelihood that females will drop out of computing degrees. Encouragement and helping females obtain internships, teaching or helping as a lab assistant and other opportunities offered to them at the collegiate level can bolster their confidence in their technology skills (Beyer, et.al, 2003).

Researchers have found that a lack of female role models, lack of encouragement to enter STEM fields, and the belief that science and math fields are too difficult, boring, and inflexible when it comes to work-family balancing have led females to lose interest in science and math at a young age (Lavorata, 2017; Farland-Smith, 2009). Weinberger (2004) found that many young women perceive the work required to become a computer programmer or engineer as more difficult than the work required to become a surgeon. There are also many stereotypes about information technology fields that are still pervasive today, such as the idea that information technology careers are only for social loners or computer "geeks" (Croasdell et al., 2011).

Stereotypes based on gender widely exist in the STEM field. One of the most well-known stereotypes is the low awareness of female academic competence (Koch, et.al., 2008). However, research has shown that gender stereotypes in the academic domain are often inaccurate (Beyer, 1999). Beyer surveyed nearly 300 college students and found out that despite higher GPAs by females in masculine majors, participants

believed that males have higher GPAs. Female students outperformed males with respect to academic achievements at both the high school and college levels (Fan & Li, 2005). A study of an introduction STEM course found that women who reported having less experience or programming skills outperformed men who reported having a high level of programming experience (Kadijevich, 2000) Women reported more stereotype-consistent perceptions than did men (Ehrlinger et.al, 2017).

Research focuses on ways to remedy the gender disparities in STEM degrees. A good start is to increase women's awareness and experience of computing when they are young (Kermarrec, 2014). A significant correlation between early computing experiences and success by females in a college computer course was detected in a study conducted by Taylor and Mounfield (1994). Sainz and Lopez-Saez (2010) believe that exposing females to computers early can reduce gender differences in computer attitudes. Outreach efforts should focus on ways to engage parents because the influence of family is found to play a critical role in encouraging females to enroll in computing degrees (Wang, et.al, 2015).

Another approach to remedy gender disparities in STEM degrees that has not received much attention in literature, but is the focus of this study, is the potential impact of gendered wording in the naming of program and course titles. Gendered wording has been shown to have impact when used in job descriptions, career development programs, and other recruiting materials for the workplace (Gaucher et al., 2011; Hentschel et al., 2020; LinkedIn, 2019).

Gaucher et al. (2011) studied the wording of job recruitment materials in order to determine whether gendered wording (which they define as wording associated with gender stereotypes) could be an institutional-level mechanism of inequality maintenance. They conducted experiments on job advertisements and hypothesized that masculine wording in a job advertisement could reduce women's interest in a job because it signals to them that they may not belong. They related this variable, called *anticipated belongingness*, with job appeal. Results of their study found that men showed only a slight preference for advertisements with masculine wording, and the wording did not affect men's anticipated belongingness. They also found that women were deterred from advertisements with masculine wording, and found those jobs less appealing than the same jobs advertised with more feminine wording. Women also had less anticipated belongingness for jobs with masculine wording in the advertisement.

Hentschel et al. (2020) conducted two experimental studies and found that stereotypically masculine wording negatively influences women's evaluations of career development programs. The sample for the studies included 329 university students (163 female, 166 male). Masculine wording in recruitment advertisements also resulted in women showing lower anticipated belongingness, lower expected success of a job application, and lower intent to apply for a job.

A report by LinkedIn (2019) on gender diversity looked specifically at language use in the workplace in relation to gender. The study found that 44% of women, compared to 33% of men, would be discouraged from applying for a job if the word "aggressive" was included in the job description. One in four women would be discouraged from working at a company that is described as "demanding" in the job description. The report also looked at "soft skills" and found that 61% of women associate the term "soft skills" with the female gender. However, 52% of men associate "soft skills" with the male gender. This shows that both men and women think that they are skilled at the soft skills, though women and more likely to showcase soft skills in their LinkedIn profile than men. The study found that while both men and women favored being described at work by the words "powerful," "strong-willed," and "confident," only women favored being described at work as "likeable" and "supportive."

Newman et al. (2008) conducted a study of over 14,000 text samples written by men (5,970) and women (8,353) and analyzed the language use by gender. They found that women were more likely to discuss people and what they were doing, and to communicate internal processes, including doubts, to others. The

list of words that women used more than men included words related to thoughts, emotions, senses, other people, negations, and verbs in present and past tense. Women also used more pronouns and more intensive adverbs. The authors found that men were more likely to use language as a "repository of labels for external events, objects, and processes" (p. 229). The list of words that men use more than women included words related to occupation, money, and sports. Men also used more articles, numbers, prepositions, long words, and swear words. Both men and women equally used language related to sexuality, anger, and time. There was no difference in the number of words, question marks, and qualifiers (but, though) used by men and women.

Methodology

The survey research method (Fowler, 2013) was used to collect data for this study. The population included adults aged 18 and older who live in the United States. An electronic survey published through Question Pro was used to collect data, and 376 responses were collected (n = 376). This study was approved by the university's Institutional Review Board.

Amazon Mechanical Turk (MTurk) was used for sample selection and distribution of the electronic survey. MTurk is a crowdsourced marketplace where people can choose to complete Human Intelligence Tasks (HITs) for payment. The marketplace is often used in academic research (Zhang & Gearhart, 2020; Redmiles et al., 2019; Lovett et al., 2018; Sheehan, 2018; Peer et al., 2017) where survey completion is considered a HIT. The marketplace allows for specific inclusion criteria, in this case age and location, to be enforced. Researchers offer compensation in a set amount for each HIT, and MTurk workers choose the HITs that they wish to complete. For short electronic surveys (approximately 5-10 minutes time to complete), the compensation offered is typically between $.10 and $.50 (Lovett et al., 2018). This survey had an average completion time of 5 minutes, and compensation was provided in the recommended range.

Zhang and Gearhart (2020) conducted an experiment to compare survey results from a paid commercial panel and MTurk, and found that despite the commercial recruitment industry's higher price, MTurk provided better data quality. While MTurk has sometimes been criticized due to concerns that some MTurk workers could be "professional survey takers" and not spend enough time or attention on survey questions, Sheehan (2018) found that MTurk workers were more successful in passing manipulation checks, indicating engaged attention. Sheehan (2018) also postulates that workers devote more attention to tasks because approval of the task completion is required before payment is rendered. Zhang and Gearhart's (2020) study also found that MTurk workers had a higher level of education and lower age than commercial panel participants on average.

The survey collected age and gender demographic data, and then asked a series of questions about information technology-related programs and courses, focusing on the wording of the program and course titles and asking participants for their opinions and preferences regarding the wording selection. There was a total of 23 questions on the survey. The inclusion criteria for the sample were purposefully open to all U.S. adults, regardless of their experience with information technology-related programs in order to get the most unbiased perceptions of males and females about the wording choices.

Results

After the results were collected, the researchers utilized SPSS to do a deeper analysis. The researchers wanted to understand two demographic characteristics (gender and age) and analyze them alongside the participants views on academic programs and courses. The gender breakdown of this study was comprised of 52.4% male and 47.6% female. Participants were provided 6 different cohorts which include 18-24, 25-34, 35-44, 45-54, 55-64, and Above 64. The largest age cohort of 51.1% spanned the age group 25 – 34

followed by 25.8% for the age group 35 – 44. A cross-sectional breakdown of age and gender are further provided in Table 1 below.

Table 1: Age versus Gender

Age	Male	Female	Total
18 – 24	2.7%	1.9%	4.5%
25 – 34	29.3%	21.8%	51.1%
35 – 44	10.4%	15.4%	25.8%
45 – 54	7.4%	6.6%	14.1%
55 – 64	2.7%	1.6%	4.3%
Above 64	.0%	.3%	.3%
Total	52.4%	47.6%	100.0%

As a starting point, the researchers wanted to understand what areas of study would be attractive to each participant if they were considering a new major. Participants were permitted to select more than one area of study when answering this question. As noted in the literature, some keywords can influence or attract particular genders to specific academic programs. Based upon the results, it was noted that keywords such as "cyber" were more attractive to males than females with such programs as "Cybersecurity" and "Cyber Forensics and Information Security." Additionally, "science" was noted as another area that was more luring to males than females with academic programs such as "Computer Science", however, the gap was minimal compared to "cyber." Other programs containing the words "digital" had a much smaller gap when comparing the results between both genders. The breakdown of these results is detailed in Table 2 below.

Table 2: Areas of Study by Gender

Area of Study	Male	Female
Cybersecurity	13.00%	8.80%
Computer Forensics	17.00%	19.10%
Cyber Forensics and Information Security	13.80%	11.70%
Computer Science	28.70%	27.40%
Information Science	0.00%	0.00%
Information Systems	21.00%	18.40%
Computer Information Systems	0.00%	0.00%
Management Information Systems	0.00%	0.00%
Information Assurance	6.40%	6.10%
Digital Forensics	5.90%	4.00%

The survey asked the participants what gender was targeted by the recruiting efforts of three majors which include "Computer Science", "Cybersecurity", and "Cyber Forensics". The possible responses include Male, Female, Neither, and I don't know. In response to "Computer Science", 67.5% of the male participants felt recruiting was a male targeted initiative while 20.1% felt it was a female targeted recruitment. The female participants were asked the same question and 20.2% of the female respondents felt it was a male targeted recruitment while 64.6% of the female respondents felt it was female targeted. These results illustrate that each gender felt it was targeted to their specific gender.

The other two programs were "cyber" focused and in both scenarios, most males felt the recruiting efforts were targeted at males with a higher percentage compared to "Computer Science." With "Cybersecurity," 72.3% of males felt it was male targeted while 16.4% of males felt it was female targeted. In regard to "Cyber Forensics," 68.2% of males felt it was male targeted while 20.5% felt it was female targeted. A larger audience of females felt these two programs were targeted at males when compared to "Computer Science" and less females felt it was female targeted. A complete breakdown of these results are found in Table 3 below.

Table 3: Gender Targeted Recruitment Efforts

Targeted Gender	Computer Science		Cybersecurity		Cyber Forensics	
	Male Participants	Female Participants	Male Participants	Female Participants	Male Participants	Female Participants
Male	67.5%	20.2%	72.3%	40.8%	68.2%	33.7%
Female	20.1%	64.6%	16.4%	44.6%	20.5%	46.6%
Neither	11.3%	11.2%	10.3%	11.2%	10.8%	15.7%
I Don't Know	1.1%	4.0%	1.0%	3.4%	.5%	3.9%
Total	100%	100%	100%	100%	100%	100%

The researchers asked 15 additional questions where each participant was asked to pick between two different course titles. The goal of this exercise was to evaluate, by gender, which course title was more appealing. Based upon the findings, the researchers wanted to identify key terms that either influence a specific gender or ones that are equally attractive to both genders. Table 4 below provides the details of this analysis. For each question, the percentages sum up to 100% for each gender so we can compare the viewpoints of males versus females for each of the two different course names.

Table 4: Gender Preference for Course Titles

Question #	Courses	Male	Female
Q4	Cyber Security	62.40%	47.50%
	Information Security	37.60%	52.50%
Q5	Digital Forensics	66.80%	55.90%
	Cyber Forensics	33.20%	44.10%
Q6	Computer Science	66.50%	66.70%
	Information Systems	33.50%	33.30%
Q7	Computer Information Systems	74.50%	75.30%
	Management Information Systems	25.50%	24.70%
Q8	Information Systems	70.10%	68.50%
	Information Science	29.90%	31.50%
Q9	Cyber Investigations	53.30%	51.10%
	Digital Science Analysis	46.70%	48.90%
Q10	Discrete Mathematics Applications	50.00%	47.20%
	Quantitative Analysis	50.00%	52.80%

Question #	Courses	Male	Female
Q11	IT Security	56.90%	63.50%
	Cybersecurity Risk Management	43.10%	36.50%
Q12	Cybersecurity Policies, Standards, and Compliance	62.90%	62.90%
	IT Governance	37.10%	37.10%
Q13	Secure Programming	42.30%	41.30%
	Software and Application Security	57.70%	58.70%
Q14	Computer Forensics	65.50%	65.00%
	Digital Forensics	34.50%	35.00%
Q15	Python Programming	60.20%	55.10%
	Applied Python Applications	39.90%	44.90%
Q16	Data Analytics	62.60%	68.00%
	Business Analytics	37.40%	32.00%
Q17	Data Science	47.70%	50.30%
	Data Analytics	52.30%	49.70%
Q18	Data Mining	43.40%	40.90%
	Data Analytics	56.60%	59.10%

Discussion

Gender gaps have existed for decades when it comes to different industries. Specific areas like nursing have encouraged a predominately female population while physicians have seen a higher population of males. For example, the US Bureau of Labor (2023) statistics reports that Nurse Practitioners have 6 times as many females as males. In the same publication, it found that there were nearly 30% more males than females who were employed as Physicians. After reviewing the statistics, the analysis found technology fields, like computer programming, have gaps of 3 times as many males than females employed. These gaps not only represent an unfounded stereotype that certain professions are geared towards specific genders, but one must understand that the gap itself starts with higher education and how we recruit students to carefully named academic programs and courses.

RQ1: Gender Word Preference for Academic Programs

The researchers developed a hypothesis based upon related literature that academic programs containing the word of "cyber", "science", and "programming" are more attractive to males than females. Two of the options presented to the participants included "Cybersecurity" and "Cyber Forensics and Information Systems" illustrated that 13% of males and 8.8% of females found this as an attractive area of study, which supports the theory that programs with "cyber" are more attractive to the male gender. The second term "science" was tested by evaluating two academic programs called "Information Science" and "Computer Science." Unfortunately, none of the respondents for both genders selected "Information Science." However, 28.7% of the males selected "Computer Science" while 27.4% of females selected "Computer Science." While a little surprising by the percentage of females who selected "Computer Science," the percentage of male respondents for this program were still slightly higher than females. The results do not provide as large of a variance between males and females as the researchers expected, but there is still some evidence to support that the programs containing words like "cyber" and "science" tend to attract more males than females.

Additionally, other programs were evaluated to see if other trends can be found based upon naming conventions. The "Computer Forensics" program resulted in a higher percentage of females than males who were interested in the program with 19.1% and 17.0% respectively. "Information Assurance" had approximately a .3% variance where 6.4% of male and 6.1% of female participants were interested in the academic program. Lastly, "Digital Forensics" had a lower response rate and less than a two percent variance where 5.9% of males and 4.0% of females were interested in this program. The lower response rates do make it difficult to hypothesize on how programs containing words like "information", "forensics", and "assurance" might influence each gender to select it. At a minimum we can assume that these are attractive to both genders and could provide a neutral effect when recruiting students. To understand these phrases, the researchers would recommend additional research leveraging additional academic programs that include these words.

Lastly, the researchers analyzed the participants views on recruiting efforts for academic programs of "Computer Science", "Cybersecurity", and "Cyber Forensics." While the participants' responses were close between both genders on selecting "Computer Science," the results of the recruiting efforts were also close where 67.5% of males felt the program was targeted at males and 64.6% of females felt the recruiting efforts for "Computer Science" was targeted at females. Most notably is that a larger portion of males felt the program recruitment was aimed at their respective gender compared to females. On a similar note, "Cybersecurity" and "Cyber Forensics" illustrated a larger variance with the same logic where roughly 70% of males felt both programs recruiting was targeted for their gender and approximately 45% of females felt the recruiting efforts were targeted at their gender. This gap illustrates that the program titles containing "cyber" seem to have a stronger influence on attracting males than females which helps support the hypothesis of this word being more attractive to the male gender. Actual values broken down by academic program can be found in Table 3 above.

RQ2: Gender Word preference for Academic Courses

The researchers took another approach to identify how specific words can influence a participant's selection of specific academic courses. Fifteen questions were presented, and each question identified two different courses to assess if a pattern existed between a participant's gender and the course names. Courses that had the title "cyber" yielded a larger percentage of males who preferred the course. A larger variance existed with "Cybersecurity" with 62.4% of the males selecting it and only 47.5% of females selecting it. Additionally, "Cybersecurity Risk Management" had a larger percentage of males selecting it compared to females. Lastly, "Cyber Investigations" also had a larger male to female ration, but the variance was not as high compared to the other two courses.

Courses that contained the word "Computer" tended to have a slightly higher percentage of females selecting it compared to males. Participants were also asked about a course title of "Data Analytics" compared to other courses like "Business Analytics" and "Data Mining" with the result that a larger percentage of females selected it compared to males. Lastly, courses like "Computer Forensics", "Digital Forensics", "IT Governance", and "Information Systems" illustrated that both genders had nearly identical percentages when selecting these courses.

Based upon these results, there is a clear indication that course titles with "cyber" do yield a higher association towards the male gender compared to female gender. Course titles with "science" yielded a higher percentage of preference for males compared to females, but the variance was not as drastic as "cyber." There is sufficient evidence to support the hypothesis that these two words can lead towards specific genders. On the other hand, there was also evidence that words containing "computer", "digital", "analytics", and "information" tend to remain neutral towards both genders or have a slightly female directed influence.

Conclusion

Technology related fields have historically seen fewer female employees as compared to males (US Bureau of Labor, 2023). These trends start from recruitment efforts in higher education and based upon the hypothesis of the researchers, it is believed naming convention of courses and programs can also influence which genders it attracts. These concepts are important to know if we are trying to influence and engage more females into technology related fields and academic programs. Often, universities do not consider naming conventions in relation to gender. Instead, they often look for courses that have a "wow factor" to attract any student. Some course titles can be adjusted to try and attract students regardless of gender which include words like "computer", "digital", and "analytics." Academic institutions are continuously growing their offerings to increase overall enrollment and if they evaluate their course and program names, it may potentially yield a broader audience that their programs attract. Future research is needed in this area to further understand additional terms that may be gender neutral or possibly influence more females into the technology related fields.

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