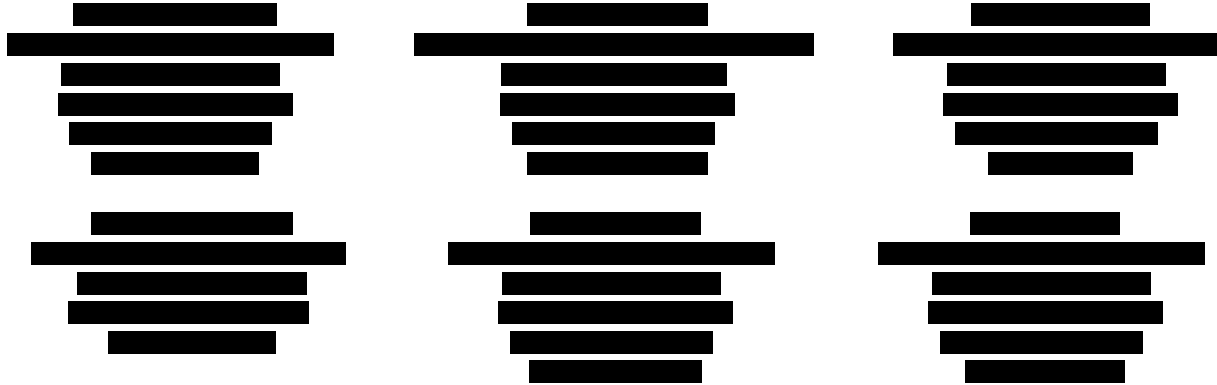


Breaking Barriers and Building Confidence: Unleashing the Power of Digital Tools and Gender-Balanced Teams in Engineering Education



Abstract—This research-based work-in-progress focuses on building confidence and inclusion of women engineering students by implementing various modes of learning (e.g., an interactive-online textbook, Pre-recorded Lecture Videos (PLVs) and equally gendered-ratio teams for in-class team worksheets and course project) into a sophomore-level engineering course. It has been recognized that the lack of inclusion has been linked to negative outcomes in student performance, specifically for women. As most engineering majors are dominated by men, it has been seen that women students find it hard to participate in group work settings. When working in groups, women students have experienced gender-biases that were demeaning, and often have their ideas or designs second-guessed. These feelings of self-doubt and lack of involvement repeated over time lead many women students to leave engineering. It is hypothesized that by providing many learning opportunities outside the classroom that positively reinforce their knowledge and understanding, and by balancing the gender ratio of teams, women students will be more confident in their abilities and feel more included, respectively. Confidence plays a deciding factor in the retention rates of women within science, technology, engineering, and mathematics (STEM) fields of study.

Anecdotally, it was discovered that during the development and implementation of an interactive-online textbook, and through the use of PLVs, many women within the introductory Statics and Mechanics of Materials 1 course felt something unfamiliar in comparison to other STEM courses: confidence. Confidence is a prime indicator of successful completion of a program. To further explore this finding, a study involving focus groups was conducted with three assemblages of women within the course. Two focus groups discussed the use of the interactive-online textbook ($n = 8$ and $n = 9$), while one focus group discussed the use of PLVs ($n = 8$). These focus groups were moderated by two women, a Ph.D. student in Physics and a current Mechanical Engineering undergraduate student. The focus groups were recorded using the University's approved video recording platform (Panopto) and were transcribed using NVivo, being both corrected and verified by researchers.

Various themes were found, with one indicating that women felt more confident about their abilities and knowledge when having the opportunity to engage with the interactive-online textbook than when using traditional educational methods. Interestingly, the use of the textbook and PLVs also helped women feel more confident both going into, and asking questions, in the classroom. Another finding was that the equally-gendered structuring of groups for in-class team worksheets and projects was viewed as a very positive action by the women students. The findings of this study sets up future work scrutinizing which mechanisms not only promote confidence, but a sense of belonging for women within engineering, and hopefully other fields within STEM.

Index Terms—Flipped class format, online lecture videos, engagement with digital media, women, gender, engineering

I. INTRODUCTION

As of 2018, women accounted for only 13.3% of awarded Bachelors of Science degree in Computer Engineering, to a staggering 50.6% of award degrees in Environmental Engineering, with varying percentages for all other disciplines [1]. Current research into why women make up a small portion of engineering students has attributed these relatively low percentages to women's self-efficacy, namely confidence, and stereotype threat; these factors can either dissuade women from pursuing engineering, or cause them to leave an engineering program before completion [2]. Stereotype threat occurs when a student holds the belief that others, such as their peers or instructors, are negatively stereotyping them. This perception leads to decreased academic performance [3, 4]. Stereotype threat also undermines social belonging [5] and inhibits engagement, or conversely, promotes scientific disidentification [6].

Marsh et al. found that women left STEM fields due to their negative perceptions thereof [7]. Ertl and Hartmann attributed one possible reason for a negative view of engineering, whether while deciding on pursuing an engineering career, or whilst in their education program, is that women tend to be more altruistic than men which does not align well with the goals of traditional engineering courses (i.e., these courses focus on tangible creations to solve a problem, whereas women tend toward "people-oriented" solutions) [8]. This notion is refuted by Lakin et al. [9]. There must be another motivating factor then, and that may be the lack of a sense of belonging.

Belonging, specifically socially, is an important aspect for any student to succeed in a program. Seeing other students similar to yourself contributes substantially to a sense of belonging. Engineering fields that are historically dominated by men led to a diminished sense of belonging for women students [10]. Common experiences for women, particularly women of color, include being excluded from group work and/or study groups, being the last-picked student within a group, or the recipients of microaggressions, which can lead to a feeling of not-belonging. This feeling of invisibility or hyper-visibility has led to women having reported imposter syndrome and subsequently reduced confidence in themselves and their abilities [11]. Often times there were escalations of microaggressions into discriminatory actions, which led to women, Latinx and Black

students leaving STEM more often than their Asian and White men counterparts. Furthermore, approximately one-half of women who experienced discrimination decided to leave the STEM field [12]. These discriminatory acts are not just experienced at the collegiate level. Nguyen et al. found that negative behavior from men directly contributed to pre-engineering women feeling like they have been excluded and discouraged from the field of engineering. They also found the young women within their study sought support from their parents, teachers (who can be a source of discouragement as mentioned previously), and peers [13].

To address some of the issues identified such as stereotype threat and imposter syndrome, interventions have been implemented. Good et al. had college students mentor seventh-grade students. These college students provided support and encouragement to their mentees in an attempt to prevent the adverse effects of stereotype threat; the mentees outperformed a control group of students on standardized math tests [14]. In the realm of imposter syndrome, Robinson et al. worked with various faculty scholars to develop a video mentoring program which is accessible online [11]. It has been noted by Ortiz-Martínez et al. that to increase retention of women within STEM, there should be remote mentoring programs (with mentoring being a common theme), the use of digital networking platforms, and training of instructors/faculty members to address systemic issues [15]. Along the same vein, ecological interventions have been implemented to increase the retention of Black, Latinx and Indigenous students, which have addressed issues of belonging and lack of confidence [16]. Recently, the use of virtual learning (due to Covid-19) and the subsequent anonymous nature of online learning has been investigated in terms of women's sentiments toward the classroom. It was found women felt more comfortable participating online, for their anonymity removed preconceptions and judgements from their peers [17].

To this end, the researchers posed the following research questions: What aspect of digital learning is beneficial to women in engineering?; How can we restructure basic aspects of a course to minimize stereotype threat, microaggressions and discrimination from men while also fostering a sense of social belonging? It is hypothesized that by providing women an interactive and engaging online learning environment, they will feel more confident in their abilities, and be more willing to participate in class. This online learning environment was multi-fold. The first implementation was an interactive, online textbook, denoted as the Top Hat textbook (THT) [18]. This textbook had embedded questions, which would provide hints if answered incorrectly, and explanations for correctly and incorrectly answered questions. It is noted that this textbook was authored by a woman student. Prior research has detailed on the development of the textbook [19], documented the positive impacts of engagement with the textbook on course performance [20, 21], as well as students' perceptions of engagement with the textbook [21].

The second implementation was PLVs that were paired with online conceptual checkpoint questions. These questions were similar to the textbook questions in that they provided hints and feedback, but were more conceptual in nature. Prior research showed that engagement with PLVs with through an interactive means led to increased student performance [22]. It is also hypothesized by having equally-gendered teams in which the students would work in the entire semester for both in-class activities and the term project, that the women would not only provide support to one another, but being in pairs, there would be an increased a sense of social belonging.

II. METHODOLOGY

Three focus groups consisting solely of women enrolled in a sophomore-level Statics and Mechanics of Materials 1 course were created; two focused on the use of the interactive, online textbook ($n = 8$ and $n = 9$), and the other focused on the use of PLVs ($n = 8$). Participants were from four sections of the same course, the percentage of women per class in each section, in ascending order, were 23%, 28%, 44% and 53%. Considering all four sections, the approximate ratio of women to men for the course is 35%.

The focus groups were moderated by two women, a senior Mechanical Engineering student, and a Physics Ph.D. student. The students were allotted 50 minutes to discuss the given prompts. The focus group discussions were recorded using Panopto and were transcribed using NVivo (corrected and verified by researchers). The research team then reviewed the transcripts and used quotes from within to understand the students' thoughts and feelings about the learning modalities, and to see what impact they had on their sense of confidence and belonging. The questions asked to the two focus groups are as follows:

- 1) *Do you identify with the term "engineer?" Did your perspective on whether you would label yourself as an engineer change while using this textbook/PLVs compared to a standard classroom experience?*
- 2) *Did you experience self-doubt more or less often while working with this textbook/PLVs compared to a standard classroom experience? Is this change related to working/learning alongside men classmates in a standard classroom experience?*
- 3) *Does the course set-up (flipped lecture format, interactive textbook, team worksheets) make you feel more included? Do you feel more or less comfortable participating in online discussions?*

III. RESULTS AND DISCUSSION

Data from the focus groups is presented below in categories that relate common themes, but also which lead to a concluding sentiment; all of these tools are helping treat a symptom of a systemic issue that begins early in these women's careers, an issue that is exacerbated when these women interact not only with their peers, but instructors and men outside their field of study. We start by probing the effect of learning modalities on confidence (i.e., PLVs, the THT, and gender-balanced teams), and then progress into the timing aspect of these teaching methods, followed by scrutinizing mechanisms that undermine(d) their confidence and sense of belonging. We then take an introspective approach about how we as educators and mentors are implementing this pedagogy, and specifically, who we are directing them at.

A. Do Learning Materials and Modalities Help?

The research team wanted to know if PLVs and the THT changed women's perspectives on whether or not they identified as an engineer, whether these modalities reduced self-doubt (or conversely increased confidence), and/or increased their feelings of inclusion and comfort with participating within the classroom environment (physically or virtually). Below are numerous quotes from respondents within the focus groups. It was found that by providing PLVs to students, the participants' understanding of material improved due to their ability to watch and re-watch the content. Not only did the PLVs complete their intended function (i.e., provide an understanding of the material), having a learning mechanism to prepare for class did lead to women reporting having increased confidence within the

classroom. This increased confidence helped the women overcome the negative effects of stereotype threat. One student noted:

I agree that watching the videos and... being able to rewind is really helpful... I feel like that helps me feel more confident when I go to class because I feel like I understand the material better than some of my classes where I just sit there and listen and don't always absorb what they're talking about... I don't really feel like it would make a difference whether or not I was sitting next to a male classmate or something like that. But I do feel like there are implicit biases we have within ourselves as women... I feel like growing up it was like "Boys are good at math and boys are good at physics," that I naturally feel stronger in the sciences. So then I feel like if I can go to class more confident by rewinding videos then it helps me...

Another student noted the pre-class preparation helped them feel more confident in class, and that this mechanism can counteract some negative effects of the behavior of men in class (e.g., such a monopolizing discussions/class time with questions), which was also seen previously [17]:

...any... chance to... know the content before class... helps with... self-confidence during class, like [being] able to answer questions sometimes... I think... learning against male peers... they usurp so much of the class time, [they] just ask questions... that aren't relevant whatsoever.

It is seen that having an engaging and interactive method of learning before class (with an emphasis on a teaching mechanism where the students are active learners, not passive learners) helps the women feel more confident going into class, and thus will more likely participate while there. The combination of online materials, and how they were paired, did have a positive impact on the confidence of women, as noted by one participant:

...I definitely like this way of teaching is being done for making me personally feel more confident in my abilities... and then... this way of teaching is making me feel more confident... However, the people, I'm going to use "men-gineer," the men-gineers around me like to dwindle that.

Theses men engineers, or "men-gineers," were noted to have large amounts of unfounded confidence, and that the women within the study group did not have these artificially high levels of confidence. A student noted:

Confidence also plays a big role. I feel like... even though we're learning the same things, as a guy and as a girl. I feel like they approach it a lot more confidently.. than a girl... So it's like stressing me out.

The women interviewed mentioned that they were able to build up their confidence prior to class, but yet this confidence could be eroded through interactions with men, both students and instructors (as will later be discussed). However, the set-up of the class provided resources for women to learn on their own, and the gender-balanced teams helped reduce implicit biases as one student noted:

I feel like at first I was really overwhelmed by the fact that it was flipped again because of how awful Physics 1 and 2 were for me and the entire time I was in Physics 1 and 2 I was like, "Should I be an engineer? [I]f I can't figure out Physics 1 and 2, should I be an engineer?" So that was definitely a huge self-doubt thing for me, and then going into Statics, "Oh, it's flipped again. And here's a textbook." And I was like, "Oh, God, here we go! Round two! Like,

I'm just gonna cry myself to sleep every night because this is going to suck." And it literally has not been that bad. So I definitely think it helps with the self-doubt a little bit because I'm kind of proving to myself that I can figure it out on my own. I don't need to be... walked through everything and I can use resources to get somewhere. So I think it's really help[ed] me and I also like how it's a flipped class. We have group time. [B]ecause my group is two guys and two girls, I feel like it's been pretty even, we all know kind of what we're doing. We ask each other questions and there's not any bias that I've found from either side. So I think that's been good as well.

In regards to the groups, one respondent noted, "I feel like my group is very good, an example of... us collaborating together and believing in each other in a way." Two students who were in the same group commented, in comparison to other courses they have taken, "[T]his has definitely been my best group out of all the ones I've had where it's just been all male[s] or all female[s]."

Another student commented that this was the first time since they've been in college that someone has talked to them about how they may be perceived by men. Yet another student made the same comment stating, "I hadn't really thought about the male aspect in a while... now I feel like in class I don't think about it, because I see just as many girls as I see as guys... since there's such an equal ratio now it just hasn't crossed my mind." This comment provide an insightful perspective on the matter that when women are not the overwhelming minority in a classroom, they don't think about the men within the classroom, which may in turn reduce stereotype threat and increase their sense of belonging. Many times in the interviews, students would note in previous classes how their teams were very unbalanced, and that once their teams were gender-balanced, they no longer noticed the lack of homogeneity. A student remarked, "I probably would feel weird if I was the only girl in the group. But... since I'm not, I don't think I've thought about it." Removing the cognitive load of noticing you are minority does appear to have improved their experiences within the class. Along the lines of not thinking about being a woman in STEM until prompted, one respondent noted:

I think it's just the fact that the ratio of girls and guys [is] so much better now. But I guess it's good that I haven't thought about that in a while. And I do have a lot of male professors, but I also have way more female professors now, that I think... we see them a lot more commonly than we did before. It makes me feel more accept[ed] I guess.

The major takeaway from these responses is that gender-balanced teams positively create a sense of social belonging, and that seeing someone like yourself in a position above you, whether it is a more senior student, or someone on the instructional team, creates another sense of belonging. The latter is an issue that can't necessarily be controlled within a classroom, but efforts can be made to ensure not only the teams are gendered-balanced, but the instructional team is diverse and representative.

The last remaining teaching modality was the THT. One participant said the textbook was shown to "...boost [my] confidence in a sense of my understanding and my learning." Another student noted that this boost in confidence comes from being able to do many practice problems, and getting feedback on those problems. Along the same line, another student said "Yeah, the textbook makes me feel good about this." One student noted:

I think it [has] really helped bring up our confidence as well... I was able to put two and two together from the

lecture and past readings and videos and figure out the problem... I usually ask one of the men-gineers for help because they seem to always know what they're doing, but this time like I kind of stopped that.

This is an interesting sentiment; if a resource creates a situation where a student does not have to pursue a path for help that may be negatively impacting their confidence and sense of belonging, then an improved educational and inclusive experience has been provided. An aspect of the interactive, online textbook that was inadvertently implemented by the instructional team was the chat (or forum) feature, which can provide a very similar experience to the interactive nature of the THT. Some women in the focus group mentioned their peers used it, and they wished they had because, "I don't ask questions in class and because I just don't feel confident enough." The chat features provides the student with the ability to ask questions, and their peers, TAs and/or instructor can answer, and they themselves can answer other's questions. Once this item was brought up, another woman noted:

Yeah, I wish I knew about that [be]cause I don't like asking questions in class... so then I just feel stupid in person, and I'd rather feel stupid over the internet.

An interesting feature of the THT, in addition to the chat feature, is ACE. ACE is a version of ChatGPT that only pulls content and information from the textbook and no other online resources while forming responses to students' inquiries. ACE is able to answer questions, generate example problems, and even answer embedded questions in the text. One respondent commented on the use of generative artificial intelligence:

Yeah, I feel like now that we have ACE, though I still wouldn't really use the online forum because then you could just ask ACE any question and it would answer it for you.

This indicates a preference of interacting with a non-judgemental resource over having to interact with a peer or instructor, either in person or online, even if anonymously. An interesting and contrasting view point was that without seeing how others are doing, there was no way to gauge your own performance relative to others:

...I think with learning on your computer, you can't really see how other students are doing. [T]hey're like, "Oh, I'm struggling on this. But is anyone else confused or is it just me being stupid or something?" I think that's the only, or one of, the cons... yeah, so maybe a little more self-doubt.

Immediately after, another student responded saying "I never really understand things the first time I learned something... then I feel like I'm already getting behind and that's intimidating." Her peer agreed, and said that the class format "equalize[s] the access that we all have to... learning the material... everyone has the same chance to... put as much work into as they need to."

The interactive, online textbook can only do so much. Yes, it can help the women feel confident in their abilities by providing an unbiased (hopefully) learning experience. But it is just a book, and does not address systemic issues. One respondent noted: "I'm not really sure how the textbook relates to... gender roles or expectations in the classroom because the textbook... it's just sitting there. [T]he textbook can't really do anything." Another student shared a similar sentiment about how the instructional materials, although helpful to education and confidence, aren't addressing the real issue:

If the textbook is seen as a resource that would help even the playing field, I guess in that kind of sense. We're all like, what, twenty? Nineteen? I feel like this is a Band-Aid

for anything that happened beforehand that would make the playing field uneven in the first place... So small, subliminal things from early childhood.... those small things, this textbook doesn't, isn't going to come in and save the day and start from scratch... but I feel like even though the textbook can help even out resources and those kind of things, I do think that the damage has already been done earlier.

These last two comments set the stage for a sobering realization: is what we are doing occurring too late in their educational career, and should these interventions and tools be implemented sooner? This will be discussed in Sec. III-C, but we will first discuss about whether it is the "men-gineers," and/or external actors, that are sowing the seeds of self-doubt.

B. Where Do Microaggressions Live?

Many women identified where they experienced microaggressions and discrimination. Most negative experiences came from outside the classroom. Within the classroom, respondents noted many of the men were not the source of stereotype threat, discouragement, and/or the source of microaggressions or discrimination. Rather, since both men and women engineering students were in the same program together, the men did not look down on them, but rather saw them as an equal. Going through the program together created a sense of comradery. Outside the classroom, women experienced discouragement through interactions with instructors and external actors (i.e., men outside of their educational experience). One student noted:

...I feel like this is a big conversation about men in our classes, but I feel like I've had more negative interactions with... my roommate's boyfriend [who] doesn't go to Pitt... was like, "You're building a bridge?" And I was like, "Yeah, for my statics class." And he was like, "Your bridge isn't going to hold a feather." And I think he was trying to be funny. But I was just like, "Baby I'm not another pretty face... I'm a little bit smart. You don't really know me that well." I feel like that was way more discouraging than any conversation.

Her peer immediately jumped into the conversation and commented:

[S]omeone who is completely different from what you're doing, who doesn't have any background in engineering telling you that your bridge isn't gonna hold a feather: "Wow. Great. Thanks" (in a very sarcastic tone)

The student who was discouraged by an external actor then continued:

...maybe that's just a note for whoever is conducting the survey, that it's not just men in the classroom... I feel like... the people in engineering... you all relatively know that all of you are smart... where that guy doesn't really know me... but that's one thing I would say like having read these questions... I have more negative experiences with men outside.

In terms of instructors being a source of microaggressions and discrimination, there were two note-worthy comments. One student commented on a time she went to office hours to get clarification on a questions she missed on an exam. The instructor's first comment to the student was he thought she didn't come to class. The student noted how incredibly unfounded and mean this comment was, for she attended every class and was there to get help. This interaction left her feeling not only invisible, but discouraged from getting help.

A singular interaction had such a lasting affect on this student's educational experience. A few students commented on one instructor who has demeaning and derogatory content about women posted on his personal website, and how his views and behavior towards women directly resulted in them not learning from him. One student refused to go to this instructor's office hours after she witnessed said instructor arguing with a woman over her not understanding a concept he thought was simply understood.

Many students commented that they had/have supportive and encouraging men within their program, whether they were their peers, TAs, and/or instructors, who show patience and compassion. They did mention though some instructors were a source of self-doubt and a sense of not belonging. In particular, some respondents were discouraged to seek help because their instructors would be demeaning toward them for not knowing something that the instructor assumed was common knowledge, which in most situations was gender specific (e.g., related to machinery or cars, etc.). Interestingly though, even if the woman had a STEM-based role model in their life, they vicariously experienced microaggressions and discrimination:

My mom is an engineer. She works with computers. She's a STEM major. And having said that, she's the only STEM major that I know of [who] is a female. But then, seeing the way that she gets disrespected by other male counterparts... her coworkers or just other male friends. It showed that no matter what you kind of did as a female, you're going to get disrespected. Either way, someone else will just be stupid and dumb and just do it, because either way, they're going to see it the way they are.

It appears that any positive work towards increasing the confidence and sense of belonging of women within this engineering course could be undermined by internal and external actors, and that overcoming deeply rooted feeling of self-doubt and lack of inclusion requires more than a topical and late-stage treatment.

C. Is It Too Late?

Findings of this work are that these teaching methods helped women feel more confident in their abilities, and that many of these women agreed these interventions are happening too late. Without being prompted, the participants in one focus group noted that they did not, or do not, have many women role models within the STEM field in their formative years. Although this contrasts what a respondent said in a prior focus group, it is well-founded. She said:

...it's not about being in the room with them [men] or learning next to them, it's about the root cause... I feel like the root of self-doubt comes more from [that] I didn't have very many women in STEM in my childhood. Pretty much none at all. I don't know a single female engineering professional. I'm not related to any, no one in my family is an engineer, and so I feel like it's not about the stupid boys in the class... It's... deeper. Go talk to four-year old me and come back. It's like the self doubt is very deep rooted... it's not about the guys in the class.

It appears that online learning tools and gender-balanced teams treat an immediate symptom of stereotype threat and a lack of social belonging, but without representation at all levels of a career ladder (e.g., a senior-level student, TA, instructor, etc.) during their formative years, there is an inherent sense of self-doubt. Coupled with the continual erosion of their confidence, a dire picture is painted.

D. Are We Going About This Wrong?

This work, and many others, have been focused on pedagogy and interventions that not only encourage and support women in STEM, but also help them overcome barriers. But are we not trying to treat a symptom as opposed to the cause? One respondent described this perfectly:

I guess... there's [one] observation about... these questions, the theme. I feel like it seems the questions about the flipped class is "Do you feel more confident when you're not surrounded by your male peers?" But, "Why?" The fact that that's the question in the first place, why should it have to be like, "Let's separate you guys so that they don't bother you." Why don't we talk to the guys and work at the root of the problem and not make them obnoxious in the first place.

Another student shared the same sentiment, saying "OK. So we feel this way as a result. What is the problem, you know?" Although many of the respondents noted the 'damage has already been done' and that some focus should be on addressing the preconceived notions, implicit biases, and associated negative behavior of men (both students, faculty, and external actors), that does not mean we should stop trying to provide an educational experience that increases the sense of belonging and confidence of women.

IV. CONCLUSION

The research team was interested in whether different learning modalities (PLVs, a THT, gender-balanced teams) would increase both confidence and a sense of belonging of women within an introductory engineering course. PLVs prepared women for class (i.e., they were able to watch and re-watch the content until they understood the material) which led them to feeling more confident going into the class, and while they were in the classroom. The THT increased confidence by providing them with the opportunity to not only complete numerous practice problems, but by receiving feedback on their understanding. Within the THT, women enjoyed the chat feature, which allowed them to anonymously ask and answer questions. Furthermore, respondents preferred ACE, a version of ChatGPT embedded within the textbook, because they were able to obtain assistance with the material judgement-free. Gender-balanced teams made the women feel more at ease; they did not notice the unequal gender ratios of the class (only two of the four course sections were approximately equal in terms of genders (44% and 53%)). When the women were in gender-balanced teams, there was reduced stereotype threat and an increased sense of belonging.

Although these learning modalities had many perceived positive benefits towards building confidence, reducing stereotype threat and increasing a sense of social belonging, many of the respondents noted that these initiatives are being done too late in their academic careers. Furthermore, these changes to their education aren't addressing the root cause of self-doubt and a feeling of not belonging. Internal (instructors namely, as opposed to peers) and external (men not within their field) actors were the most identified causes of self-doubt through either microaggressions or discriminatory actions. Most of the participants agreed that focus should not be placed on trying to diminish the symptoms they feel by creating new educational experiences for them, but rather some of the focus should placed on eliminating the biases, preconceived notions, and inappropriate behavior of men. There also needs to be recourse for inappropriate behavior of the men within their academic setting. If women felt more confident and included, it is hypothesized more women would

be in role-model positions, filling in the existing vacancies that these students noted; there are few women instructors and practicing engineers, which leads a diminished sense of belonging. We begin to see the circular nature of these issues.

V. FUTURE WORK

With the existing set of data, the research team plans to code the data further for patterns that emerge within the responses to gain a richer sense of the data. This may give further insight into common themes that are represented within focus groups. In future work the researchers would also like to improve upon their original focus group questions and begin to explore what other teaching modalities many not only improve the experiences of women within engineering, but begin to address some of the main causes of self-doubt, imposter syndrome, and a lack of a sense of belonging.

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- [21] [REDACTED]
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