STEMinism in the classroom: Reflections from a female GTA

Sophie Kempston

PhD Student, University of Warwick

Sophie Kempston

PhD Candidate Institute for Global Sustainable Development, University of Warwick

S.Kempston@warwick.ac.uk

Sophie Kempston (she/they) is a current PhD candidate at the Institute for Global Sustainable Development at the University of Warwick. Her research focuses on measuring the sustainability impacts of the increase in demand for raw materials as a result of the UK's increasing demand for electric vehicles. This includes forecasting scenarios for EV uptake and battery market shares in the UK, and developing a framework to assess the holistic sustainability impacts of these scenarios. They are also a Graduate Teaching Assistant in the School for Cross-Faculty Studies and are kindly funded by the Leverhulme Trust through the TRANSFORM Doctoral Programme.

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Abstract

The need for professionals with a science, technology, engineering, or mathematics (STEM) background is higher than ever before, and this need will continue to rise in future years, particularly for those with a university degree. Applications for STEM degrees in the UK are at an all-time high; however, women are significantly underrepresented in STEM courses at university, have higher dropout rates from these courses than their male counterparts, and even when they obtain a STEM degree, are less likely to choose a career in this field. These issues have been well-documented in the literature for over a decade, yet these issues still persist in the present day.

This is a reflective piece from my perspective as a female graduate teaching assistant (GTA) teaching in STEM, highlighting the tools I use in the classroom to try and empower particularly female students and equip them for success. It also reflects on my own experiences, both as student and teacher, and discusses how GTAs working in STEM subjects can be pivotal in addressing some of the gender gaps outlined above.

Keywords: STEM fields; feminism; STEMinism; teaching; university spaces

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STEM subjects and their representation problem

The need for science, technology, engineering and mathematics (STEM) skills is higher than ever before, and looks set to continue to grow in the coming years. In fact, STEM roles are predicted to grow 10.8% compared to now, versus only 4.9% growth across all other careers (Bureau of Labor Statistics, 2023). Yet the UK has a skills gap in this area, with 89% of STEM companies reporting difficulties in recruiting staff with necessary skills, leaving an average of 10 unfilled roles per business (IET, 2021).. The reasons for this are varied and multi-faceted, but with women representing just 10% of the workforce (STEM Women, 2022), the gender gap in STEM is seen as a huge problem facing the industry.

Applications for STEM degrees in the UK are at an all-time high (Peacock & Riggers-Piehl, 2023). And yet, women are significantly underrepresented in STEM courses at university. An American study found that while 74% of middle school girls (aged 11-14 years) express interest in STEM subjects, just 0.4% choose computer science as their major in college (Mazenko, 2016). In the UK, the number of girls choosing STEM subjects has risen significantly in recent years, and they are more likely to achieve higher grades in these subjects than their male counterparts (Department for Education, 2021); yet still only 31% of university students in STEM subjects in the UK are women (STEM Women, 2022). This gender disparity is even worse for engineering and technology subjects, with women making up just 21% of these courses (STEM Women, 2023). While the total number of women applying for STEM courses has increased, the number of men applying has also increased, meaning that the percentage of women on university courses of this type has broadly plateaued over the past decade (ibid.).

When women do choose to study a STEM degree at university, they are more likely to drop out before graduation (Herrmann, et al., 2016; Jacobs, et al., 2020; Isphording & Qendrai, 2019). This is despite them having typically higher grades before entering university. One study found that compared to men studying STEM subjects, women are more likely to report a disconnect from their institution and subject (Isphording & Qendrai, 2019). The authors theorise that this could be due to

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the role of teachers and professors in shaping a student's career decisions; female teachers have been shown to improve women's performance in STEM courses and increase the likelihood of women making it to graduation (Griffith & Main, 2021; Polevoi, 2019). Women are more likely to feel like they belong when there are female role models on display, increasing motivation to pursue studies in their chosen field (Herrmann, et al., 2016; Polevoi, 2019; Griffith & Main, 2021). But with less than 30% of scientific researchers being women (Department for Education, 2021), these role models are often hard to find.

Even when women graduate with degrees in STEM subjects, they are less likely to choose a STEM career. In the UK, women engineers account for just 13% of the workforce, with women IT professionals falling to just 19.5% of the workforce in 2022 (WISE, 2022). This is a worrying trend, especially considering the previously mentioned skills shortage in technology areas. The reasons for women avoiding STEM careers are varied, but many cite a culture of sexism and a so-called "boys club" as being off-putting to considering tech companies (Khan, 2023). As well as this, gender bias is still widespread – research shows that men's performance is rated higher on average than that of a woman, even in controlled experiments and situations. For example, a 2014 study showed that scientists perceived a job candidate called John to be more competent than a candidate called Jennifer, despite their CVs being identical, and this discrimination can be more profound in face-to-face interviews (Moss-Racusin., 2014). Women can also be discriminated against for requiring maternity leave, and a lack of parental leave can discourage women from entering the STEM workforce to begin with (Correll, et al., 2007).

There are many issues within the STEM education system and industries, and it is important to start addressing these and create more diverse groups working to solve problems in the world today. Research has shown that teams with higher levels of diversity, including teams with women, produce better results and collaboration (Hunt, et al., 2015). Encouraging women to pursue STEM subjects could help to alleviate the UK's technology skills gap in both industry and academia, particularly as the world shifts to require more STEM jobs (UKCES, 2015).

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What is STEMinism?

STEMinism is a cross between STEM and feminism, and a STEMinist is defined as "someone who promotes equal opportunities in Science, Technology, Engineering and Mathematics (known collectively as STEM)" (Cambridge Dictionary, 2018). The STEMinism movement was created by activists to address the underrepresentation of women in STEM fields across all levels of education, to create a more diverse workforce in STEM areas. In recent years, this has also expanded to pushing for equality for other underrepresented groups, including racial minorities, disabled people, and those who belong to the LGBTQ+ community (Patrizio, 2023).

The STEMinist approach seeks to improve the gender gap in STEM and encourage women and girls to push forward with STEM subjects at university and beyond. The main way STEMinists address this is through the lack of representation, both in textbooks and in classrooms and industry settings. A report by TeachFirst found that no woman's name appears in the national curriculum for GCSE science, and only 50% of British adults can name a female scientist (Sundorph, 2023). The STEMinism movement encourages women already in the field to take up the challenge of teaching where they're needed most, and to talk about the realities of a career in STEM to encourage the next generations (Myers, et al., 2019; Polevoi, 2019; Patrizio, 2023).

There have been critiques of the STEMinist approach, though. Some critics argue that it puts too much emphasis on the individual, without challenging institutional biases that are responsible for many of the barriers women face in STEM subjects, such as being seen as uncapable of comprehending science, or being unable to succeed in the field (Myers, et al., 2019; Popson, 2020). But STEMinism has an important place in allowing young people of all types to see themselves represented, and see the opportunities and careers they might have, without limiting themselves to specific subjects.

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Applying STEMinism to university spaces

When I began teaching at university, I was mainly teaching maths and statistics seminars to non-STEM students in their first year of undergraduate studies. It was here where I first really noticed the gender disparity in the classroom. Men were generally the only ones who contributed when I asked questions to the class as a whole. Further, even though there were no real differences in test scores, I found that female students ranked their confidence in the subject much lower than the male students in module surveys.

For me, it was important to try and be a role model in the space to encourage all of my students, as this was something I felt I lacked when completing my own undergraduate degree. It has been shown that having a female role model in the form of a professor can improve STEM retention rates for women studying these subjects (Mazenko, 2016; Sundorph, 2023). I hoped that it would lead to women being more confident to carry on with STEM throughout their degrees, using quantitative methods in future projects and dissertations and further, into the workplace. I implemented small changes that I hoped would make all students feel more included; for example, changing textbook examples to include female names, introducing myself with my pronouns, and encouraging students to bring their own examples of real-world statistics to class to end up with a more diverse set of examples for the class to discuss. Being open to diversity and creating a safe space in the classroom to discuss these issues, even in a subject like statistics where they are little discussed, has been shown to improve retention and grades of students overall, including female students (Peacock & Riggers-Piehl, 2023; Isphording & Qendrai, 2019).

Further, I tried to use a range of tools to get more engagement from female students in my classroom. This included using tools like Kahoot and Mentimeter to ask questions to a class. These online platforms allow students to join on their laptop or smartphone, and they can vote anonymously on the answers to questions, rather than having to put their hand up and answer on their own. Not only does this

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increase engagement and empower students to contribute without fear of being singled out, it also allows me as the educator to see if there are any glaring problems – if most people are answering a question wrong, it gives me a good indication that we need to spend some more time there (Peacock & Riggers-Piehl, 2023; Ward & Gale, 2016). This method has been proven to be beneficial for students (ibid.), and was well-received in student feedback.

I made sure to offer help in a variety of ways. When I ran office hours in person, I found that only male students would take me up on the offer; however, when I ran them hybrid, I found female students were much more likely to make use of my virtual office hours. I allowed time in class for students to work on problems, and circulated the class to answer questions. I found that both female and international students were much more likely to ask questions in this one-on-one approach compared to when the class was asked as a whole. I also provided online tools and resources for students to access and, where possible, tried to include videos with captions in a variety of languages that were spoken in the classroom. These resources were able to help those who felt less confident to practice and build their confidence in the safety of their own time, and a few female students would come to me after the module to express how much these helped, particularly resources with Mandarin subtitles. Many of these practices are not exclusive to promoting female participation, but a wider range of minority groups, such as international students, mature students, carers, and others (Ward & Gale, 2016).

Finally, I tried to talk openly and honestly about my experience as a female researcher in a male-dominated field. I attempted to show myself as a competent teacher and researcher, and made sure that students were aware of a diverse range of leaders in fields they were studying. I spoke at induction events for undergraduate and postgraduate students about the career path I took, and discussed the potential options for STEM careers with my class of non-STEM specialists. By equipping students of all disciplines with STEM skills, it can help to alleviate the skills shortages mentioned above, and ensure a more diverse workforce in academia, industry and beyond (Department for Education, 2021; STEM Women, 2023).

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Conclusions and personal reflections

As a woman who has gone through a STEM undergraduate degree and master's programme, and is currently researching in a highly scientific field, I can understand how hard it is to excel in a male-dominated field. I struggled to see a future for myself in STEM due to a variety of factors during my undergraduate degree. One of the main ones was the lack of female professors and role models that I saw excelling in my department – in my first year at university, I was taught by more men called Oleg (3) than women (1)! When it came to choosing a career, I ruled out most STEM ones, even though a degree in Mathematics and Statistics would have made me more than capable to take them on, and decided that once I had completed my master's I would move into a policy-related field rather than a scientific one.

However, during my master's, suddenly I was being taught by a variety of professors from across STEM fields. These were powerful professors in the classroom that showed me an untraditional career path, crossing a variety of industries and academic departments. Our course was led by a female engineer who shared openly the highs and lows of working in the field, and we were able to listen to a diverse set of speakers in the classroom, who were honest about the challenges facing the field but hopeful about the future opportunities. I started to see a career path for myself in STEM, and began to believe that it was possible for me to succeed in those fields.

When I started to teach, I wanted to bring this approach into my classroom and open up STEM subjects for women the same way those female professors opened them up for me. As a woman teaching, it can be very discouraging – there are many reports that female professors are ranked worse than their male counterparts even in controlled studies, and consistently get worse module feedback from students, which can affect career progression (MacNell, et al., 2015; Moss-Racusin, et al., 2012; Khazan, et al., 2020). But change is being made. I believe that with more women and diverse populations teaching students these subjects at all levels, suddenly students can see a pathway for people that look like them in academia, in STEM more broadly, and in any career, that women will start to see themselves in these

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careers. The change is beginning, with 40% of STEM doctorate degrees being awarded to women (Nature, 2017), but we still have a way to go.

The STEMinist movement allows for female researchers and industry professionals to inspire women and young girls to see what a life in STEM could be like. However, this needs to be coupled with a push for institutional change. Only by combining these two things can we expect real and lasting changes to be made, with the STEM gender gap reducing and even being eliminated entirely). Women are capable of succeeding in STEM, and while we are on the right path, more must be done to encourage them to stay in STEM fields. This push needs to come from everyone involved in the STEM field and not just women; by attending outreach events, highlighting female contributions and challenging gender biases in the classroom, male professors and GTAs can also encourage women to consider a career in STEM. Further, STEMinism needs to also push for more disabled representation, more LGBTQ+ representation, and more minority representation in general, to ensure that STEM can be as diverse and inclusive as possible.

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