Teaching coding inclusively: if this, then what?

Olivia Guest[1,2] and Samuel H. Forbes[3]
[1] Donders Institute for Brain, Cognition and Behaviour, Radboud University, Nijmegen, The Netherlands
[2]School of Artificial Intelligence, Radboud University, Nijmegen, The Netherlands
[3]Department of Psychology, Durham University, UK

We present our stance on teaching programming with the aim of increasing reflexivity amongst university educators through dissecting and destroying pervasive anti-pedagogical gendered framings. From the so-called male geek trope that dominates Global North/Western perceptions of technology to the actively anti-feminist stances such demographics espouse: programming has a sexism problem. Herein, we touch on how and why programming is so gendered in the present; we expound on how we manage this in our classrooms and in our mentorship relationships; and we explain how to keep doing so moving forwards. Through weaving examples of programming into the text, it is demonstrated that basic coding concepts can be conveyed with little effort. Additionally, example dialogues — exchanges between teachers and students and between educators — are worked through to counteract inappropriate or harmful framings. Finally, we list some ground rules, concrete dos and don'ts, for us to consider going forwards. Ultimately, as educators, we have a two-fold obligation, for our students to *a*) learn programming, and for them to *b*) unlearn problematic perceptions of who can code.

1 Scoping the issue

```
// What is the value of z in the following
// JavaScript code snippet?

var x = 5;
var y = 6;
var z = x + y;
```

Programming has a sexism problem. There is a documented history of women being not only the first programmers and the first computers, but also of them being actively pushed out and expunged from the historical record (Evans, 2020; Hicks, 2017; Lee Shetterly, 2016). Relatedly, there is also a present-day highly masculinised view of the field starting from children's perceptions, such as that captured by the so-called male geek trope, which dovetails with masculinist ideologies within the tech sector (Birhane & Guest, 2021; Erscoi et al., 2023; Hermans, 2024; Lewis et al., 2016; Margolis & Fisher, 2001; O'Mara, 2022; Salter & Blodgett, 2017; White, 2020). Furthermore, there is the view that the tech sector is the only place where coding skills are relevant — a caricature akin to 'writing is only useful if one wants to be a novelist.' (viz. Hermans & Aldewereld, 2017) In turn, this translates into dissuading and disincentivising girls and women from learning to read and write code, believing in their skills, and realising what coding truly is (Busjahn & Schulte, 2013; de Wit et al., 2024; Hermans, 2021). The interrelated dynamics of Global North/Western gendered and racialised perceptions of technology and the relevant pedagogical situations in which these perceptions are relevant, such as teaching programming, is our focus herein. Teaching effectively has to take on these issues (as well as cognitive ones, Morrison et al., 2015) against the backdrop of their latent cause: patriarchy.

Given all this, no wonder *a*) women do not appreciate the fun or usefulness of learning coding, or learn some basic principles and *b*) the layperson has no idea programming is for everybody. Ultimately, a solution-oriented mindset is part of the problem (also see Blum & Frieze, 2005). If girls, women, and the feminised generally, are made to believe they are not intelligent or do not belong, or they are sexually harassed and assaulted, (Dresden et al., 2018; Essanhaji, 2023; McKinley, 2018) the problem lies with the educator, the institute, and society at large for not

Olivia Guest Samuel H. Forbes
Corresponding Author: Olivia Guest, Donders Institute for Brain, Cognition and Behaviour, Radboud University, Nijmegen, The Netherlands. E-mail: olivia.guest@donders.ru.nl

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challenging gender apartheid, for not practising reflexivity (Goffman, 1977; Lind-Guzik, 2023).

While by no means is it true that everybody needs to code (viz. Basman, 2017), we make a different case: everybody already knows how to code at least with respect to some basic concepts and everybody who wants to learn should be afforded the same respect to do so. Because our pedagogical focus herein is programming, we are at odds with an existing hyper-masculinised culture, that does not set us on a fair footing to foster deep care for each other's experiences in educational and pastoral contexts. Quite the opposite, as shall be seen: technology culture is interwoven with white supremacy (Little & Winch, 2020), capitalism, competition-as-virtue; and it defaults, when left unchecked, to extremely polarised gendered mores and archetypes (Erscoi et al., 2023; Hicks, 2017). For example, Lindsay Meyer has stated "I felt like I had to tolerate [sexual harassment and assault] because this is the cost of being a nonwhite female [technology company] founder" (Benner, 2017).

In this piece, we — under the guidance of our students' feedback, through examination of our own (inter)relationships and lived experiences, and as a function of other academics' views (Abbiss, 2008; Anderson, 2016; Hermans, 2021; Kramarae, 1988; Light et al., 2015; Mayer, 1981; McCracken et al., 2001; Mitcho, 2016; Sheard et al., 2014; Shrewsbury, 1987; Turkle, 2005; Webb et al., 2002) — speak to fellow educators who ignore these issues at their students' and mentees' perils. We reach out to our peers, teaching staff within the higher education sector, who care about learning environments and outcomes, to highlight and foreground the importance of addressing the issues unpacked herein.

We aim to probe, dissect, and destroy anti-pedagocial framings and rhetoric that aid few and harm many, especially the racialised and feminised, in the academy and beyond. We posit that such a journey is fraught with peril because of the wider social framing of technology, technical skills, and programming specifically as male-dominated, masculinised, and inappropriate, even unsafe, for women, the feminised, people of colour, and any minoritised group. In other words, we face the double bind of being (seen as) both internally and externally hostile to anyone who falls outside the standard white male geek archetype; i.e. we often are, or minimally appear, unwelcoming to outsiders, and are actively hostile towards learners and practitioners on the inside. Freeing ourselves, at least within the confines of the classroom, is a big ask that we lay bare for fellow (perhaps hitherto well-meaning, but uninformed) colleagues.

2 Dysfunctional programming

```
// In this Scala snippet, what does the function
// main() print?

@main def main() = println("Hello, World!")
```

The current state of teaching coding often minimally ignores the backdrop of sexism and maximally plays into it. How do we include those whom their classmates, other educators, and society at large are excluding? To answer such questions, the wider context of learners needs to be understood, e.g. what goes on between tech and girls/women before the programming class?

From a young age, children learn that tinkering, reverse engineering, video games, and other such activities, are seen as prototypically masculine (Lien, 2013). Worse, these activities or hobbies are not recognised as such when the feminised generally take part in them or when these activities occur in less male-coded settings (Scott, 2019), e.g. puzzle video games are not seen as true video games, HTML is not seen as a true programming language. This facilitates statements, e.g. about women's programming capacity, such as in Dialogue 3, to be seen as uncontroversial.

Obfuscating women's interests in and contributions to technology, echoes through the ages (e.g. Erscoi et al., 2023). Culinary recipes are archetypal algorithms, but cooking is not seen as related to programming (cf. Shore, 1985). Jaccard looms, machines that weave cloth, are the original use case for punchcards — physical pieces of paper that were used to program computers (Harlizius-Klück, 2017). Ada Lovelace invented the first computer program (Aiello, 2016). Women mathematicians and programmers worked with the first digital computer, the ENIAC (Kleiman, 2022). Grace Hopper invented the compiler (Beyer, 2012). Core rope memory was created through knitting copper wires by mainly middle-aged or older women for NASA's Apollo missions (Rosner et al., 2018). Margaret Hamilton was Director of the Software Engineering Division that inter alia took humans to the Moon (Hamilton & Hackler, 2008). And on and on; see Figure 1.

The contradictions rising evermore give us framings such as 'women are good at language and men are good at logic and maths' which fail to notice logic, maths, and programming languages are all languages. All these framings are not only sexist, but discombobulating to our students and false (Kelly et al., 2022; O'Dea et al., 2018; Voyer & Voyer, 2014). Ultimately, these are typical trends within

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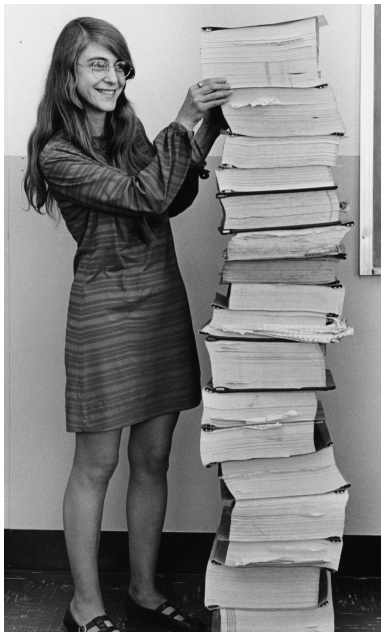
Figure 1

An example of the types of historical photographs that can foster a more inclusive atmosphere in class by educating students on the history of computers and coding. Depictions of successful programmers and computer technicians serve to (re)claim such activities when confronted with perceptions about who can code.[1]

1969: 'Space age needleworker "weaves" core rope memory for [Apollo missions'] computers.' (Raytheon, 1969, p. 18)

1962: Mathematicians and programmers, Patsy Simmers, Gail Taylor, Milly Beck, Norma Stec, holding parts of the first computers.

c. 1972: African-American woman computer operator at the Office of Personnel Management.



1969: Margaret Hamilton with the code she and her staff wrote for the Apollo 11 mission.

capitalist patriarchy, where women's — and all minoritised people's contributions — are systematically hidden from the historical retelling of humanity's achievements (also known as cryptogyny, the Matilda effect; for more see: Connell & Janssen-Lauret, 2022; Evans, 2020; Gage, 1883; Hicks, 2017; Kleiman, 2022; Lee Shetterly, 2016; Pozo & Padilla, 2019; Pozo-Sánchez & Padilla-Carmona, 2021; Rossiter, 1993; van den Brink & Benschop, 2012). Part of a good teacher's repertoire is this fact, which drives both a more expansive appreciation of their own field, and which results in a broader and more interesting syllabus.

Another piece of the puzzle is what goes on in our university-level educational contexts, the spaces we inhabit on a daily basis. Importantly, a significant part of exclusionary rhetoric at this stage often focuses on who is a programmer or what makes one a programmer. Often, our students or colleagues express unscientific anti-pedagogical opinions about what drives such skill sets and interests.

In the Dutch setting, often direct relationships are proposed between what specialisation in high school students chose, i.e. between so-called hard sciences or so-called soft sciences, prior to entering our classrooms — and this prior exposure is taken as predictive of their aptitude, or even of their ability to pass certain courses at the university level (Scheerens et al., 2019). Even in the context of Dutch, the fact that technology, programming languages, are so Anglocentric rears its head from childhood interlocking with class and educational attainment (Hermans, 2024; Swidan & Hermans, 2023). Ironically, this is not taken as a (perhaps challenging) part of our jobs as educators, but as a deficit or an essential characteristic of the student (Abbiss, 2008; O'Dea et al., 2018).

In the Anglosphere setting, often these relationships to technology or so-called hard sciences are traced further back to childhood (Lien, 2013; Margolis & Fisher, 2001; O'Mara, 2022; Scott, 2019). Statements from mentors recruiting childhood exposure, such as 'I learned to code when I was 7 years old. So I don't expect people who have just started to learn to really know anything,' are said lightly without empirical or pedagogical reflexivity.[2]

[2]While our focus is not one that lies outside the Global North/West, the first author grew up shielded from many such framings (although with exposure indeed at a young age to computers) in Cyprus. The value of a childhood un- or less tainted by

Adding to the irony, these are the same mentors who do very little to no coding on a daily or weekly basis. If any property of a skill is uncontroversial, it is that frequent exercise of said skill is likely indicative of current aptitude.

However, and much more importantly, there is no critical window for learning coding. There is no special cognitive capacity, over and above knowing natural language and basic maths skills, for rudimentary coding aptitude. There is no biological clock that starts ticking, counting down from birth to childhood when a magical exposure to code sets one on a course to being adept at coding for life — and if this window is missed, one is doomed to never being technical or understanding formal languages like programming (cf. Forbes et al., 2022). There is nothing stopping anybody at any age from having fun with code or retraining as a programmer. Basic coding is not radically different from adding a little formal veneer to basic literacy and numeracy all students have already been exposed to and have mastered (see Dialogue 1).

On this note, in the next section, we move to dialogical strategies for both framing your views and for addressing others'. These short dialogues pave the way for expressing opinions that are largely left unsaid, and for countering narratives largely left uncontested.

3 Dialogic deprogramming

```
/* What is on the left of the :-  is true if what
is on the right is true in Prolog. What does this
mean? */

grandparent(X, Y) :- parent(X, Z), parent(Z, Y).
```

In the Computer Science B.Sc. of the first author, it was often heard from peers that 'women are stupid' and 'women cannot code as well as men' (also see Margolis & Fisher, 2001; Yates & Plagnol, 2022) — these were sometimes taken as facts of the matter and not open to debate or questioning, let alone unpacking as forms of abuse (see Dialogue 3). This continues in our proximal academic environments to this day, as reported by our own students in an Artificial Intelligence programme of study and by women students in Computer Science in Margolis and Fisher (2001) and Yates and Plagnol (2022).

On the other hand, in Psychology, educators are often not only reluctant to teach these highly-prized skills, but are also outspoken and defensive about their reluctance (see Dialogues 4–7). This reluctance is in stark contrast to the facts on the ground where back in 2014 the book *Learning statistics with R: A tutorial for psychology students and other beginners* by Danielle Navarro (2013) was averaging 90 downloads per day. She also notes on page xii:

> Over the last few years I've been pleasantly surprised at just how little difficulty I've had in getting undergraduate psych students to learn R. It's certainly not easy for them, and I've found I need to be a little charitable in setting marking standards, but they do eventually get there. [...] So if the students can handle it, why not teach it? The potential gains are pretty enticing. If they learn R, the students get access to CRAN, which is perhaps the largest and most comprehensive library of statistical tools in existence. [T]hey learn data analysis skills that they can take to an employer without being dependent on expensive and proprietary software.
>
> Danielle Navarro (2013)

Her extract above is notable because it is making clear the backdrop of negativity she is reacting to, i.e. that students are expected to be reluctant or even unable to learn coding. For perhaps obvious reasons, academics are not often on the record claiming women in psychology cannot (learn to) code, but this is no reason not to address these claims — i.e., just because they are not archival (although see Long, 2018) does not mean they do not rule the landscape our colleagues and learners need to navigate (viz. Tupas & Tarrayo, 2024). Relatedly, BSc degree programmes, including Psychology, appear to have negative consequences on women's academic careers, e.g. "there is often a smaller percentage of women than men among doctoral graduates even in domains in which they are in the majority at the undergraduate level." (Aelenei et al., 2019, p. 4)

In the remainder of this section, we give some paraphrased examples — followed by further analysis below each dialogue.

Dialogue 1

👩🏽 I am too old to learn to code; others started in childhood.

👩🏿‍💻 Many learn to code, and many other complex skills, later in life. But also, programming basics are not novel concepts, e.g. *if-statement*, 'if you are hungry, then you can have a snack;' *while-loop*, 'while there

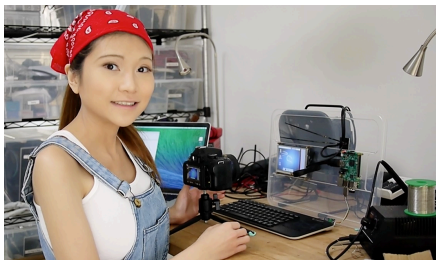
the ceaseless gendering of technology has not gone unnoticed, especially when bombarded with these framings on moving to the United Kingdom. Both the effects of childhood experience with technology which contribute directly to demystifying it, and the effects of not wondering if 'girls can code' are interlinked since one reinforces the other both interpersonally, in her classroom experiences as a teen, and in the broadest possible cultural landscape.

[3]Image licences clockwise: a & b) used with permission of the depicted women, c) used with permission from the Computer History Museum, d) CC BY-SA 4.0, by Chickymaria: https://commons.wikimedia.org/wiki/File:Regina_Honu_01.jpg.

Figure 2

By the same token as Figure 1, such images and related materials serve as inspirational (providing role models, confidence, a feeling of belonging) and educational (providing the impetus for learning more about the diversity of computational scientists and tech workers) to our students.[3] *Displaying the breadth of what one can do with coding skills, or what a person with computational skills looks like, dissolves sexist assumptions and demystifies what these skills are for.*

Abeba Birhane: a cognitive scientist who specialises in inter alia responsible and ethical AI, at the Mozilla Foundation and Trinity College Dublin.



Naomi Wu: a DIY maker (a subculture that creates though hacking, tinkering, and otherwise innovating tech, arts, and crafts) and expert in 3D printing.

Regina Honu: a tech entrepreneur, who founded Soronko Academy, a school for girls to learn coding.

Adele Goldberg: a computer scientist and one of the creators of the programming language Smalltalk.

> are slices of pizza left, offer them to your guests;' *object-orientation*, 'a dog is a type of mammal, so you can typically expect it to have four legs. An orca is also a mammal, but has modified legs for an aquatic life.' Age is not relevant. Those who use their prior, much younger, exposure to code are gatekeeping you; they are not warning you of real educational dangers, but using this false excuse to stop you learning. Unlike some facets of cognitive development, *there is no critical window for learning to code*; this is a myth.

What is typified here is a classic framing that takes perhaps useful notions from education like zones of proximal development (ZPD; Vygotsky & Cole, 1978) or critical windows (e.g. Burrill, 1985) and misapplies them in a self- and other-harmful way.[4] We absolutely do not mean to blame the victim here and the self-harm is the product of the active hostile enculturation that is tacitly and directly promoted by those who want to gatekeep (i.e. keep women out of coding; Hicks, 2017; Yates & Plagnol, 2022) This framing is also typically found outside undergraduate courses that require coding in their first year, since there the students in many ways have no choice: the programme they are enrolled in, e.g. computer science, requires programming. As discussed previously, such settings are prevalent in Psychology, for example, when advanced methods courses cause the learners to confront their minimal technical or coding skills. The men, while dramatically fewer than the women in Psychology, nonetheless end up being the 'stats guy' or the 'code guy' (Johnson et al., 2020; White, 2020).

Dialogue 2

👩 I do not know how to code, even though I am in my final year of an Artificial Intelligence BSc.

👩‍🔬 Why do you think this, given you have passed all your programming classes?[5] That is the university's definition of knowing something, which

[4] See Angeli and Georgiou (2023), Gilsing et al. (2022), Macrides et al. (2022), and van der Werf et al. (2022) for how these concepts can be appropriately applied to teach programming in childhood.

[5] Perhaps unexpectedly, this was heard from one of our most

might not mean much, but what metric are you using? Stereotypically polluted perceptions of women coders taken from your classmates, teachers, or society at large? Remember, the coding you do is real coding.

Not believing in our skills as women coders within Computer Science or Artificial Intelligence is a typical personal and academic journey (recall Yates and Plagnol, 2022; also see Lehtinen et al., 2021). Most women seem to think, due to the years of denigration, that they are not as good as the men. In other words, "in the academic contexts in which women are less certain that they belong, they may consequently feel less academic self-efficacy" (Aelenei et al., 2019, p. 6). While the male readership of this article may be self-selecting in parts, even the kind of men who will choose to read this should reflect on how there have been moments where they have also held biases, made throwaway comments that denigrated, or allowed such comments or attitudes to pass uncritically.

Dialogue 3

👱 Women are not good at programming.

👩🏽‍💻 If you think this, then can you explain how a woman, e.g. invented the compiler (Grace Hopper), wrote the code that took humans to the Moon (Margaret Hamilton), and on and on? If these are somehow exceptions to some baseline where most women are not that good at coding, I can grant it if you also grant that most people are not that good. Not everybody is an expert writer or mathematician, but girls excel at these subjects, much more so than boys in primary and secondary school (Kelly et al., 2022; O'Dea et al., 2018; Voyer & Voyer, 2014). Something else is going on that contorts your view of women as competent coders.

These self- and other-harming comments are a reaction to perhaps their world view starting to shatter. Notably Hicks (2017) and Lee Shetterly (2016) might be useful reading materials for such students regardless of their gender to help set them on a better footing. This might also be an opportune moment to remind of the vicious cycle at play here. Sexism drives and is driven by many of these assumptions, i.e. "women on GitHub [a social code-sharing website] may be more competent overall, bias against them exists nonetheless." (Terrell et al., 2016, p. 1)

Dialogue 4

👦🏻 Students want or need graphical user interfaces (GUIs), otherwise they do not enjoy the course and/or they cannot learn as well.

👩‍💻 Pupils from a young age, for example, learn complex enough linguistic, mathematical, and artistic skills without the use of GUIs. Besides, we already expect undergraduates to have the ability to navigate complex statistical or conceptual work without multimedia.

This is a very strange myth that is pushed in part by the technology industry itself, e.g. by vendors of programs such as MathWork's MATLAB and IBM's SPSS, which offer graphical interfaces to avoid teaching what is going on behind the scenes. While GUIs might seem easy to use, they are not conducive to (and in fact may harm) so-called 'computational thinking' (Anderson, 2016; Angeli and Giannakos, 2020; Wing, 2006; but also see Basman, 2017) which is the skill we are trying to teach here.

> [Computational thinking] represents a universally applicable attitude and skill set everyone, not just computer scientists, would be eager to learn and use. [It] builds on the power and limits of computing processes, whether they are executed by a human or by a machine. Computational methods and models give us the courage to solve problems and design systems that no one of us would be capable of tackling alone.
>
> Jeannette M Wing (2006)

Learning to use a GUI is a different skill set and not the subject of a class on programming, necessarily.

Dialogue 5

👨 We cannot teach them to code because scoping (or any other programming concept) is difficult and time-consuming to learn.

👩🏿‍💻 If the goal is to make every course as easy as possible — where easy means the teacher is purposefully avoiding what they perceive as difficult, but they have this knowledge — then our students will rightfully complain because this is both elitist and anti-pedagogical.

These are frames that — like much of misogyny or seemingly gentler forms of sexism, or other types of dehumanisation or bigotry — are premised on the idea that

academically successful women students in Artificial Intelligence, while she was doing an incredibly high-quality final-year thesis project that involved coding.

somehow computational knowledge or higher forms of reasoning are more difficult to learn in the abstract and not as a function of the teacher or the social contexts in which the learners are embeded (Birhane & Guest, 2021; Gould, 1981; Hampshire et al., 2012). Which is to say:

> Programming, despite the hype and the self-serving fantasies of [masculinist] programmers the world over, isn't the most intellectually demanding task imaginable. Which leads one to the inescapable conclusion: The problem with women in technology isn't the women.'
>
> Paul Ford (2015)

We can even invert the paradigm that difficulty with respect to coding is somehow unique or gendered in essence (viz. Abbiss, 2008):

> English is hard. Not everybody is Maya Angelou or William Shakespeare. Not everybody is going to win a Nobel in Literature. We still learn English grammar at school, write essays, learn how to spell, etc.
>
> Maths is hard. Not everybody is Grigori Perelman or Maryam Mirzakhani. Not everybody is going to win a Fields Medal. We still learn arithmetic and elementary algebra at school and some lucky people learn calculus and linear algebra too.
>
> Olivia Guest (2018)

All learners of English, e.g. in primary school or as a second language as adults, learn the 26 characters of the alphabet, or the arbitrary mappings from shapes and sounds to objects and meanings. When we learn to drive, we practice and perfect certain complex motor and related skills, literally including in life and death situations. And learners who are even children, i.e. late teens, learn to drive; and the things they learn are by definition complex enough to require schooling, instruction, supervision, licenses, and so on. This is what learning anything of value is: a serious but not impossible commitment. To say one cannot teach something because that something (e.g. computational thinking, Brennan & Resnick, 2012; Wing, 2006) is difficult is to say one is not qualified to do so. Furthermore, to say what one teaches is driven merely by (perceived) difficulty is a serious error. This becomes doubly erroneous if claimed by a member of staff in a psychology department from the perspective of understanding human cognitive capacities (cf. Fine, 2010). Students enjoy learning complex and difficult things, and they do so in-depth and often with little extra effort from the educator provided other aspects of the environemnt are in place: "when students have the feeling that they do not have enough information or knowledge to complete the exercise or to solve the problem, they tend to resort to a more surface approach to learning." (Kyndt et al., 2010, p. 408).

Dialogue 6

👱 Teaching students to code is zero-sum, so that means removing other parts of the course.

👩‍💻 Coding can be taught alongside other things. In psychology this can be during experimental design, since academics use programming language(-derived tools), and during statistics courses (Anderson, 2016, also see). Often these are packaged together as 'research methods,' which span the full breadth of a 3-year degree in psychology, meaning there is ample time to teach relevant programming practice as you use in your research.

This zero-sum property may indeed be the case. In other words, it may be the case that given constraints on what needs to be taught, there is little time and mental space left without overburdening the students. This is important to bear in mind. In the United Kingdom context, for example, the British Psychological Society (BPS) controls curricula, which means that to be accredited certain criteria must be met. A welcome change is the flexibility in teaching Research Methods, which includes statistics. Furthermore, the BPS explicitly states statistics taught in R is an appropriate method of teaching students some of the required research skills (The British Psychological Society, 2017). This means teaching programming can be folded into a course on Research Methods, and not add overhead to students who may otherwise not have the curriculum space.

On the other hand, in the Dutch context, students are often systemically overworked: "on average students experience a higher workload than 28 hours per EC" (Faculty Student Council, 2022) and "the number of students taking longer than 3 years to complete their studies [for 3 year degree] is relatively large, as was already pointed out by the previous accreditation panel." (QANU, 2020, p. 16) Students, as teachers, need stretches of uninterrupted and unstructured time in order to manage their time (Kyndt et al., 2013) Humanisation of both groups is imperative — however care must be taken not to centre teachers when students have in any case no power to help, and students are the responsibility of the teachers not vice versa. Statements such as "students expressed worries about the workload of the teachers" (QANU, 2020, p. 16) may serve to ring alarm bells; not only about any potential workload issues which or may not be the case with the staff, but about how to students are emotionally reflecting staff views and issues and not vice versa. To wit, students can

express they deserve well-rested and unstressed teachers, but often framings such as students "express[ing] worry" about teachers could be indicative of much more serious issues.

Dialogue 7

🧑 You cannot teach them how to code during a stats class because some students will have a "handicap" if they have not coded before.[6]

👩‍💻 Isn't the real disadvantage leaving university without ever learning how academics do their work? If some students already know how to program, which is your contention, the problem is that imbalance. You can address this by having a class that weaves these concepts into their statistical training, or indeed a separate class.

As mentioned above, this is a type of zero-sum framing (viz. Kyndt et al., 2010), which may or may not have direct value for us, and which we nonetheless need to navigate. Educators like Navarro (2013) can do it, so others can draw inspiration from her materials.

We would like to problematise the assumption that the educator in a university setting where the learning goals comprise 'learning how to program' has to do much, if anything, for students who have already learned how in previous stages of education. These students are often the very same who, having been enculturated in masculinist notions of programming, inadvertently or not perpetuate them (Margolis & Fisher, 2001; McCracken et al., 2001). As educators, we have a responsibility, to protect our students from anti-pedagogical framings, especially ones which directly interfere with the learning goals. We must use our judgement to decide if a student who meets the learning goals already can be safely taught to promote our values in class or can be moved to a space where their current stage does not harm their colleagues, e.g. women or other minoritised groups.

3.1 In the classroom

```r
# What does the following R code print?

a <- 33
b <- 200

if (b > a) {
  print("b is greater than a")
}
```

Large classrooms — e.g. in the School of Artificial Intelligence at Radboud, we currently have just under 300 students learning to code in their first year of study — have their own sets of difficulties and requirements. Some students will be learning this skill for the first time, others may have had previous exposure. The role of the teacher here is to make sure those students who have the least exposure learn to code — and (recall Dialogue 2) know they have learned to code.

In contrast, seasoned, or perceived-to-be experienced, coders are not the responsibility of the educator to keep entertained (recall Dialogue 7) . Unlike other earlier stages of education, university classes are often not mandatory. An undergraduate student who feels un(der)stimulated by classes on topics they already know can either not attend and pass the exam based on their previous skills, or request to be given an exemption and instead attend classes suited to their current skill set. This is important as an educator's job is to teach those who do not know how to code and not to keep experienced coders highly stimulated (which perhaps might be the case in prior stages of education; primary school teachers' skills at the intersection of gender and programming is an active area of research and scholarly discussion, e.g. Angeli, 2022; Angeli & Valanides, 2020; de Wit et al., 2023). Herein, we propose something that seems radical to some of our colleagues, that a teacher's role is to help those who meet the entrance criteria of their course and take them on a pedagogical journey to meet (or indeed surpass) the learning objectives laid out in the course description.

Workgroups or practical sessions, where students work on their devices and directly practice their programming skills, also present a series of difficulties (Lehtinen et al., 2021; Morrison et al., 2015). This is especially so if the teacher is unable to spread their attention over all groups, pairs, or individual students at all times. For example, teaching assistants need to be trained to spot the deployment of statements presented in Dialogues 1–3 and act appropriately, perhaps with the replies presented here, or with other appropriate interventions. Lacking these interventions, educational contexts can easily be derailed into significant emotional labour being requested from certain groups towards the privileged, e.g. wherein feminised students are traumatised by framings of their inability to (learn to) code (Lewis et al., 2016; Lind-Guzik, 2023; Terrell et al., 2016; Yates & Plagnol, 2022). This imbalance plays out in other relevant power relationships, as also been seen previously, in the Dutch setting, where students express empathy towards teachers' workload. There is no need to push downwards towards the least empowered members of a university, i.e. from faculty to students. Emotional labour is not owed to us as educators from our

[6] For example, 'I worry about students without coding experience feeling that they start with a handicap (because they do). In their first stats course, I like students to grasp the concepts, not "tapply".' (Wagenmakers, 2018)

class.

3.2 In mentoring

```ruby
# What will this Ruby snippet print?

n = -1
if n > 0
  puts "n is positive"
elsif n == 0
  puts "n is zero"
else
  puts "n is negative"
end
```

In contrast to the larger setting of the classroom, one-on-one mentoring relationships allow for a more direct and in depth examination of any problematic baggage our mentees may carry. Such a more intimate setting requires even more due care and attention, as things said in such contexts may have the deepest impact. Situations such as those uncovered in Dialogue 2, where mentees disclose deeply held (harmful) personal beliefs about their skills, arise only when the mentor-mentee relationship is one where divulging such self-images is seen as safe.

A healthy mentoring relationship is a requirement for a flourishing mentee (Phillips-Jones, 2003). In such settings, which are part of every academic's pastoral and managerial responsibilities, we should strive to elevate our mentees in ways that they themselves may not yet be ready to face due to trauma visited upon them by previous pedagogical experiences (recall Dialogues 1 & 2). Importantly, however, not all our mentees will be women or feminised, in fact it is unlikely most of them will be given the current gendered landscape if the context is programming. Relatedly, some, of any gender, may be more likely to express or believe sentiments such as those captured by Dialogue 3, and this is much more likely if we ourselves are not feminised. In other words, men mentors, for example, may have differing opportunities for intervention. We implore our colleagues to take such opportunities to facilitate changing perspectives.

In the Dutch setting, PhD candidates, for example, may take classes to further hone or refine their technical skills. In the United Kingdom setting, PhD students are often more actively mentored, and are not seen as employees, which allows for deeper and most custom pastoral care. As their supervisor or mentor, we have a responsibility to investigate if their presence is safe for the other learners, especially if the mentee is a man. Conversely, if our mentee is gendered and/or racialised, we should allow space for them to report to us what tensions or problems may arise in these spaces from their perspective. PhD candidates learning to program, especially at the standards required in academia, is a fertile environment to collaboratively address and rectify biased or otherwise lacking educational experiences.

In the next section, we set out a list of dos and don'ts. These are inspired by all the aforementioned issues, dialogical techniques, and our own personal learning experiences; we distil these into short actionable points.

4 How not to go loopy

```python
# Can you guess what a for-loop does in the
# following example in Python?

fruits = ["lemon", "banana", "pineapple"]
for fruit in fruits:
  print(fruit)
```

Given all the abive is at play, what concrete steps may an educator take? We have an obligation to deradicalise our masculinist students, both for their own benefit and for the safety and educational success of their peers (also see Abbiss, 2008; Berry et al., 2022). Intertwined with this, we also have an obligation to support our most vulnerable students through learning concepts and skills that are not inherently difficult but are embedded in a minefield of distractors and punishments (recall the history of erasure). Below are some basic things to avoid and promote in your learning spaces:

Avoid catering to the most competent students other than to give them (if they ask) work on diversity, inclusivity, and equity issues within programming. For example, essays on historical programmers, or better still, organising events like viewings of *Hidden Figures* (a film based on Lee Shetterly, 2016). Recruit them to help other students sparingly — preferably not at all — and ensure they do not recapitulate that certain demographics are inherently more skilled.

Remember there is no one way of teaching other than your own way of imparting knowledge and nurturing the students. If you inherit materials, question them. If you have high student attrition, look at the demographics and ask why. The answer is generally socially unjust forces are at work, but your unique case may need certain specific interventions, new teaching methods or more women staff might not be enough. Think deeply and take your time.

Avoid assuming you are a good teacher — do not take your students' word on this as final. Be ready to grow. While student evaluations are indispensable, they are not experts on what you should teach and

how. Pedagogy comprises many academic fields, and students are not trained in them. It is your responsibility to seek out and listen to experts on teaching programming (see our reference list for ideas).

Avoid pretending sexism is absent from your classroom, from daily interactions with other students, from students' educational histories. Neglecting this keeps the door open to masculinist radicalisation, harm to the feminised programmers. The same goes for racism and white supremacist, or otherwise socially unjust, notions of who can code (e.g. ableism; Bocconi et al., 2007; van der Meulen et al., 2023).

Avoid deploying individualistic framings such as so-called stereotype threat, so-called impostor syndrome, or so-called implicit associations. Telling students that all else equal, the problem is within their own head is an improper basis on which to build a functional learning environment, and is tantamount to victim blaming in this context. Sexism and racism are out there in the world and not something women or people of colour are creating in our classrooms to subvert our pedagogy.

Ask students to care about each other and each others' learning experiences. Warn them away from gendered dynamics wherein the masculinised students are typically explaining things to the feminised students, but nonetheless empower them to help, support, and care for each other. Competition-as-virtue and individualism are not useful paradigms in a pedagogical safe space (Okun, 2021).

Remind mentees of humility because it is important to remember that nobody knows everything about everything (Okun, 2021). Technical things themselves are constantly changing, and so current knowledge becomes outdated faster than people realise. Relatedly, being wrong about things, e.g. introducing bugs to code accidentally, is part of the learning process.

Promote reflexivity — there is value in looking back at and thinking deeply about both how far learners have come in terms of the direct learning goals and with respect to overcoming sexist, racist, or other, framings (Okun, 2021). Learning how to code itself, exploring their ability to teach others if they are mentoring their peers or assisting you with teaching, as well as surpassing maladaptive social conditioning about who can code, are all valuable achievements to take stock of.

On this final note, the above suggestions are meant to inspire educators' reflexivity in their own methods; and are not meant to be used as a way to be catastrophically self- or other-critical (viz. Okun, 2021). Cultivating healthy learning spaces is a permanent work-in-progress; definitionally unfinalisable and in flux.

5 OO, so what now?

```python
# A class is a blueprint for creating objects.
# What is the output in the following Python
# snippet?

class Fruit:
  def __init__(self, name, colour):
    self.name = name
    self.colour = colour

f = Fruit("strawberry", "red")

print(f.colour)
```

Looking forwards, we ask that educators who are not able to carry the whole classroom take a step back and question why; what is holding you back? If you experience institutional lack of support, then discussions with your institute are a possible worthy cause over abandoning teaching altogether. Presenting materials such as herein (Figures 1 & 2) to class can go a long way. If you are a woman, feminised, or gender diverse, showing up has impact; from an Artificial Intelligence undergraduate in her final year:

> [Women professors and educators] inspire me to maybe pursue an academic career. I used to think not seeing many women didn't bother me, but apparently it really helps. I just realised this week we only have had 1 female teacher for all the compulsory courses.

Humans learn and continue to learn, and we can also choose to forget. We can collectively decide to leave behind toxic framings that critical windows exist for learning to code, or that only certain types of people can learn such a skill. This constitutes a zeroth step in the long road towards reclaiming and rehabilitating the skill of coding and profession of programmer, invented by women who have been erased from mainstream history; and presents unique challenges to both learner as student and learner as educator.

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