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Is science, technology, engineering and mathematics in higher education sexist and racist? all surface, no substance

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Is science, technology, engineering and mathematics in higher education sexist and racist? All surface, no substance

Reham ElMorally
International Development, University of Reading, UK

Billy Wong
Widening Participation, Institute of Education, University of Reading, UK

Meggie Copsey-Blake
Institute of Education, University of Reading, UK

Abstract

Scholars have long argued there is systemic injustice within higher education, particularly with regards to ethnic and gender disparity in Science, Technology, Engineering and Mathematics (STEM) education (Race, 2005; Rollock and Gillborn, 2011; Singh, 2011; Gillborn et al., 2016; Arday and Mirza, 2018; Bhopal and Henderson, 2019a; Advance HE, 2021a). In the UK, 35% of STEM students are female, but STEM disciplines are not innocent of bias and a females' ethnic background poses another hindrance to their academic and career trajectories (Bosworth and Kersley, 2015). Existing studies have highlighted institutional bias towards White male students and applicants, and it is undeniable that there is a myriad of gendered and racial biases, especially in the physical sciences. Using data collected over a two-year period, 69 qualitative interviews were coded and analysed from an England-based University to gain further insights and add to existing literature concerning racism and sexism in STEM degrees. This article argues that the UK is currently experiencing the 'height of capitalism', where the value of labour is considerably disproportionate. This can act as a demoralizing force against inclusivity within STEM disciplines. The race and gender gaps, particularly in terms of attainment, are two of the most significant avenues where we see the value of labour diminished, and capitalism pronounced. In addition to racial and gender biases, institutionalised racism and systemic injustices embedded within the higher education system has *doubled*, if not more, the burdens and barriers women and ethnic minorities in STEM face (Jones, 2019). This paper is not a crusade against corporations, but an investigation into the

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Corresponding author:
Reham ElMorally, International Development, University of Reading, Whiteknights Road, Reading RG6 6AH, UK.
Email: r.elmorally2@reading.ac.uk

intersectionality of gender and race in relation to opportunity discrepancy and attainment, to better understand why large discrepancies in inclusivity is more pronounced in STEM disciplines and professions. The research explores the themes of *microaggression* as a possible explanation for attainment gaps, attitudes towards *affirmative action and positive discrimination* and the policy's attempt in mediating systemic injustices through representation, and introspectively unpacks its effects on students' potential career opportunities in the *capitalist* labour market.

Keywords
racism, sexism, underrepresentation, underachievement, women in science, technology, engineering and mathematics

Introduction

Examining experiences in Higher Education (HE) is not without its limitations. Race and gender are two of the most prominent characteristics undergoing scrutiny from the public, as the effects of racial and gendered systemization is very real for participants and can bring about demoralising and unequal outcomes for those affected (Bhopal and Henderson, 2019b; Bhopal and Pitkin 2018; Castilla 2008). Studying race and gender is often limited by the available data, such as in the UK. Gender differential occupational requirements exist in today's observed labour market (Perales, 2013), where the pay-gap is a reliable criteria for investigating gender-based inequality (Chareles and Grusky, 2004) as it signals a lower occupational rank and prestige (Peterson and Saporta, 2004), and connotes women's slower career growth and progress as compared to their male counterparts (Magnusson, 2009). (Arday and Mirza, 2018; Rollock and Gillborn, 2011; Gillborn et al., 2016; Race, 2005)

Similarly, ethnic inequalities persist to exist in the labour market, where there is evidence of an ethnicity pay gap, as White employees make on average more money for the same job performed compared to an ethnic minority individual (Brynin and Guveli, 2012; Jones, 2019). Furthermore, unemployment rates are significantly higher among Black African, Bangladeshi and Pakistani groups as compared to the White groups, and occupy lower grade vocations (Heath and Cheung, 2005). Brynin and Guveli (2012) argued that 'the more the proportion of people in an occupation who are from ethnic minorities the lower the wage gap, consequently ethnic minorities earn consistently less than their White counterparts' (2012: 585). One could assume that the gap decreases the higher the educational level of a minority ethnic[1] employee, but Rafferty (2012) suggests that there is no positive correlation between the two, and presupposes an institutional bias towards White employees over minority ethnic employees with the same or similar skills and qualifications. Nielsen (2011) exposed the fact that minority ethnic employees are systematically occupying positions for which a White counterpart would be considered over-qualified, revealing the racial bias towards the White majority population and the unreasonable 'blocking' of ethnic minority individuals (2011:513).

Moreover, the adoption of an intersectional lens to critically evaluate the gender and ethnicity awarding gaps, socially embedded inequalities and biases become more pronounced and show a significant correlation between the educational and occupational gaps and patterns we can observe in the UK (Bradley and Healy, 2008). Although some evidence suggests that academic awards and achievements could enhance minority ethnic individuals' access to the labour market (Platt, 2005), the statistical significance does not necessitate or even serves as a precursor to social mobility (Rafferty, 2012).

This paper suggests that there has been a tremendous level of progress on an institutional level to make Science, Technology, Engineering

and Mathematics (STEM) disciplines more inclusive of historically marginalised groups. Yet, we argue that efforts from the HE sector, especially in the UK, is currently insufficient to combat or control the unequal career trajectories and outcomes of female and ethnic minority students. We find that efforts to counter gender and ethnic inequalities appear to be a box ticking exercise to raise the profile of the institution as opposed to benefitting the students afflicted by social inequalities.

This paper is divided into three sections. The first section titled *Positive Action* versus *Positive Discrimination* introduces and defines both concepts, leading into a review of existing literature concerning the role of affirmative action and representation in the quality of HE experience. The second section of the paper titled *The Study* presents the methodological approach adopted for this research. The third section of this paper presents qualitative findings, which revealed two distinct shortcomings: (1) The 'Woke' culture and its bearing on women's experience of HE and STEM, and (2) critically engaged with how institutional efforts to mitigate diversity shortcomings could lead and/or turn into an ineffective check-box exercise where intersectional issues such as race and gender are overlooked. Lastly, this article concludes with recommendations and suggestions to better incorporate a race and gender mainstreaming efforts into HEI.

Positive action vs positive discrimination

Implementing policies, such as Affirmative Action (Crosby et al., 2006) – a political and institutional movement started by former US president Lyndon Johnson (1963–1969) to improve living standards and access to opportunities of African American citizens – received a myriad of backlash from the community. Pierce (2013) noted that 'backlash politics has created a convenient racial alibi for White middle-class and upper middle-class Americans. By pointing the finger at the working-class, White managers and professionals can claim 'racial innocence'', attributing the backlash to institutionalised racial attitudes (Pierce, 2013:923). Affirmative action, also referred to as Positive Action in this article, is commonly misunderstood as 'because you're a minority, you get special standards, special treatment in the eyes of some' (Coaston, 2019) and thus misrepresented and presented as an issue of social ignorance as opposed to systemic institutional injustice designed to maintain a certain status-quo. Additionally, it has been argued that affirmative action 'promotes solipsism at the personal level and division at the social level' (Coaston, 2019). However, affirmative action occurs when an organisation devotes resources (including time and money) to making sure that people are not discriminated against on the basis of their gender or their ethnic group. Yet, research conducted by Feagin and O'Brian (2004) on the theory of post-racial era found that not only do White men deny being racist, but they also oppose taking any steps in their personal life and professional career as managers to counteract social and institutional discrimination, that is, they oppose the proactive dedication of resources to counter biases. The backlash recorded in the United States was also observed in the United Kingdom. Research by the European Social Survey (2020) noted that while 43% of UK respondents support legislative changes for affirmative action, the Number Cruncher Politics (2020) found that only 11% White respondents supported general measures to racial and gender discrimination in the workplace (NCP, 2020). Benson, et al., (2021) in their study also found evidence of 'hostility towards more interventionist remedies, such as the redistribution of income or affirmative action' both in the UK and the US (2021:11).

In essence, affirmative action has the same goal as equal opportunity, but differs from equal opportunity in being proactive. Affirmative action is therefore a tool to ensure that administrative processes and decisions are equal and fair (Burstein, et al, 1994; Crosby and Cordova, 1996; Miller and Hunt, 1997), by employing processes such as quota systems and anonymised applications to guarantee the objectivity of employers and admissions committees. The

approach is meant to equitably level the playing field for historically marginalised groups such as ethnic minorities and women.

Affirmative Action and the power of representation. Affirmative action on its own has gained unrequited backlash, where members of the social hegemonic bloc have claimed opportunities they 'rightly deserve' are being allocated to ethnic minorities to 'fill the quota'. This sense of entitlement of some members of the hegemonic bloc requires us to further deliberate over mechanisms to reinforce the spirit of affirmative action. One mechanism is the instigation of substantive representation over symbolic representation (Pitkin, 1967). Hanna Pitkin (1967) divided representation into four categories, each meant to complement the other: (1) Formalistic Representation, which aims to reformulate the authorization and accountability within institutions; (2) Descriptive Representation, which is concerned with the physical attributes of a representative and whether it resemble whom they are meant to represent; (3) Symbolic Representation, covering what a representative 'stands for' and whether that aligns with the groups they are represented; and lastly, (4) Substantive Representation, which includes a closer investigation of the representative's actions and whether they adequately advance the interests and benefit the ones being represented. One can argue that representation in all its forms subliminally influences attainment and opportunity, as it acts as a force of encouragement to minority ethnic groups and provides an alternative influence on one's identity construction. Howarth (2002) believed that there is a 'need to highlight the dialectic between how we see ourselves and how others see us', and therefore agrees with the findings of other scholars who insisted that 'how we have been represented and how that bears on how we represent ourselves' (Hall and Du Gay, 1996:4), substantiating the significance of this article in enhancing existing literature on the dynamic relationship between attainment and representation. The Commission on Race and Ethnic Disparities (2021) also identified and acknowledged how the underrepresentation of minority ethnic groups in education and workforce is aggravated by the rise in tuition fees, which predominantly disadvantages minority ethnic students and acts as a socio-economic barrier to equal access and opportunity (CRED, 2021).

Furthermore, other scholars, such as Iris Marion Young (1986) and Suzanne Dovi (2016) insisted on rethinking the concept of representation. Young (1986) stated that the suppression of difference is a problem for all representation, urging representatives to acknowledge and publicise their positionality to benefit their constituents. She used the example of Latino representatives being predominantly straight and how the quota of 'Latino' has inadvertently suppressed queer Latino voices and interests to highlight her argument. Dovi (2009) agreeingly described a reconceptualised framework of representation, where instead of attempting to 'bring in' marginalised groups we limit the overrepresentation of the privileged hegemonic bloc, thereby equitably levelling the playing field. Dovi built on the work of Hardin who stated 'if we wish to assess the morality of elected officials, we must understand their function as our representatives and then infer how they can fulfil this function' (Hardin, 2004: 79), by arguing for the necessity of evaluating the behavioural performance of a representative to include the following criteria: gatekeeping, good mindedness and critical trust building (Dovi, 2002). Similar strategies could be implemented on the bureaucratic level in HE institutions as to avoid 'ticking box' exercises and effectively change achievement and awarding outcomes for women in STEM disciplines. Equality and Diversity policies must not be a simple codification of policies but need to become part of the socio-cultural fabric for it to have tangible effects (Bhopal and Henderson, 2019a).

The intersectionality of identity and Women's HE experience. Needless to say, there is a real need

to reconsider the double, if not multiple, burdens (Hervey and Shaw, 1998) as identified and defined by the Intersectional Approach (Crenshaw, 1991). The intersectional approach stipulates that 'ignoring differences *within* groups contributes to tension *among* groups' (Crenshaw, 1991:1242), meaning that experiences of a member of a group cannot be generalised. If generalization were to occur, affiliates find themselves and their experiences essentialised. The process can reduce one's 'burdens' to accommodate for generalizability. As a consequence, we find a surge in stereotyping and prejudicial manners, which operate on the basic assumptions created by essentializing group experiences. The approach is therefore the attempt to dimensionalise women's experiences, where we tap into the different, and predominantly disadvantaging, identities and intersectionally observe their effects on ethnic minority women's social mobility (1991:1244). It is the purpose of this research to shed light on intersectional identities and how they affect women's HE experiences and future trajectories. Thereby countering the effects of, perhaps unintentionally produced, intersectional subordination, which 'in fact, it is frequently the consequence of the imposition of one burden that interacts with pre-existing vulnerabilities to create yet another dimension of disempowerment' (1991: 1249).

When deliberating over the status of women in STEM education, one can deploy the Intersectional Approach as an umbrella term within which representation is a key aspect. Accepting the premise that ethnic minority women in STEM disciplines are subject to more than one disadvantaging characteristic will increase the probably of inclusivity, equality and equity for the duration of their studies, but also for their career trajectories. One might consider class, ethnicity, race, and gender as the main obstacles facing women in STEM. According to Workforce Statistics UK (2019), approximately 1 million women work in core-STEM fields, making up 24% of the total workforce (WISE, 2019). Yet, women in STEM earn approximately 11% less than their male counterparts (O'Neil, 2019) and, the pay-gap, is now increasing due to the outbreak of COVID-19 (Scott, 2020).

It is crucial to mention that the latest UCAS (2021) reports indicate 35% of STEM students are female, which insinuates a quantifiable progress. Nonetheless, the statistics of women progressing into a career in STEM is much lower, so that for every 100 women, 12 choose a STEM discipline to study, and only three continue working in STEM post-graduation (Marcus, 2014). Furthermore, AdvanceHE' (2020) statistics highlight that approximately 25.6% of UK STEM registered students are of minority ethnic backgrounds, thereby corroborating the earlier findings that ethnic minority women are underrepresented in STEM subjects (Black British Professionals in STEM – BBSTEM, 2020; Engineering UK, 2019). Additionally, STEM education has been accused of being culturally narrow, where practitioners from non-Western backgrounds, and by extension non-Western audiences were unvalued and unrecognised (Finlay, et al., 2021). Allowing for a broader perspective and critical commentary on the nature of science/STEM would assist in the reformulation of student needs and supplement the efforts to diversify the curriculum students are exposed to throughout their degree.

Accordingly, this study investigates the intersectionality of race and gender on female university students in STEM degrees. The objective is to understand the nuances of institutionalised racism and gender roles and how these relate to wider socio-cultural concerns, such as the gender pay gap and career trajectories in STEM fields (Bosworth and Kelsey, 2015)[2]. Bhopal (2020:706) elaborated that even though there is significant numerical progress in terms of minority ethnic student enrolment in STEM degrees, 'this is not necessarily translated into the academic labour market' and obtaining permanent employment has become more competitive than ever. By understanding the intersectionality of individual characteristics (especially gender and ethnicity) within the

framework of a capitalist economic superstructure, this paper attempts to construct revised policy recommendations for HE institutions to substantively counter gender and race disparities embedded and perpetuated by the capitalist system (Wiseman, et al., 2017)[3]. The premise is that women and ethnic minorities are subjugated to a variety of institutional and social barriers, including gender roles and expectations, and reproduced by the value for labour as commanded by a capitalist apparatus (Blundell et al., 2021).

The study

Science, Technology, Engineering and Mathematics (STEM) are widely valued by institutions and governments worldwide. Nonetheless, in some Western communities, increased apprehension towards the inclusivity and diversity of STEM in terms of experience and career trajectories of minority ethnic students, is observable. Scholars have used numerous metaphors to describe the tense relationship between race and ethnicity (Elias et al., 2006), that includes the 'leaky pipeline' metaphor which describes the systemic and increasing dropping-out rates evident in STEM disciplines as evidenced by the degree awarding gaps (Berry and Loke, 2011; Wong et al., 2021). Traditionally, there were claims about STEM being most suitable for White, privileged, males with sufficient leisure time to engage in scientific research. This myth, however, has been debunked, and the correlation between a biological predisposition for scientific inquiry was made redundant. Nonetheless, the widespread discourse proves that even if the proactive efforts to subvert women, minority ethnic, and working class groups is formally abolished, the cultural discourses it brought about are still very much alive (Cohen and Kelly, 2019; Losh, 2010; Ong, 2005). Science, Technology, Engineering and Mathematics careers are highly valued by ethnic minority families and is oftentimes utilised as a means to social mobility and security, as STEM-related careers tend to possesses a higher earning potential and an associated social status (Wong, 2016a, 2016b). However, the current data suggest that HE institutions have improved and reformed admission policies and are currently actively encouraging diversity and inclusivity in STEM disciplines, the same diversity and inclusivity is not translated into STEM-careers.

The exploratory nature of this study requires the investigation of publicised data, in which it is revealed that approximately 25% of UK-domiciled undergraduates are of an ethnic minority background. Of the 25%, 26.9% of UK-domiciled undergraduate are enrolled in STEM disciplines and 17.4% in non-STEM disciplines (AdvanceHE, 2020), which is proportionately representative of the UK population. The AdvanceHE data also revealed that England has the largest attainment gap of 15.6% points (AdvanceHE, 2021b/(16). The particular England-based HE institution sampled in this study has identified an attainment gap of 16.5% points between minority ethnic and White students in undergraduate degrees, which highlights a higher attainment gap than the national average.

This paper is based on 69 interviews run over the course of 2 years. Interviews were performed with undergraduate students from different disciplines, including psychological science, pharmacy, mathematics, computer science, biological science, etc. The interviewed participants were mainly from two different groups. The first included 51 participants from minority ethnic groups, while the second included 18 participants from White British group. Considering minority ethnic groups, these included the following: Black ($n = 8$), East Asian ($n = 8$), Middle Eastern ($n = 5$), Mixed ($n = 8$), 'Other' ($n = 2$), South Asian ($n = 11$) and White European ($n = 9$). The majority of students self-identified as women ($n = 52$). Considering sociodemographic characteristics, this study takes place in a medium-sized English University, where students composition is in line with national statistics, here also including student diversity.

The project started in fall 2018, when a call for participation was launched in all STEM undergraduate degrees. The focus was on those individuals self-identifying with a minority ethnic background. The project included 100 staff contacts and a virtual learning environment to help with the selection of the participants. An e-voucher was offered to attract participants. As already mentioned, White British and International participants were also included. All participants self-identified their ethnicity. There were no explicit exclusionary criteria and the researchers interviewed students who responded to the recruitment call. Organically, the participants recruited reflected the demographic diversity of the university and therefore inclusion/exclusion criteria were unnecessary.

Interviews took place within university facilities. The average interview time was 1 hour. Interviews were recorded through audio and transcribed verbatim. The different topics discussed included: their views on the ethnicity awarding gap, the role of gender and race/ethnicity in their education, and overall university experiences. Of particular importance were topics related to race and racism, as well as sexism[4] in higher education.

The researchers themselves were affiliated with the case-study university. Each of the researchers comes from a social science background and self-identify as Middle-Eastern woman, British East Asian man, and White British woman. During this period, Reham El-Morally was a final year PhD Candidate in International Development, Billy Wong was an academic staff with an additional role which champions inclusion, diversity and equality, and Meggie Copsey-Blake had just completed a Masters Degree in Education. To minimise biases, the authors rotated the students they were interviewing, and the data they were coding, analysing and writing.

Data analysis was informed by a social constructionist perspective, which understands social phenomena as socially constructed and discursively produced (Burr, 2003). Using NVivo, transcripts from each interview were added and codified, easing management of the data and analysis. This helped with the iterative process, expanding the data comparison and refining dimensions of concepts and themes (Corbin and Strauss, 2014). Interviews were coded by relevant themes, following a rigorous discussion and comparison process between the authors. These codes were further aggregated into higher-level themes of 'Higher Education Experience', 'STEM Identity and Experiences', 'What do you want to do after you graduate and why', and 'Ethnicity and Sense of Belonging'. These themes included a variety of questions which were probed during the interviews. Data coded in these themes was used to inform our analysis of the intersectionality of gender and ethnic inequality, and assess the implications of using descriptive demographic categories, like race and gender, to address the issues of institutional bias, degree attainment and career opportunities. The following section is unpacking why the institutional commitment to decreasing discrimination could turn into a check-box exercise as opposed to substantive and reformative effort towards equality. Different examples were drawn on from the data as reflected on by the interviewees, which included their students' views on affirmative action and positive discrimination, which was earlier established as a reflection on social discourses and willingness to challenge existing power structures, as well as their experiences as a minority ethnic person in HE. Through an intersectional lens, the analysis unpacks how attainment and opportunity can be influenced by race as well as gender, furthering the inequality of women. This has helped in unpacking the experiences of minority ethnic groups in relation to racial inequality and enhance our understanding of gender dynamics in STEM higher education.

Being 'Woke': the intersection of multiple inequalities

'Woke' as a term is relatively novel to today's vernacular. It is commonly used to insinuate an

attitude or a behaviour which depicts a knowledge and critical awareness of social injustices. This critical awareness is suggested to be a motivating factor for individuals and societies to address the injustices they recognise within their environments, that is, a collective consciousness (Freire, 1973, 2000). This section unpacks how being 'woke' holds a positive and proactive connotation to students of an England-based university, which use the term to mean a 'critical consciousness of intersecting systems of oppression' (Ashlee, et al., 2017:90). In an article titled *We are Woke: A Collaborative Critical Autoethnography of Three 'Womxn' of Color Graduate Students in Higher Education* the authors recited the definition of woke as 'cultivating a critical awareness of privilege and oppression and doing whatever is in my capacity to dismantle those forces' (Ashlee et al., 2017: 93). Recently, more research has been emerging about the necessity of using *woke pedagogy*, arguing for the unlearning of the idea of colour-blindness and instead 'seeing' cultural differences and their intersectionality is necessary to learning how to respect them equally (Gay, 2002; Irvine, 2010; Ladson-Billings, 2014; Allen, 2020).

With that understanding of what being 'woke' entails, we need to identify the major obstacles to *woke action.* Microaggressions are one of the barriers to being woke. They come in different forms and are performed by individuals and institutions alike for different motivations. Some microaggressions can result from a general disinterest in utilitarianism, which may include a heightened interest in profit. Other examples may include institutional and political agendas with capitalist objectives, where ethical questions such as effects on the environment and the social wealth distribution are simply irrelevant. However, for this research, microaggressions with a racial and gendered undertone are of interest. Microaggression can also manifest itself in terms of gender discrimination. Melony, a White-British female, for example, discussed the gender role division in the STEM workplace:

> I think, obviously you hear comments like sexist comments. When I was at work, one of the managers was saying, we have to go and lift something and they're always like, we'll get the boys together, lift it. The girls were always made to waitress, not be seeing out of the front, whereas the boys do the room service and things like that. There's still like a pay gap and things.

Although Melony's statement may seem like a miniscule matter, she reflected the general work environment within the private sector, where gender dynamics and socially constructed and ascribed roles are reproduced and perpetuated. Not only is this evidence of internalised misogynistic sentiments codified and manifested in work environments, but it also cognitively perpetuating the sentiment of women's inferiority as they are not as 'visible' as men. More importantly, the more visible women are in STEM-degrees the more likely the labour market would evolve to accommodate the new graduates, as skilled-labour, theoretically, is valuable and sought after irrespective of gender and race.

What we observe, and is most pronounced, in the West could be considered a radicalised understanding of the 'invisible hand', as proposed by Smith (1779), where heightened individualism coupled with capitalist influence has diminished and silenced any efforts to reorient the culture away from obsessive materialism. Experiences such as Bella's, a White-British female, who during her work placement also experienced sexism, told us she 'had a bad experience with this doctor … He put me down a bit, and brushed me off, and was really patronising', reveal to us the extent to which work environments are and have been affected by extreme notions of individuality and self-interest. The effects of said extreme understanding, can oftentimes be projected in microaggressions like that Bella experienced.

Similarly, Positive Action in isolation is not sufficient as a policy effort and must be accompanied by institutional/organizational efforts to normalise women and ethnic minority

groups in the work culture. If not implemented holistically, Positive Action could also serve as a disadvantaging tool, used to shame those it is meant to benefit. This is clearly highlighted in Lazda's experience, an Eastern-European female who stated:

> I don't really see (being female) as an advantage. But people tell me, 'Oh, you have got an advantage because you're a girl.'

The institutional bias against females and ethnic minority students appears to be very much alive, to the extent that even students like Rachel, a White-British female, felt the need to say that 'I think it's a lot of subtle things … just consistently make BAME students feel like they're cut out from it or they're below White people'. To counteract this experience which was echoed by many students, many universities devised their own Diversity and Inclusion Departments, and created their own Ally programmes and Safe Spaces (Deller, 2019; Stengel, 2010; Ramsay, 2017; Williams, et al., 2020; Witherup and Verrecchia, 2020). For example, University of Westminster diversity and inclusion action plan included the #ClosingTheGap (Jarvis, 2021). Similarly, many universities are striving for the *Athena Swan Charter Framework*, which in itself employs numerous action points on how institutions can create more diverse, inclusive and safe campuses both in terms of Teaching and Learning as well as student experience and combating all types of misconduct (AdvanceHE, 2022). These efforts are all in line with AdvanceHE (2021)a recommendations on how to create more inclusive environments in HEI. However, in spite of the tremendous efforts to combat any type of misconduct and/or discriminatory behaviours, subtle acts of sexism and racism still occur. At the university under investigation, this insinuated that an act of injustice will not go unnoticed yet there may not be a system in place to rectify it. The term 'woke' was used here consciously as it denotes attentiveness and raises awareness of a particular social issue. Although some of our White students could be considered woke, others have adopted the radical-right's weaponised denotation of the term to attack liberals and socialists and claim 'victim status' (Rose, 2020). Unaware of students like Pakiza, a British South Asian female, who explained:

> When people talk to me, I feel like they always used to see my skin colour, or they just assumed things about me before actually knowing me. And I feel like it sometimes took a lot of work to get over those stereotypes. People tried not to explicitly come over and say things that were stereotypical or, in my opinion, racist. But they'd make comments, and you'd just be, like, 'Well, that's not okay'.

Many still subscribe to Bret Easton Ellis' description of 'woke' individuals (Brooks, 2018; Dolgin, 2018; Gray, 2019. 2018; Morris, 2020; Sobande, 2020; Wilber 2021). One study found that in the UK people are divided over whether the term is an insult or a compliment, showcasing that 'Labour supporters, Remainers, and young people are much more likely to think the term has a positive connotation' (Duffy et al., 2021:13). Elli's definition is that woke individuals are riddled with 'over-sensitivity, their insistence that they are right … their lack of placing things within context, the overreacting, the passive-aggressive positivity, and, of course, … the meds they've been fed since childhood by over-protective 'helicopter' parents mapping their every move' (Schilling, 2015).

Statements like these provide insight into just how tense race relations are and highlight the pronounced and central race is for ethnic minority students. Efforts by institutions and organizations to be more inclusive and diverse does not necessarily influence or change subtle acts of microaggressions. Particularly, the constant feeling of people seeing one's sex or colour as a signal of their social status is frustrating for affiliates of a minority group. To substantiate this claim, we asked students how they would remedy the predicament they have found themselves in as young adults. Although

most ethnic minority students responded with a 'shrug' to insinuate 'I don't know', most of our White students stated they would confront, or if the situation dictates it, report fellows/ colleagues/peers for discriminatory behaviour. This would speak to the culture of silence which years of socialization have led to students of ethnic minority backgrounds to internalise their own status as 'inferior' and 'choose' a passive path as not to disturb the delicate racial balance in the UK (see also Wong et al., 2022).

This embodiment of 'inferiority' starts very early on, where from birth, each individual is raised to know their 'position' in society, may that be in gender or racial dynamics – women traditionally are socialised as 'subordinates' of men (Ram, et al., 2014; West and Zimmerman, 2009), whilst White people and discourses are often portrayed to be dominant and 'superior' (Neblett et al., 2006; Thomas and Speight, 1999; Thornton, et al., 1990). For many, this means the adoption of 'keep your head down' attitude. This is exemplified in the mannerism in which students have reacted to sexist and racial encounters on campus as well as on work placement. For instance, Nancy, British East Asian female, shared with us her experience in the programming industry, saying:

> So it turned out that there was about 80% boys and then 20% girls. And I did think at the time, I always felt more stupid than the guys because they'd always be like hardcore coders, and they'd be super nerdy. So, I always felt stupider than them. And then they always made me feel a bit stupid. So, sometimes it does inadvertently, subconsciously I think that did kind of bring me down because they were like mostly male upper class, like White males at my old school.

Nancy's experience sheds light on the *double-burden* minority ethnic female students are subjugated to. The first being a woman and having to tackle social and institutional sexism, and the second being a person of minority ethnic background and having to tackle social and institutional racism. This double-burden is reflected the fact that STEM disciplines are still male dominated, and access for women is being actively stunned by toxic work environments and the refusal of corporations to foster safe environments for their workers (Althof, 2021; Growe and Person, 2017; Walby and Olsen, 2002). Secondly, as many women have been socialised to believe in the biological predisposition myth, it did not come as a surprise that Nancy's reaction was not just a frustrated one, but one of self-doubt resulting from repeated reiteration of her social discourse of women being inferior, weaker, less intellectual, and less STEM inclined, and generally less capable than men, especially by employers. This effect is exacerbated by the fact that she is of British East Asian background which made her feel inferior to her White male counterparts.

One can draw from these accounts how intensely the intersectionality of racialised and gendered encounters is, and how difficult it is for one to successfully assimilate in the situational and contextual positions they find themselves in. Initiatives that attempt fostering an inclusive environment that is 'blind' to race and gender is not compatible with minority ethnic students' and female students' minority's ambition to change public discourse about their capabilities and skills, particularly in STEM degrees and STEM-oriented career paths. Having adopted an intersectional perspective for analysis, it was evident that our assigned gender or race do pose a glass ceiling for progression. We revisit this in more detail in the discussion.

The 'Check box': is race just a number?

Institutional bias and an understanding of wider inequalities requires active interest to be critically examined. Institutional biases can be evaluated by investigating representation. For this research, our evidence shows that the homogeneity of ethnic and gender backgrounds within faculty and staff can be demoralizing for

students of historically marginalised groups, such as ethnic minority and female students, particularly in the physical sciences. Micro-aggressions, epitomised in a students' experience where a lecturer asked her to 'learn English', was posited as hypothetical scenario for students to attest their awareness of micro-aggressions and their ability to discern subtle racist remarks. By setting hypothetical questions that we know some students have been subjugated to allow our students to critically examine, evaluate and produce an opinion about their environment and their own personal experiences.

A natural derivative of that question is: would you report it? Lily, a White-British female, responded with:

> I would be shocked because I don't think that's something to say at all, especially in front of whole lecture theatre. I think that's also trying to completely point that person out and be like, 'You're not from here', which I don't think is a nice thing to do. You've got to be inclusive.

Although the sentiment may be honourable, earlier in our investigations, we found that most students would not report a discriminatory instance due to a culture of silence paired with hopelessness that anything would actually amount of it without them being negatively affected.

Kevin, a Black British male, reflected on what we might call *passive discrimination*. He stated 'I feel like especially from my background … I definitely think that to be able to inspire more people from my background, it would help having more people involved in the field'; thereby, reflecting on the representation, and the lack thereof, as a factor contributing to a culture of silence and fear from authority figures such as lecturers.

Since 2011, a number of universities in the UK have adopted some form of positive action (Fahy, 2011) to promote fairer opportunities for ethnic minority students to advance and influence their immediate surroundings positively, bearing in mind that positive discrimination is still illegal under the Equality Act 2010 which replaced anti-discrimination laws (Government Equalities Office, 2011). However, this idea of inclusivity and the significance of position action and representation appeared to have bothered some students, like Rachel, a White-British female, who stated, '(ethnic minority) students are prioritised in order to make uni look like a diverse place'. With this, Rachel vocalised a sentiment that other White students at this England-based university had expressed when asked about diversity, for example, Gerogia, a White-British female, viewed affirmative action as an unjust method to decrease the awarding gap, stating 'If say they had their quota for students … that might mean that say if only one ethnic minority person did apply, obviously they'd let that person on, but then that means that white people would miss out, if there wasn't enough space for them'. Both students seem to dismiss the efforts of their university in pursuing diversity and inclusivity, particularly to historical marginalization and equal opportunity demands, and carry a resentful undertone. This undertone is revealing of a sense of entitlement she possesses as a White-British person, and is also reflective of the hegemonic bloc's hierarchical structure in which White persons are superior. Similarly, Georgia stated:

> It might not be because they're from another ethnic minority like Indian, stuff like that, it might just be because they don't have as in-depth research into specific conditions like around here. So that might be why we don't see anything from other countries other than here and America, and maybe Australia, I don't know'.

Georgia's account is particularly interesting, as here she exhibits a form of internalised superiority of her culture and simultaneously dismisses other cultures as not-evolved enough to contribute to academic research output. This internalised superiority complex is why movements such as the *Why is my Curriculum White?* emerged (Peters, 2015). To measure how

significant this movement is for our students, we asked them to reflect on their own curriculum. Many expressed surprise and discontent with the lack of effort to decolonise the curriculum. For example, Kevin, a Black-Caribbean male, expressed his surprise over how 'one-sided' his curriculum is. He told us 'a lot of studies that I've seen, people from Africa or [have an] African backgrounds aren't reflected enough in research. But, maybe (because) a lot of the western countries kind of go into African countries and use people as participants'. Kevin articulated disturbance with the utilization of Africa as the research arena/lab of western countries, and sequentially stated:

> I think that's the case with not just science research, but a lot of things really. I think you can generalise it …especially England, how it got its power. We're not taught that at all. We're not taught that it took advantage of people from other countries. We need to be taught about (it). How the history of, not just science, but the empire.

Indeed, Africa has long been considered the research arena of the West, which contributed to the formation of unequal power dynamics, which favour the West, and solidified the idea of African inferiority throughout history (Boum, 2018; Crane, 2011). Moving forward, we need to contextualise curricula and re-examine the subliminal messages of power hierarchies conveyed when scholarship is consumed by students.

Moreover, while students such as Rachel and Georgia were not reserved about expressing their opinion and discontent about efforts to diversify, ethnic minority students shared how these sentiments have affected them on a personal level. Wes, a Black-British male, stated that 'unconscious racism that really sets the barrier to prevent (us) … assuming a Black person is not going to be attentive or so on' are only few of the challenges he faces as a Black student. He later added the struggle of being Black at university and having to combat all the preconceptions of Black people, such as the stereotype of them being lazy and aggressive (for male). Similarly, Chetachi, a Black-African male, felt that these negative stereotypes are not susceptible to change due to the lack of existing role models for Black students. Describing his experiences, Chetachi shared:

> I barely see any black staff. There's only one in [my department], and sometimes I ask myself, 'How does he feel being the only black person in the whole building full of maybe Europeans and Whites? How would you feel?'

He continued to add there is a lack of role models for black students to guide and substantially tip the scales in favour of ethnic minorities, respectively. Katherine, a Black-British female, touched upon the double-burden of being an ethnic minority and a woman, stating:

> So many BAME students do come from a working-class background, not all of them, but it could be once again that just not relating to someone (other Black women). Or maybe the institution itself, maybe, cos obviously uni is a middle-class institution, so it may be hard to just kind of reach to that level.

Contrasting the responses of Rachel, Katherine and Wes, we can clearly see how entitlement and privilege can blind someone to the realities that exist from around them. Although it is not a secret that many Black-British families are working class, Rachel's privilege prevented her from accepting racial injustice and appreciating the efforts of universities to offer more equal opportunities, especially to those who have been systematically discriminated.

To further shed light on how the realities of minority ethnic students are not exaggerated as some White students believed, Chetachi (Black-British male) shared a story of how racial profiling has affected his friend's education, stating that his friend scored very highly on her A-levels which 'they were surprised when she got because she's a Black student. They were, like, "How did she get these grades?"'. In his frustration, he expressed that 'it was expected'

and when asked to reflect upon the university's efforts to be more inclusive and account for injustices like this, he said, 'to be honest, I don't see them doing much in terms of what I see around. Maybe they are doing something, but I don't think they publicise it enough'. Agreeingly, Wes, a Black-British male, elaborated on the need for universities to implement positive action. Cautiously of backlash from some of his White peers who believe that minority ethnic individuals have it 'easier' because it is the new 'trend', he stated 'obviously I think it'd be unfair to employ someone just on the base of their skin just to fill a quota, but then obviously, it'd be nice to get a wider range of history'.

What all the students have in common is their frustration with the current hierarchical structure within which they exist. If universities were to adopt Young's (1986, 2000) representation criteria, perhaps in the future, we will transcend into a more egalitarian and equitable state of affairs. As Gratia, an East-European female, said 'your brain doesn't have a colour'.

Conclusion: race and gender mainstreaming – the significance of intersectionality

When social injustices occur Millennials and Gen Z people, particularly, have realised and actualised the power of assembly and association to confront these. As Millennials and Gen Zs were the first generations to be exposed to an unfiltered interconnectedness and globalization through the internet, and by extension social media. By realizing the power of the internet and social media platforms, minority ethnic groups and individuals were able to publicise injustices, gain social support, build connections and allies, and in some cases even, apply public pressure on authority figures (Bishop, 2020; Rosenblatt, 2020). Although seeking public support, building alliances and coalitions is not a novelty, they have become more significant in this day and age; being a supporter or an ally of a cause has become the threshold for social standing. This is particularly evidenced by active institutional support, where HE institutions such as Harvard University, US, created and published blogs and articles on how to 'Be a Better Ally to your Black Colleagues' (Castelli, 2020) and the University of Reading, UK, 'Women Scientist on Sexism in Science' (Jones, 2015).

Why are these initiatives important? Firstly, initiatives are an active admission by HE institutions, and to some extent corporations, that there is a problem with sexism and racism in their immediate environments. Secondly, and more importantly, these initiatives signal a commitment by institutions and corporations to close the gender and race gaps, by creating an environment that is transferrable and transactional. Fostering a 'Zero-Tolerance' environment can inform and even steer career trajectories. The more inclusive an organisation is, the more likely it is to attract employees and raise the profile of the institution or organisation.

In the employment and education contexts, the glass ceiling is comprised of internalised emotions and stereotypes of 'Others' – emotions such as inferiority/superiority that unconsciously arise through repeated socialization, or stereotypes embedded and unconsciously associated with certain groups, such as the stereotype of the 'Angry Black Woman' (Childs, 2005) or the 'Aggressive Black Man' (Harrison and Esqueda, 2001), have created what we call an *Over-Compensatory Effect*. Our conception of *Over-Compensation Effect* recognises the unspoken and invisible effects of socialization, which lead affiliates of minority and historically marginalised groups to over-compensate for their uncontrollable characteristics by doing more than what is asked of them, in educational and professional settings alike, to prove the negative stereotype wrong. The *Over-Compensation effect* comes at the cost of the disadvantaged, while in reality, the burden to create an environment of meritocracy and 'zero-tolerance' should befall the institution or organisation. This phenomenon is also a derivative of the Gender-Mainstreaming efforts exerted

worldwide since the 1995 Beijing Women's Conference (Woodford-Berger, 2004), which insists on the essential role of *including* women in the decision making process by increasing their substantive and symbolic representation to influence decision-making processes. By adopting a race and gender mainstreaming perspective, the intersectionality of *burdens* affecting women and minority ethnic women in particular are mitigated through their participation in the public sphere. It also reveals that disadvantaging characteristics can overlap to increase the level of disadvantage by recognising the social constructs surrounding each, in this context it is the interplay of gender and race, that pose additional challenges for women trying to enter to workforce.

Furthermore, we must acknowledge the cultural context within which HE institutions and corporations alike, operate. We recognise the individualistic cultural configuration within the UK and realise the difficulty of rallying support for utilitarian ends. The individualistic spirit, we presume, arose from the liberal economic theory of Adam Smith. The concept of the 'invisible hand', particularly, has greatly contributed to the cultural configuration. It is commonly misunderstood that Smith's theory of the 'invisible hand' connotes that every individual should work to advance their own interest and by 'trickle effect' will benefit those around them, and the chain goes onward. However, many seem to dismiss that the 'starting line' is different for minority ethnic groups and women who are by virtue of the environment they are in disadvantaged. By failing to recognise the racial and gender disparities as valid barriers, affirmative action or positive discrimination efforts would sadly be restricted to a check-boxing exercise with no substance to merit hope for future change. We therefore suggest that institutions and corporations alike, utilise Nudge strategies (Baldwin, 2014; Richardson et al., 2011) to complement diversification and equal opportunity efforts and increase the collective consciousness, a.k.a wokeness, of their staff and employees/students. We predict that by changing understandings work-place and academic cultures will organically change to reflect the 'new' collective consciousness.

In sum, this paper investigated the effects of symbolic and substantive representation on women and ethnic minorities within STEM-degrees and STEM-oriented careers. The research explored how female and ethnic minority students are affected by the White-favouring learning and work environments. We argued that the White-male culture of STEM within the UK, and England in particular, have contributed to the lack of interest and pursuit of STEM degrees and careers. As one of our participants, Feng, a South-Asian female, stated, 'They not really diverse, but we still have like an Asian lecturer, but it's only one, I think'. She continued on to state that it can be demoralising and anxiety inducing to feel like you are the 'only one' and listed the benefits of a more diverse faculty saying 'I think they will be more encouraged to take the course because I think people always like to find someone who is from the same background as them, and they will really feel like it is safe to talk to them'. Other students also provided us with similar statements, in which they emphasised how representation makes them more susceptible to learn and more excited about the course because minority ethnic lecturers could provide a more ethnically sensitive perspective and novel standpoints to existing literature and scholarship. This will not only benefit minority ethnic students to feel 'safer' and better represented but simultaneously contributes to broaden the horizon of White students and the effects of most HE institutions to decolonise the curriculum. In essence, adopting *wokeness* and woke pedagogy will foster a more egalitarian and equitable collective consciousness. This, hopefully, will assist in dismantling racial and gender social and institutional barriers to education and employment of marginalised groups.

It is clear that biological differences alone are not causing the lack of women in STEM. However, if colleges, universities and STEM workplaces implemented the changes necessary

to accommodate women, especially ethnic minority women, and provide more support and a more positive environment for them to focus on their skills without the pressure of being compared to their male counterparts, particularly to White male counterparts, we would not only see more women in STEM but also be able to combat the surplus of unfilled STEM positions.

We recognise the difficulty for HE institutions to affect public policy decisions, and therefore recommend that HE institutions develop a framework which introduce and prepare senior university students for 'life post-graduation in STEM fields'. The training modules could include 'Racism and Sexism in the Work Place', 'Your rights as an employee under UK law', and 'How to be assertive'. We also recommend that all undergraduate students receive 'Zero-Tolerance' training during 'Fresher week', so if incidents were to occur, students would know the appropriate channels to report it to, as well as hold perpetrators accountable and avoid the trap of 'I did not know'. Lastly, we suggest that universities and corporations alike adopt a gender and race mainstreaming policy approaches, to avoid the risk of affirmative action and/or positive discrimination from being check-box exercises with little to no real effects on existing structures. By doing so, the intersectionality of experiences and characteristics would be accommodated for, thereby creating a safer and more efficient environment for students and staff. We urge universities and corporations to review their staff demographic in order to improve diversity as mandated by the Equality Act (2010). By reviewing demographics at all levels, specifically managerial and executive levels, we can reinvent work-cultures and provide ethnic minorities and historically marginalised groups with the role models they need.

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Ethical approval

This project has been reviewed following the procedures of the University Research Ethics Committee (within University of Reading) and has been given a favourable ethical opinion for conduct. Approved 17 October 2018.

ORCID iD

Reham ElMorally https://orcid.org/0000-0002-5555-6052

Notes

1. We acknowledge that the acronym BAME is not an uncontested term. There are diverse and different experiences between minority ethnic groups and there is a danger that grouping all ethnicities under BAME neglects the specific challenges of particular ethnicities. We therefore chose the term 'minority ethnic' to refer to students of any other ethnic group besides White. The acronym BAME as shorthand is only used by participants interviewed for this study and are quoted exactly as they were stated.
2. In the study titled *Opportunities and outcomes in Education and Work: Gender Effects,* the authors analysed survey data from the Labour Force Survey - LFS, and the Skills and Employment Survey - SES) as well as from the Department for Education, the Higher Education Statistics Agency – HESA, and qualitative interviews (p.3). Their analysis found that 'the individual consequences of limited choices, opportunities and outcomes for women as compared to men combine both financial impacts for women and their families and non-financial impacts, including greater insecurity and unfulfilled potential' (p.39).
3. The study, titled *Understanding the Changing Gaps in Higher Education Participation in Different Regions of England* concluded that 'Traditional economic studies of the impact of socio-economic status on decisions about higher

education suggest that students from socially disadvantaged backgrounds participate less because 'they accumulate less human (…), and have lower preferences for education' as well as being more sensitive to the perceived costs and benefits of higher level study' (p. 27) substantiating the argument put forward in this article that gender and racial disparities are informed by the capitalist labour system and effectively influence observed attainment gaps.

4. In this paper, the following definition of sexism will be used: Sexism will be used to refer to act of discriminating between men and women on the basis of a gendered understanding which assumed women have certain 'roles' and 'responsibilities' in the society. As Leet (1965) stated 'When you argue … that since fewer women write good poetry this justifies their total exclusion, you are taking a position analogous to that of the racist – I might call you in this case a 'sexist' … Both the racist and the sexist are acting as if all that has happened had never happened, and both of them are making decisions and coming to conclusions about someone's value by referring to factors which are in both cases irrelevant' (Shapiro, 1985: 6).

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