Tertiary STEM for All: Enabling Student Success Through Teaching for Equity, Diversity and Inclusion in STEM

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Abstract

This position paper sets out the need and rationale for systemic change in STEM learning and teaching as a means of retaining and supporting the success of underrepresented cohorts in STEM. Efforts in recruiting and retaining these students in STEM higher education degrees and subsequently, STEM careers, will continue to be undermined, if we are unable to provide them with a supportive learning environment that recognises and mitigates the inherent disparities that they have historically faced and continue to face. We propose that rather than focusing on an individual equity group and how to best support them, which may lead to perpetuation of a deficit mindset for faculty, we instead propose a project that considers the biases inherent in our current pedagogical practices and the ways in which we can build awareness of the inequities that these entrench. We intend for the outcomes of this project to support the ongoing efforts for individual equity groups as well as mitigating against future inequities by empowering faculty to create inclusive learning experiences.

Introduction

Australia is a country known for its incredibly diverse and multicultural population as reflected in the 250 language groups of Australia's First Peoples (Australian Institute of Aboriginal and Torres Strait Islander Studies) and by the 2016 census data identifying that almost 1 in 2 Australians had either been born overseas (first generation Australian) or have one or both parents born overseas (second generation Australian) (Australian Bureau of Statistics, 2017). Australia's diversity is not just cultural, it is broad and includes other demographic groups including gender identity, disability status, sexual orientation, and caring responsibilities. However, this diversity is not reflected in the STEM workforce or STEM departments at university – as examples, women, disabled people, and people from non-western cultures, face barriers in accessing traditional bastions of STEM academia and industries (Fisher, Thompson, & Brookes,, 2020; Dancy, Rainey, Stearns, Mickelson, & Moller, 2020; Wanelik, Griffin, Head, Ingleby, & Lewis, 2020). This situation is disappointing given the benefits of diverse teams, which are more likely to have increased knowledge sharing, flexibility, creativity and, as a result, better team performance. Empirical studies have found evidence for this relationship, in both experimental and organisational settings (De Dreu & West 2001; Kurtzberg & Amabile 2001; Milliken, Morrison, & Hewlin, 2003; Nakui, Paulus, & Van der Zee, 2011).

There have been concerted attempts to minimise disparity from a gender perspective through national efforts such as the Science in Australia Gender Equity (SAGE) programme and the Male Champions of Change (MCC) STEM that were established by the Federal Government

in 2016, however, there has been limited progress – a mere 2 percentage points from 2015 to 2019 (STEM Equity Monitor Data Highlights, 2021). Even when looking across the decade from 2006–2016 there has been just a 3% increase in women with University STEM qualifications (Office of the Chief Scientist, 2020). Females and female identifying cohorts also continue to be poorly represented in the STEM workforce and earn less than their male counterparts (STEM Equity Monitor Data Highlights, 2021). Beyond girls, women and female-identifying cohorts, other historically underrepresented demographic groups such as people with disability and those from culturally and linguistically diverse backgrounds also face challenges in not only accessing STEM-related study but also STEM careers. For all these cohorts, including women, even if they do manage to get into STEM career paths, they earn less, usually working in low-skills, low-rung positions such as laboratory assistants or technicians (Vakil & Ayers, 2019; STEM Equity Monitor Data Highlights, 2021).

In trying to address this issue, Australian higher education authorities have clearly articulated the need for universities to focus on ensuring equivalent opportunities for the academic success of these cohorts (*Higher Education Standards Framework (Threshold Standards) 2015* – Section 2.2). However, statements alone are insufficient to drive the change necessary to overcome the challenge. Although there are many efforts underway to support the success of individual equity groups (Latimer et al., 2019) such as the creation of pathways via bridging courses, alternative degree structures, exceptions to standard entry requirements, offers of targeted scholarships to underrepresented groups, and the creation of 'culturally safe spaces' for students by Australian institutions, there are still gaps in retention and success, some of which broaden further if we consider the longer-term career paths for these students (Carrington & Pratt, 2013).

Given the effort and resourcing going into widening participation and reducing the gaps, it is crucial that we look beyond the obvious. There is a need to look more critically at the issues as proposed by Kumashiro (2002, p.9), a renowned educational equity and social justice scholar, who speaks of the need for educators to "reflect on their own assumptions, identities, theoretical frameworks, and educational practices and put to use whatever insights are gained" (p. 25). In the same vein, Fuentes, Zelaya, and Madsen (2020) speak of how classrooms "operate as a microcosm of greater society, and therefore, systems of oppression may be played out in classroom dynamics" (p.71). The academic staff who create the learning environments for students are key to achieving sustainable change, and consequently, it is necessary to understand the dynamics of the Australian STEM higher education classroom and to get extensive buy-in from teaching leaders and teaching faculty. Whilst most teaching faculty are invested in doing the right thing by their students, they may be unaware of their unconscious biases or overwhelmed by lack of know-how and/or resources, and therein lies the complexity of achieving sustained change.

The seminal work of Aikenhead and Ogawa (2007) highlighted the nature of STEM education globally, which privileges a Eurocentric world view (Boisselle, 2016; Gandolfi, 2021) and with-it, members of society who are namely white, and male (Dancy et al., 2020; Moore Mensah & Jackson, 2018). There is also a general obliviousness and/or lack of appreciation for critical sociocultural awareness in the context of traditional STEM education (Zeidler, Herman, & Sadler, 2019). The development of critical sociocultural awareness is not inherent in traditional STEM education as it posits science as "purely objective, solely empirical, immaculately rational, and thus, singularly truth confirming" (Aikenhead, 2001, p. 337). Such definitions of science suggest that science knowledge production is disassociated from the knower's subjectivity and in this way discount the social context of knowledge production.

Boisselle (2016) cites Stanley and Brickhouse, who, as far back as 1994, proposed that this perspective perpetuates a "universalist epistemology: that the culture, gender, race, ethnicity, or sexual orientation of the knower is irrelevant to scientific knowledge" (p.388). To date nothing much has changed. The Australian STEM higher education curriculum does not value the social context of its students as it has been designed to present only 'objective and universal' knowledge as understood through a single scientific discipline such as chemistry or biology (Kennedy & McLaughlin, 2017). Therefore, initiatives intended to increase participation of marginalised students in STEM will not result in meaningful progress without the wider STEM educator and teaching leadership population being made aware of the impact of sociocultural factors on STEM learning through troubling their assumptions and biases when dealing with difference.

Although there has been much talk and awareness around the "isms" in recent post-COVID times (after the Black Lives Matter and the #MeToo movement), there is a need to disrupt the Australian culture of institutional silence (Mapedzahama, Rudge, West, & Perron, 2012; Vass, 2013). Drawing from Freire (1970), Spiller, Evans, Schuyler, & Watson (2021) explain how "silence or silencing" happens when there is pressure to conform or avoid speaking against the norms of the dominant culture. This "silence" has been prevalent in Australian higher education culture (Fredericks, 2009; Gunstone, 2020; Lander & Santoro, 2017). Therefore, there is a need for acknowledgement and open discussion to explicitly name and tackle biases that are unconscious or otherwise. Recent research by the Diversity Council of Australia (2021) reports that almost 1 in 5 Australian workers do not engage with diversity and inclusion efforts at their workplaces – that is they neither support nor oppose their workplace taking diversity and inclusion action. Considering the specific context of higher education institutions, academics are also challenged by workloads that are unrealistic (Miller, 2019), and it is therefore likely they will need targeted support for their engagement in inclusive approaches.

As STEM educators, we, the authors, believe that it is important that we not only speak openly about these issues but also acknowledge, educate, and action reparation efforts for traditionally marginalised cohorts. Further, we believe that without sustained changes to make education broadly inclusive at the tertiary level, it is counterproductive to focus efforts on individual equity groups. Individuals cannot be supported by only paying attention to one aspect of their identity. Particularly when that aspect is not formally categorised as an equity group but will have an impact on their university experience e.g. First in Family (Patfield, Gore, & Weaver, 2022), or when data on completions shows that disadvantage is compounding across equity groups (Department of Employment Skills and Education [DESE], 2020a). For students belonging to multiple equity groups, their completion rates are lower than what would be expected by the sum of each of the individual categories. We must also be careful of conflating equity needs with students who are perceived to have lower academic capacity (Gale & Parker 2013). As some of the largest impacts of equity status on completion rate happen in the highest ATAR bands (90 and above) (DESE, 2020a). Most universities have put significant effort into creating bridging programs, equity-identified places, alternative entry requirements, scholarships and other support and engagement mechanisms. Most of these interventions are external to the core learning experience and are thereby limited in reach (equity students access additional supports less often that their peers (Scevak et al., 2015)) and transitory in their impact (most support programs have fixed funding windows and are replaced by new initiatives every few years e.g. Higher Education Participation and Partnerships Program [HEPPP] funding scheme). There is some evidence that monitoring of equitable participation recognises that the identity of individuals will cross more than one equity category and are incorporating this intersectionality through, for example, simultaneously considering gender and Indigeneity

(STEM Equity Monitor Data Highlights, 2021). There is also a recognition that targeted efforts will need to respond to the differing engagement of diverse cohorts with different disciplines within STEM. For example, in areas such as Engineering, Physics and Mathematics, many equity groups are more poorly represented than they are in Biology and Chemistry (DESE, 2022) and that these differences in participation across the disciplines begin in secondary education if not earlier (Cooper & Berry, 2020).

What we would like STEM faculty to turn their attention to, is the curriculum, the learning and assessment culture, and their own Diversity, Equity, and Inclusion (DEI) competency. We agree with Naylor and James (2016) that equity cannot be achieved through accepting students unlikely to succeed in the name of social inclusion. However, we must also consider how inclusive curriculum design can be critical to supporting the success of a wider group of students. If curriculum design is to be a tool for inclusion, then it is important to reflect upon and ask of our current curricula, "whose curriculum and for whom?" For those of us engaged in scholarly educational processes to evaluate our practice it is also important to consider the values and ideologies that frame our research (Takeuchi et al., 2020) before we start considering pedagogical approaches and assessments within that curriculum. Now this philosophically-driven approach may for some seem incongruous with STEM, and certainly some scientists have argued that philosophy is irrelevant to the tangible doing of science (e.g. Physicist Richard Feynman) – but as STEM educators working in complex social and political contexts, we argue that the methods of philosophy are highly relevant to the development of critical thinking in scientific practice (Olson, 2018). For example, it may be worth considering why in most STEM teaching we continue to present students with a curriculum that prioritises a cartesian-reductionist paradigm – one in which we view our world as having functionally fixed mechanised structures that can be understood through reducing them to their smallest components (Capra & Luisi, 2014) - when for the last 150 years or so STEM disciplines have been changing. For example, evolutionary theory, quantum theory, systems engineering and ecology, supported by ever more sophisticated non-linear mathematics, are redefining how we understand the world scientifically as a series of networks and relationships that vary over time. But although this shift has been occurring through some disciplines, as is often the case, our curricula lag. For example, in biology, we teach cell structure and function as though the cell is a factory with mechanised components, and we teach evolution with the language of hierarchies (the progression of life towards human-like complexity being better than remaining single celled) rather than recognising that organisms and the biodiversity they create form complex networks of relationships, they are not hierarchically organised. STEM education remains exclusive of many of these shifts in understanding and portrays older reductionist ideas as un-questioned truths rather than culturally situated models of reality.

Interestingly this same reductionist paradigm influences our inclusion practice so, whilst in theory we know that equity categories co-exist within students and within a complex system, we are yet to disrupt our compulsions of compartmentalising (through naming and responding to the struggles of individual equity groups) in ways that can support the changes needed in our educational approaches. Such naming and compartmentalising can also lead to deficit thinking. Rather than focussing on what increased diversity will bring to STEM, we try to work out what the students placed in these categories lack that has prevented them from succeeding without additional support (Hitch, Macfarlane, Nihill, 2015). This focus on deficits can alienate students and create a sense of resentment on the part of the academics. This approach has likely led to the conflation of increased diversity and lowered academic standards (Molloy, 2014). Rather than looking to be more inclusive, we lowered the bar and then blamed our own actions on what we perceived to be 'wrong' with the students. To break out of this mindset we need to

build awareness and a better understanding of the concepts of diversity, equity and inclusion, as well as how STEM academics can become more critically reflective to support the success of marginalised students (Fuentes et al., 2020).

Unpacking DEI - what does Diversity, Equity and Inclusion actually mean?

We, the authors, have heard many variations on the phrase "I am not sure how diversity equity and inclusion have relevance to the teaching of STEM", revealing a sense of uncertainty amongst STEM academics (see also Dewsbury & Brame, 2019). The terms diversity, equity, and inclusion (DEI) have become buzzwords in our post-COVID, post Black Lives Matter world. But, what do these terms mean in the context of STEM education practices? Often these terms are used interchangeably with a general perception of broadening participation with respect to social justice. So often, that they become euphemistic, leading to tokenistic enactments. For example, the term diversity is used as the opposite of the heterosexual, able-bodied, middle-class white male identity. This is misleading: an individual cannot have 'diversity' (Harrison & Sin, 2006) as "[d]iversity refers to compositional differences among people within a work unit" (Roberson, 2019, p.70). As STEM educators, if we truly desire equitable outcomes for all our learners and ourselves, it is important for us to educate ourselves, to understand these terms and conceptualise how they intersect before we can realise them in practice.

When we refer to diversity in STEM, the focus could be on a range of differences: gender, race, socioeconomic status, ethnicity, ability, geography, religion, and other constructs. But these constructs do not exist in isolation. Instead, systems of inequality based on gender, race, ethnicity, sexual orientation, gender identity, disability, class intersect to create individuals with multiple social and political identities that overlap and are interdependent resulting in the marginalisation of individuals (Carter & Vavrus, 2018). Often there is a perception of diversity as a one-dimensional construct which creates obstacles to achieving social justice and fairness for all (Cho, Crenshaw, & McCall, 2013). By reducing the focus of our diversity initiatives to a series of isolated stereotypes we may be inhibiting open discussions, as those being asked to participate (both the 'dominant' and 'marginalised' groups) may perceive an element of threat compared to when approaches are focused on broad inclusivity (Cundiff, Ryuk, & Cech, 2018). It is only through recognising, understanding, and accounting for intersectionality that we can truly achieve equity.

Crenshaw (1993) proposes three types of intersectionality: structural intersectionality, political intersectionality, and representational intersectionality. According to Crenshaw (1993), structural intersectionality pertains to how particular traditionally marginalised individuals are categorised and prescribed overlapping subordinated status; political intersectionality refers to how they are excluded from relevant mainstream discussions – for example discussions of STEM participation tends to focus on gender and in this way privilege the experiences of white, able-bodied women over the experiences of women of colour or disabled women who face multiple subordinations; and representational intersectionality refers to how particular constructs are linked to negative essentialised stereotypes. Understanding intersectionality is important to enable the participation of marginalised groups in STEM (Association of Women in Science, n.d.).

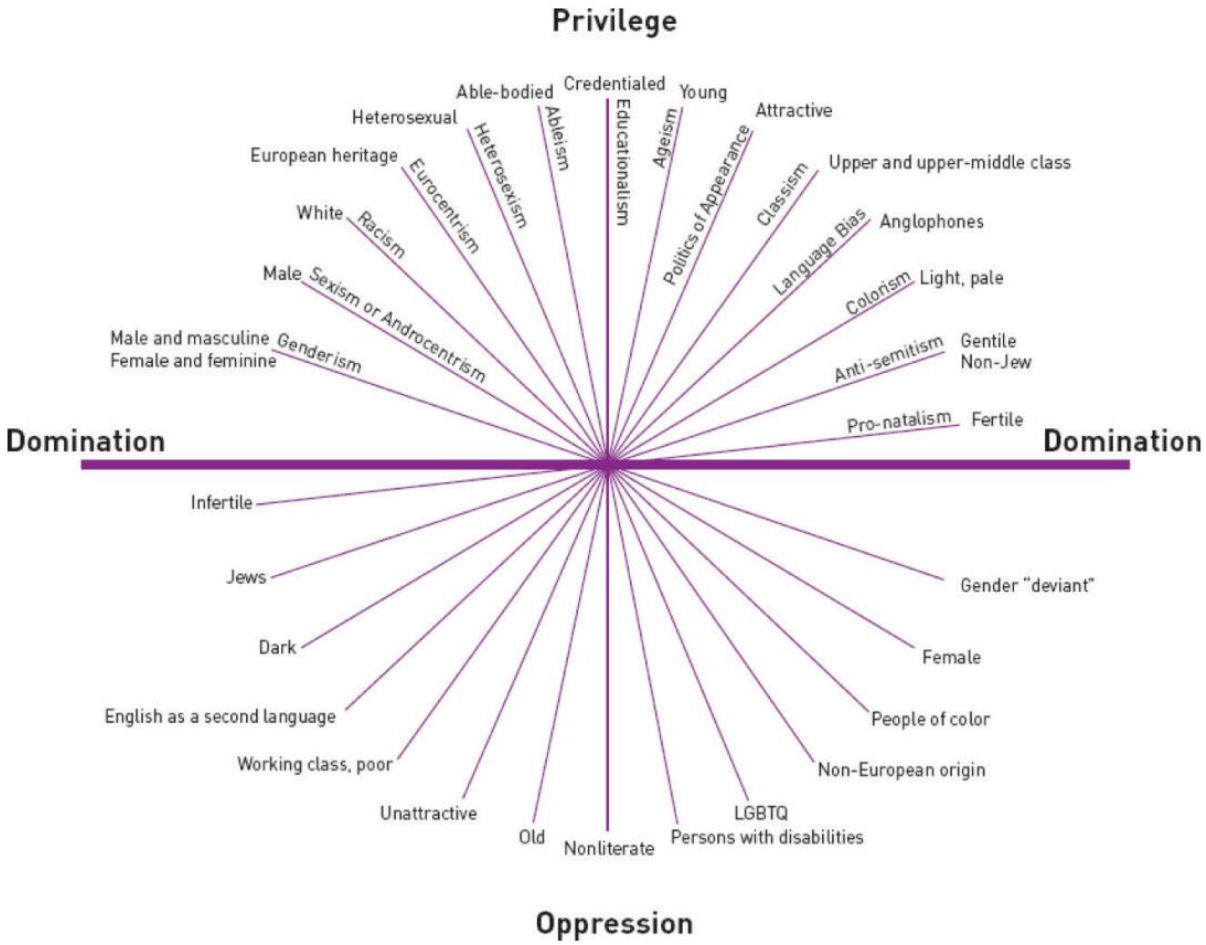

Figure 1: This diagram shows how intersecting identities can come together to form systems of oppression. From *Intersectionality: A critical framework for STEM Equity factsheet* by Association of Women in Science, n.d. (https://www.awis.org/wp-content/uploads/AWIS_FactSheet_Intersectionalityv4.pdf)

The Oxford English Dictionary (2021) defines equity as "the quality of being equal or fair". The UNESCO 2030 Agenda for Sustainable Development has a focus on equity with its call for "leaving no one behind" in a desire to build more inclusive and equitable societies. In educational contexts, equity is about fairness and justice for all through acknowledging and acting for systemic inequalities to ensure that everyone has access to the same opportunities and outcomes (Qvortrup & Qvortrup, 2018). There is a perception that achieving diversity within a community is a mark of inclusion; however, a diverse group does not consequently lead to inclusion. Inclusion means accepting and valuing all members by enabling their participation and contribution at all levels; people who have power, voice and decision-making authority should come from diverse backgrounds. A leading inclusion strategist Verna Myers says that "Diversity is being asked to the party. Inclusion is being asked to dance". This metaphor reflects the importance of inclusion as a means of belonging for active, legitimate, and respected participation.

We argue that to employ a teaching and learning practice that makes it inherently harder for some students to learn than others, or to use an assessment that creates inequitable performance conditions, is akin to creating a learning 'hazard'. In STEM fields we are very accustomed to assessing and then controlling for hazards through formal risk assessments, so it should be possible for us to bring this skill to bear on our educational practices. Within educational

contexts, inclusion is defined as "a process that is concerned with the identification and removal of barriers to the presence, participation, and achievement of all students (Ainscow, Booth, & Dyson 2006). This definition includes the concept of equity with its reference to "identification and removal of barriers" and the concept of diversity by its reference to "presence…of all students". Seen in this light, inclusion within STEM educational contexts means acknowledging and recognising the historical marginalisation of underrepresented groups (Wanelik et al., 2020) and normalising reparation efforts as legitimate means of narrowing the gap instead of using deficit theory to rationalise reparation (China, 2018). However, this is only possible if we as STEM educators and leaders, are prepared to examine our own cultural and societal norms with respect to our identities, assumptions, and biases (Ainscow, 2020).

A story of diversity initiatives in Australia – how did we get here?

Australia's higher education institutions have their origins in the principle of widening participation. The first of our higher education institutions were established in the mid 1800's specifically to allow the British colonists to attain tertiary education in Australia, rather than having to return to England for study (Gale & Parker, 2013). But, despite these origins, the doors to higher education have remained closed to many – initially anyone who was not male and white. White women did not attend universities in Australia for another 30 years, and this door opening, first proposed by Adelaide University in 1874, was challenged by the British government at the time (Welch, 2020). The first white woman to enrol in a STEM degree was (Edith) Emily Dornwall, who completed a science degree at Adelaide university in 1885. But despite graduating with first class honours and receiving several awards during her degree, she never used her qualification in a science profession (Cook, 2011). In 1918, the first female scientist was hired at the Advisory Council of Science and Industry – which would become the Commonwealth Scientific and Industrial Research Organisation (CSIRO). Mary Ellinor Archer was a qualified botanist with a Masters degree in science, yet was given a job title beginning with 'Secretary' – Secretary and Investigator to the Special Committee on Seed Improvement (Jeckells, 2020).

The number and diversity of institutions grew post World War II in response to government investment and policy efforts, notably the Minister John Dawkins' reforms to university fees in the 1980's which began the massification of higher education in Australia (King & James, 2013). Through its growth in providers and then students, the sector aimed to support university attendance for the broader Australian population living across the country, recognising that the likelihood of attending higher education is strongly correlated to proximity to a university. This is still the case today whereby students who live close to a university are more likely to continue through to higher education than those further away (Macken, Hare, & Souter, 2021). As the student body grew so did the governments' interest in the inequities that were becoming more obvious, and categories of disadvantage were created (*A Fair Chance for All* – Department of Employment, Education and Training, 1990). The largest growth period for students in higher education then occurred post the 2008 Bradley Review of Higher Education, whose full recommendations implemented the 'demand driven system' which was place from 2010 until 2017 (Department of Education, Employment and Workplace Relations, 2008). According to the Productivity Commission (2019), the combination of measures introduced such as lifting enrolment caps, creating equity targets and providing student support funding, increased higher education enrolments from 50 to 63% of the age cohort by 2016. But who were the additional students and how did they fare in their pursuit of higher education?

Most of the growth was from metropolitan students of low SES backgrounds and those first to attend university in their family who took up places in universities outside the Group of Eight (Go8) universities. Bradley had recommended a 20% Low SES student participation by the year 2020 – a number lower than proportional representation (25%), but one that was seen as attainable (King & James, 2013). At the time of the Bradley Review, the proportion of Low SES students attending Australian higher education institutions was 16.1%. In 2017, the caps on supported places were reinstated, at which point Low SES student participation, which had been trending upward, was just over 17% (Productivity Commission, 2019). This year there are currently 16.05% of our university students recognised as Low SES (Department of Education, Skills and Training, 2022). However, if we compare this to the STEM student population, just 3% of students come from Low SES areas of the country (Cooper & Berry, 2020). This suggests that the policies implemented did not have sustained impact, nor the same impact across discipline areas. There was limited impact on student participation for Indigenous and regional or remote areas (Productivity Commission 2019). Retention and success for these additional students was also lower, as was their initial competitiveness in the labour market after graduation. Students from equity groups appear more likely to be employed after graduation if working in their final year of study, which may count as success in employment, but their employment was less likely to be related to their qualification (Pitman, Roberts, Bennett, & Richardson, 2019). A recent focus has been placed on ensuring gender equality, with educational initiatives focusing on recruiting more female adolescents into STEM degrees (Department of Education, Skills, and Employment [DESE], 2020b). But as mentioned in our introduction, the effect has been arguably limited with the proportion of women enrolling in STEM degrees increasing by 2% between 2015 and 2019. Therefore, we suggest that a different approach is needed to help bridge the gap.

Alongside efforts to increase the diversity of our STEM students, there has been a significant push in recent times to increase the diversity of the workforce in various industries so that they are reflective of the overall population. Girls and women may not only face the barrier of being female within a male-dominated area, but when this intersects with a non-western, Low SES or rural background, they may face compounding barriers to success compared to males (Hughes, 2018). Males are also 1.8 times more likely to be working in a STEM occupation compared to female peers (DESE, 2020b), which demonstrates that females may not be provided the same opportunities as males entering the STEM field, given that this is a male dominated area (Farndale, Biron, Briscoe, & Raghuram, 2015). O'Connor et al. (2020) have shown women are less likely to receive sponsorship and mentoring from their PhD supervisors and senior men in their field, compared to their male counterparts and consider this to be a key source of invisible advantage for men in STEM. In male dominated areas, the endorsement of stereotypical attitudes aligned with masculine dominated fields, such as "put work first" or "dog eat dog", are often correlated with negative mental and physical health, low cooperation, and work-family conflict, among other negative outcomes (Fine & Sojo, 2019). Of the females who do enter the STEM workforce, half have experienced some form of discrimination due to their gender (Pew Research Center, 2018). For example, earning less in comparison to a male in the same role, being treated as though they were incompetent, feeling less supported or encouraged, or as though they needed to prove themselves within their role to be respected (Pew Research Center, 2018).

Changing the story – where are we now and what next?

Given the experiences of women in STEM workplaces, it is unsurprising that there is a push within organisations to create roles and performance indicators that aim to improve diversity and inclusion amongst the workers, however, Stanford (2020) questions whether this is enough. Rather than creating a role which focuses on diversity, they state that the organisation must focus on DEI as a vital mission or as part of their core values, for there to be any consequential change. The workplace environment and perceptions regarding diversity have an influential role on team performance, especially when there are employees from multicultural backgrounds (Kadam, Rao, Abdul, & Jabeen, 2020). Theoretically, it is thought that having employees from diverse backgrounds would create a larger wealth of skills, abilities, and viewpoints that would enable more creativity and innovation at work in comparison to a group of comparable individuals (Duchek, Raetze, & Scheuch, 2020). Whilst these findings have been supported within both experimental and organisational settings (Duchek et al., 2020), the culture of the workplace is influential on whether the employees are able to work harmoniously together.

Organisations with internalised prejudices, discriminatory practices, or preferential hiring, may experience conflict and discrimination between employees, as well as poorer performance (Roberge & van Dick, 2010). Those which value diversity are more likely to have employees who work together successfully, which also significantly improves innovation, and overall performance (Kadam et al.,2020). Similarly, Hofhuis, van der Rijt, and Vlug (2016) also found that when diversity was embraced by the organisation it led to increased job satisfaction and inclusion. This was thought to relate to the positive environment, reducing the creation of subgroups, an increased effort to overcome potential difficulties or perceived differences, and increased knowledge sharing within workgroups.

There are clear benefits of embracing DEI within the workforce, however, this can only occur when organisations actively make DEI a priority. Given that the aim of tertiary education is to prepare its students for the workplace, and that DEI is now often being identified as an important part of organisational values and policies, higher education institutions have advocated for and made attempts to demonstrate inclusive practices. However, there are several challenges within the tertiary education system that mean the gains are perhaps smaller than these efforts and the equity-specific government funding might be presumed to bring. For example, the Higher Education Participation and Partnerships Program (HEPPP) represents around $300 million of annual Commonwealth investment, but with all other funding sources considered, is estimated to be a multi-billion dollar spend annually (Brett, 2018). The challenges include differences in the perceived importance of equity initiatives and equity groups across the tertiary sector. For example, tertiary education leaders have questioned monitoring of participation and success of groups such as Women in Non-Traditional Areas and those from non-English speaking backgrounds (Brett, 2018). The challenges also relate to inconsistencies in funding streams for different equity groups and in institutional cultures and values. These shape the implementation of national equity initiatives where there are internal responsibilities for evaluation and/or limited regulation by the Tertiary Education Quality Standards Agency (TEQSA), leading to inconsistency with respect to the success of these initiatives (Brett, 2018).

Across the tertiary sector, universities have created specifically targeted strategic plans to guide their actions toward improving DEI, which, as of 2017, appear to universally reference equity (Brett, 2018). However, the subsequent focus on individual equity categories in the

implementation of these plans means that each institution has its own combination of equity sub-groups that are selected for explicit attention. In 2017, this was most likely to be Indigenous students (93%), low SES students (53%) and regional students (55%), and least likely to be first-in-family students (15%), students from non-English speaking backgrounds (5%) and women in non-traditional areas (2.5%) (Brett, 2018). If such differences in how we are valuing categories within the spectrum of diversity are not being fully understood and acknowledged within higher education policies, particularly with regard to the ways they then play out in classrooms and curriculum, we risk conveying the message to students that their inclusion is either unimportant or tokenistic (Fuentes et al., 2020). To limit this risk, DEI needs to be addressed first as inclusion of the whole cohort within the syllabus, course description, objectives, and approaches taken within the classroom to fully embrace the range of students we teach and ensure that everyone has an equal opportunity to succeed (Fuentes et al. 2020).

To this end, our current project seeks to explore how DEI is currently being addressed within STEM tertiary education through speaking to those at the interface with Australia's tertiary STEM students – the leaders and academics engaged with learning and teaching. We aim to elucidate the potential barriers facing academics in embracing inclusive approaches in learning and teaching, and what resources or support are needed to help ensure DEI practices are a priority. The study is envisioned to answer the following questions:

1. To what extent are STEM academics in Australia aware of sociocultural identity constructs – theirs and the students that they teach?
2. What is the capacity of STEM academics to understand the barriers to learning for students of diverse backgrounds?
3. In what ways can STEM faculty be inspired to take action to modify their teaching practices to enable equitable student success in their diverse student cohorts?
4. How are STEM academics being supported by teaching leadership and institutional structures to enable the success of students of diverse backgrounds?

To answer the above questions the study is using a critical-interpretivist approach to move beyond singular understandings of a context to one that seeks to examine "social, cultural, educational, and political issues that disproportionately affect the lives and experiences of "minoritized" populations" (Patton & Haynes, 2014, p.30). As STEM academics themselves are subject to institutional constraints and power structures beyond their control, it is necessary to take a critical perspective of the context to understand how systemic factors perpetuate the underrepresentation of these cohorts in question. To accomplish this objective, the study employs a national level survey aimed at STEM academics along with voluntary interviews of survey participants. We are also running professional development workshops aimed at engaging STEM academics to reflect on social identity and bias, by moving beyond deficit-discourse discussions (Lawrence, 2005) to becoming aware of their own and their students' social identities. In this way, STEM academics are exposed to student success barriers such as faculty attitudes, stereotype threats, microaggressions and fixed mindsets (O'Leary et al., 2020). To understand leadership impact, we will be running a focus group discussion for Associate Deans of Teaching and Learning in Science through the ACDS network and seeking interviews with STEM teaching and learning leadership.

Ultimately, the findings from this study will help the establishment of good practice benchmarks and guidelines that are relevant to the Australian STEM higher education context. Further, it envisions the creation of a framework for a multi-level approach (faculty leadership; teaching and support staff; and administrators) to normalise inclusive pedagogy in STEM higher education courses. We will also be curating a range of learning and teaching resources

on inclusive STEM pedagogy as exemplars of good practice. In these ways we hope to respond to Teaching Academics that may be feeling "unsure" about how DEI relates to the teaching of their discipline and take meaningful and sustainable steps toward a more inclusive culture in STEM higher education in Australia.

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