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Critical race theory and its relevance for chemistry

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Critical race theory — an academic framework that serves to understand systemic racism in the USA and beyond — can help inform endeavours to advance justice and equity in the chemistry community.

The year 2020 brought about substantial shifts to how everyone, globally, understood and engaged with life. The COVID-19 pandemic affected the lives and health of millions of people, substantially changing the rules and norms for social interactions. Simultaneously, continuous displays of anti-Black racism within the USA — including excessive police brutality and the murders of George Floyd, Breonna Taylor, Rekia Boyd and others — prompted global calls for racial justice, as more people were made to witness and contend with these atrocities[1,2].

In reckoning with anti-Black racism and how it continuously morphs and manifests across time throughout various institutions (such as education, science, law or religion) scholars and activists have turned to academic theories and frameworks to anchor their calls and acts for racial justice[2] — among these, critical race theory (CRT)[3]. In this Comment, I provide a brief overview of CRT and discuss how it can be used as a lens to critically examine the culture and practices of postsecondary chemistry education (learning, research and engagement) in the USA and beyond, as well as identify tangible strategies for redressing and mitigating structural racism in chemistry.

Why is CRT appropriate for chemistry?

The numerical underrepresentation of Black individuals in postsecondary chemistry — and in science more generally — is well documented in the USA and other Western countries such as the UK[4,5] (https://www.rsc.org/policy-evidence-campaigns/inclusion-diversity/surveys-reports-campaigns/racial-and-ethnic-inequalities-in-the-chemical-sciences/). Research demonstrates, as seen from resources listed in the Supplementary Information, that chemistry (and science in general) has maintained a culture that typically favours white, cisgender, middle-to-high socioeconomic status, heterosexual, non-disabled men[6].

Studies on the experiences of Black students outline the stereotypes and biases they face within science, technology, engineering and mathematics (STEM) spaces[6,7]. Chemistry students describe their postsecondary environments as spaces where they must alter their presentation of themselves to be seen as someone capable of succeeding — including abandoning aspects of their home and cultural identities, having to go above and beyond to demonstrate their intellectual capabilities[6,7].

Black students disclose feeling both invisible and hypervisible within science classrooms[7]: they are often overlooked by their instructors or peers when it comes to classroom engagement — unless the conversations feature race or ethnicity, in which they become hypervisible. They also reported feeling hypervisible when it comes to performance indicators, as if they have to represent their entire race or ethnic group, proving that their people are capable of success[6,7]. Students who maintain multiple targeted identities experience unique challenges — Black women report experiences that are different from those of Black men or white women[8].

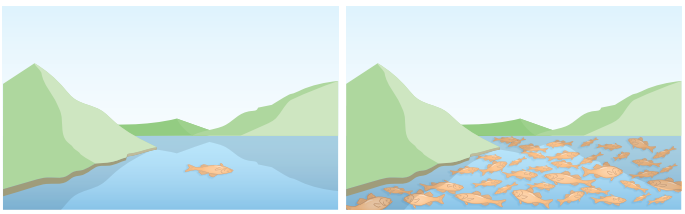
Amidst the calls for inclusion and equity in chemistry and science[9], CRT provides a lens to critically examine marginalization and address its root causes.

Critical race theory

CRT is a framework that identifies and challenges the presence and impact of structural racism and intersectional oppression embedded within policies, procedures, practices and sociocultural norms across various institutions, organizations, fields of study and communities[3]. CRT has primarily been applied to Western societies such as the USA and UK[3,10]. It positions racism and intersectional oppression (which arises for people who identify with more than one minoritized group; for example, gendered racism) as structural over interpersonal. This means that racism occurs through the subjective interpretations of presumably 'neutral' policies and procedures from well-intentioned people, and not just through acts of violence and hate committed by presumably lone and 'irrational' individuals.

A metaphor adapted from the Racial Equity Institute (https://www.racialequityinstitute.com) can help one to understand this perspective (https://medium.com/inspired-ideas-prek-12/in-a-time-like-this-lessons-from-the-racial-equity-institute-ef6704824d24) (pictured). Most people walking alongside a lake and seeing one fish belly-side up would ask, "what is wrong with the fish?" However, walking alongside a lake and seeing tens of thousands of fish belly-side up, most people would ask, "what is wrong with the lake?" This metaphor conveys the toxicity of various societies and institutions (the lake) and its impact on Black people (the tens of thousands of belly-side-up fish), signifying the need to focus justice and equity efforts towards structural change, fixing the lake rather than the fish.

Within the current US political climate, there is ongoing debate about CRT. It has come under attack by conversative lawmakers and right-wing political strategists. Contrary to their claims, however, CRT is not divisive, it is not designed to shame, demonize or encourage hate, and it does not inherently produce feelings of guilt or blame. Rather, CRT calls for a critical examination of the existing systems and



structures and how they perpetuate a social stratification of people and their cultural values. It is also worth noting that CRT is not currently being taught in primary and secondary schools in the USA, and it is also rarely taught at the undergraduate (postsecondary) level. What are seen in primary and secondary education are lessons on the complex history of countries related to the racial, ethnic and gendered experiences of people. There are lessons of morality and ethics in addition to lessons on civic identities and responsibilities. Though educators may discuss these concepts leveraging a CRT lens, it is inaccurate to claim that CRT is being explicitly taught in schools.

A CRT analysis

As a framework, CRT holds several principles or tenets that outline its core perspective. The title of those tenets can vary between fields (such as law, education, sociology) but their definitions and meanings remain similar.

Racial realism. This tenet purports that racism is endemic, permanent, systemic and integral to all social institutions[3].

Racial realism applied to chemistry acknowledges that the field, and science generally, exists as a microcosm of the broader society and thereby perpetuates structural racism or gendered racism. Through this lens, existing trends in enrolment and degree completion in chemistry — for example, the continuing numerical underrepresentation of Black people — can be seen as an outcome of structural racism or gendered racism, given biased policies and practices such as tracking or streaming in primary and secondary school (regulating students' access to certain courses based on their performance in prior courses, standardized tests and assumptions of students' capabilities) and 'selective' admission criteria for colleges and universities[11,12].

Whiteness as property. Whiteness is sociopolitical capital maintained by white people that can be used to regulate access to and full engagement with resources, spaces and ideas[3]. This capital is a product of the social, cultural and legal establishment of the USA coinciding with the enslavement and dehumanization of people of African descent and the attempted extermination of Indigenous people[3] — presenting 'whiteness' as the default standard[13].

In chemistry, this tenet serves to rationalize the oppressive experiences Black students are subjected to as they operate in the 'white space' of science[14]. Black realities and Black intellectual contributions are not meaningfully incorporated within science curricula and science teaching; instead, they are excluded or typically presented in a tokenistic manner through one-off racial spotlighting[15]. The erasure of Black perspectives and experiences in science, historical and contemporary, normalize science as white property, perpetuating feelings of invisibility and hypervisibility for Black students.

Critique of liberalism (myth of meritocracy). The belief in individualism and the bootstrap mentality communicated through US laws and social norms is a false reality given racism and its de facto outcomes[3].

This tenet challenges the idea that one's success is the sole reflection of their individual hard work. It highlights the field's failure to account for resource inequities and injustices that are explicitly tied to race or gendered-race identities, including how financial, social and cultural capital play a significant part in determining success in chemistry. Financial, social and cultural capital play a role in who has the privilege to 'only' be a student versus having to manage multiple responsibilities, including learning. It also impacts letters of recommendation.

Letters of recommendation, prevalent for enrolment, scholarships or awards, internships, research experiences, promotion and tenure, serve as gatekeepers for access and engagement. The letter itself and who writes it (in terms of academic pedigree) matters. Letters from 'non-recognized' people and institutions are typically more scrutinized and carry less weight than those from 'prestigious' labs, reflecting bias and discriminatory practices. Additionally, the process of soliciting a letter of recommendation can also be analysed through this lens. Obtaining a letter is about more than just a person's merit; it is also a reflection of a student–professor relationship. Students must therefore be aware that they will need such a letter and develop an appropriate rapport with the professor, which requires a certain form of social and cultural capital not readily available to all students.

Interest convergence. This tenet conveys that efforts towards racial progress only occur at the juncture where those in power benefit from investing in the interests of those racially minoritized[3].

Applied to postsecondary chemistry, this tenet would imply that investments to make chemistry inclusive (such as inclusive teaching or diversity scholarships, fellowships and programmes) occur in ways that ensure institutions gain notoriety and maintain power. Interest convergence can help us understand why, despite continuous 'good faith' diversity and inclusion efforts, the field is still fraught with challenges and oppression: the efforts put forth and maintained are ones that support those minoritized in ways that do not completely disrupt the status quo, with no real shift in power occurring.

This tenet can help analyse undergraduate research experiences, typically presented as a high-impact practices that diversify science and help retain people from marginalized groups in science[16]. These experiences support students with gaining access to STEM opportunities and careers, but are often implemented in ways that expect students to assimilate into the existing culture and practice of science, typically at the expense of their well-being[16]. Institutions gain notoriety for promoting diversity through undergraduate research experiences, while Black students make modest gains that come at a high cost.

Intersectionality. Structural oppression operates on those of multiple marginalized identities uniquely[3].

Intersectionality in postsecondary chemistry critiques numerical representation in relationship to resource allocation and the extent to which representation and resources are equitable and appropriate across several identities (for example, race–gender–class).

Existing diversity, equity and inclusion efforts tend to focus on one identity demographic (services and support specific to race or gender or sexuality) and rarely attempt to nuance their approach to people across intersecting identities; initiatives for People of Colour and for women do not provide resources that specifically meet the needs of Women of Colour. In practice, gender-focused diversity opportunities (scholarships, internships, research experiences, hiring practices, and so on) absent of an intersectionality approach favour and privilege white women as opposed to Women of Colour[17].

Counter-story. The dominant narrative is recognized and challenged by elevating, embracing and empowering the stories and voices of marginalized people[18].

Existing equity and inclusion practices implemented within postsecondary chemistry often focus on the absence of Black people and on ways to include them. Practices adopted typically involve rehabilitation (such as tutoring, additional training, summer programmes), the

development of coping mechanisms (for example, mentoring, teaching navigational skills), or training for faculty on inclusive teaching — these endeavours all stem from the perspective of the dominant group.

In contrast, rather than engaging in practices that 'help minority students', counter-stories position students as bold, capable individuals, and point to the flawed environment (the lake) as the space that needs change.

Leveraging CRT in practice

There are multiple ways in which CRT can be used in practice towards social justice within one's individual and collective action.

Structural change. Structural change requires addressing racism and gendered racism at the root, shifting individual mindsets and changing collective policies, norms and practices.

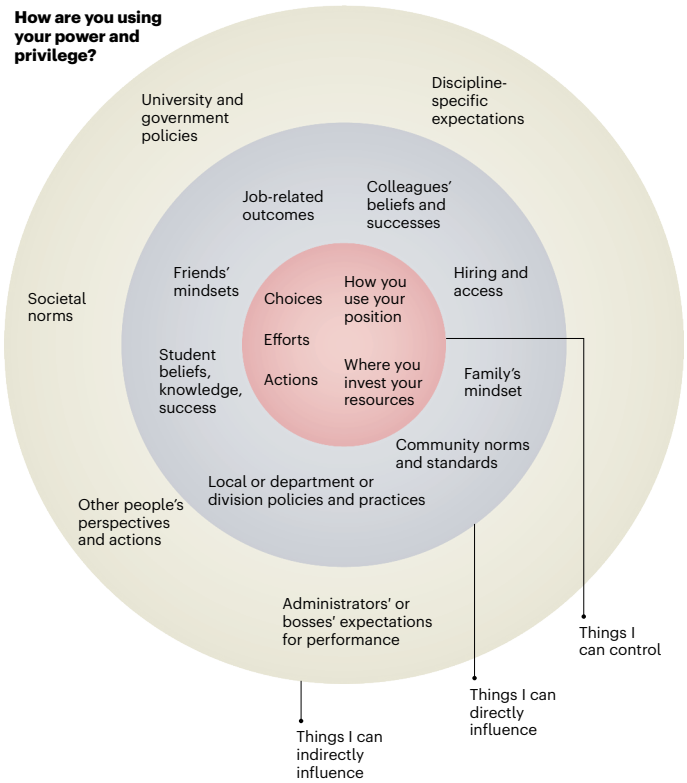
Strategies to foster structural change include generating a critical mass of people who share similar ideologies regarding the liberation of Black people. This critical mass should reflect a diversity of Black social identities but also include non-Black scholars. This diversity must be established in chemistry departments and professional structures across all ranks (from junior faculty to senior faculty to administrators) — not just among those with the least power to effect structural change (junior faculty or professional staff).

This can be achieved through intentional recruitment and retention practices that build communities (mixed-rank cluster hires in which several scholars across ranks are hired at the same time in a department) and transform policies and practices around power (such as revising tenure and promotion) to account for structural racism and gendered racism. Hiring and promotion criteria should be adjusted to specifically value and reward scholarship, teaching and service activities (such as informal mentoring of Black students) that intentionally advance the needs of Black communities. Institutions should also put in place accountability structures to ensure that scholars do not in any way perpetuate discrimination or bias against Black people.

Professional societies and spaces (such as academic journals) can advance structural change by making anti-racism and anti-oppression core to their mission, values and practices. Expressed commitments to anti-racism must be coupled with anti-oppressive practices that prompt cultural change. Sustaining diverse physical and ideological representation among their leadership teams is one suggestion. Sustaining diverse representation does not mean electing one person as a chief diversity officer or diversity specialist to ensure that the entire organization engages in equity and inclusion. Rather, it requires dispersed power and leadership responsibilities across every facet of an organization. This practice requires critical examinations of the processes by which people are elected or appointed to positions of power within these structures to ensure that multiple Black individuals continuously maintain leadership positions and decision-making authority.

Mitigating racism and gendered racism. Inequities in the field of chemistry can also be mitigated as the field collectively validates the systemic presence and continuous influence of racism and gendered racism on scientific inquiry and education. Each person should evaluate their position and actions towards social justice — with respect to their identity, privilege, exposure, awareness and commitment. High-quality research and literature that outline the lived experiences of Black people across the globe exists; I have shared some of those resources in the Supplementary Information. Access that scholarship and read. Attend meetings, professional lectures, and conference presentations

Sphere of influence
Developed based on the general concept of a sphere of influence or control



by Black scholars. Watch documentaries and other forms of media that discuss Black experiences from their vantage points. Each person can leverage their power and privilege to fight for racial and gendered racial justice through the various constructs and spaces that they can control or influence, directly and indirectly (pictured).

Senior leaders set the vision for their institutions (for example universities, colleges, units, labs), as well as actions beyond including justice, equity, inclusion and diversity in mission statements. Efforts need to be well-funded or resourced, and accountability structures (beyond celebratory awards) must be put in place to ensure that they are implemented. Collins and Olesik[19] outline how chemistry department chairs can act, through: disaggregating data to paint a more accurate picture of the current racial inequalities; listening to Black students; systematically assessing course syllabi; reviewing teaching practices; and engaging with chemistry education researchers, in particular Scholars of Colour. These recommendations can be extended to universities and/or other organizations.

Similarly, faculty members are responsible for ensuring that inclusion and social justice principles are integrated into their courses or lab spaces. This means featuring work from Black scientists and discussing problems and solutions that specifically attend to Black experiences[20].

While there is a lot of effort and enthusiasm around racial and gender spotlighting in science, it is important to highlight people from marginalized groups throughout the entire year (not only during designated times, for example Black History Month); it is also important to diversify who you feature rather than focusing on a few individuals. Featuring the social identities, lived experiences and backstories of every scientist (including Black scientists) within classroom conversations

should be routinely incorporated when discussing scientific concepts and contributions. This would lessen tokenism and reduce hypervisibility for Black students.

Additionally, learning that many scientists supported racist, sexist and other oppressive ideologies about people and their capabilities[21]—eugenicists Francis Galton and Ronald Fisher being two of the most notorious examples—would encourage students to critically assess the relationship between a person, their scientific contributions and their ethics. This would foster critical thinking skills as well as opportunities for learners to envision scientific innovation that speaks directly to their cultural and community needs.

A variety of different communication styles and teaching strategies also exist that should be incorporated into science education to allow students to bridge their cultural worlds and scientific knowledge[22]. Examples are the use of project-based learning—a practice where teaching occurs through solving real-world problems that are based in different cultural communities—or creative types of assessments, such as asking students to write an Afrofuturistic children's science book over taking a standard cumulative multiple-choice exam. And though this process undeniably takes more time to evaluate than multiple-choice exams, changes heralded by university administrators would ensure that faculty are provided with sufficient resources, such as teacher aids or assistants, and formal awards for engaging in these practices.

This should be part of a wider change to revisit what counts as knowledge and how it can be displayed, obtained or gained. This can be achieved by departing from a Eurocentric model to one that embraces all perspectives as valid and appropriate. Engaging in this process would also require making amends for the generations of systemic and epistemic oppression against Black people[23].

There is an increasing body of work on establishing holistic classrooms that invite students into the learning space rather than keep them out, including in chemistry[19]. Building from these ideas, these can include practices such as co-constructing attendance policies and establishing peer accountability groups within the class, such as shared class notes spaces online, designated partners who check in with each other when one may not be able to physically attend class, or small working groups that can function as study groups for understanding course content. Making the learning space more communal, intentionally leveraging the power of peers as sources of encouragement and support in the classroom space does require, however, that teachers ensure that inequities are not reproduced during group work[24].

The same suggestions for mitigating racism and gendered racism in the classroom apply to the research and teaching lab environments. Kimble-Hill describes an interesting approach: risks associated with marginalized social identities—for example, isolation, anxiety, discrimination, harassment and even assault—represent safety threats that can be assessed and addressed in a similar way to other hazards present in a chemical lab[25]. As with chemical risks, proactive approaches in research and teaching labs would therefore work to eliminate risks related to identity threats, establish learning norms that build on students' cultural identities, communicate trust and confidence in their ability to take intellectual risk and to make discoveries, and provide them with the right support to explore their ideas and feel validated within their research.

This requires work

The ideas provided are but some examples of ways in which the field of chemistry can leverage CRT to advance justice and equity endeavours. This list is not exhaustive! Scholars and practitioners are building from this framework to create new possibilities in chemistry, and science more generally. What this list does communicate, however, is that the work to create a better learning environment and discipline is far from done. It is also clear that a radical shift is needed in how the field of chemistry approaches justice, equity, inclusion and diversity endeavours.

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The author declares no competing interests.

Additional information

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