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Curricular change for social justice: Teaching science by drawing on students' lived rural home experiences in higher education

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Abstract

The likely presentation of scientific knowledge as faithful copies of reality, as well as orderly activities from science textbooks, could lead novice students in the field of science to believe that the learning of scientific concepts such as accuracy, precision, and methods such as observations, among others, may only take place in the classroom. Contrary to how scientific concepts and methods are normally presented by means of empirical qualitative data, in this article, I argue that the abovementioned concepts and methods are likely to be encountered in the local rural home environments of students. Data was sourced from focus group interviews that were conducted with second-year science students at one of the historically white and privileged institutions in South Africa. This article aims to contribute in theoretically informed ways in terms of enhancing equity of success and social justice in the field of science in higher education. Social justice issues were conceptualized through Nancy Fraser's normative framework of social justice. From this understanding, an argument is put forward that a sociological framework of critical realism and social realism has the potential to draw the scientific world into the social world. From this sociological framework, it is possible to develop an understanding of students' prior experience and to draw on it in the classroom for better educational outcomes.

Keywords: teaching science, higher education, social justice, critical realism, social realism

Context

Unlike other research-intensive universities in South Africa, the research site in this article is in the Eastern Cape Province in South Africa, in a fairly remote impoverished town where the majority of the students are not from the area. About two decades ago, the student body was predominantly white and privileged. Currently, the majority of students are black, and a large number come from working class and, possibly, rural backgrounds (Boughey, 2018). Most students in this study come from the villages of Port Alfred, Mount Frere, Qumbu, and Mthatha

in the Eastern Cape Province; Nquthu, Phongolo, Ulundi, Umbumbulu, and Hluhluwe in the KwaZulu-Natal Province; and Makhado, Lephalale, Polokwane, Tzaneen, and Phalaborwa in the Limpopo Province. It was partly this realisation that prompted a need to investigate students' experiences of learning science in higher education, particularly those who come from rural areas in South Africa.

A rural area is a profoundly political structure in South Africa (Naidoo, et al., 2020). Apartheid[1] played a considerable role in the displacement of the South African black population to the rural, impoverished areas and so, in South Africa 'rurality as a concept reflects the broader history of colonialism and dispossession' (Walker & Mathebula, 2019: 3). These events are one mechanism that have marginalised black people from participating in mainstream South Africa. Therefore, students from rural areas are likely to be the most affected by historical inequities of rurality, especially as they interrelate with race and ethnicity. These events had and still have deep effect on the structure and enactment of curriculum in South Africa's higher education context.

The experiences of students in higher education, especially students from working class including those from rural areas,[2] are associated with the notion of filling the gap within universities merely by being present without significant change to university structures such as the curriculum (Bozalek & Boughey, 2012; Bunda, et al., 2011; Mgqwashu, 2018; Mgqwashu, et al., 2020). It could thus be argued that a more inclusive or socially just curriculum is still an ideal in most parts of higher education, particularly in the field of science. In other words, the modes of teaching and learning and assessment tend to be structured to favour certain worldviews to the exclusion of others (Bernstein, 1999; Bourdieu, 2010; Gee, 1990; Mgqwashu, 2019a). I argue elsewhere that success and participation in the classroom in the context of the current system are a challenge for students from rural areas because how they have learned to see the world is often not used as a starting point or seen as relevant when the science curriculum is enacted (Madondo, 2020). These students' ways of learning are not used in the university and are not rewarded, and therefore they are often alienated in science classrooms. The implication for this is that the curriculum in the discipline of science is not connected to the lived experiences of students from rural areas and the ways of being of their home communities and is therefore exclusionary. This is a challenge for most higher education institutions (Heleta, 2016; Le Grange, 2016).

For the curriculum to become more genuinely inclusive in higher education to enable success and participation for all, the notion of filling the gaps mentioned above could be seen as a form of injustice and therefore can act to favour certain worldviews or ways of coming to know

[1] Apartheid regime was a system that institutionalized racial categorization and the dominance of white people over other races in South Africa, in terms of political and economic discrimination. This discrimination warranted the emergence of a hierarchy of social and financial privilege along racial category.

[2] 'Deep rural' learners frequently attend poorly resourced schools, located in isolated areas, with high levels of poverty, disease, and unemployment (HSRC, 2005). Deep rural in the South African context is associated with poverty, disadvantage, and lack of economic and educational opportunities (Trends in International Mathematics and Science Study, 2015).

above others. Acknowledging prior learning of students from rural areas has the potential to enable the curriculum to create a dialogue and contestation among different ways of knowing. It is possible to imagine a curriculum that draws on the experiences of all those involved in curriculum events. This is because

> Curriculum does not occur in a vacuum; rather it is influenced by the context within which it is implemented, the context for which it is being taught, and the principles upon which it has been based. Ultimately, it is the educator who breathes life into the curriculum, bringing her own norms, values, experience, and expertise into the educational space (Jacobs, et al., 2020: 112).

It is possible to see that curriculum is not designed by curriculum angels in heaven and therefore it is not fixed (Connell, 1992). From the above quote, it is the academic teacher who designs and 'breathes life into the curriculum' (Jacobs, et al., 2020: 112). In this way, it is possible for the academic teacher to open opportunities that would enable the curricula the spaces for authentic engagement with diverse lived realities of students while using this knowledge as the foundation for cumulative disciplinary knowledge building.

While I am acknowledging the idea of curriculum that is not fixed, I am, also, conscious that not all students or people in general learn in the same way. In this article, the intention is not to essentialise how learning takes place in rural areas, but the brief deliberation above demonstrates that some students experience formal schooling including higher education in similar ways to the ways learned at home (Gee, 2012; Heath, 1983). Writing about students from middle class educated homes, often white, Boughey (2018), for example, posits that university education is rather a continuation of the literacies that these students have already acquired at home. She argues that the homes of these students prepare them for a university education long before they join the university, and so '...the people they would be required to be as students were not too different from the people they had been at home' (Boughey, 2018: 33). It is then possible to see that for these students, participation in the conceptualisation of concepts such as accuracy and precision and methods such as observations in the classroom is most likely. For other students, formal schooling seems to conflict with home-taught ways, and this is likely to constrain participation in settings involving literacy (Zipin, et al., 2015).

In the context of this article, literacy does not only involve encoding and decoding of printed texts but is also construed as a set of practices emanating from birth and shaped by the contexts into which individuals are born and raised (Jacobs, 2019; Street, 1984). These factors highlight issues of inclusivity and/or exclusivity from structures such as the curriculum in higher education in general and the field of science in particular. The implication is that some students would most likely not be able to participate as equal and full partners in the construction of scientific knowledge, with the result that social justice issues are likely to be compromised, either wittingly or unwittingly, by academic teachers. To participate as equals is an issue of social justice.

To further deliberate on the issues raised above, the first part of this article elaborates on Nancy Fraser's (2000, 2003, 2008) normative framework for social justice and in the process presents an argument for social justice that 'requires joining knowledge redistribution to ethical concerns for recognition of diverse cultural knowledge, and representation of diverse social-cultural groups in the processes of knowledge selection' (Zipin, et al., 2015: 27). The article then proceeds to present a theoretical framework to identify structural and cultural emergent properties that constrain and/or enable the development of the agency of all those involved in the construction of knowledge in the field of science. While social realism accentuates the universality of knowledge (Zipin, et al., 2015), which is true in the sciences, the question of what and whose knowledge is selected and how it is selected is pertinent regarding social justice issues (Fraser, 2008), thus broadening the social realism analysis. Lastly, findings and data analysis are presented. From the analysis of data, it is clear that there is a potential to include the relativity of human experience in the realist claims of science. It is possible to understand this interconnection if we agree that everyday knowledge/concepts could be useful assets for scientific/formal learning (Zinyeka, 2013).

The aim of this article is thus to provide empirical evidence in making an argument about the 'need to value various ways of knowing, types of knowledges and ways of learning that are not necessarily mainstream' (Mgqwashu, 2019a: 68) for agential development in the construction of knowledge in the field of science.

Given this aim, the broader focus of this article is teaching in the sciences and how this activity can misrecognise and misframe the knowledge resources that students from rural areas can bring with them to higher education. This misrecognition and misframing can amount to social injustice, and therefore, Fraser's (2003; 2008) concepts of misframing and misrecognition are useful to understand how these students' home literacies are neither acknowledged, valued, nor rewarded in higher education in the field of science, which negatively impacts their participation. It is partly this realisation that the concepts of structure, culture and agency are used in conjunction with Fraser's (2000, 2003, 2008) concepts to explore how structure, culture or agency could constrain rural students' participation in science classrooms, leading to social injustice. One point of note is that the consequence of misrecognition and misframing of the rural students' knowledge resources could also be conceptualised as epistemicide (De Sousa Santos, 2014). While epistemicide was not part of this study's framework for analysis, its use can be important to this article's discussion because it helps to realise the destruction of indigenous knowledge forms as a result of the hegemony of Western knowledge forms (Leibowitz, 2017).

I now turn to Nancy Fraser's (2000, 2003, 2008) normative framework of social justice.

Misframing and misrecognition of students lived rural home experiences

For students to participate fully in the construction of knowledge or in social interactions, Fraser (2000; 2003; 2008) proposes what is called parity of participation, which involves equity of access to higher education and equity of educational outcomes. According to Fraser (2003: 73), for parity

of participation to take place, a particular social arrangement is required that will enable '… all to participate as peers in social life', for example, in the case under study in higher education. Several scholars argue that not the curriculum in itself but rather how it is constructed is a problem; what it contains tends to favour certain worldviews but ignores others (Boughey & McKenna, 2021; Boughey & Mckenna, 2017; Mbembe, 2015, 2016; Mgqwashu, 2019b; Ndlovu-Gatsheni, 2013). In this way, curriculum enactment is positioned as an unequal construct because it fails to recognise (Fraser, 2003) different ways of constructing and expressing scientific knowledge. This has a potential to adversely affect access to the Discourse[3] of the discipline of science, particularly for those students who have not been socialised into practices and discourses congruent with those of academia (Jacobs, 2019). It is Fraser's (2000, 2003, 2008) multidimensional framework of justice that addresses parity of participation through which we can begin to see how not recognising primary socialisation could constrain access to the Discourse of science. This framework involves economic, cultural, and political dimensions that are likely to favour certain worldviews over others.

From an economic point of view, access, or the lack thereof, to material resources such as wealth or income would enable or constrain individuals' abilities to participate on an equal footing in social interactions. Economic deprivation or constraint would result in what is termed distributive injustice. Hence, because of lack of economic resources, some students may not gain physical access to higher education. There are two types of distributive injustice; one focuses on the economic aspects mentioned above and the other on students' inability to gain access to how knowledge is constructed within disciplines, including the discipline of science. This type of distributive injustice could be captured in institutional cultures embodied in disciplinary knowledge, pedagogic practices, methods of assessments, use of technologies, studying methods and resources that tend to covertly determine who is likely to gain access to the Discourse owing to consistency between home socialisation and schooling background. To this effect, Jacobs (2019: 4) notes a social justice issue in that:

> knowledge construction is largely dependent on the social structures and academic communities to which some students have access, and others not … some of our students have been socialized into practices and Discourses which are much closer to those of academia than other students.

[3] Discourses are assumed to be 'thinking, feeling, believing, valuing, and acting' (Gee, 1990: 143), and this understanding has been further developed to mean Discourse with a capital letter D, which potentially means:

> . . . a socially accepted association among ways of using language and other symbolic expressions, of thinking, feeling, believing, valuing and acting, as well as using various tools, technologies, or props that can be used to identify oneself as a member of a socially meaningful group or "social network", to signal (that one is playing) a socially meaningful "role", or to signal that one is filling a social niche in a distinctively recognizable fashion (Gee, 2012: 158).

Based on Jacobs' notes above, it is possible to see why some students regard university education as a continuation of the literacies that they already have and thus find participation easier, while others do not. The literature also shows that the literacies that students from rural areas bring with them into higher education could be a useful resource in accessing the Discourse of the particular discipline (Zinyeka, 2013; Zipin, et al., 2015). These literacies can be important because there are ways of knowing and being in rural areas that are valid and have scientific underpinnings but are simply ignored in the construction of knowledge in higher education (Madondo, 2018; Zipin, et al., 2015). Students from rural areas might be exposed to home practices that have scientific underpinnings. For example, in most rural homes in South Africa, leaves or roots of certain trees and plants are used as remedies for ailments (Brendler & Van Wyk, 2008). The practice of using leaves or roots of plants to treat, for example, diarrhoea, fever, cough, or pain relies on soil pH and the chemical constituents and antibacterial and antifungal properties of the leaves or roots, but the average student or even the parent from whom the student might have learned the practice is unlikely to be aware of these properties and chemical constituents. My argument therefore is that students from rural areas can draw on these practices/everyday knowledges to access university-principled knowledge in Chemistry, for example. It is partly for this understanding that Fraser's (2003) cultural dimension of social justice is important.

From a cultural perspective, institutional practices have the potential to be exclusionary in the sense that some students are constrained from achieving educational success. This could happen when the attributes associated with people or the activities in which they are engaged are not valued in the social arrangement. Parity of participation would be prevented when the cultural dimensions of those involved in social interactions are misrecognised (Fataar, 2018; Fraser, 2000, 2003). This might mean that students do not see themselves in terms of institutional structures such as the curriculum and therefore remain largely marginalised.

From a political perspective, Fraser (2008) argues that for parity of participation, social arrangements should be such that all social actors are equitably represented. In other words, in social interactions, for example, in the conceptualisation of concepts in the science classrooms, those involved, including students who come from rural areas, must be accorded an equal voice in the construction of scientific knowledge in such a way that they could see their worldviews being represented in the science curriculum, but critique these to open dialogue and contestation among different ways of how to know. This is a critical aspect of knowledge generation in higher education

So far, I have presented an argument against disregarding the lived experiences of subordinated[4] students. The next section presents a framework of critical realism. This framework provides different layers of reality to help unpack the experiences of students who come from

[4] According to Quijano (2000) race was an organising principle to justify and legitimize European conquest. 'The conquered and dominated peoples were then situated in a position of subordination, as a result their human traits and cultural features were considered inferior to the European epitome' (Oyedemi, 2020: 401).

rural areas, including their home practices, beliefs, and values. Critical realism places a strong emphasis on justice and equity. In the context of this article, social justice would involve improved student learning and improved teaching by enabling identity shifts of students who come from a background of historical inequity.

Critical Realism

In the section above, I have argued for parity of participation for students in science classrooms, including those who come from working class backgrounds[5], such as rural areas, to enable access and success of students at a South African university. To enhance equity of success and social justice in the field of science for students who are other to the middle class educated families that gain the most access to higher education, an ontological framework is also needed (Madondo, 2020; Torres, 2011). For this, Archer's (1995, 1996, 2000) theory of social realism is proposed. It is, however, necessary to first engage with Bhaskar's (1978, 1979) theory of critical realism since it forms the foundation of Archer's theoretical work. Bhaskar (1978, 1979, 2011) presents a layered understanding of reality. This layered reality is represented by the iceberg metaphor presented in Figure 1 below, adopted from Fletcher (2017: 6).

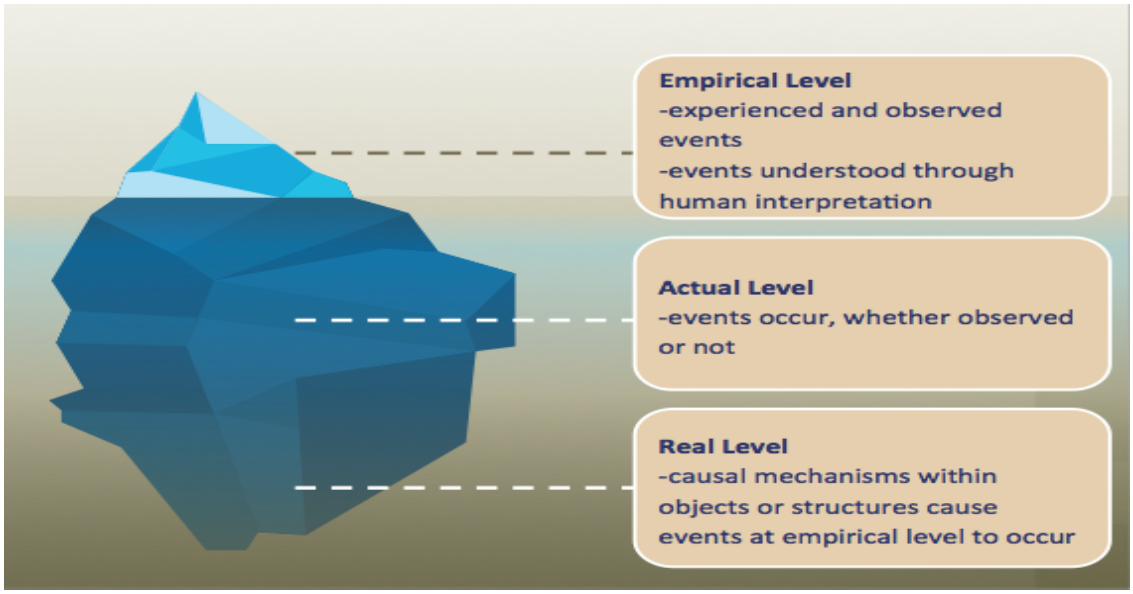

Figure 1: Iceberg metaphor of layered ontology adopted from Fletcher (2017)

[5] Students who participated in this study, given the legacy of Apartheid in South Africa, generally come from poor socio-economic conditions, are first-generation university students, English is not their home language and typically attended poor schools (Ellery, 2016; Mgqwashu, 2019; TIMSS, 2015). Based on this understanding, these students are categorised as working class in this article. I am, however, aware that categorising students from rural areas as working class is a generalisation as this might not necessarily pertain to all students from rural areas. But it does describe general trends and provide some background context about students who participated in this study. Coming from a rural area and be categorised as working class does not signify that these students are deficient as they can have the necessary cultural capital for educational success (Fataar & Fillies, 2016; Mathebula, 2019).

Bhaskar's critical realism

Bhaskar's critical realism consists of three layers of reality: The Empirical, which is the first layer, involves human experiences and observations that are constructed and are ever changing (Bhaskar, 1978, 1979, 2011). Such experiences, as represented in Figure 1 above, are conditioned by our past histories and are, therefore, relative.

The second layer of reality is the Actual, which concerns events. These events may be experienced directly or indirectly by agents[6] in the social world in several ways; these events are readily seen and observable. It is from this layer that experiences and observations emerge.

Accessing information and understanding from the Empirical and Actual layers is limited in explaining and understanding the makeup of the studied reality, hence the significance of the Real layer (Bhaskar, 1978, 2011), which consists of structures such as education system, class and geographical area, and mechanisms that include discourses from which experiences and observations have a tendency to emerge. This will enable coming as close as possible to understanding the reality of a given phenomenon, and Archer's (1996) theory of social realism is useful in that regard.

Archer's social realism

Archer (1996) uses the concept of analytical dualism to explain the functioning of structure, culture, and agency. According to Archer, these entities must be studied separately to guard against what she terms the 'fallacy of conflation' (Archer, 1996: xv). Guarding against this fallacy could help researchers not to conflate structure, culture or agency when analysing data.

For Archer, culture is discursively constituted. This means that sets of ideas in language and other sign systems constrain and enable the emergence of events at the level of the Actual and experiences and observations of these events at the level of the Empirical.

The education system, as a social structure, could be said to be one of the mechanisms, among others, in the domain of structure. In the Archerian (1996) framework, mechanisms are inactive until agents exercise their own powers to draw on them to engage in a project that will allow for the attainment of goals. Students in higher education would, for example, be expected to draw on discourses about what constitutes knowledge and appropriate ways of learning as well as structures such as the location of their home and the social class of their family to generate events that would lead to the attainment of their goal, namely a qualification. Students from working class rural backgrounds could thus be expected to draw on very different mechanisms than students from middle class, educated, urban homes.

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[6] From a realist perspective, agents are actors (people) in the domain of human actions and interactions who are separate from but connected to other domains of people's social world (Archer 1995; Ashwin, 2009). For Archer (1995), these other domains include structure and culture. Structure (parts) is the domain of social positions, roles and rules defined by a social organisation of society that is skewed in favour of the wealthy while culture (parts) is the domain of ideas, knowledge, attitudes, beliefs, myths, and norms. The crux of Archer's thesis is the constant interplay between the 'people' and the 'parts', which is relevant in this article.

The theoretical lens of critical realism and social realism thus has the potential to allow for a more sophisticated understanding of the need for welcoming prior experience in the university classroom.

Strategies to investigate the phenomenon

The primary source of data in this article was focus group interviews conducted with a sample of 12 purposefully selected second-year science students. These students were enrolled for the BSc (Bachelor of Science) which is the usual first degree in the faculty and requires a minimum of three years of study after school. At second year level students are required to have chosen their major subjects and students in this study had, for example, Mathematics, Ichthyology, Geology, Physics, Cell Biology, Environmental Science, and Chemistry as their major subjects. It was interesting to see the connections that students made between their major subjects and their rural home experiences, a more detailed explanation is provided in the findings section regarding these experiences.

Because I, as a researcher, sought to explore and promote scientific concepts and methods encountered from students' local environments and use them as a starting point in the teaching of formal science in higher education, focus group interviewing was used to organise and source data. I realise that 12 second year students constitute a small sample of the phenomena under investigation and so, findings cannot be generalised, and that one focus group was used. It is the theoretical framing of this article, and its aim is to understand the phenomena under microscope.

In a focus group, research participants must share certain characteristics relevant to the focus of the study; the participants in this study have lived and learned in rural areas (Marshall & Rossman, 2006). Since focus groups generally consist of only seven to twelve participants (Marshall & Rossman, 2006), optimal communication among participants is facilitated, which increases the potential for useful data to be generated. This method of gathering data allowed for students' voices and their understandings of their own experiences to emerge as they shared these in groups. Focus group interviews were therefore a useful qualitative approach to uncover students' experiences and the ideas and beliefs that are formed in contexts such as rural home learning (Townsend & Weiner, 2011). The focus group interviews were thus designed to elicit responses that would indicate the ways in which students' home practices were congruent or not with practices valued in the construction of scientific knowledge.

Three sets of questions formed part of the focus group interviews:

- How can you describe your rural learning world by referring to the place(s) that influenced your learning?
- What connections, if any, can you make between your learning at university and your learning in rural areas?
- What is a critical incident from home that you think has been influential for you?

It was important to understand what the participants' interpretations of their experiences meant as this data only represented their experiences of learning from home and at university. Obviously, multiple truths or realities were presented by the participants and so, data was

descriptive. To arrive at an understanding of what these multiple truths from the data mean, the work of rigorous research has to move beyond simply presenting various viewpoints and everyday descriptions to powerful and nuanced but also well theorised accounts. As such, a theory was needed that would allow for an understanding of a reality beyond the immediate experiences or observations of the participants, a theory that would allow for an understanding of the emergence of events (what students did and why) and experiences, hence the relevance of Bhaskar's critical realism and Archer's social realism frameworks. Regarding the truth claims that I am making, for example, I could not say, most of my participants said XYZ and so XYZ must be true. Critical realist theory allows a move from participants' relativist data to my realist claims (Hoddy, 2019).

Findings

In this section, I present the overall findings of the study. The students' responses to the focus group interview questions indicate that they are unable to draw on discourses about what constitutes knowledge related to their home-based literacy practices. Furthermore, the inability mentioned above could be understood as a form of distributive injustice located in the domain of structure in terms of the science curriculum because while broadening access in higher education has meant that higher education institutions no longer deal with a socio-culturally homogenous student body but with students from different educational backgrounds, languages and cultures, the academic practices that are valued in higher education institutions still *misrecognise* rural students' cultures and identities. The findings expressed above are captured in participants' responses below, where NM represents me, the researcher.

> NM: Could you provide me with some background in terms of your learning experiences at university and learning experiences at home?
> There is similarity between indigenous knowledge like our grandparents knowing how to diagnose cows when they are sick from grazing. We went to a dam, we went there, they know back home how to detect climate changes that are affecting water where you were not sure when you were growing up, you were not sure whether it's true or not but when you experience it [at university] you are like oh, actually I've heard about this (focus group interviews).

Based on the above excerpt, it could be argued that two events emerged from the Empirical layer of reality (Figure 1). Firstly, participants' grandparents knew how to diagnose cows when they were sick from grazing. The implication is that grandparents used observations for such diagnosis. They looked at the behaviour of a cow and could tell that something was wrong with the cow. They might not have made an accurate or a precise diagnosis, but they could tell from *observing* that the cow was not well. Secondly, 'back home', or people in rural communities 'know how to detect climate changes'. Again, this implies observing a natural phenomenon. When the method of observation was presented in the classroom and/or in the field, students

realised that they knew this from home but when it was presented, it seemed that it was not contextualised to their lived rural home experiences. It is thus possible to see a lack of participation of these students in the construction of knowledge in relation to science as they have internal conversations about these experiences, and they realise that such experiences are misrecognised. The experience of observing sick cows or climate changes could be said to have emerged from the Real layer of reality (Figure 1), that is, the geographical location in rural areas.

Another event that could be said to have been experienced from the rural geographical location was captured in the following response:

> It just upgrades the existing knowledge but to add on that there was this other time Natural Assessment. We had to assess the soil (…) but I was familiar with that thing because before at home you know when it's planting season, before we plant, we crop rotating (…) assess the soil if it is good to plant spinach (…) actually our professor he was impressed like he loved it (focus group interviews).

The participant mentioned that before planting could take place, soil assessment was done. Again, observations took place. While it is *careful observations* that inform scientific procedures, observations do take place in students' rural environments. The fact that the professor approved of what the student did, that is, assessing the soil first before planting, could suggest that the student used knowledge from home to execute a science experiment, but the professor did not in the first instance use the knowledge that students already possessed as a starting point in his teaching. From the response by the participant, it could be said that the professor's design and thus enactment of the curriculum did not consider the students' prior learning experiences, including those from rural areas. Again, it could be argued that the participants' prior experiences were *misrecognised*, which could be regarded as a form of social injustice.

Curriculum is understood as a structure that regulates access to material resources (Boughey & McKenna, 2021) involving, but not limited to access to, knowing and knowledge. From the findings above, curriculum design and thus enactment could be seen as constraining the development of students' agency, as shown below:

> Sometimes before the professor planted, I felt like it [indigenous knowledge] wasn't acknowledged, I felt they would say … you see how science flows with experience, they want facts, they want to prove if you say this happened doing this and this, they will say prove it, that's science. If I say my father does this (…) they say how so it's not acknowledged even though the procedures are similar (focus group interviews).

Evidently, these findings show the potential of the curriculum to favour certain worldviews and ways of being and knowing above others and as a result does not treat all those involved fairly (Boughey & McKenna, 2021). Subordinated students may feel ignored by the curriculum and the teaching and learning processes that it encompasses, a clear indication of misrecognition.

This situation has the potential to adversely affect participation of these students in science classrooms or in the field as what they bring with them is likely to be misrecognised and/or misrepresented.

Given the unlikelihood of participation in the classroom and based on the study findings, the implication is the misrecognition and misrepresentation of students' voices and their participation in the science curriculum events. While it is correct to argue that scientists concentrate on obtaining accurate data to validate scientific claims, it is also correct that the evidence that is obtained based on accurate data is obtained through observations and measurements (procedures). The participant pointed out that due to a lack of evidence, she could not relate what she had learned from her father, who was 'uneducated', to the process of growing plants in which the students were involved with the professor. However, the participant became aware of the similarities in procedures of selecting the right soil, whereby the method of observation was used. The implication here is that the participant felt out of place or *misrepresented* in the abovementioned experiment and perhaps in academia more broadly (Fletcher, 2017). This is an example of events in the domain of culture that students perceive as demonstrating their marginalisation associated with the continuing elitist and exclusive nature of the institutions in which they have enrolled to study. Again, the structure of the curriculum could be regarded as constraining students' agency, as reflected below:

> Before student could count [s/he] is able to memorise cow by their colours and the position and types of horns. Learned how to recognise the herd in this way. Learning how to count as a child has duties, like taking cows to graze and fetching the cows by that time you don't even know how to count, but you know that all cows are there when you look at them. You memorise them with their colours, you also memorise the position or type of horns they have so you recognise the cows according to their horns, their colours and you never go wrong. You know when you look at a whole lot of them if one cow is short and which cow according to the horns is not there even though you don't know how to count (focus group interviews)

From the excerpt above emerged an example of an important aspect of scientific procedures, that is, careful observation. The participant was able to recognise when one cow was missing by just looking at them. This was possible by observing certain features that the cows possessed. The point here is not to suggest that science is simplistic in that it could just be associated with observing the colours of the cows or their horns. However, observing the colours of the cows or their horns at the rural geographical location of the participants could be a useful skill in science lecture halls or out in the field when the professor is teaching about the method of careful observation. If the professor had known about this experience, it would have been possible to use it as a starting point in teaching about observations in science. This illustrates the importance of knowing who the students are whom we teach and what their background is before we even begin our lectures.

The pertinent argument from the above analysis is that there is a need to effect change at the level of curriculum structure and enactment that will incorporate experiences and identities other than the dominant perspective of scientific procedures taking place in controlled environments. I mean that we need a structure that could reflect the experiences of all students, including those who come from rural areas; their worldviews might shift the way in which they view science. In this way, the learning of scientific concepts and ways of knowing in science could be contextualised so that it encompasses students' prior learning or home environments, provided that we come to understand how to use those experiences to provide them with access to the ways of knowing and being in science (Madondo, 2018). A curriculum structure that is not reflective of all students' experiences could have the potential to misrecognise and misrepresent a variety of students' experiences within science lecture halls or out in the field. As this research has shown, there is a need to acknowledge knowledge and learning that is not necessarily mainstream in higher education (Mgqwashu, 2019a) so that all students could see that what they already know is also valued in higher education. This understanding calls for a change in the curriculum and in pedagogic practices in higher education (Boughey & Mckenna, 2021). The need to effect change in the curriculum and in pedagogies was also indicated by the following:

> Rural/indigenous knowledge is not taken into account. Instead, students need to adapt (you) have to change, and the curriculum just stays the same (focus group interviews).

The findings presented above are echoed by Leibowitz (2017) when she argues that there has been no substantial change in higher education content although the demographics of the student body have changed drastically over recent years. Looking at the findings, it is possible to identify misrepresentation in the domain of structure, that is, the science curriculum. Although there has been a significant increase in the number of first-generation black students at the research site, it seems that the content delivery has remained largely unchanged to cater for the experiences of these students. Thus, it was important to discover specific incidences or experiences with scientific underpinnings from the participants' lived rural home experiences to effect change at the curricula level. Including these incidences into the curriculum can accommodate other worldviews in the teaching and learning of science to address the issues of social injustice, epistemicide, marginalisation, and the misrecognition of non-western ontologies, world views and epistemologies (Heleta, 2016; Le Grange, 2016; Torres, 2011). The aspect of specific incidence that participants experience, which has scientific underpinnings is captured in participants' responses below:

> NM: Could you identify any specific incident or practice that took place at home that you can relate to your learning at university?
> Learning geography in the community (…) When like learning ploughing and plant garden on and which soil carries too much water and which soil is not good for planting because

> maybe the seed will get washed away (…) and when you really come to university even though they don't talk about ploughing but you get to learn about the different types of soil and then you put a name to that soil (…) (focus group interviews).

From the findings above, it is possible to observe that academic teachers are most likely drawing on discourses that produce fewer positive events and experiences and thus are arguably less effective in contributing to change (Boughey & McKenna, 2017). In other words, in the domain of culture, it seems that the dominant discourses that construct learning and teaching in the discipline of science are playing a big role. These discourses construct learning and teaching as asocial, apolitical, ahistorical, and acultural. These discourses are thus likely to constrain academic teachers in drawing on learning experiences taking place in the rural home environments of their students and then contextualising these to learning taking place in science lecture halls or out in the field. If academic teachers perceive the university as a 'neutral' space, the likelihood is that we would not normally draw on students' lived rural home experiences in our teaching contexts and students would most likely associate with the opinion expressed by the participant below:

> For me I could say what I learned in the community I could not take seriously (…) Even if they are similar forms of knowledge but we don't pay attention like maybe let's say in order (for) you (to) say now it's going to rain, never took them seriously (…) Why? I think I was undermining the information that we are getting from rural area (focus group interviews).

From this quote/extract, it is possible to observe the politics of knowledge generation (Ndlovu-Gatsheni, 2013) emanating from an understanding of valid knowledge that could be scholarly relevant. The participant did not believe that the knowledge gained from home was relevant in any way and thus experienced misframing between what was learned at home and at university. This demonstrates that students undervalue home-taught ways as they seem not to contribute to knowledge construction in academia. These students are thus structurally conditioned not to draw on their home location and rural area. Their home location could thus be seen as a structural constraint because the university structures and cultures are seemingly not congruent with the students' home practices, which might nevertheless have scientific underpinnings. Based on the findings above, it could be argued that students from rural areas are likely to consistently experience an academic cultural system and a curriculum that tend to devalue and negate their cultures, histories, and identities, thus positioning them as culturally deficient (Luckett, 2016).

Discussion

From the above analysis of the data, it is clear how in the domains of structure and culture, the political and cultural dimensions of Fraser's (2000, 2003, 2008) framework were crucial to

explore how not just the field of science but the HE system itself could be framed as socially unjust. Misframing could be seen as a form of social injustice in that participants' rural geographical location, informed by the legacy of apartheid, could not really be regarded as a viable resource/structure to draw on, which negated local knowledge that might nevertheless be relevant in science classrooms. The notion of misframing could thus be said to be a useful analytical tool for the South African landscape in that the rural geographical location of these students is misframed in social justice claims in higher eductation because literacies learned from home are not viewed as relevant for higher education, including science. Based on this line of thought, I argue that without identifying the ways in which rural area practices tend to be constructed in especially negative ways (Mgqwashu, 2019a; Mgqwashu, et al., 2020) and how this construct could act as an educational disadvantage for students from these areas, the problem or the difficulty that the study participants identified is likely to remain unchecked. If checked and understood, the knowledge resources gained from the rural geographical location of the participants could be crucial to access and participate in the construction of knowledge in science. In relation to this point, Mathebula (2019) argues that university spaces can provide opportunities for epistemic contributions for rural youth by enabling this youth to draw on valuable capitals that they can mobilise for gaining university knowledge. When these subordinated students fail, the dominant discourse is likely to be that the problem lies with the student without realising that black students and students from rural areas in particular are enrolled in an academic cultural system that privileges particular ways of being, such as middle class, English speaking, often white, and Western (Bernstein, 1999; Bourdieu, 2002; Gee, 1990). This is patently unjust.

Clearly, students from rural areas have been conditioned not to value locally originated knowledge. In this article, the argument has been made that there is a need for academic teachers to open to different ways of constructing knowledge in science and be adept in finding pedagogic ways to draw on this form of lived experiences to be shared in collective and learning spaces. Realising that university education is not 'neutral' could affect the science curriculum structure and enactment in a way that will be reflective of different worldviews regarding concepts in science classrooms. This has the potential to change how academic teachers in the field of science structure the curriculum content to accommodate different worldviews, including those of students from rural areas. An example to this effect was provided by a participant when she mentioned that 'even the professor was impressed with her when she assessed the soil before planting'. There is thus a potential for the emergence of positive educational events in the form of improved outcomes.

Conclusion

This article began by offering a brief overview of how Fraser's (2000; 2003; 2008) concepts of misrecognition and misframing can be used to understand how certain worldviews are recognised and represented while others are not in the construction of knowledge in higher education. Misrecognition and misframing may affect how differently positioned groups are able

or not to interact and participate on equal footing in higher education, especially in the construction of scientific knowledge.

The second section focused on a discussion of the theoretical framework that informs the central argument in this article. It asserts that Archer's (1995, 1996, 1998, 2000) social realism and Bhaskar's (1978, 1979, 2008) critical realism theories have the potential to allow us to draw on the ways of knowing and the knowledge resources that students bring with them into our universities to validate them as individuals as well as to contribute to their success. The article argued that structures such as curricula have the potential to misrecognise and misframe who the students are and what they represent in our classrooms because the literacy practices that they bring with them from their rural homes are not always acknowledged or recognised. The article showed that the use of explanatory theories that would allow us to realise that learning in higher education is in fact social, cultural, political, and historical (Gee, 2008; Street, 1984) is necessary. The importance of this understanding is that in the context of science, the social aspects of learning and teaching are usually ignored in favour of understandings of a reality that is objective and independent of human thought and action. It is here where Archer's social realism and Bhaskar's critical realism theories are useful because they account for the relativism of human experience and the realism of an absolute world.

The third section described the research method used to generate data appropriate to the focus of this article, namely, to investigate what learning from their rural home environments students bring to higher education.

The article concluded by presenting an analysis of the research findings. The findings revealed the extent to which the participants regard some aspects of science curriculum as not acknowledging the knowledge resources that they bring with them from home. The findings also showed that when scientific methods such as observations are engaged in the science classroom or in the field, the students can identify these from their home experiences but because when these methods are taught, they are not contextualised in relation to the students' worldviews, they seem foreign and thus adversely affect participation in the construction of knowledge. These findings have important implications for social justice whereby all students can regard themselves, their worldviews and their home-based experiences and practices as a valued part of the curriculum and as relevant to draw from in teaching and learning in science, and in universities more broadly.

Author Biography

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