

(Re)imagining spatialities for equity in mathematics education

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Contemporary discourse about the ‘opening’/‘closing’ of schools and what is ‘inside’/‘outside’ the curriculum potentially exacerbates existing inequities in mathematics education. This paper explores how different spatial imaginaries might advance or hinder efforts to deeply and systematically pursue equity. We use critical postcolonial thought for our (re)imaginings in the South African context. We argue that viewing the school, the mathematics curriculum, and language as noded, bounded, spatial objects highlights what needs attention and for whom, but also points to the indelible, structural nature of exclusion. We propose a notion of spatiality as experienced encountering. This recognises all people and their practices as strategic agents, and emphasises relations between people, but also between the mind, body and Earth.

Introduction

Changes to our ways of being, necessitated by a worldwide health pandemic, has drawn attention to notions of space and mobility. Education discourse has focused on the ‘opening’/‘closing’ of schools, and what should be ‘inside’/‘outside’ the mathematics curriculum. Increasingly, educational inequities, notably, who can be said to be ‘inside’ or ‘outside’ of mathematics, are recognised. These inequities are not new, but are revealed in the process of troubling the rhetorical devices at play in discourses on education in relation to the pandemic, some of which serve to exacerbate the effects of exclusion. Thus, there is an urgent need to bring to this contemporary discourse, critical scholarship on access, power and equity, but also for the research community itself to think critically about assumptions and practices made in the name of inclusion.

This conceptual paper focuses on our thinking and language use about physical and conceptual spatialities, guided by two questions: What entry points exist for (re)imagining spatialities in mathematics education? How do these spatialities advance or hinder our efforts to deeply and systemically pursue equity? To respond, we focus on spatialities of mathematics curriculum, language in mathematics, and the school itself. Indeed, we embark on an ambitious project, noting that each aspect is deserving of deep interrogation in further writing. This paper thus acts as an early agenda, not for an action plan, but for spatialities of possibility in pursuit of what matters most in mathematics education, as we write from the

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purported 'postcolonial' context of South Africa. The concerns raised are both personal and political for us, as scholars writing from the experientialities and imaginaries of this context. However, in stating this as a reflexive positioning of our collaborations, we acknowledge our privileged positions, spatially, differentially, and corporeally relative to the postcolonial and the risk of reifying the very spatialities we seek to trouble.

To provoke our (re)imaginings of mathematics education, we embrace metaphors of land, cities and language. We deploy postcolonial thought from within critical theories of decoloniality, (eco)feminism, social-ecology, critical space theory, and related. Certainly, experiences of the colonial project and its ongoing remaking in successive global design projects, such as development, modernisation, and globalising capitalism, are diverse within and across postcolonial contexts (Mignolo, 2007, 2010). Yet, there are some commonalities in how these projects are operationalised and experienced in situated contexts that scholars thinking from these contexts are forced to confront (Bhan, 2019; Mignolo, 2007). Critical postcolonial thought is productive for our interest in spatialities. Firstly, thinking about physical and conceptual spatialities is central to the social construction of difference between people, and between people and the Earth, as a colonial strategy across global contexts. Secondly, while an 'outside' to the colonial project is not possible, this critical thought may offer us a glimpse from a temporary 'outside', in order to prize open, even if momentarily, alternative entry points to reimagining spatiality in our pursuit of equity in mathematics education. Thirdly, critical postcolonial thought brings into view ways of knowing, acting and being that have been marginalised in successive global imaginaries.

The objectification of space in global design projects

Postcolonial thought identifies the centrality in global design projects of imagining spatiality as an object contained within a boundary line, and solidified in nouning language. In order to frame an 'inside', that is the physical and conceptual 'territory' of empire, coloniality has needed 'exteriority' (Mignolo in Delgado et al., 2000; Mignolo, 2010). It has needed to invent an 'outside', which requires that the 'outside' and the 'other', "be brought into the frame" (Mignolo, 2010, p. 122), while also identifying the margins of that frame. In this sense, coloniality is "concerned" with the 'other', "even when not concerned" with the 'other' (Dlamini, 2020, p. 61). The latter has been achieved through an epistemology of universality, which masks the 'outside' and the naturalised power relations controlling the boundary line of difference.

Writing about the creation of the object, 'national park', in South Africa, Dlamini (2020) shows how the boundary line, physical (a fence) or conceptual (a land law), gives spatial form and content to this accepted 'reality'. These lines are fictions, yet they fix what and whom we expect to be in that space and what can happen there. Since a bounded object is contingent on an 'outside', defining content and participants requires non-content and non-participants, thus creating alterities and (re)enforcing hierarchies. This objectification privileges "roots" (Dlamini, 2020, p. 108); it "freezes" (p. 59) people spatially, thus fixing identities, commonly in racialised terms, in and across spaces (Dlamini, 2020; Green, 2020). It also interrupts and dispenses with historical flows – the "routes" (p. 108) – of people and

animals across space (Dlamini, 2020), demonising those that transgress these invented rules of the current global imaginary and constructing movement and boundary crossing as a ‘risk’ that needs to be managed and policed, physically or digitally (Mbembe, 2020). The securitisation of these risks is part of this invention and of the sense-making process of the ‘real’. Since colonial difference masks the ‘outside’ and the ‘other’ (Mignolo, 2007), the bounded object potentially draws our attention to what is contained ‘inside’, not the ‘outside’.

Imagining a bounded object also signals a ‘start’/‘end’ in temporal space, with successive land laws in colonial and apartheid projects in South Africa ignoring and thus erasing previous histories, the “peopled past” (Dlamini, 2020, p.26). Language, particularly English as lingua franca, as the “companion of global designs” (Mignolo in Delgado et al., 2000, p. 12), is another device for establishing a temporal “hubris of zero point” (Mignolo, 2007, p. 159). In the past, this was achieved with the spatial operations of pen and paper in colonial bureaucratic audits by which ‘life’ began under colonisation and changed the place, experience, and future of the colonised (Ashcroft, 2014). It also was achieved in the codification of indigenous languages as objects; by converting interactive languaging practices “inscribed in your body into something that is ‘outside’ yourself on which you become dependent”, this process changed people and the power relations between them (Mignolo in Delgado et al., 2000, p. 17).

In summary, imagining spatiality as a nouned, bounded object creates a fixed, naturalised ‘reality’ with clearly delineated content and participants to which our attention is drawn. Simultaneously, the necessary non-content and non-participants are frozen and hidden. This is a hierarchical structure in which power is invested through control of the line. Access in these terms then means crossing a policed line. Thus, it is a process and structure that manifests and maintains inequity.

Indeed, education, and ‘Euromodern’ mathematics and its use in scientific processes of objectifying human and non-human resources were key conceptual and institutional technologies for controlling and framing colonial ‘territory’ (Bishop, 1990; Green, 2020). We could argue that the ‘real’ of mathematics education and the contexts it locates to actualise its practices were operationalised through the reification of these imagined realities in the image of accepted global design projects. Indeed, this spatial imaginary is ubiquitous in mathematics (education) discourses, including in contemporary, instrumental debates about schools and mathematics curricula described in the introduction. For example, accepted mathematical practices include classification and objectification, and the formatting of its applications (Skovsmose, 1994) in maps and algorithms. Critiques of ‘Verdinglichung’ and its connections to the reification of mathematical objects and their nominalisation have been made to mathematics education, and associated with a way of forgetting (Swanson, 2017). This view invigorates binaries that frame mathematics education discourses, such as mind/body, everyday/mathematical, and Western/indigenous mathematics, and in prevailing triads such as mathematical concept/student/technology (Sinclair, 2021) or indeed amongst the oldest: mathematics/cognition/the child.

Objectified ‘realities’ in mathematics education

We now explore what the rhetoric of spatiality as bounded object might offer our thinking about equity in relation to school mathematics ‘curriculum’, ‘language’ for mathematics and the ‘school’ in South Africa¹. First, we note that a description of context, of any length, cannot capture its complexity (Christie, 2020). How to represent socio-political context as an actor in mathematics education without essentialising is a recognised quandary (e.g., Valero, 2007). In addition, our description is limited to physical and conceptual realities that are shaped by their boundedness. Recognising the risks involved, we follow Valero (2007) by recruiting “existing literature and policy documents” (p. 227) for our contextual description. We stress that the product serves the purpose of advancing our thinking about spatial imaginaries for equity.

South Africa has a complex, 400-year history of colonial rule and its subsequent design projects. The spatialised relations established during this time became entrenched in the apartheid project that began in 1948 (Christie, 2020) with physical and legal boundaries marking lines of control. People and their identities became fixed, and racial linguistic classifications of ‘white’, ‘black African’, ‘coloured’, or ‘Asian/Indian’ came into form within bounded geographical spaces. Colonial era laws to control movement of ‘black African’ people took material form through the ‘pass book’ (Savage, 1986).

During this time, a hierarchy of bounded, segregated schools, mathematics curricula, and languages were developed. The state prioritised resources for the ‘inside’ of schools for participants classified as ‘white’ who spoke English or Afrikaans. Mathematics was important content for students being prepared separately for academic and skilled labour (Khuzwayo, 2005). Schools with ‘black African’ participants were tasked with producing unskilled labour, and thus mathematics was backgrounded and trivialised. Bounded African languages were to be used in primary school, with a switch to 50/50 English/Afrikaans in high school. In all schools, mathematics was tightly bounded. In fact, it was differentially presented as abstract/concrete based on the racial classification of the participant (Swanson, 1998).

This objectification of space historicising inequity provided an important focus for change in the transition to democracy, with legal changes intended to dissolve hierarchies and to weaken boundary lines. The Constitution recognises the ‘other’ in the form of equal rights to dignity, health, safety, water, sanitation, and basic education, and equal status for 11 languages, including nine African languages. Policy declared schools open to ‘all races’, paving the way for legal shifts and multilingualism. Funding policies used the geographic location of historically ‘outside’ schools to shape decisions around directing financial resources for basic infrastructure and fee waivers. In the development of one mathematics curriculum ‘for all’, People’s Maths and ethnomathematics were brought to the table as recognition of the ‘other’ as a mathematics participant (e.g., Bopape, 1998).

¹ We focus on state schooling, constituting approximately about 94% of South African schools (Statistics South Africa, 2020). The private school system, which has its own hierarchy, is itself implicated in the constitution of inequity in this context.

Yet, almost thirty years into democracy, a hierarchy of bounded schools, mathematics curricula and languages is being reproduced, with existing boundary lines only slightly redrawn. Shifting the boundaries of imaginaries does not shift the location of schools geographically, nor the material base on which the content needs to be “developed” (Christie, 2020, p. 8). The participant/non-participant binary is no longer a simple race-based ‘white’/‘other’, but a related, complex mix of racial, socio-economic, class and linguistic, geographical difference, well-described in the binary “fortified”/“exposed” schools (Christie, 2020, citing Teese & Polese, 2003). While these objectified descriptions reify people and schools and do not recognise difference and how people navigate multiple spaces, they highlight potential spaces for necessary equity work. Crucially, since four-fifths of all schools are exposed schools, most students attend schools that cannot “catch up” to fortified schools (Christie, 2020, p. 8).

Policy change has removed racialised school boundaries, yet movement between schools has been one-directional, and only for some, into historically ‘white’, English-medium schools in legacy ‘white’ and wealthy suburbs (Soudien, 2004). Political compromises have allowed these schools to control their boundaries. Firstly, they can raise extra school fees to fortify these spaces with more mathematics teachers and commensurate smaller classes. Thus, these schools are closed to those who cannot afford the fees and/or the commute. The historically ‘outside’ schools cannot ‘fortify’ themselves in the same way, and 80% of participants rely on daily school feeding (Christie, 2020). Given the historical inequity, state funding directed at these spaces has not been sufficient; in 2018, 30% of schools had no running water and 20% inadequate sanitation (Christie, 2020). Also, fortified schools are closed to those who do not speak ‘standard’ English with a particular accent, adopt a certain demeanor and appearance, and play certain sports (Hunter, 2019). Students highlight how their bodies – their hairstyles, speech volume, and ‘African’ language use – are policed using pass book mentalities (“Sans Souci Girls’ High School pupils protest”, 2016).

1990’s reform produced a Grade 1 to 9 mathematics curriculum ‘for all’, with a choice of “Mathematics” or “Mathematical Literacy” for Grades 10 to 12. Focusing on content such as “number” and “algebra” for “critical thinking”, “problem solving”, and “decision-making” (Department of Basic Education [DBE], 2011a, p. 8), the curricula show similarities to other contexts. Mathematics is defined as a “human activity”, yet mathematical practices attributed to the ‘other’ are hidden in descriptions of “real life” contexts (p. 8). “Mathematics” and “Mathematical Literacy” participants will contribute as “citizen[s]” and “worker[s]”, yet only the former can access university science, with the latter being “self-managing” (DBE, 2011b, p. 8).

Yet, most students are ‘outside’ the school mathematics curriculum. Policy prescribes a switch from mother tongue instruction in Grade 3 to English for mathematics instruction in Grade 4. Students at exposed schools are most likely to be those learning mathematics in a language they are still learning. School Mathematics may not be offered in Grades 10 to 12 at these schools. Of those who start school, approximately 12% will meet the 30% pass mark

of either Mathematical Literacy or Mathematics in Grade 12, with 3% of (mostly fortified) schools producing more Mathematics distinctions than the rest (Spaull, 2019). Data on what “work” (DBE, 2011a, p. 8), if anything, is open to mathematics non-participants *and* participants, suggests few opportunities for educational mobility. Almost half of South African youth are unemployed and are likely to remain so in their lifetime, and for those who have work, it is increasingly likely to be informal and precarious (Spaull, 2015).

The vast differences between fortified and exposed schools reflect how COVID-19 can only exacerbate inequity in South Africa. The ongoing effects of the pandemic require revisiting what is ‘inside’ the mathematics curriculum, with debates currently dominated by catch-up plans, predicting learning loss, and counting non-participation or dropout rates (e.g., Macupe, 2021; Pournara & Bowie, 2020). Yet, possibilities for virtual or safe physical boundary-crossing to schools and the mathematics curriculum are inequitable, whether resourced through the home or school. Crucially, the physical closure of schools, either completely or on a rotational basis to ensure safety, denies nine-million children access to daily school feeding.

This brief narrative reveals the ways in which historical, physical and conceptual spatialities of nounced, bounded objects have and continue to lay out maps of reality and of pre-determined futures for various peoples differentiated through their proximity or distance to colonial spheres of discourse and practice. In our pursuit of equity, this highlights, in this spatiality, what needs attention towards realizing even basic rights and for whom. Crucially, thinking in terms of critical spatial relations highlights the deep and indelibly structural nature of exclusion in this context and the challenge of overcoming the oppressions that this reality animates. Challenging the inequity entrenched within related colonial, global design and apartheid spatialities requires more than legally opening boundaries or providing more resources for some to ‘catch up’. Rather, this pursuit requires a different spatial imaginary all together.

(Re)imagining spatialities as experienced encountering

In a counter move to the nounced, objectified spatialities of school, mathematics curriculum, suburban places, and non-participant ‘others’ of mathematics, we propose a process notion of spatiality, using the verbing language of *experienced encountering*. Imagining experienced encountering, especially in relation to mathematics education is a challenge, given how spatiality as a nounced, bounded object has been naturalised in this field. We use postcolonial thought as a guide as to where to forage for our agenda of (re)imagining. Since global design projects have subordinated the content and participants of an ‘outside’, we need to think *from* the ‘outside’ (Mignolo, 2007) as ethical allies with sub-alternated *peoples*, their *ways of moving* in the world, their *practices*, as well as their strategic *agency*. We need to act *relationally*: with people, and with the mind, body, spirit and Earth. We need to recognise *embodied (inter)acting, moving, journeying, changing, transienting, transgressing, differencing*, and *(em)powering*, not as risks to be removed, but as parts of an immediate life-world of the majority (Bhan, 2019; Mbembe, 2020).

We stress that our thinking does not involve a re-imagining of a romanticised, pre-colonial way of acting, moving and the relations defined by it. For the global imaginaries constituting our common world are characterised by “relations of authority, exclusion and inclusion, hegemony, partnership, sponsorship, appropriation between intellectuals, institutions in the metropole and those in the world periphery” (Connell, 2007, pp. viii–ix). Rather, it involves recognising *all* as participants, and as “infected” (Mignolo in Delgado et al., 2000, p. 11) by these projects, albeit differentially. This includes historically sub-alternated peoples and their motivated (*inter*)action. It also involves critique of the power relations invested in these interactions and their effects, such as the forced movements of people as a result of global/local conflict and climate change.

Experienced encountering in mathematics education

We now explore what the rhetoric of spatiality as experienced encountering might offer our pursuit of equity in mathematics education. We use verbing language: mathematics ‘currere’, ‘linguaging’ and ‘schooling’ to provoke our imaginings. Our use of ‘currere’ draws on the work of Pinar (2011) in curriculum studies and its use in mathematics education (e.g., Wolfmeyer et al., 2017). Whereas ‘curriculum’ as noun generally identifies content to be learned, the verb ‘currere’, from the Latin word ‘to run’ a course, to journey, evokes learning as experiencing or living. In relational terms, students and mathematics-ing in schooling act as participating in the world.

We propose that mathematics currering in schooling involves experienced meaning-making for a student’s (inter)actions in the world, where the social, cultural, political, and physical (both natural and human-made ecologies) co-exist. This notion includes the bounded spaces of buildings (school or home) that might provide the necessary security for students to live safely and with dignity. For us, experienced encountering involves safely moving in a world that is increasingly precarious. For some this might require practising schooling and mathematics-ing amidst the climate change related risks of water shortages, flooding, fires, and health crises (Gibson, 2020).

Encounterings in this world require expanding *who* is involved in mathematics currering: students, peers, scholars and educators in mathematics and other disciplines, caregivers, community groups, civil society organisations, the state, and health professionals. We find isiXhosa linguaging useful for imagining these peopled (inter)actions. The two verbs ‘ukufunda’ (to read, learn or study) and ‘ukufundisa’ (to teach) (Kirsch & Skorge, 2010) recognise that all people bring to and learn in the encounterings in particular ways of knowing, acting, being, and linguaging.

We argue that meaning-making in these encounterings involves an assemblage of practices. This includes critical mathematics education practices for understanding how mathematics acts in the world (Skovsmose, 1994), as well as critical information literacy for understanding how mathematical practices may enact an equitable world. Crucially, it involves the related sociological, ethical and political literacies for acting with *all* people in the world, and recognising difference, not so much as multiplicity, but as transienting as

characterising meaning-making. Meaning-making involves transdisciplinarity in which mathematics does not act to neutralise the political or render utilitarian the objects it recontextualises (Swanson, 2005). Lastly, meaning-making and (inter)actions involve languaging practices. We propose notions of languaging from postcolonial thought that strive to reinvent ways of using language that are the norm in multilingual contexts (e.g., Makoni & Pennycook, 2007). This heteroglossia reflects linguistic practices commonly referred to as ‘translanguaging’ in school mathematics in South Africa (e.g., Tyler, 2008). Here, languaging practices reflect people’s flexible and agentic use of semiotic resources and meaning-making and (inter)acting as they move spatially. Such resources include registers, genres, and modes (written words, verbal talk, symbols, images, bodily movement and gesture, and touch). They include various language codes and accents, with languages not viewed as fixed, but as (inter)changing in (inter)acting, including transgressing practices.

Conclusions

We have presented the first steps of our journey to explore rhetorical devices for (re)imagining spatialities for equity in mathematics education. We acknowledge the limitations that (in)dwelling, in one context, on the metaphor of spatialities and the accepted ‘realities’ of mathematics education render. Yet, the two entry points we have explored, provoked by our reading of and (in)dwelling on critical postcolonial thought, suggests that such reflexive practice – self-reflexive and between epistemic positions – may be productive. Spatiality as a nouned, bounded object highlights pressure points in South African schools and mathematics curriculum for working towards realising even basic rights ‘for all’. Yet, in highlighting how this imaginary, by mapping realities of difference, (re)produces inequity, we identify the need for a new spatial imaginary.

We propose, thus, spatialities of experienced encountering that recognise all people and their practices as strategic agents, and in the process make visible the importance of relations between people, but also between the mind, body and Earth. This renders embodied (inter)acting, journeying, changing, transgressing, as actions, not as risks to be controlled, but as ways of being-in-the-world for the majority. This (re)imagining requires further elaboration in an interactive process of in-depth engagement with critical postcolonial thought in relation to specific cases in South Africa. For the latter, we plan to begin by exploring experienced encounterings of schooling, mathematics-ing, and languaging amidst the climate change related risks of water shortages, flooding, fires, and health crises [as exemplified in the UKRI GCRF Water and Fire project (2019), on which one author is leading]. From this starting point, and following Bhan (2019), we aim to collaborate “incrementally from multiple locations” (p. 641) to explore how spatial (re)imaginings may emerge across contexts of precarity.

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