Peer review history for:

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Reviewer B: Round 1
Date completed: 02 April 2024
Recommendation: Accept / **Revisions required** / Resubmit for review / Decline
Conflicts of interest: None

Does the manuscript fall within the scope of SAJS?
Yes/No
Is the manuscript written in a style suitable for a non-specialist and is it of wider interest than to specialists alone?
Yes/No
Does the manuscript contain sufficient novel and significant information to justify publication?
Yes/**No**
Do the Title and Abstract clearly and accurately reflect the content of the manuscript?
Yes/**No**
Is the research problem significant and concisely stated?
Yes/**No**
Are the methods described comprehensively?
Yes/**No**
Is the statistical treatment appropriate?
Yes/No/**Not applicable**/Not qualified to judge
Are the interpretations and conclusions justified by the research results?
Yes/**Partly**/No
Please rate the manuscript on overall contribution to the field
Excellent/Good/Average/**Below average**/Poor
Please rate the manuscript on language, grammar and tone
Excellent/**Good**/Average/Below average/Poor
Is the manuscript succinct and free of repetition and redundancies?
Yes/No
Are the results and discussion confined to relevance to the objective(s)?
Yes/**No**
The number of tables in the manuscript is
Too few/**Adequate**/Too many/Not applicable
The number of figures in the manuscript is
Too few/**Adequate**/Too many/Not applicable
Is the supplementary material relevant and separated appropriately from the main document?
Yes/No/Not applicable
Please rate the manuscript on overall quality
Excellent/Good/Average/**Below average**/Poor

Is appropriate and adequate reference made to other work in the field?

Yes/**No**

Is it stated that ethical approval was granted by an institutional ethics committee for studies involving human subjects and non-human vertebrates?

Yes/No/**Not applicable**

If accepted, would you recommend that the article receives priority publication?

Yes/**No**

Are you willing to review a revision of this manuscript?

Yes/**No**

Select a recommendation:

Accept / **Revisions required** / Resubmit for review / Decline

With regard to our policy on 'Publishing peer review reports', do you give us permission to publish your anonymised peer review report alongside the authors' response, as a supplementary file to the published article? Publication is voluntary and only with permission from both yourself and the author.

Yes/No

Comments to the Author:

Although the manuscript puts on the table a relevant debate for the context in which the research is developed, the document presents some weaknesses that need to be worked on in order to provide solidity to the argument and, above all, coherence to the results, which are not connected to a theoretical debate relevant to the analysis carried out. Although the cases mentioned are interesting and provide clues to the main research question, and in themselves account for the need to decolonise educational processes, the absence of an in-depth theoretical debate at the beginning of the document means that the analysis carried out is not linked to a theoretical conversation that would help to explain the relationship between the research questions, the analysis and the results presented. It is therefore convenient to incorporate a solid theoretical discussion that allows the reader to understand the research problem statement, the theoretical conversation in which it is inserted and how these theoretical discussions allow us to arrive at the results presented in the analysis of each case.

Author response to Reviewer B: Round 1

The manuscript puts on the table a relevant debate for the context in which the research is developed

AUTHOR: Thank you for this comment.

It presents some weaknesses that need to be worked on in order to provide substance to the argument and, above all, coherence to the results, which are not connected to a theoretical debate relevant to the analysis carried out

AUTHOR: We have developed the theoretical debate more substantively at the start of the paper, and have linked the questions, analysis and results to the theoretical debate.

We have located the theoretical debate more directly at the intersection of science engagement, place-based learning, and learning theory, with implications for decoloniality in higher education. We have removed the focus on curriculum, and have centred the paper instead on learning.

We have provided a new introduction, and a section in which we deal with the theoretical aspects of the study. We have then clarified a methodology section, and an analysis section in which the analysis is much more directly linked to the theoretical debate presented in the theoretical section.

Although the cases mentioned are interesting and provide clues to the main research question, and in themselves account for the need to decolonise educational processes, the absence of an in-depth theoretical debate at the beginning of the document means that the analysis carried out is not linked to a theoretical conversation that would help to explain the relationship between the research questions, the analysis and the results presented

AUTHOR: Thank you for this comment. It elaborates further on the comments above, and has been addressed through the changes above. We have also linked the interpretation of the cases to deepening the theoretical debate. This makes better links between questions, analysis and results.

important to incorporate a solid theoretical discussion that allows the reader to understand the research

problem statement, the theoretical conversation in which it is inserted and how these theoretical discussions allow us to arrive at the results presented in the analysis of each case.

AUTHOR: Thank you for the comment.

This comment is similar to the comments above, and has been addressed through the attention to the theoretical debate as indicated above. The paper has been substantively revised accordingly and more structured section headings have been included to better guide the reader through the study.

Reviewer F: Round 1
Date completed: 18 May 2024
Recommendation: Accept / **Revisions required** / Resubmit for review / Decline
Conflicts of interest: None

Does the manuscript fall within the scope of SAJS?
Yes/No
Is the manuscript written in a style suitable for a non-specialist and is it of wider interest than to specialists alone?
Yes/No
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Yes/No
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Yes/**No**
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Yes/No
Are the methods described comprehensively?
Yes/**No**
Is the statistical treatment appropriate?
Yes/No/**Not applicable**/Not qualified to judge
Are the interpretations and conclusions justified by the research results?
Yes/Partly/No
Please rate the manuscript on overall contribution to the field
Excellent/**Good**/Average/Below average/Poor
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Is the supplementary material relevant and separated appropriately from the main document?
Yes/No/Not applicable
Please rate the manuscript on overall quality
Excellent/**Good**/Average/Below average/Poor
Is appropriate and adequate reference made to other work in the field?
Yes/No
Is it stated that ethical approval was granted by an institutional ethics committee for studies involving human subjects and non-human vertebrates?
Yes/No/**Not applicable**

If accepted, would you recommend that the article receives priority publication?

Yes/**No**

Are you willing to review a revision of this manuscript?

Yes/No

Select a recommendation:

Accept / **Revisions required** / Resubmit for review / Decline

With regard to our policy on 'Publishing peer review reports', do you give us permission to publish your ocuseded peer review report alongside the authors' response, as a supplementary file to the published article? Publication is voluntary and only with permission from both yourself and the author.

Yes/No

Comments to the Author:

Title

The title needs to be looked at critically. In its current form it promises to decolonise higher education, when in fact the article is not focused on higher education as a discipline but rather as a context wherein the authors want to decolonise the curriculum. Would it not be better so refer to 'science engagement curricula' or something related to science and curriculum. Moreover, in the section just before the conclusion, the curriculum is mentioned again emphasising decolonial curricula (not higher education, which is too wide and includes many other facets unrelated to this research).

Methodology

Methodological depth is needed to guide the reader. It is mentioned that an analysis of two case studies was performed but it is not explicit what methodological framing this is based on. I wondered about place-based research but in the section 'Placed-based research and learning in higher education' it is claimed that this is used by the article as a theoretical framing. The I wondered if this might be a multiple case study. It remains unclear and should be more explicit what methodology is underpinning this article.

In addition, how were these cases accessed by the authors of this article?

Theory

Complicated conversations are used without theoretical depth. William Pinar (2004) invoked the idea of curriculum as "complicated conversation" but his work is built on and inspired through 'conversation' as framed by authors like Richard Rorty and Michael Oakeshott. More theoretical depth is needed on complicated conversations considering the central role is plays in the article and in arguments made in Table 2.

Mention to "curriculum as an active force" is mentioned for the first time in the section just before the conclusion of the article. Consider linking this earlier in the article and even to your conceptualisations of complicated conversation.

Argument

The article is structured by: Introduction; Theoretical framework (Place-based research and learning in higher education); Discussion of cases and Conclusion. I think this distorts the flow of argument. Include a section heading on the 'methodology' before the discussion of cases to situated this in the article. At present it is part of the theoretical framework. The after the 'discussion of cases' and before the 'conclusion' a theoretically inspired and rigorous section is needed to problematise and complicate what is presented in the cases and by the theoretical framework. This starts to have in the paragraphs following figure 1 but it remains unclear exactly what is being argued for here. Mention is made to a 'guiding typology', decolonial curriculum, transgressions of loop learning and so on. I think if this section can be more ocused with its own section heading advocating its key contribution to new knowledge that this article is claiming that will make it clearer.

Author response to Reviewer F: Round 1

The title needs to be looked at critically. In its current form it promises to decolonise higher education, when in fact the article is not focused on higher education as a discipline but rather as a context wherein the authors want to decolonise the curriculum. Would it not be better so refer to 'science engagement curricula' or something related to science and curriculum? Moreover, in the section just before the conclusion, the curriculum is mentioned again emphasising decolonial curricula (not higher education, which is too wide and includes many other facets unrelated to this research).

AUTHOR: Thank you for this comment.

Based on the shift and further clarification around the theoretical focus of the paper, we have revised the title: The new title is “Engaged Sustainability Science And Place-Based Transgressive Learning In Higher Education” We think this better reflects the core argument being made in the paper following revisions. We have also revised the abstract and significance points accordingly.

We have also removed the focus on curriculum, but do refer to implications for curriculum from the learning processes analysed in one paragraph.

Methodological depth is needed to guide the reader. It is mentioned that an analysis of two case studies was performed but it is not explicit what methodological framing this is based on. I wondered about place-based research but in the section ‘Placed-based research and learning in higher education’ it is claimed that this is used by the article as a theoretical framing. The I wondered if this might be a multiple case study. It remains unclear and should be more explicit what methodology is underpinning this article.

AUTHOR: Thank you for this comment.

We have created a separate section on methodology. We have further clarified the use of case study, and we have given further detail on how the cases were constructed with references to the methodological work undertaken. We have not used ‘multiple case study’, but have instead referred to two case studies, as the study overall was not conducted as a multiple case study, rather the paper draws on two case studies that were similarly conducted but in different places and times.

In addition, how were these cases accessed by the authors of this article?

AUTHOR: Thank you for this question.
We have clarified that the cases are from primary research led by Author 1 et al. (Case 1) and Author 3 (Case 2) which took place over multiple years. In both cases, there are extensive records and existing reports on the cases which are referenced in the texts. In this article we offer a summative view of the cases.

Complicated conversations are used without theoretical depth. William Pinar (2004) invoked the idea of curriculum as “complicated conversation” but his work is built on and inspired through ‘conversation’ as framed by authors like Richard Rorty and Michael Oakeshott. More theoretical depth is needed on complicated conversations considering the central role is plays in the article and in arguments made in Table 2.

Mention to "curriculum as an active force" is mentioned for the first time in the section just before the conclusion of the article. Consider linking this earlier in the article and even to your conceptualisations of complicated conversation.

Thank you for this comment.

Overall, we have removed the work on curriculum and curriculum theory as we decided to focus more directly on science engagement and learning as indicated above.

Reference to complicated conversations is no longer in the paper and has been removed.

We have kept reference to ‘curriculum as active force’ but more as an implication for the type of learning we are describing. It is therefore not a major focus on the paper, but could be useful for readers who wish to consider the implications of the argument for curriculum research.

The article is structured by: Introduction; Theoretical framework (Place-based research and learning in higher education); Discussion of cases and Conclusion. I think this distorts the flow of argument. Include a section heading on the 'methodology' before the discussion of cases to situated this in the article. At present it is part of the theoretical framework. The after the 'discussion of cases' and before the 'conclusion' a theoretically inspired and rigorous section is needed to problematise and complicate what is presented in the cases and by the theoretical framework. This starts to have in the paragraphs following figure 1 but it remains unclear exactly what is being argued for here. Mention is made to a 'guiding typology', decolonial curriculum, transgressions of loop learning and so on. I think if this section can be more focussed with its own section heading advocating its key contribution to new knowledge that this article is claiming that will make it clearer.

AUTHOR: Thank you for this comment. With comments from Reviewer 1 in mind as well, we have restructured the flow of the argument:

1) Introduction
2) Theoretical framework
3) Methodology
4) Case studies (presentation)
5) Discussion of cases which surfaces the main findings and claims being made through the paper.
6) Conclusion

We have removed Table 2 which had the 'guiding typology' as we decided to remove the focus on curriculum in the paper.

Reviewer G: Round 1
Date completed: 22 May 2024
Recommendation: Accept / **Revisions required** / Resubmit for review / Decline
Conflicts of interest: None

Does the manuscript fall within the scope of SAJS?
Yes/No
Is the manuscript written in a style suitable for a non-specialist and is it of wider interest than to specialists alone?
Yes/No
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Yes/**No**
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Yes/**No**
Are the methods described comprehensively?
Yes/**No**
Is the statistical treatment appropriate?
Yes/No/**Not applicable**/Not qualified to judge
Are the interpretations and conclusions justified by the research results?
Yes/**Partly**/No
Please rate the manuscript on overall contribution to the field
Excellent/Good/**Average**/Below average/Poor
Please rate the manuscript on language, grammar and tone
Excellent/**Good**/Average/Below average/Poor
Is the manuscript succinct and free of repetition and redundancies?
Yes/**No**

Are the results and discussion confined to relevance to the objective(s)?

Yes/No

The number of tables in the manuscript is

Too few/**Adequate**/Too many/Not applicable

The number of figures in the manuscript is

Too few/**Adequate**/Too many/Not applicable

Is the supplementary material relevant and separated appropriately from the main document?

Yes/No/**Not applicable**

Please rate the manuscript on overall quality

Excellent/Good/**Average**/Below average/Poor

Is appropriate and adequate reference made to other work in the field?

Yes/No

Is it stated that ethical approval was granted by an institutional ethics committee for studies involving human subjects and non-human vertebrates?

Yes/No/**Not applicable**

If accepted, would you recommend that the article receives priority publication?

Yes/No

Are you willing to review a revision of this manuscript?

Yes/**No**

Select a recommendation:

Accept / **Revisions required** / Resubmit for review / Decline

With regard to our policy on 'Publishing peer review reports', do you give us permission to publish your anonymised peer review report alongside the authors' response, as a supplementary file to the published article? Publication is voluntary and only with permission from both yourself and the author.

Yes/No

Comments to the Author:

The work is thought-provoking enough, but need to strengthen the abstract and the conclusion. Methods to be clarified and the implications of the findings.

Since the paper uses endnotes, there is a need to be careful about the style of writing so that the notes don't interfere with smooth flow or reading

[See Appendix 1 for Reviewer G's comments made directly on the manuscript]

Author response to Reviewer G: Round 1

This work needs to be informed by a relevant post-colonial theoretical framework. While this could inherently be noted by experts in the field, the non-experts will struggle to see it. hence the need to be explicit. This paper can make a good reading for the broader community of EE/ESD and recommended for publication, but subject to improvements in the selected areas: Abstract, theory, methodological clarity, conclusion, and some grammatical smoothening.

AUTHOR: Thank you for this comment. Drawing on comments from Reviewer 1 and 2 which were similar, we have reworked the theoretical framework of the paper, and have located within theory on science engagement, learning, place-based education and decoloniality.

We have also attended to the structural weaknesses of the paper, and have provided a more structured organisation of the paper as indicated above.

We have also reworked sentences where necessary to attend to 'grammatical smoothening'.

Abstract requires rephrasing to show the argument of the paper

AUTHOR: Thank you for the comment.

We have rephrased the abstract according to the main changes effected as indicated above.

Check use of footnotes to keep flow of text
AUTHOR: We do not have footnotes in the text.
Check use of page number style for journal
AUTHOR: We have tried our best to improve the style of referencing. The Vancouver style is complex, especially as not all journals have acronyms. However, where these were found they were inserted.
Avoid use of etc.
AUTHOR: We have removed use of etc.
Don't cite Table in conclusion, rather bring out key points
AUTHOR: We have removed Table 2, and have removed reference to this in the Conclusion.
Final sentence: This is the key thesis of the paper that can be strengthened
AUTHOR: Thank you for this comment. It helped us to refocus the paper as indicated above. The Title of the paper now also reflects this key contribution.

Author response: Other additions

Many thanks for facilitating the reviews of our paper. We received three sets of review comments which we have addressed as carefully as possible. We re-submit a track change version of the paper to make the revisions explicit.

Based on recommendation from the reviewers, we have changed the title of the paper to more accurately reflect the refined focus of the paper: Engaged Sustainability Science and Place-Based Transgressive Learning In Higher Education. This changes it from the original title 'Decolonising higher education with place-based transgressive learning'.

The reviews were most useful, and we think they have helped us to focus the paper more clearly.

We have tried our best to ensure that all references are correct, but it was not possible to find acronyms for all journals, hence we have included only those that appear to have formal acronyms. Some journals in the social sciences seem not to use acronyms.

We have also reworked the original diagram, as we were not getting response from the journal diagram support service. It does not change the argument at all, and the diagram is therefore our original version.

We include the more detailed response to the reviewers below in a Table for specific reference as to how we have addressed the comments.

Our paper deals with SDG 4, and SDG 2 specifically.

Appendix 1: Reviewer G comments on manuscript

Decolonising higher education with place-based transgressive learning

Abstract:

Decolonisation of higher education is being widely deliberated in South Africa. In this article we extend this deliberation by offering an analysis of science engagement place-based research and learning as a pedagogical orientation with potential to advance decolonising of curriculum and research in place. Through analysis of two case studies we propose that co-engaged place-based research and learning emerges as a form of multi-loop, transgressive learning that offers possibilities for advancing understanding of decolonisation of curriculum and new possibilities for being and becoming. This is offered as an approach to deepen science engagement in contemporary African contexts.

Keywords: sustainability science engagement, place-based education, decolonising curriculum, transgressive learning; learning science.

Significance:

- The article offers insight into how science engagement curricula as place-based research and learning can contribute to decolonisation of higher education.
- It offers a multi-loop learning typology extended by decolonial transgressive learning with potential to guide decolonial science engagement curricula, and a deepening of the concept of science engagement.

Introduction

Decolonising higher education is a topic that has been in keen focus in South African academia in the past ten years. The topic is not new in African Higher Education circles with some of the earlier more famous works being Ngũgĩ wa Thiong'o's[1] call for 'Decolonising the mind', and Fanon's [2,3,4] multiple works. Internationally, the calls for decolonising higher education are also expanding rapidly[5,6,7]. In South Africa, authors such as Ndlovu-Gatsheni[8], and Mbembe[9] have produced interesting multi-layered analyses of the demands for epistemic decolonisation in higher education which in short, involves unlearning coloniality. Mbembe[9] relates this challenge to the realities of climate change in Africa with implications for forms of reasoning.

With these broader calls in mind, Author 2[10] et al. offer a review of efforts to decolonise the curriculum in higher education in South Africa. They report "use of extensive public lectures, seminars, and workshops as a common strategy to deal with the calls for the decolonising of curricula" (p. 25). In the process, they alert academics to the problem of "decolonial-washing" (p. 2[illegible]) and argue for engaging more substantive approaches to decolonisation, one of which is proposed as 'complicated conversations'. By this they mean conversations that academics have with students, peers and communities that are frank, open and aimed at self-criticism. Author 2[11] points out that such conversations decentre dominant voices, reducing debilitating effects of hierarchical power relations.

Our paper seeks to extend the discussion on substantive approaches to decolonisation by considering **co-engaged place-based research and learning** as an engaged science curriculum process with curriculum decolonisation potential. While science engagement has many meanings, in this paper we consider this concept to include **active involvement of the public and researchers in scientific knowledge (co)**production (cf. https://falling-walls.com/engage/about/). Informed by the learning sciences, the notion of 'complicated conversation' is illuminated as a form of **multi-loop, transgressive learning**. Furthermore, the engaged sustainability science curriculum process under investigation offers a potential 'line of flight'[12] from dominant bifurcated nature-culture relations that characterise mainstream curricula, with roots in the logics of western modernity and their colonial projects[6], as will be elaborated further below.

Place-based research and learning in higher education

Place-based research and learning in higher education has been described by Woodhouse and Knapp[13] as: originating from the attributes of a place; being inherently multidisciplinary; being inherently experiential; reflecting an educational philosophy which transcends 'learning to earn'; and connects place with the self and community. Place-based research and learning as used in this paper is premised on a particular understanding of place. Three broad conceptions of place help to differentiate. The first understanding of place dates back to the 1950s and has its origin in the discipline of Geography whereby place is understood in technical terms as area and locality - as coordinates on a map[14]. Such a notion of place suggests an abstract notion of dehistoricised spatiality devoid of inhabitants, be they human or more/other-than human[15]. The second is a phenomenological notion of place, based on the idea that in experience nothing is unplaced[16,17] recognising that we are beings in the world. This is a view of place that is not characterised by universal laws and spatio-temporal space but by distinct neighbourhoods, local events and communities, and that recognises that relationships with/to such places elicit feelings, moods, perceptions and attitudes.

Most relevant to this paper, the third broad sense of place concerns a critical, resisting and regenerative notion of place. This notion of place recognises that places have been colonised, and in a neoliberalising world are characterised by discourses of accountability and economic competitiveness. This view of place also recognises that places can be renewed or regenerated through processes of restoration, maintenance, transformation, care and/or re-membering, which involve the (re)discovery of both self and place[18]. Resisting and regenerating is salient to decolonising places. Mies and Shiva[19] argue that places concern living resistance to colonial constructs of race, gender, nature and value - places mean resisting that which is disembodied, dematerialised and deracialised.

From a curriculum perspective, engaging with place in resistant and regenerative ways means transgressively learning and manoeuvring around the "impasses of human agency, the linearity and limitations of capitalist teleology", in the process upturning the dominating "substructures of our experience as a species", recognising that, "the very materiality of the world is inescapably entangled with epistemology and justice (or 'justice-to-come')"[20] (pg. 828). Such a view of place embodies "relations of responsibility"[21] (pg. 265) where researchers and learners are embedded in, and part of the tapestry of becoming. In this article, our framing of sustainability science engagement curricula as place-based research and learning is aligned with the third broad notion of place because it concerns researchers and students working together with/in local communities and through culturally attuned and place-centred democratic processes that involve multi-loop transgressive learning to co-transform local

spaces/places in response to sustainability concerns. Here, sustainability concerns of local communities in place form the primary focus of engagement.

To provide an empirical base for elaboration of our argument, we draw on two case examples of science engagement curricula as place-based research and learning (cf. Table 1). In these programmes, post-graduate scholars, working with lecturers and other students (e.g. Diploma or Degree students) and a range of community actors (e.g. government officials, NGOs, farmers associations etc.), undertake co-engaged research and learning with communities around place-based matters of concern that affect the communities they engage with (e.g. water for food; food insecurity etc.). They engage in expansive learning actions over time with communities, together uncovering and learning 'what is not yet there'[22]. Each time the matters of concern, and the associated groups are co-defined in place-based contexts.

The first case emerges in the rural Eastern Cape, South Africa, where post-graduate scholars from two universities and diploma level students in an Agricultural Training Institute (ATI) have been working with rural farmers on sustainability challenges related to land and water for food production in a post-apartheid land reform setting where indigenous farmers were given back their land. Farmers were being given some support from the local government to develop sustainable agriculture as a means of economic production and livelihood, but they had little or no access to water[23]. The second emerges in rural Malawi, where post-graduate scholars and degree level students in the local university were working with rural women farmers to increase agricultural production in the face of regular 'drying' of the local lake system[24]. In both cases, small holder farmers were affected by drought conditions, which were reported and recorded as being more severe than earlier times.

While each of these processes of place-based research and learning are extensive[23,24], in Table 1 we highlight some of the most salient features of the processes followed, outlining the place-based co-engaged learning sequence and ontological and epistemological dynamics involved, including the outcomes of the place-based research and learning processes over time. We purposefully draw on cases from two different southern African countries, to broaden our discourses on decolonial curriculum transformations informed by experiences on the African continent, not only South Africa.

INSERT TABLE 1 HERE

The two case examples are discussed more summatively below, drawing particularly on insights from the learning sciences.

Discussion of the cases

As can be seen from the above cases, there are interesting insights into the sustainability science engagement research and learning processes which include:

- the importance of diverse perspectives and different forms of knowledge converging through co-engaged interactions over time,
- the grounded nature of the matters of concern that are place-based and embedded in human-environment relations and local cultures and knowledges,
- relationality is core, involving nature-culture relations as well as critically constituted relations of empathy, care and solidarity, all of which provide motive for learning and which ground resistance and regenerativity in place.

To elaborate more comprehensively on these findings, we can draw on insights from the learning sciences, which differentiates between types of learning using a recursive conceptualisation of first, second and triple loop learning[25]. ***First loop learning*** sees learning primarily as science-based information transfer leading to acquisitional outcomes for the individuals concerned, i.e. learning *about and for* sustainability concerns (e.g. we notice learning more about RWH&C techniques in Case 1, and planting methods in Case 2). ***Second loop learning*** sees learning outcomes as socially critical engagements with causes of environmental problems, with learning being constituted both f*or and as part of* the sustainable development process (e.g. in Case 1 we see critical engagement with faults in the land reform process, and in Case 2 we critical engagement with gender marginalisation). ***Triple loop learning*** sees issues as complex, and learning outcomes as uncertain, constituted by ongoing reflexive processes of social or collective forms of learning 'what is not yet there'[22], embracing uncertainty, ontological and epistemological plurality and multi-voicedness. This latter framing accords most with our conceptualisation of place-based learning outlined above, and is also evident in the cases where in Case 1 and 2 we see complex processes of ongoing learning to respond to drought, marginalisation and socio-economic and social-ecological complexity over time.

In both cases we see resistance and regeneration being co-constructed in place-based contexts in multi-actor formations as no one form of knowledge or experience was seen as adequate in responding to matters of concern. In both cases a plurality of knowledges and forms of engagement were sought out in collectives, through the situated, place-based engagements with matters of concern that were shared. Solutions were not pre-determined or fixed, and alternatives were co-constructed through different co-engaged learning and

relational change processes (e.g. in Case 1 they used a 'navigation tool' and in Case 2, arts-based scenario methods, and in both Case 1 and 2 they used demonstrations). In both cases, indigenous knowledge and other forms of knowledge were mobilised concurrently to resolve contradictions and problems being experienced. In both cases solidarity relations and network building was also key to the science engagement research and learning process.

Mainstream curricula in higher education tend mostly to advance forms of first loop learning, and one could argue that second and third loop learning might better guide decolonial curriculum praxis. However, a more nuanced reading of the literatures on first, second and third loop learning point to problems in instrumentalising or narrowly interpreting reflexive and transformative learning (especially triple loop learning) as a "consultancy offering or a form of deeper strategic thinking" that seeks "utopian solutions through ever higher orders of learning"[25] (pg. 303). Tosey et al.'s[25] point is that triple loop learning is erroneously interpreted as an "ever higher order of learning", and that learning at Level III in Bateson's original work (from which most triple loop learning applications are derived[25]) is not achievable by 'instrumental means' and that such learning is generative and unpredictable and by definition not controlled, indicating that educators or researchers are not able to fully engineer the future. Furthermore, Tosey et al.,[25] note that "Bateson's Learning III differs from other conceptualizations of triple-loop learning in that it reveals a dark side to transformation, is non-instrumental, exists beyond language and is recursive"[25] (pg. 303). Reynolds[26] argues that interpretations of triple loop learning may benefit from "being grounded more in understanding, engaging with, and transforming social realities", as in our two cases (cf. Table 1). Essentially this more careful reading of the learning science literature in the context of sustainability, science engagement and decolonial curricula, raises the question of open process, rather than controlled pedagogy.

Interesting too, Bateson does not reduce Learning III to rational deliberation or discussion, but Bateson also includes the role of the unconscious and aesthetic, "saying that learning entails a double involvement of primary process and conscious thought"[27] (pg.61), accommodating not only 'hard facts' but references to emotions, aesthetics, spirituality, the sacred and "transconceptual experience"[27]. Tosey and Mathison[28] propose a development of Bateson's original framework with emphasis on "multiple modes of learning" (i.e. embodied, analytic and aesthetic) identified in Bateson's writing, which we see arising the two cases above where the embodied significance of demonstration sites, and the use of arts-based methods for co-producing scenarios and then planting experiments with rural women were catalytic in the place-based learning and research processes. This has led us to consider possibilities of what has not yet been considered adequately in the learning sciences, namely aspects of

aesthetics, cosmology and more in the opening up of possibilities for expanded third loop learning interpretations as articulated by Tosey and Mathison[28] and thus also decoloniality of curricula. We also note that our cases reflect a recursive relationality between first, second and third loop learning premises, as outlined in Figure 1 below (i.e. the processes were not separate but iteratively related).

INSERT FIGURE 1 HERE

The cases also show the need for explicitly including a focus on transgression in discussions on triple loop learning, especially transgression of unsustainable norms and practices (e.g. transgression of mono-culture agriculture and high intensity irrigation praxis; dominant narratives of hybrid seeds of extension officers; dominant patriarchal cultures marginalising women's knowledges etc.)[29,30,23,24]. Our cases show that this can help to overcome the nature-culture bifurcation, fact-value and expert-novice dichotomies that characterise mainstream higher education curricula, along with limitations in learning theory which tend to see learners as acquirers of siloed knowledge (first loop learning). Decolonial curriculum theory and associated studies emphasise these limitations[8,11].

Importantly to the discussion of our cases, and the emerging argument, is that the dualist logic of western modernity has seen an artificial separation between indigenous and western science knowledges. As a consequence of European colonialism/imperialism, modern western science has been given the superior status of 'knowledge' whereas the knowledges of colonised people is regarded as mere 'culture'[31]. The superior status given to western modern science and its constructed separation from indigenous knowledge has been challenged by decolonial scholars, postcolonialists, feminist philosophers of science, multiculturalists, sociologists of knowledge, etc.[2]. An imperialist view of knowledge privileges representation rather than performance and declares knowledges as different, superior/inferior. However, when the performative side of knowledge is accentuated as in our two cases and via the recursive single-triple loop process (Table 1; Figure 1), then science is understood as a situated activity which connects people, sites, forms of knowledge. In other words science/knowledge is locally co-produced through processes of negotiation based on the social organization of trust and a co-construction of meaning using diverse approaches to knowledge (e.g. drawing on indigenous knowledge while also conducting comparative science experiments on productivity related to their knowledge as in Case 2). It is not reliant on empirical verification/ falsification as the only means of valorisation. Viewed in this way, seemingly disparate knowledge traditions can work together to produce new knowledge in

new knowledge spaces, and / or regeneratively recover the existing validity of marginalised knowledges[32,24].

With respect to curriculum, viewing curriculum as an active force[33] means that curriculum is not predetermined but immanent to the present situation of places and an outcome of the intra-actions that occur amongst human and non-human agents. In other words, curriculum is always curriculum-to-come. This view of curriculum is aligned with discussions on expansive[22] and triple loop learning [25,26,27] above, as well as decolonial and posthuman curriculum theorising[34,35]. In our cases (Table 1), we can see that curriculum-to-come is also a transgressive movement[29,30], a process of co-learning and becoming in place for researchers, community members, and other actors alike.

Drawing from the above, in Table 2 below, we offer an elaboration of the main tenets of single, triple and double loop learning for sustainability science engagement research and learning opportunities, and our interest in advancing decolonial curricula. Through this we offer a 'guiding typology' which is offered as a tool for reflexive engagement and the development of decolonial curricula.

INSERT TABLE 2 HERE

Conclusion:

In this paper we have sought to offer a perspective on how place-based learning and research can be conceptualised and enacted as decolonial curriculum praxis in the sustainability science and education sphere. As can be seen from the two cases in Table 1 this requires that academics and students collaboratively co-engage with communities around their matters of concern in place, and in the process involve other actors (including the more-than-human) and a plurality of cultural tools (e.g. diversity of knowledges as well as ethics of care, solidarity and empathy and sensibilities to a plurality of eco-cultural relations). These all work together to support communities to respond to their particular matters of concern through emergent processes that are reflexive and which remain open-ended; creating new or regenerative possibilities for being and becoming in practice, that is inclusive of eco-cultural relations, breaking away from modernist and colonial dualisms (Table 2). As shown in Table 2, 'complicated conversations' around contradictions and structural and / or historical challenges, are elaborated via co-engaged attempts to resolve these contradictions and challenges in embodied multi-actor formations where students in universities offer relations of solidarity and

care, as well as research-based support, co-learning from the process. This helps to embed complicated conversations in forms of transformative praxis that matter to those concerned.

Our argument is that sustainability science engagement, conceptualised as place-based forms of research and learning, can extend conceptualisation of what a decolonised curriculum in South Africa might look like, at least in those parts of the Higher Education system where the learning and sustainability sciences meet.

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TABLE 1:

Table 1: Cases of science engagement as place-based research and learning processes

Features of the unfolding place-based research and learning process	**Case 1: Access to water for food production in rural smallholder farming communities (Eastern Cape, SA)[23]**	**Case 2: Women's empowerment in food production in climate change adaptation programmes (Lake Chilwa, Malawi)[24]**
Context of the research and learning processes	Smallholder farmers in the rural Eastern Cape were given back land via land reform in post-apartheid period, but no access to water. There was Local Economic Development support for their practice, but not support for water infrastructure maintenance and supply.	In the Lake Chilwa area in Malawi, communities are dependent on fishery. Levels of poverty are high, and the area is experiencing periodic droughts that lead to 'drying up' of the lake. This has significant impacts on local food security, and puts additional pressure on women farmers.
Matter of concern as articulated by communities in place	Farmers were seeking support for addressing their 'water for food' problem. They wanted to know more about rainwater harvesting and conservation (RW&C) practice relevant to their scale of farming.	Women farmers were experiencing food insecurity stress as a result of the lake drying up. They have valuable indigenous and local knowledge on food production (including use of Open Pollination Variety (OPV) seeds), but this was being undermined by extension officers who were promoting mono-culture and hybrid seeds.
Sustainability oriented challenges identified	Drought was reported to be more frequent in the area, affecting already difficult conditions for developing farming enterprises.	Drought affecting normal food production rhythms, where conditions of poverty are already severe.

		Women household food producers most under stress.
Learning oriented challenges identified	Excellent information available on RWH&C practices produced by the scientific community, even available in the local ATI, but not being used due to historical influence of mono-culture agriculture dominance in the curriculum.	Some knowledge available on climate change adaptation practices. The validity of women's indigenous knowledge, however, was marginalised. Dominance of mono-culture and hybridised seeds being promoted by extension services and scientific organisations, including local scientists and market actors.
Summary of the co-engaged research and learning process followed	There was a common interest in advancing knowledge of RWH&C to address smallholder farmers problem, amongst farmers, and local economic development officers, ATI lecturers and farmers association. A learning network was formed, supported by a 'navigation tool' that gave access to more detailed information on 26 RWH&C practices (produced by water scientists for the Water Research Commission). The learning process started with mobilising local indigenous knowledge of farmers, which created space for further choices of RWH&C practices and development of collective demonstration sites. The collective demonstration site process expanded over time across the community. Farmers started assisting each other and an indigenous collective farming practice 'illima' was re-instituted in the community, and offered practice-based learning opportunities for ATI students. Community radio tools and digital tools such as WhatsApp were also used for wider social learning and ongoing knowledge exchange and co-learning.	There was a common interest in finding ways of responding to the implications of the drying lake and its impact on local food security, especially amongst women farmers and NGO partners, and the university research team. A process of working with the women farmers to surface their knowledge and learning was initiated, and a scenario-building approach was used to surface women's desired options for resolving the matters of concern. This combined science and arts-based methods, and offered a cultural translation tool to approach the gendered environment. This led to the establishment of comparative demonstration plots where women's indigenous agricultural knowledge was applied, and compared to the production resulting from the knowledges being shared by extension services. The university and students assisted with scientific analysis of the resulting production processes and outputs. This helped to both surface and validate the women's knowledge which showed higher levels of production output from a food security point of view. This also addressed some of the gender-based challenges identified.
Features of the ontological and epistemological experiences reported	Motivation to seek out new knowledge was grounded in matters of concern of interest to the communities in place. Indigenous knowledges provided means of evaluating and expanding existing knowledge and experience. Co-defined	Motivation to seek out different approaches to food security as a climate change adaptation strategy was grounded in the matters of concern of the women farmers in place. Indigenous knowledges were surfaced, as well as local gender and modernisation politics which were

	approaches providing access to new knowledge and co-engaged critically situated experiences (e.g. demonstration plots development) helped with identification of knowledges necessary for advancing practice in co-defined ways. Empathy for older women farmers was catalytic in establishing the learning network and solidarity relations, which were crucial in catalysing regenerative collaborations in place.	subjugating women's knowledges. Through arts-based methods new communication tools were developed which produced spaces for a wider scope of knowledges to emerge and be tested out in practice. The materiality of the indigenous farming practices was crucial to the resistance and regenerativity in the context. In the process new relations of solidarity were created.
Observations on place-based transgressive learning	Learning was iteratively grounded in encounters with situated, historical, existing and new knowledges. These were combined iteratively over time with critical analysis of the status quo (why water systems were not in place) and trying out new theory-practice combinations that seemed feasible and meaningful to the socio-material situation. The process was multi-voiced and recursively expansive around the matters of concern over time.	Learning was iteratively grounded in encounters with situated, historical, gendered, existing and new knowledges. These were combined and evaluated through a critical analysis of politics of subjugation, which allowed for surfacing marginalised knowledges of women, and trying out alternative possibilities, and making their validity more visible through experimentation and dialogue. The process was multi-voiced and recursively expansive around the matters of concern over time.
Documented outcomes of the place-based research and learning processes for farmers, students, and other actors	**For farmers:** they were more able to test out and use a wider range of RWH&C practices and were able to gather support and new knowledge resources for their practice; improving food production at local levels and validation of their indigenous knowledge and practices, while also expanding these. Stronger relations of solidarity were also established which they continue to draw on. **For students:** they were more able to iteratively relate theory and practice, and their modalities of learning were expanded and more substantively grounded in the materiality's and social experiences and knowledges of communities, equipping them better for responding to risk and matters of concern. **Other actors:** the solidarity network strengthened relations of empathy and community building, and has equipped diverse actors to be more responsive to farmer's needs, a tendency which has	**For women farmers:** increased levels of food production; validation of their indigenous knowledges and embodied knowledge and practices; changed gender relations; stronger solidarity networks which validated their status and capabilities as primary food producers building on their socio-material relations with the land and food production processes. **For students:** more able to iteratively relate theory and practice; develop insights into the validities of a diversity of forms of knowledge; to ontologically ground their learning; equipping them better for responding to risk and matters of concern. **Other actors:** a wider repertoire for responding to recurring drought conditions, and abilities to use multi-methods that include aesthetic processes, and complex conversations such as those arising in the gendered environment. Relations of empathy and community building and solidarity networks strengthened, with ongoing networks of supportive co-learning in place.

	shaped curriculum review in the ATI, and ongoing supportive engagement with farmers over a period of approximately 10 years now.	

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369 TABLE 2:
370
371 *Table 2: A guiding typology for education and sustainability curriculum praxis (elaborated partially from*
372 *Gough and Scott[36,] and Vare and Scott[37])*
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Type 1: Education and Sustainability Curriculum Praxis Influenced by single loop learning theory	**Type 2: Education and Sustainability Curriculum Praxis: Influenced by double loop learning**	**Type 3: Education and Sustainability Curriculum Praxis: Influenced by triple loop learning theory and some tenets of post-humanism**	**Type 4: Education and Sustainability Curriculum Praxis: Influenced by expanded triple loop learning theory informed by transgression and decoloniality**
Type 1 approaches assume that, the problems humanity faces are essentially environmental (e.g. climate change / water availability is an environmental problem), and that these can be understood through science. Curricula are oriented towards teaching 'the science of climate / water etc'. Assumptions are that problems can be easily resolved with pre-defined environmental and/or social actions and technologies (i.e.	**Type 2** approaches assume that the problems humanity faces are fundamentally social and/or political. Environmental problems emerge from social and political problems, and can be understood by social-scientific analysis. Curricula typically support learners to think critically about and/or beyond the status quo, and to critically test the voracity of perspectives in relation to social	**Type 3** approaches assume that what is (and can) be known in the present is incomplete, and that 'facts' and/or other forms of knowledge on their own are not adequate. Problems are not seen as either social or environmental, but social-ecological or deeply eco-cultural. Learning must be open-ended, and must be worked out through a diversity of approaches and knowledge's, cultures, and relational inter	**Type 4** approaches reflect many of the tenets and processes outlined in the Type 3 column adjacent. **Additionally,** drawing on transgressive learning theory, they include a focus on aesthetics, and deep seated eco-cultural relations typical of many indigenous communities cultures and cosmologies. They also embrace an explicit intention to transgress normalised forms of unsustainability which

behaviourist solutions or technical solutions). It is assumed that learning leads to change if facts are defined and individuals 'grasp' the facts (often captured via individualised assessments in mainstream silo curricula). Education is rarely place-based, and rarely involves other actors. It is mainly an activity involving an expert teacher and learners who 'absorb' facts and knowledge as provided for in the curriculum (often decontextualised). Expert knowledge is therefore also pre-determined and uni-directional. Mostly those on the receiving end of the expert knowledge are encouraged to learn *about* and *for* sustainable development. Few 'complicated conversations' arise in this approach. This approach can lead to important and often immediate practical benefits and outcomes, especially when expert knowledge is needed in a crisis situation.	settings and/or places. Education can be place-based, but in such instances the place-based education is more to test whether expert theories are valid or not, and to deepen understanding of the social and political challenges producing the environmental problems. Such approaches allow students to explore the contradictions inherent in different contexts, and learning can be seen *as* a socially critical process of enabling sustainable development. Here sustainable development *is* a learning process[36], and needs to be worked out in the context of the complex social and political contexts that are shaping environmental problems. Here 'complicated conversations' are oriented towards politics and structural challenges affecting curriculum praxis.	and intra-actions in particular contexts. Curricula would typically allow for learning what is not yet there. Neither the lecturers, students or communities are all-knowing experts (even if they do have specific expertise); all need to collaborate through combining their best available knowledge (i.e. scientific facts, indigenous knowledge, experiential knowledge etc.). Such approaches are most often place-dependent as micro-level resolutions (if temporary) of complex matters of concern can only be worked out in place in practice. Type 3 approaches are necessary to include in education if the uncertainties surrounding sustainability challenges, and the complexities inherent in how we live now are to lead to reflective social learning about how we might live in the future. The outcomes of such learning processes are ongoing reflexive change processes, through continuous and responsive co-learning and research processes. These, as argued by Gough and Scott[36], are the human species' most characteristic endowment.	presents in both epistemic and ontological forms, and is often also embedded in mainstream curricula and ways of thinking about, and working with knowledge. It embraces ethics of care, empathy and solidarity with the most marginalised (e.g. marginalised women or unemployed youth) but also other forms of life (e.g. polluted rivers and their ecosystems which are in failure). Here sustainability is an embodied, eco-cultural praxis of co-engagement with people and place. And decolonial curricula are place-based transgressive learning spaces for students, lecturers, communities and the more-than-human others that are involved in their matters of concern (e.g. the OPV seeds of the women farmers or the soils being tilled by the students in ilima praxis). 'Complicated conversations' are merged into transforming praxis as outlined in Type 3 adjacent, but also being and becoming associated with plural onto-epistemic possibilities and futures regenerated or not-yet-visited or known.

		The education process becomes a co-engaged eco-cultural and social learning process of recovering or embedding ourselves in human-ecological relationalities and intra-actions. 'Complicated conversations' arise from this co-engagement in place, and are merged into transforming praxis.	

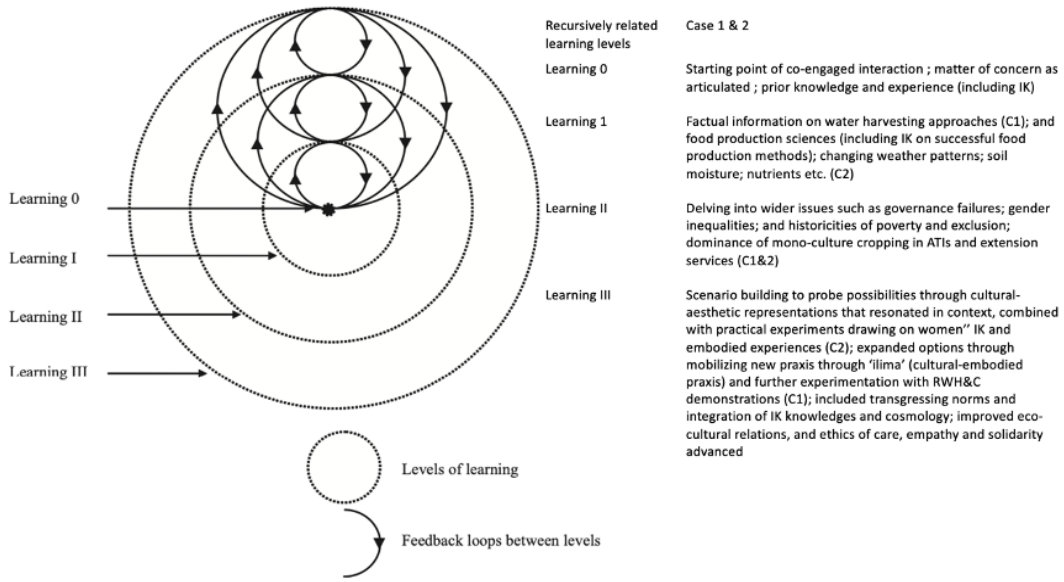

Figure 1: Bateson's levels arranged as an interrelated, recursive hierarchy with case interpretations (figure adapted from Tosey et al.[25] (pg. 300))