

## Peer Review Report

# Review Report on Reimagining Geoscience Education for Sustainability

Review, Earth Sci. Syst. Soc.

Reviewer: Rebecca Williams

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### EVALUATION

#### Q 1 Please summarize the main theme of the review.

This review considers the topic of geoscience and education for sustainable development. It suggests that geoscience curriculums must transform and engage fully with ESD in order to modernise and halt the decline in admissions seen (at least in the UK, USA, Australia, Europe) in the discipline in Higher Education. It briefly reviews published works on the state of geoscience education, education and the SDGs, strategies for reshaping the curriculum, and broadening the training of geoscientists. It concludes that efforts to date hasn't seen any significant change in the understanding of the role of geoscience for sustainable development.

#### Q 2 Please highlight the limitations and strengths.

This article is timely in that there has been a proliferation of commentaries, articles, and resources on geoscience and sustainability and it is a topic ripe for review. The manuscript sets out the case clearly and summarises some key resources and actions for the community. I think that this could be a welcome contribution - a starter for 10 for educators to quickly become familiar with the topic and a gateway to further resources and literature. However, the specific contribution this manuscript makes above that proliferation of literature isn't clear.

There is a USA/Europe bias that whilst is acknowledged, there is little to no effort to overcome. My feeling is that conversations around ESD in the geosciences is more broadly linked to calls for a general modernization of the geoscience curriculum which more broadly engages with social justice, EDI, decolonization - in order to solve global challenges we need a diverse, global, ethical workforce. Whilst this is touched on a bit in the section about geoethics, I think that this topic is more intertwined with these broader conversations than the author acknowledges (see suggested references and references therein).

In line 532 - 533, the author states "This is far from the first paper to highlight weaknesses within geoscience education that limit its effectiveness as a catalyst for change and it certainly will not be the last." I'd like to see the contribution of this paper more clearly articulated. What is this paper revealing/calling for/etc that is new and or different to the others on this topic?

I find the reference to the Schafer paper (line 484) interesting and kind of wish it had come sooner. Even as a starter - what has changed in the last 12 years? Why haven't we yet broken out of this vicious cycle? I for one have been to many of these meetings, crisis summits, read and written commentaries, journal articles, done schools outreach, participated in TV documentaries. But sadly the decline seems to only have continued. So, how can we break out from this vicious cycle? Will embedding ESD do it? Gill and co have been writing on this since 2017, SDGs have become embedded in many degree programmes at least in the UK, and yet we have seen little impact in the wider perception of geoscience of either the public or government. Can this manuscript help direct efforts? This related back to my first comment that the contribution of this manuscript could be clearer.

Line 494 states that most degree programmes follow a 'business as usual approach' which I'm not sure is true. Unless the author surveys degree programmes in some way, then this assertion isn't evidenced. Particularly as some of the references cited are getting to be 5+ years old which is a longish time on the timetable of

curriculum reviews (at least for UK HE). Further, there is no discussion of the role of professional bodies/accreditation/national standards in directing the curriculum (and at least in the UK there has been significant shift here in the last 2–3 years on this topic). In the UK (and other countries that use the SBS), the QAA Subject Benchmark Statement specifically requires programmes to engage with education for sustainable development principles and the SGGs. Accreditation by professional bodies (e.g. in the UK Geoscience degrees are accredited by the Geological Society of London) can both explain why some degrees are still doing the traditional and be a reference to how there is a firm call for change (e.g. see below on the details of where sustainability is now included in accreditation).

Use of direct quotes – the author often uses direct quotes. I think a more narrative/social science style of writing would make these easier for the reader e.g. by directly referring to the author of the quote before the quote is used e.g. “Di Capua writes/concludes/emphasizes” etc. Also, I think that direct quotes should be appropriately referenced with page numbers, depending on the referencing style of the journal.

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**Q 3****Does the review include a balanced, comprehensive and critical view of the research area?**

There is a USA/UK/Europe bias to the manuscript. I don't have any particular references in mind to help correct this problem but the author could do more in the manuscript to either think critically on this or expand the references to try to correct it.

Here are the references I may have pointed you towards, plus others that might be useful:

\*Rogers et al., 2022 <https://gc.copernicus.org/articles/5/189/2022/>

Has Educate for sustainability as item 10 on its list of suggestions for working towards a decolonised geology curriculum – shows how this issue is intertwined with other contemporary issues in geoscience education.

\*Rogers, S. L., Egan, S. S., and Stimpson, I. G.: Tracking Sustainability Concepts in Geology and Earth Science Teaching and Learning, Keele University, UK, The Journal of Academic Development and Education, 10, 14–29, <https://doi.org/10.21252/KEELE-0000028>, 2018 <https://keele-repository.worktribe.com/output/410743>

\*Dowey, N., Barclay, J., Fernando, B., Giles, S., Houghton, J., Jackson, C., Khatwa, A., Lawrence, A., Mills, K., Newton, A., Rogers, S., & Williams, R. (2021). A UK perspective on tackling the geoscience racial diversity crisis in the Global North. *Nature Geoscience*, 14(5), 256–259. <https://doi.org/10.1038/s41561-021-00737-w>  
In their section on Inclusive teaching Dowey et al state “Geoscience is vital in developing a more sustainable society, and a critical aspect of sustainable development is the reduction of inequalities (Goal 10, UN Sustainable Development Goals). Sustainability in Geography, Earth and Environmental Science HE education is considered by Gormally (2019), who advocates for interdisciplinarity, diversity of approach, and moving beyond environmental sustainability to include social, cultural and political perspectives. By teaching a geoscience curriculum more focussed on global perspectives of sustainability, and less on (typically white) traditional geoscience perspectives, we can create a more relevant and inclusive curriculum to students of all races and ethnicities.” This again shows how this issue is intertwined with other contemporary teaching issues.

\*QAA Subject Benchmark Statement Earth Sciences, Environmental Sciences and Environmental Studies March 2022 <https://www.qaa.ac.uk/the-quality-code/subject-benchmark-statements/earth-sciences-environmental-science-and-environmental-studies>

Has Sustainability as a core component of the ES3 degrees (see page 4). The first bullet point for Content of an Earth Science Degree is “The concepts and applications of sustainable development and systems thinking. This should be consistent with the QAA and Advance HE Education for Sustainable Development Guidance” (page 9). The first application of the degree listed is “the role of Earth sciences in meeting the UN Sustainable Development Goals” (page 10).

\*Geological Society of London accreditation. <https://www.geolsoc.org.uk/Education-and-Careers/Universities/Degree-Accreditation/Accreditation-of-Undergraduate-and-Postgraduate-Degree-Programmes/Application-Procedure-and-Requirements-for-Accreditation-of-Undergraduate-Degree-Programmes>

This both explains why some degrees are still 'traditional and technical' (because accreditation by the professional body requires it) but also demonstrates a change in that accreditation now demands that students are taught "Socio-environmental global development frameworks (e.g. UN Sustainable Development Goals) and the concepts of geoethics and environmental justice" (Theme 4, Appendix 3).

\*Geoscience for the Future website <https://geoscienceforthefuture.com/>

\*Geoscience for the Future poster <https://www.geolsoc.org.uk/~media/shared/documents/education%20and%20careers/Resources/Posters/Geoscience%20for%20the%20Future%20poster.pdf?la=en>

\*Bird et al., 2020. The future of geoscience. *Geoscientist* 30 (8). Doi: 10.1144/geosci2020-103  
<https://www.geolsoc.org.uk/Geoscientist/Archive/September-2020/Soapbox>

\*DecolEarthSci <https://www.decolearthsci.com/>

\*TeachEarth <https://earth-science.org.uk/teach-earth/>

An effort to create material aimed at the UK national curriculum on Earth science-related topics taught in other disciplines e.g. geography, physics, chemistry etc.

\* The Sustainable Geoscience Award at the University of Hull <https://www.gfgd.org/higher-education-learning-resources>

An example of how the GfGD module is being used.

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#### **Q 4** Check List

Is the English language of sufficient quality?

Yes.

Is the quality of the figures and/or tables satisfactory?

Not Applicable.

Does this manuscript refer predominantly to published research? (unpublished or original research is non-standard for a review article, and should be properly contextualised by the author)

Yes.

Does the manuscript cover the topic in an objective and analytical manner

Yes.

Does the reference list cover the relevant literature adequately and in an unbiased manner?

Yes.

Does the manuscript include recent developments?

No.

Does the review add new insights to the scholarly literature with respect to previously published reviews?

No.

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#### **Q 5** Please provide your detailed review report to the editor and authors (including any comments on the Q4 Check List):

Overall, I think this manuscript is a succinct review of geoscience and education for sustainable development. I think that it could make a valuable contribution to the discipline, in being a 101 for educators wanting to get up to speed on the topic. I do think that the inevitable geographic bias could be reflected upon more critically. There also needs to be some discussion of some more recent efforts and resources available and more

consideration of how this topic is part of a wider conversation on social justice and ethics in the discipline. What contribution can ESD make to these conversations? What are the pitfalls of ESD in relation to these conversations – is the idea of geoscience and sustainable development problem free? This could be considered more critically e.g. are the SDG neo-colonial, issues around the role of geoscience in green colonialism etc. In relation to Q4 checklist – these are minor points and can be easily corrected in review. I think the review can add new insights but this just needs to be more clearly articulated. I have attached a PDF with some technical corrections.

#### QUALITY ASSESSMENT

<b>Q 6</b>	<b>Quality of generalization and summary</b>	
<b>Q 7</b>	<b>Significance to the field</b>	
<b>Q 8</b>	<b>Interest to a general audience</b>	
<b>Q 9</b>	<b>Quality of the writing</b>	