

**Equitable Exchange: A framework for diversity and inclusion in the geosciences**

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## **Files Uploaded Separately**

Original Version of Manuscript (2020AV000359)

First Revision of Manuscript [Accepted] (2020AV000359R)

Author Response to Peer Review Comments

## **Peer Review Comments on 2020AV000359**

### **Reviewer #1**

I reviewed an earlier version of this commentary, and commend the authors for an excellent job with the revision. This new version is substantially improved, and I recommend publication in the current form. While I would have liked to see more discussion of potential strategies for overcoming some of the substantial challenges (e.g. those described in lines 246-259), this is probably beyond the scope of this article. Overall, I think this will be of broad interest and make an important contribution to the ongoing work in our community to increase justice, equity, diversity, and inclusion in geosciences.

### **Reviewer #2**

*Please see review that begins on the next page.*

## **SUMMARY:**

This piece proposes a a system of equitable exchange (EE) to increase diveristy and inclusion in geosciences. While this manuscript is a positive attempt to facilitate dialogue and shifts in behaviors aroundnd the geosciences, there are key issues that need to be addressed.

## **MAJOR POINTS**

**This paper does sufficiently acknowledge or situate the historical context from which the authors operate, meaning that is a Western academic gaze.**

- There is very little discussion about what has constituted legitimate knowledge and related to that, the fact that “mainstream” science has been used to justify colonial and imperialistic needs of Europe and the West.
  - Line 90: “Elevating” local/traditional knowledge is not the same thing as equivalence because elevating above erasure does not mean it is considered at the same level as Western knowledge. Should reconcider language
  
- The authors have also not included numerous educational initiatives in the geosciences whose curriculum was built around place-based research in order to increase equity and inclusion. There are key tenets within these programs that are translatable and applicable to research (some of which have involved authors ex. COSEE). Separating teaching pedagogies from research paradigms is a missed opportunity to leverage off of already tried and true methods that have engaged a broad swath of learners and community partners. Failing to mention these programs could potentially emphasize that other epistemologies are sufficient for education but not for research. >> lines 84-84 and lines 156 - 176
  - Apple, Jude, Judy Lemus, and Steven Semken. "Teaching geoscience in the context of culture and place." (2014): 1-4.
  - DeFelice, Amy, et al. "Engaging underrepresented high school students in an urban environmental and geoscience place-based curriculum." *Journal of Geoscience Education* 62.1 (2014): 49-60.
  - Ward, Emily M. Geraghty, Steven Semken, and Julie C. Libarkin. "The design of place-based, culturally informed geoscience assessment." *Journal of Geoscience Education* 62.1 (2014): 86-103.
  - Johnson, Adam N., et al. "Indigenous knowledge and geoscience on the Flathead Indian Reservation, northwest Montana: Implications for place-based and culturally congruent education." *Journal of Geoscience Education* 62.2 (2014): 187-202.
  - Gilligan, Matthew R., et al. "Building a diverse and innovative ocean workforce through collaboration and partnerships that integrate research and education: HBCUs and marine laboratories." *Journal of Geoscience Education* 55.6 (2007): 531-540.
  - Matsumoto, George I., et al. "A collaborative and mutually beneficial Tribal Marine Science Workshop format for Tribal natural resource professionals,

marine educators, and researchers." *Journal of Geoscience Education* 62.1 (2014): 74-85.

- Dalbotten, Diana, et al. "NSF-OEDG Manoomin Science Camp Project: A model for engaging American Indian students in science, technology, engineering, and mathematics." *Journal of Geoscience Education* 62.2 (2014): 227-243.
  - Dublin, Robin, et al. "COSEE-AK ocean science fairs: a science fair model that grounds student projects in both western science and traditional native knowledge." *Journal of Geoscience Education* 62.2 (2014): 166-176.
  - Cajete, Gregory. *Look to the mountain: An ecology of indigenous education*. Kivaki Press, 585 E. 31st St., Durango, CO 81301, 1994.
  - Cajete, Gregory A. *Igniting the Sparkle: An Indigenous Science Education Model*. Kivaki Press, PO Box 1053, Skyland, NC 28776, 1999.
- Because there is poor acknowledgement of historical context, seminal works in this area have not been cited and they should be considered in this paper.
    - Paulo Freire: *Pedagogy of the Oppressed*
    - Linda Tuhiwai Smith: *Decolonizing Methodologies*
    - Robin Wall Kimmerer: *Braiding Sweetgrass*
  - Lines 95 – 103, 156-179: Other examples of place-based research that would be appropriate include the large body of literature concerning Indigenous peoples of the Arctic and climate change
    - Riedlinger, Dyanna, and Fikret Berkes. "Contributions of traditional knowledge to understanding climate change in the Canadian Arctic." *Polar record* 37.203 (2001): 315-328.
    - Berkes, Fikret, Carl Folke, and Madhav Gadgil. "Traditional ecological knowledge, biodiversity, resilience and sustainability." *Biodiversity conservation*. Springer, Dordrecht, 1994. 269-287.
  - Line 119: stipulating that a “common paradigm for geoscience is discovery emanating from wonder” fails acknowledge that paradigm is a Western framework that developed in the 17th century as an outcome of the Enlightenment. In addition, it seems odd that a common paradigm would have a citation that is as recent as 2019. Recommend to either change “common” to “emerging” or cite additional less recent references.
    - Importantly, there is an assumption (based on the title of Figure 1) that this is “how individuals relate to science”, which is a Western science view. At minimum the authors should modify the figure to include other paradigms including actionable science but also non-Western science paradigms. At minimum, marginalized communities should not be relegated to solution-based science only. Also, where does applied science lie in this graph?
    - This paragraph in general was poorly referenced.
  - Lines 208-222: Work undertaken by other areas of the academy (primarily social sciences) to engage in and develop authentically new research paradigms based (e.g. post-positivism, critical theory). There’s no discussion about positioning EE,

actionable science or discovery emanating from wonder in relation to these established paradigms

- Also that participatory-based methods have been attempted in other science fields (biomedical science) to some success. referenced in terms of lack of recognition of previous efforts in other “mainstream” sciences to integrate/adopt participatory methodologies in their their research paradigms (e.g. biomedical sciences)

**Furthermore, throughout this paper, the authors use problematic terminology or misuse terms:** Language matters. Use of terms inappropriately perpetuates and reproduces systemic problems within the academy.

- currencies: is particularly problematic as the authors propose to move from transactional to relational interactions between researchers and community but use transactional, monetized terms to describe EE. There is an over-emphasis on equitable exchange but perhaps more attention should be paid to reciprocity.
- mainstream: to refer to Western research paradigms. This centers Western science and marginalizes non-Western scientific traditions (Eastern, Indigenous). Recommendation is to use “Western” rather than mainstream.
- paradigms: used in reference to “discovery emanating from wonder” and “actionable science” seems to be a misapplication of the term. Research paradigms derive from distinct ontological, epistemological, methodological axiological frameworks. >> the paradigms referenced in this piece all derive from the positivist research paradigm so they are different methodologies. It would be appropriate and recommended for the authors to include examples of non-Western research paradigms here.

#### **Inherent issues with EE:**

- Conception of knowledge as being mutually “owned” (line 224) is at odds with most Indigenous epistemologies, which hold knowledge as being communally held rather than individual. This is a critical tension between Western and Indigenous knowledges and research paradigms.
- Onerous burden is placed on boundary spanners to carry out EE in the “*who is involved*” section (lines 230 – 245). Given that the ability to nurture more boundary spanners involves education, this would be another area to provide additional examples of curricular geoscience programs that support these students (see citations above)

#### **MINOR COMMENTS**

- Line 37 & 304: consider “historically marginalized” rather than “under-represented”

- Line 67: #BlackinX was created by Stephanie Page, PhD (@ThePurplePage). Appropriate attribution should be made; should also include efforts such as Urge (<https://urgeoscience.org/>)
- Line 190: It's not clear what "maintaining individuality" mean?
- Citations in the text that are missing from the References:
  - Pandya 2012
  - Borrelle et al 2020
  - Spencer et al 2020

## **Peer Review Comments on 2020AV000359R**

### **Reviewer #1**

This is the third time I've reviewed this manuscript, and I recommended publication of the previous version. However, I carefully read the comments of Reviewer 2 who clearly has different expertise than I, and thought they made some very important points. Based on my review of this version and the response to Reviewer 2, it seems that the authors took these suggestions very seriously, and did a sufficient job of addressing their concerns. While some of the suggestions were not followed, I think they struck the right balance and did what was reasonable for the AGU advances format and audience, and provided clear justification for those suggestions they were not able to incorporate. I am very much in favor of publishing in this current form. It is well-written, appropriately referenced, and comprehensive, and will be of great interest to the geoscience community.

Note, there is one typo on lines 251-252 where "research" is repeated twice.

### **Reviewer #2**

The authors have addressed my points satisfactorily and I am happy to see this work published.