

**Review 1 Citation:** <https://doi.org/10.5194/gc-2021-28-RC1>

Review of "From Virtual Field Trip to Geologically-Reasoned Decisions in Yosemite Valley" by Barth et al  
Dear NC Barth and co-authors,

The present paper is interesting and well-written. It presents an elegant Virtual Field Trip (VFT), the authors' reasoning behind this VFT, some analysis on the technical solution for this VFT, some thinking on VFTs in general, and the instructor's impression of the learning outcomes of the students exposed to this VFT. The VFT itself looks polished and is easy both to understand and to use, and will likely be interesting to many. I have only a few comments, and I think this paper only needs very minor revisions to make it accessible to as many as possible. Many parts are somewhat descriptive and describe basic functionality in the technological solution, or are somewhat repetitive. This could be streamlined a bit.

Thank you for your detailed review, and in particular, your efforts to make our study more broadly accessible. We are pleased you found our manuscript needing "very minor revisions". We address your specific comments as individual responses below and have incorporated the majority of your suggestions.

My specific comments to the paper can be found below.

Sincerely,

Christian Haug Eide

University of Bergen

October 5<sup>th</sup>, 2021

Main points 1: Present link to virtual field trip earlier in paper

Right now, the link to the VFT is not presented before Section 2, Line 55. I believe many readers would like to see the VFT itself as early as possible, and I think it would be useful to place this link in the first paragraph of the introduction.

We have added a link to the four-part activity in the Introduction and have added a link to the VFT in the Figure 1 caption (first called out in the Introduction). Figure 1 more directly relates to the VFT component of our activity than the Introduction does generally. We think including the link in the first paragraph of the Introduction would disrupt our narrative flow and is more suitable at the end of the Introduction.

2: US-centric jargon

Many terms relating for example to how far students are into their study programme are US-specific and not immediately obvious to readers from other locations. Examples include upper division, summer field, course, module, gradebook, major.

Yes, we recognize now this is a bigger problem than we anticipated so thanks for helping us communicate effectively to a global audience. We removed all instances of “upper-division” and replaced with “advanced undergraduate” or “third or fourth year undergraduate” or “capstone” depending on the use. Reference to “grade-level” was changed to “knowledge-level”. Reference to “grade” was changed to “score”. Reference to “gradebook” was changed to “records of scores”. The first instance of “courses” was changed to “educational experiences” with a description of US terms after. The new first instance of “course” in the manuscript is now followed by “(i.e. “module” in the European use)”. To avoid confusion, we have removed our usage of “module” altogether and replaced it with “activity” throughout the text. “Summer field” now occurs in a parenthetical clause linking it to “capstone field geology educational experiences”. “Major” is no longer used to describe a concentration in study.

### 3: Unnecessary sections?

I am not sure section 3.3 adds very much? (This might just be because I am a philistine). 3.4 also seems to me to be much longer than necessary?

Concerning Section 3.3: The focus of much of the manuscript is on the remote learning activity we developed, how the format of VFT we chose fits into it, and comparative advantages/disadvantages of our general approach. Section 3.3 provides heavily referenced discussion from state-of-the-art literature surrounding geoscience education- studies on how humans learn and what strategies have proven effective in learning. This discussion section seeks to expand our study’s contributions by placing the advantages of our chosen VFT format into a broader context of learning and hopefully to encourage other VFT creators to consult documented strategies for effective learning. The other two coauthors consider these discussion contributions by our educational research colleague to be valuable and entirely appropriate to the call of the special issue to which we have submitted. We have actually decided to lean into this section more (partly in response to more directed comments below) by adding five references and sentences on cognitive load. Notably we added “Cognitive load refers to the load that performing a particular task imposes on the cognitive system (e.g. Paas and Van Merriënboer, 1994; Sweller, 2011). The amount of information one’s cognitive system can process at a given moment is limited. Thus, the presentation of too much information, some of which is unnecessary information when it comes to solving the task, can result in artificially increasing the cognitive resources needed to process the relevant content. This is referred to as extraneous cognitive load by Sweller (2010), and it results in decreasing the efficiency and efficacy of the learner’s cognitive system (see review of cognitive load theory by Paas et al., 2010).”

Concerning Section 3.4: This is by far the shortest section of four in the Discussion. We find every sentence to be on topic with the section header “From General Public to VFT to Geologically-Reasoned Decisions”. We feel this section, largely aligned with the overall title of the manuscript, sums some of our lessons learned and logically leads the reader into the Conclusions section. We could remove the detailed course statistics, but note that elsewhere the reviewer asked for more of these if available, as did the other reviewer (which we did). We do not see a need to shorten this section and prefer not to remove it altogether.

### 4: Hillshade

It is not clear how the hillshade functionality was delivered in Google Earth? On lines 312-3 it is stated that Google Earth can remove vegetation, but this is not standard functionality as far as I know. This should be described better.

We did not mention hillshade or intend to suggest that Google Earth digitally removes vegetation, but we do see the potential for confusion here. We removed the “e.g.” concerning vegetation entirely here; we think the sentence at line 308 adequately provides two examples of extraneous irrelevant information to the task at hand.

Minor points:

L17, L299 and 301: The term scaffolding is used but it seems vague to me what this actually means. Perhaps the authors could clarify this?

Literally, scaffolding is a network of platforms temporarily applied to allow workers to access and construct buildings. The term is pervasive in educational literature since the 1970s. Generally scaffolding is where a teacher provides a lot of support initially to aid students and then progressively removes that support as the student gains confidence and ability.

For the reviewer’s sake, here is a useful summary of scaffolding as a method in education:  
<https://www.gcu.edu/blog/teaching-school-administration/what-scaffolding-education>

For the sake of readers less familiar with pedagogical terms, we have added a parenthetical after the first in-text appearance that clarifies it as “additional learning supports that can eventually be decreased with increasing ability” and also added a reference to provide further background.

L30: “Most instructors” is a bit vague.

We do not have exact statistics available to us unfortunately. The corresponding author knows of three out of at least fifty schools (6%) that were able to run in-person field activities largely as they would have pre-pandemic. It is perceived that these are a vocal minority and the actual percentage is likely to be lower. It is beyond the scope of our study to poll all of these courses. While vague, we prefer leaving our descriptions as “a very small minority” paired with “most instructors” as we have. No change made.

L32: “began organizing and meeting virtually in March 2020” – what was this forum called?

To the best of our knowledge it started as “Designing Remote Geology Field Courses” and eventually became “Designing Remote Field Experiences”. We have added the latter forum name to the text at this location for clarity.

L44-45: Especially here, it should be clarified what a module is and what a course is.

The first author knew of many conflicting word usages in education between countries but was ignorant to the particularly troublesome uses of “course” and “module” so thanks for the enlightenment. The first instance of “course” (before this location) now has a parenthetical clause indicating equivalence to “module” in the typical European use. To avoid confusion, we have removed our usage of “module” altogether and replaced it with “activity” throughout the text.

L83: "What makes placemarks truly standout" – unnecessarily loaded, change wording.

Ok, sure. This text has been changed to "A key advantage of placemarks...".

L100-106: This is perhaps a bit too long and detailed?

At this suggestion we removed two supporting sentences here, shortening the length from 7 lines to 4.5 lines.

L122: Exceptional quality. It would be better to provide some objective measures of quality such as resolution, or "largest feature that can be recognized"

At this suggestion we have added supporting text here mentioning that individual trees and boulders can be resolved.

L133, 134: Loaded terms good, excellent. Text should be rewritten here to be more formal and more descriptive.

Text has been rewritten to be more formal. "Good" has been removed; "effective" has been substituted for "excellent." We do not think more description is necessary for this sentence.

L145: "steeped in the history of rock climbing". Vague, should be presented in a more informative manner.

We point to the Oxford English dictionary definition of "steep" provided via Google dictionary: "steep (verb) (1) soak (food or tea) in water or other liquid so as to extract its flavor or to soften it. "the chillies are steeped in olive oil" (2) surround or fill with a quality or influence. "a city steeped in history". Our use of steep here is well aligned with the second usage of the word; we argue our use is not vague and is entirely informative. We see no concern over this word choice and prefer not to change it.

L151: "An instructor-only file is provided with verified credentials." It is unclear to me what this means.

We have changed the text to clarify that a file with solutions to the exercise is available through the SERC website with verified instructor credentials.

L178-9: "are held to a professional standard." It is unclear to me what this means.

We have rewritten to "the quality of the work is expected to be comparable to that produced by an entry-level professional geoscientist".

L181-2: " these maps are among the best products students have produced in remote summer field alternative courses". Compared to what? Judged on what metrics? What is so good about them and how are these better than the ones they made before/in other modules?

We have added "UCR's" before "remote summer field alternative courses", which hopefully clarifies the many questions here and further emphasizes that this is based on our experience teaching at UCR in 2020 and 2021. We do not wish to get as granular as discussing student scores and rates of success in

meeting the many learning objectives across multiple projects, especially given the relatively small sample size (n=22). The following sentence provides two tangible examples of students meeting learning objectives; other mapping projects did not exhibit the same degree of completeness, accuracy, or understanding.

L257: Another point that should be pointed out, I suppose, is that there might be no guarantee for longevity for these VFT products. I suppose google could change their solutions and all this becomes obsolete? Or are there guarantees against that?

Google Earth is one of the most robust, long-lived, and ubiquitous pieces of software the authors are familiar with (largely unchanged over 20 years) and Google continues to support it in a reverse compatible sense to ensure no data loss. But yes, as with any format, longevity is not guaranteed and we have added a sentence to this discussion to acknowledge this.

L296: What exactly is meant by “excessive cognitive demands” here? I can think of very many experiences in higher education that places much higher cognitive demands on students than such a VFT. Also, what is meant by domain specific expertise here (i.e. which domain are you thinking about – geology, general computer skills, google earth expertise)?

What we mean by excessive cognitive demands is extraneous cognitive load. We have revised the paragraph to be clear as to what we mean by extraneous cognitive load and how the Google Earth VFT could potentially decrease students' cognitive load, facilitating learning. Additionally, we have clarified that what we mean by domain-specific expertise is knowledge about geology and about conducting fieldwork.

The relevant text is now: “Cognitive load refers to the load that performing a particular task imposes on the cognitive system (e.g. Paas and Van Merriënboer, 1994; Sweller, 2011). The amount of information one’s cognitive system can process at a given moment is limited. Thus, the presentation of too much information, some of which is unnecessary information when it comes to solving the task, can result in artificially increasing the cognitive resources needed to process the relevant content. This is referred to as extraneous cognitive load by Sweller (2010), and it results in decreasing the efficiency and efficacy of the learner’s cognitive system (see review of cognitive load theory by Paas et al., 2010). With the aim of reducing the learner’s cognitive load, the embedded instructional prompts that the Google Earth VFT format affords enables the instructor to promote guided discovery of the environment by allowing for the integration of direct instruction into discovery learning (e.g. Lee and Anderson, 2013; Mayer, 2004). This direct instruction provides students with the scaffolding (i.e. additional learning supports that can eventually be decreased with increasing ability) necessary to navigate and learn from such a perceptually and informationally rich environment (e.g. Lee and Dalgarno, 2011).”

On behalf of the authors, Nicolas Barth (nic.barth@ucr.edu) 28 October 2021

END