

Solid Earth Discuss., author comment AC2
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Reply on RC2

Manuel I. de Paz-Álvarez et al.

Author comment on "Virtual field trip to the Esla Nappe (Cantabrian Zone, NW Spain): delivering traditional geological mapping skills remotely using real data" by Manuel I. de Paz-Álvarez et al., Solid Earth Discuss., <https://doi.org/10.5194/se-2021-110-AC2>, 2021

Thank you for your review. Below we answer to your comments and provide some modifications of our original manuscript.

Specific comments

Comment: *I found that the authors were not sufficiently critical of the results of their experiment. When they asked the students to rate how well the Virtual Field Trip prepared them to face a real mapping project on their own, and their answer was 3.7/10. Frankly, this is a failing grade. De Paz-Alvarez et al. should conclude that this was not the right approach.*

Answer: The reviewer suggests that the low grade given by the students to the question 'How well the EMP prepared students for a real independent mapping project' indicates failure of the EMP. There are several issues at play behind this critique:

Firstly, this "failing grade" was a response by students to one specific question about the project, which cannot be construed as a measure of the success/failure of the exercise. Questionnaire responses, however negative, are not the same as an evaluation of the learning outcomes. It is disappointing that the students did not feel more prepared, but they have very limited field experience on which to make this assessment. With further reflection, this was not even a particularly useful question to ask.

Secondly, we whole-heartedly agree with the sentiments of the reviewer that a virtual exercise will never come close to a real mapping experience, and it is clearly stated as the authors' opinion throughout the manuscript. This exercise was developed under circumstances where a real mapping experience was not possible due to the COVID-related travel and social restrictions. It is natural that students do not feel as prepared to undertake an independent mapping project after the EMP than after a physical trip. Both activities are simply not comparable. In our view the EMP exercise does just what the reviewer recommends: "...to do something entirely new that fulfilled some of the same learning outcomes as the field experience." We aimed to achieve as many as possible of the outcomes of the field experience, but obviously there are fundamental aspects, such as those highlighted by the reviewer, that can never be achieved through a virtual exercise.

Thirdly, the rate of response of the students to the questionnaires was 30 %, which is

unfortunately low. The low response rate does not qualify the significance that can be attached to the questionnaire results.

Comment: Notice that that example of student work presented in Fig. 3 is very nice looking, but (according to the authors) the descriptions are copied from the lithologic tags illustrated in Fig. 2, and the cross section is structurally wrong! The main structure should be a recumbent syncline (Fig. 6A), not an anticline. So, what did that student really learn?

Answer: The reviewer uses as an example of the failure of the exercise a supposedly hopelessly wrong cross-section where an anticline is drawn instead of a syncline. The truth is, the cross-section was drawn in a different location than that shown in Figure 6, a location where it crosses the Pardominos anticline that generates the Valdoré tectonic window (e.g. Alonso, 1987). This structure is easily seen in the central part of Figure 1 striking NW – SE. This is a misunderstanding caused by the authors' failure to locate the cross-section in the manuscript. The caption of figure 3 has been modified to clarify that the cross section is not drawn across the fold in Fig. 6. A square-box has been added to Fig. 2A to highlight the location of Figure 6.

Comment: We could use the opportunity to do something entirely new that fulfilled some of the same learning outcomes as the field experience. The problem with the virtual field trip approach is that it becomes fundamentally a cookbook exercise, an artificial puzzle.

Answer: The EMP does attempt to fulfil some of the same learning outcomes as the field experience: this is emphasised in lines 80-84 of the original manuscript. The EMP exercise also attempts to go one step beyond than previous virtual field trips, making the experience as close as possible to a physical trip from a methodological point of view. It is not a cookbook exercise, at least no more than a real residential fieldtrip, in the sense that students are also asked to routinely perform a series of tasks in that case. Of course, many fundamental skills cannot be developed in our exercise, as acknowledged in the manuscript. It is very important to be able to identify rocks, but so is the ability to synthesize lithological and fossil descriptions into identifiable, coherent lithostratigraphical units. This skill is a focus of the EMP.

Comment: I think the preferable approach is not do a virtual field trip but to teach the students how to use the tools that a professional would use to solve a real geological problem remotely. In other words: teach them to use remote sensing data, GIS, geodetic data, potential field data, or to interpret geological data collected by others for a realistic reason (not just to make a virtual field trip).

Answer: In our view, the technology used to produce a map is much less important than the mapping skills. Thus, learning GIS does not guarantee success in the learning of geological mapping: quite the contrary, if learning GIS undercuts time spent on learning geological concepts.

The geological data used in the EMP was collected with a completely different objective than making a virtual field trip: part of it was collected during years of teaching in physical trips (that is, for the sake of education), and the rest was collected during a PhD project focussed on the deformation at the base of the Cantabrian nappes (for the sake of research). It so happened that combining both data, the authors were in a very good position for producing something like the EMP, whose development was incidental to the data collection.

Comment: In order to apply this to the Esla Nappe project the students would need to learn how to use QGIS, a step considered by the authors but rejected as impractical. I think you need to bite the bullet and teach them how to use slope and aspect of a DEM to collect strike and dip data. Teach them how to draw the contacts in the GIS. Those are

examples of skills that are applicable in a professional setting. Copying data from somebody else's field stops has very limited value.

Answer: Students were required to draw geological contacts in Google Earth, making use of the satellite images, in order to have a good three-dimensional view of the area and to better translate them onto the topographic map. As for using the slope of DEM to collect strike and dip, students were specifically asked to do so in some of the stops where provided data was purposefully missing strike and dip orientations, as we explain in sections 2.6, 3.1 and Figure 4. They were taught in the preparatory briefing how to construct structural contours and to extract strike and dip from Google Earth. Nonetheless, perhaps we should emphasize this point more in the manuscript.

QGIS was considered as the tool for the EMP but the students lacked the necessary GIS skills to use QGIS and since the course was designed during lockdown, it was not viable to ask them to learn the basics principles of QGIS and produce a geological map at the same time.

With respect with two last sentences above, we emphasize that they did not simply copy the supplied lithological descriptions, but they had to build their lithostratigraphic column based on these. It would have been all too easy for students to consider, say, all shale outcrops part of the same unit and have produced an erroneous map, but that was not usually the case. Note that they were not provided with the established stratigraphic succession in the area, and that they had to derive that from objective data. This, in our view, has a lot of methodological value.

We have added a more clear description of the requirement for the students to produce their own bedding orientation from structural contours derived from lithological contacts and the provided topographic contours.

Comment: *I recommend that the authors revise their abstract, conclusions and discussion to more clearly acknowledge the limited success of virtual field trips in teaching field skills. This was not a successful experiment; it is foolish to promote it as such.*

Answer: In the original manuscript, we clearly state that we are not advocating for changing mapping courses from physical to virtual formats. In three places (Abstract, lines 21-22; section 4.1, lines 321-331; Conclusions, 373-375) we recognise that a virtual field trip cannot replace a physical trip, due to a variety of factors which are detailed in the text.

We do not consider the EMP a failed experiment (otherwise we wouldn't have sent this manuscript). We acknowledge that the EMP has serious limitations when it comes to the training pure field skills such as rock identification, field navigation and orienteering, decision-making. Notwithstanding this, in our view the EMP helps to strengthen other important mapping skills which are essential to the fieldwork experience, which are often delivered during the evening in physical trips: analysing the data, drawing conclusions from the observations, envisioning the relation between the different lithologies, establishing a lithostratigraphic column, adequately translating the geological contacts to the map, choosing the location and orientation of cross-sections before drawing them. These constitute non-field methodologies that are also important in the development of a geologically sound map. Training in this part of the methodology is delivered in the EMP: we focussed on what can be achieved virtually, and not on what simply cannot be accomplished if not in the field.

We are happy to answer any other questions or comments about the manuscript.

Kind regards,

The authors