

Comments on “Flowing with the changing needs of hydrogeology instruction” by Gleeson, T., et al.

## GENERAL COMMENTS

This manuscript presents a literature review of hydrogeology instruction with a primary focus on introductory physical hydrogeology courses. The main body of the manuscript is largely based on the analysis of survey data conducted in 2005 and the review of the papers published in the *Journal of Geoscience Education*. The manuscript is well organized and written. It presents a nice summary of the current status of hydrogeology education and makes useful suggestions for the future. As a hydrogeology instructor myself, I agree with many of the points made by the authors. This article will serve as a particularly useful guide for young hydrogeology instructors who are starting to design their own courses, and also for more established instructors who are planning to redesign their courses. While the manuscript is generally in a good shape, I do feel that the manuscript can be improved by addressing a few comments below.

## SPECIFIC COMMENTS

1. Title has “the changing needs”, but it is not very clear to me what is changing. Does the change refer to more diverse background of students? Or is it related to changing job market? Please explain it more explicitly in the introduction or conclusions.
2. I would like to see the “punch lines” more clearly stated in the conclusions. What are the main messages of this review, and what are the recommendations? Do the authors recommend the iterative approach as the essential aspect of hydrogeology instruction? Or, do they see the use of student-collected data as the essential aspect?
3. The authors suggest that it is important to have a balanced approach integrating class-room teaching, laboratory exercise, and field data collection. I believe that very few hydrogeologists would disagree with this point, and many of them probably have thought about the same thing. An important question, then, is what has prevented many instructors from implementing the integrated approach? Some discussion on the challenges in the integration of the three components will be useful.
4. Figure 3 lists the crucial topics to be covered in an introductory physical hydrogeology course, based on the 2005 survey. I would be very interested in finding out if these had changed during the few decades prior to 2005. If the authors want to talk about “flowing with the changing needs” in this paper, it will be very useful to look at a similar list from the courses taught in 1970’s and 1980’s. It will be difficult to compile a list from many samples, but the authors could obtain lecture notes (probably handwritten) from a few universities that had undergraduate courses in hydrogeology and examine the contents. Some examples I can think of are University of Waterloo, University of Minnesota, and University of Wisconsin-Madison. Could the authors contact graduates from these or other universities who took hydrogeology courses in 1970’s and 1980’s?
5. Page 1126, line 6. I would say that software-generated contours are not only “not inherently accurate”, but also less accurate. This is because there is no room for human intervention based on the knowledge of topography, geology, presence of surface-water features, land use, etc. I would like to see this point made more clearly.

6. Page 1130, line 1. I certainly see a strong merit in using the real data collected by students themselves. However, there is also a pedagogical merit in using the appropriate data that bring out the fundamental principles more clearly than messy data collected by the students. For example, for the pursuit of real data, one may be tempted to conduct a slug test in a water-table well at a convenient location. Interpretation of such data will require an elaborate mathematical analysis using non-linear equations, or numerical simulator. Would this be a more pedagogically meaningful exercise than providing the data set (still real, but not done by students) collected from a properly designed slug test? Is there a merit in teaching the students how to design a proper slug test? Perhaps, using both (clean and messy) data sets may be ideal? A discussion on the advantage and disadvantage of using student-collected data will be useful.
7. Figure 3. Should the title of the horizontal axis be “respondents”, not “applicants”? Same applies to supplementary figures.
8. Figure S1. The figure subtitle in Page 2 should start with (f), not (e). The scale for horizontal axis for the figures in Page 2 should be “0, 20, ..., 80, 100”, not “0, 25, ..., 100”.