

Understanding how learning works results in transparent course design decisions

by Marina Pantazidou, Sept. 16, 2022

I am proud of having reported on **teaching Environmental Geotechnics** in a [paper](#) published in the Int. J. of Engineering Pedagogy and in a [webinar](#) (0:44-41:40) of the Int. Webinar Series on Geoenvironmental Engineering organized by Prof. Krishna Reddy, U. of Illinois at Chicago. The paper reviews research-based learning principles and describes examples (available in online supplement) of how these principles were translated into instructional decisions during the redesign of an environmental geotechnics course. As a companion-introduction to the paper, the webinar stresses a few basics of how our brain works and connects them to key course design decisions, such as introducing course topics with **Essential Questions**, providing sign posts for review with **Main Points**, reinforcing learning with **Recall Questions** and expressing performance-based requirements with **Learning Outcomes**. (As an example of the above, the webinar lists its own Main Points and Learning Outcomes.)

I consider the following to be the strong elements of this work:

1. The starting point for both the paper and the webinar is how learning works: the webinar presents the absolute minimum justification, while the paper offers a distillation of the research evidence.
2. Both pieces acknowledge and exemplify the two complementary starting points for course design, i.e. starting from how learning works and starting from how the content hangs together.
3. Stating the essential questions for the course is an instance of blending these two starting points in No 2 above. In order to communicate with a wider audience –and most importantly with the students at the beginning of the course– the essential questions are phrased without any technical terms; in the webinar they are compared in slide 13¹ with their more formal counterpart with the proper terminology.
4. From the educational material in the online supplement, I would recommend as directly usable by instructors the [graphic that shows the relative contribution of transport mechanisms](#) (Figure 1 in paper) and the collection of [quiz-type recall questions](#), especially those discussed in the paper (Figure 2) and the webinar (slides 21 and 22).
5. For those who, like me, prefer to first present phenomena in a qualitative way, I would invite them to have a look at the presentations for the [mechanisms of contaminant transport in water](#) (with neat animations from an open MIT course by Prof. Heidi Nepf) and for the [delay of contaminant movement due to sorption](#) (with data from a tracer experiment at the Borden site reported by Mackay et al.).

¹ Truly Essential Questions, phrased **without** and with jargon

What is the danger (from pollutants)? = Why do we base remediation decisions on risk and not on danger?

Where will the pollutant go, how will it behave? = What are the main mechanisms of pollutant spreading?

What can we do to reduce the danger? = What are the main remediation technologies?

When are things* relatively easy or difficult and why? Which are the major challenges for site remediation?

* things = contaminated sites