Active Learning Writing Assignment

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Learning “what” versus learning “how”

There is a huge difference between “declarative knowledge ‘knowing that’ and procedural knowledge ‘knowing how’” (Michael, 2006, p. 161). In fact, a student must possess problem-solving skills to apply what they know to a procedural process. Teachers should assume students do not possess these problem-solving skills, and instead provide them with opportunities to practice the “knowing how” and provide feedback that reflects the “knowing why”.

For example, students learning chemistry learn very early in the year that in a neutralization reaction when an acid is added to a base in equal amounts, the resulting product is a neutral solution of salt and water. To test this process, students must carry out a titration in a lab where they add an acid with a known concentration to a base with an unknown concentration. There is an indicator in the unknown solution of the base that will change color when the solution is no longer basic and therefore, more or less neutral. At the end of the activity, students must predict the product of the reaction and calculate the concentration of the base they used.

Although this procedure is congruent with the conceptual knowledge from lecture, most students are unable to connect the process of doing to this knowledge. They may be able to follow the directions and do the lab, but the majority of students cannot explain why they did this activity or answer any post-lab questions. Therefore, teachers must not only provide opportunities to practice these necessary skills and receive performance feedback, but they must also help the students connect their procedural knowledge with their declarative knowledge. This feedback will foster problem-solving skills they can hopefully apply to future situations.

Connection to Online Learning

Connecting declarative knowledge to procedural knowledge is challenging in an online environment for science. There are many options for online laboratory activities that are related

to stem fields, but I have not found any that are effective in providing a way for the instructor to provide feedback about the student's performance. This impacts the effectiveness of the activity and limits the problem-solving skills that the instructor hopes students learn.

In our online course focusing on teaching and learning, the micro-teach projects are extremely effective activities that connect "what" we have learned conceptually about effective lecturing techniques to the "how" we can apply these concepts to enhance our teaching skills. There is ample feedback from the professor and our peers to identify clear connections between conceptual knowledge and how to practically enhance the presenter's procedural knowledge.

I think future online science courses will require at least one hands-on lab or virtually simulated lab to be conducted similarly to the microteach activity where students perform a lab activity in a live-stream classroom or submit a recording. This way, there is video evidence of their performance that an instructor can provide feedback on.

References

Michael, J. (2006). Where's the evidence that active learning works?. *The American Physiological Society*. 30(4), 159-167. DOI: 10.1152/advan.00053.2006.