

Emerging trends in online STEM lab design

In the first four parts of our [series on online STEM labs](#), we looked at why online faculty choose to develop an online lab course, the diversity of lab solutions faculty implemented to meet course objectives, how to engage online lab students, and special assessment considerations within the context of online STEM labs. In this fifth and final part of our series, examine some cutting edge efforts to improve teaching and learning in terms of both technical solutions and pedagogical approaches.

TECHNICAL SOLUTIONS

In our [second Teaching Tip](#), we looked at four approaches to online labs, and mostly skimmed over virtual labs and simulations. Lab simulations have existed for decades, and the term “virtual lab” encompasses many computer-based lab experiences. Some practical examples in higher ed can be found at the [California State University System](#), [Oregon State University](#) and the [Howard Hughes Medical Institute](#), as well as from private companies such as [Learnexx](#).

There is some emerging evidence that the application of virtual lab experiences is effective and here to stay. Reece & Butler (2017) found no significant difference in outcomes in a comparison of traditional and virtual lab experiences. Bonde et al. (2014) found a 77% increase in achievement of learning outcomes over traditional teaching methods when virtual reality labs were used, and a 101% increase when they were used in conjunction with traditional methods.

These “virtual reality” labs are experiencing a resurgence, and with some staying power thanks to the prevalence of cheap VR headsets. The clear advantages of a virtual lab environment are access and cost, as well as the immersive experience afforded via a headset.

[Labster](#), the tool used in the Bonde et al. study, is a prime example of this. Labster was [featured in a 2015 TED Talk](#) that provides a good primer on the concepts of a virtual reality lab. Other examples of virtual reality lab experiences include the [Millipore-Sigma Virtual Reality Labs VR app](#), University of North Dakota’s [Petroleum Engineering VR Lab](#), and [Zspace.com](#).

Virtual lab experiences cannot replace locally situated investigations, hands-on explorations, or the serendipity of

discovery. But virtual labs can do a few things that these more mainstream learning experiences cannot. They can allow students to perform experiments that are too dangerous to do in a home environment. They can allow students to get focused experience with equipment or tools that are either too bulky or too expensive to distribute widely. And they can overcome boundaries of time and space to give students a perspective impossible in any other way – explore cellular organelles from within a cell, or observe the solar system from the perspective of an orbiting comet.

PEDAGOGICAL APPROACHES

As faculty develop online lab experiences, some are taking advantage of the opportunity to reconsider their teaching models and the fundamental learning objectives they hope to achieve. Teaching online affords increased opportunities for [shifting from structured inquiry models toward more open inquiry models](#). An open inquiry model is more learner centered, allows students to determine their own problem, design their own procedures, and then present their findings. In short, open inquiry models put students more closely into the role of the scientists they are learning to become.

Dave Brashinger, STEM Program Director, American Public University, recently shared some inspiring anecdotes about incorporating open inquiry into student capstone research projects. “In a lot of ways, we’re exceeding what students can typically do on campus. ... In our approach, students have a broader scope for what they can research and it’s great to watch them design their project, perform their research and then come back and present their results.” [You can view the recording here.](#)

The subjects related to designing and teaching online STEM lab courses are both deep and broad. In our [five-part series](#) on the subject, we have barely begun to scratch the surface. If you are interested in continuing the conversation, or in developing an online STEM lab course, please don’t hesitate to reach out. There is much more to discuss and many great opportunities to be explored.

FURTHER READING

For a list of recommended articles, please visit [iTeachU](#).