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Science, Technology, and Environmental Policy

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Presentation
"Leveraging Digital Learning Assets and Virtual Lab Spaces to Bridge the Gaps in STEM Education"

In a perfect world, STEM education would involve sometimes messy exploration through inquiry and hypothesis testing, and be guided by instructors who make the concepts come alive for students. Students would be excited to deepen their understanding of our physical universe. In the real world of today's traditional and often didactic introductory classes, however, such an ideal is extremely difficult to achieve. It is typically in the laboratory where such exploration is supposed to be fostered, wherein students are typically separated into groups to engage hands-on with the content. Our laboratory learning spaces, however, for a variety of mitigating reasons beyond the instructor's control, too often fall short of such expectation. It may be possible that future technology that offers students immersive, guided, and exploratory experiences, such as Virtual Reality and Artificial Intelligence, can address, and possibly solve, these problems, and even provide better and fuller experiences than those available with physical manipulatives, but such technologies are at least a decade away. In the interim, STEM educators, who have historically been skeptical of online learning, are beginning to find value in digital laboratory learning solutions, even though NASA and the U.S. Air Force have been using virtual learning spaces to train astronauts and pilots for years. Mature and commercial virtual learning technology has now found its way into the mainstream K-16 (and beyond) classroom, and is innovative enough to meet learning objectives in introductory courses, and with active learning peda/andragogy, and thus bridge critical gaps currently found in STEM laboratory education. This panel will discuss research, examples, and best practices for using virtual laboratory learning spaces to address the following gaps that have emerged in STEM education, and conclude with a discussion on their potential impacts on science education policy:

1. To follow a prescribed lab "recipe" for the sake of a good grade and within a limited time window, students focus more on the ends than the means, thereby failing to grasp the importance of, and make the deeper conceptual connections between, the steps they are performing in lab. Furthermore, time constraints result in division of labor within lab groups, with many students simply following the leader and missing important information, not understanding results, and missing the connection between the skills they are learning and their own field of study.

2. Reduced time, space, and laboratory resources (both human and monetary) create instructional limitations that foster disconnect between lecture and lab learning.

3. Students lack knowledge of nomenclature, terminology, techniques, and safety protocols, and thus consume precious lab time wasting materials/resources and learning basic knowledge "on-the-spot," preventing them from using the lab space to foster deeper learning and exploration.

4. Protocol enforcement, grading, and level of help given to students in general are often inconsistent between lab sections and instructors, and no scalable and repeatable instructional/workforce training was found to exist.

5. Online learning continues to become more popular every year, and many non-traditional students who want to take STEM courses aren't being reached.

6. Many important STEM concepts and skills are not being taught simply because they do not fit well within a traditional laboratory learning space.

Panelists
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