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Development of Advanced Virtual Radiation Detection and Measurement Laboratory (AVR-DML) for Nuclear Science and Engineering Students

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Abstract : Online education has been around for several decades, but the importance of online education became evident after the COVID-19 pandemic. Eventhough the online delivery approach works well for knowledge building through delivering content and oversight processes, it has limitations in developing hands-on laboratory skills, especially in the STEM field. During the pandemic, many education institutions faced numerous challenges in delivering lab-based courses, especially in the STEM field. Also, many students worldwide were unable to practice working with lab equipment due to social distancing or the significant cost of highly specialized equipment. The laboratory plays a crucial role in nuclear science and engineering education. It can engage students and improve their learning outcomes. In addition, online education and virtual labs have gained substantial popularity in engineering and science education. Therefore, developing virtual labs is vital for institutions to deliver high-class education to their students, including their online students. The School of Nuclear Science and Engineering (NSE) at Oregon State University, in partnership with SpectralLabs company, has developed an Advanced Virtual Radiation Detection and Measurement Lab (AVR-DML) to offer a fully online Master of Health Physics program. It was essential for us to use a system that could simulate nuclear modules that accurately replicate the underlying physics, the nature of radiation and radiation transport, and the mechanics of the instrumentations used in the real radiation detection lab. It was all accomplished using a Realistic, Adaptive, Interactive Learning System (RAILS). RAILS is a comprehensive software simulation-based learning system for use in training. It is comprised of a web-based learning management system that is located on a central server, as well as a 3D-simulation package that is downloaded locally to user machines. Users will find that the graphics, animations, and sounds in RAILS create a realistic, immersive environment to practice detecting different radiation sources. These features allow students to coexist, interact and engage with a real STEM lab in all its dimensions. It enables them to feel like they are in a real lab environment and to see the same system they would in a lab. Unique interactive interfaces were designed and developed by integrating all the tools and equipment needed to run each lab. These interfaces provide students full functionality for data collection, changing the experimental setup, and live data collection with real-time updates for each experiment. Students can manually do all experimental setups and parameter changes in this lab. Experimental results can then be tracked and analyzed in an oscilloscope, a multi-channel analyzer, or a single-channel analyzer (SCA). The advanced virtual radiation detection and measurement laboratory developed in this study enabled the NSE school to offer a fully online MHP program. This flexibility of course modality helped us to attract more non-traditional students, including international students. It is a valuable educational tool as students can walk around the virtual lab, make mistakes, and learn from them. They have an unlimited amount of time to repeat and engage in experiments. This lab will also help us speed up training in nuclear science and engineering.

Keywords : advanced radiation detection and measurement, virtual laboratory, realistic adaptive interactive learning system (rails), online education in stem fields, student engagement, stem online education, stem laboratory, online engineering education

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