

A virtual learning environment for interactive engagement with advanced quantum mechanics

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The citizen science game Quantum Moves [Lieberoth et al (2014 *Human Computation* **1**, 219)] allows ordinary people to contribute to the development of a quantum computer. The game has been played more than 400.000 times and has been used extensively to illustrate the basic concepts of quantum mechanics in workshops at the high-school [Magnussen et al (2014 *EJEL* **12**, 259)] and university level [Bjælde et al (2014 *World Conference on E-Learning in Corporate, Government, Healthcare, and Higher Education* **2014**, 218)]. Lessons learned from these workshops have now guided the design process for a new virtual learning environment.

Previous virtual learning environments for quantum mechanics have been dominated by text with the addition of a few strategic simulations and visualizations [Kohnle et al (2014 *Eur. J. Phys.* **35**, 015001)]. We wanted to explore another more interactive design approach encompassing multiple interactive exercises deployed strategically in relation to a classroom learning plan, allowing the students to reflect on and test the curriculum in continuation with their own learning trajectory.

The first test of this new virtual learning environment was a 2014 course in advanced quantum mechanics at Aarhus University. It was well received by all 47 students enrolled in the course, and at the end of the term we were able to demonstrate that students' activity in the virtual learning environment statistically predicted their performance at the exam. In this talk we present findings on how the virtual learning environment use was related to engagement and exam performance, and discuss the implications for future introductions of mandatory game inspired teaching tools in physics education.