

A new multimedia resource for teaching quantum mechanics concepts

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2011 AAPT Summer Meeting; July 30 - August 3; Omaha, Nebraska



Overview of the animations

- Aimed at University students and instructors
- Created in Adobe Flash, Mathematica used for calculations and graphs → small file size, inexpensive to produce
- Based on outcomes of education research and our lecturing experience (four quantum mechanics lecturers involved)
- Evaluation (questionnaires, diagnostic surveys, observation sessions) used to optimize the animations.
- Complementary to other multimedia resources (PhET, Physlets, QuILTs, etc.)
- Freely available at www.st-andrews.ac.uk/~qmanim

see also Kohnle et al., Eur J Phys, 31, 1441 (2010)



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Animation topics

>40 animations developed to date

- Probabilistic interpretation of classical systems (2)
- Bohr's model of the hydrogen atom (1)
- Photoelectric effect (1)
- Probability current (1)
- Wave packets (5)
- The Heisenberg Uncertainty Principle (2)
- Momentum probability densities (3)
- The one-dimensional infinite square well (10)
- The finite well (2)
- The harmonic oscillator (5)
- Bound states in other one-dimensional potentials (5)
- Measurement and wave function collapse (1)
- One-dimensional scattering (4)
- Expansion in eigenstates (5)
- The sudden approximation (3)
- Bound states in two-dimensional potentials (3)
- Time-independent perturbation theory (4)
- Multi-particle wave functions (2)
- Spin and angular momentum (5)
- Density matrix (1)
- Quantum information (1)



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Key features of the animations



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Student observation sessions

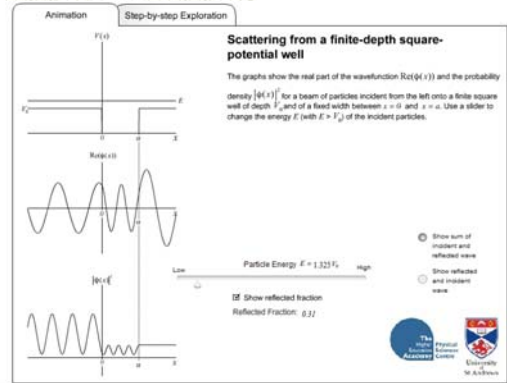
- Individual sessions with five student volunteers from Edinburgh and eight from St Andrews.
 - students asked to "think aloud" while interacting freely with a previously unseen animation
 - questions aimed to test whether graphs and explanations make sense
 - follow-up interview on experience with this and previous animations
- Consistency in issues raised. Outcomes used to optimize interface design and content of all animations.



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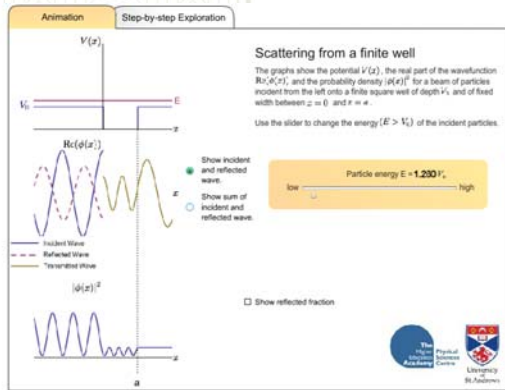


Student observation sessions: before...

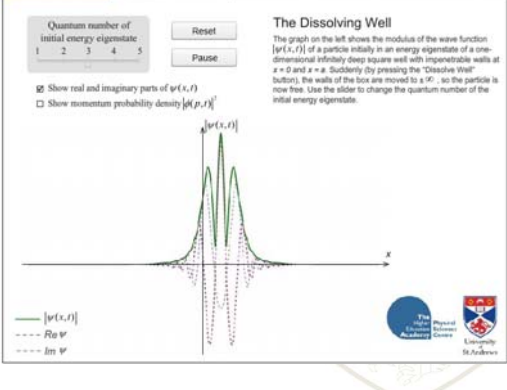


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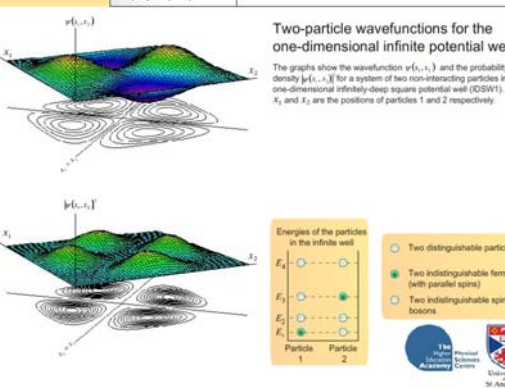
Student observation sessions: ...and after



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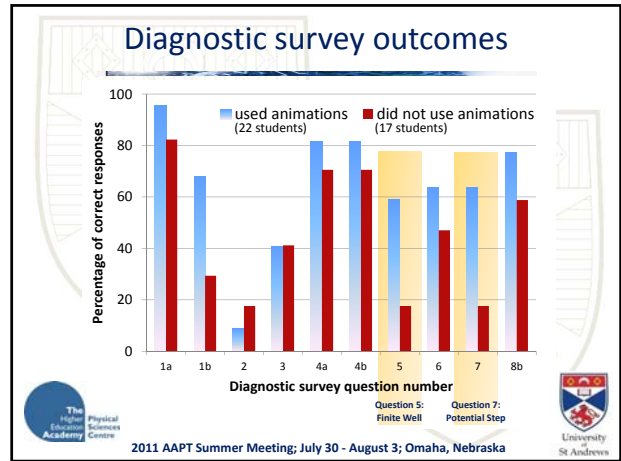
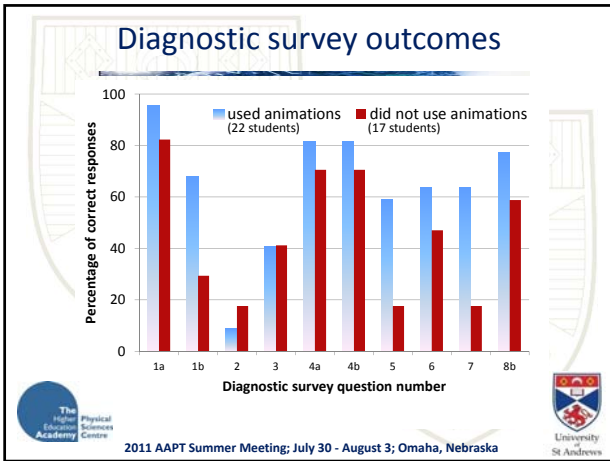
Diagnostic survey outcomes

- Diagnostic survey given to level two Quantum Physics class at a time when only half of the class had used two animations in a workshop.
- Students that had used the animations outperformed students that had not on those questions pertaining to the animation topics.



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- ### Conclusions
- Number of animations has been doubled in the past year, extending the range and topics of animations available.
 - Observation sessions used to optimize interface design and content.
 - Evaluation shows positive short-term learning gains.
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- ### Future work
- More detailed investigation of student use and long-term learning gains
 - Extend number of animations and instructor resources available, e.g. quantum information theory
 - More external user input
 - Integrate animations into multimedia learning modules
- Animations available (use and download) at www.st-andrews.ac.uk/~qmanim
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