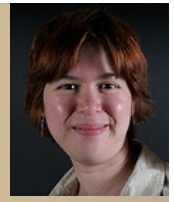
A Review of Educational Computer Simulations for Interactive Lecture Demonstrations in Introductory Astronomy Survey Courses



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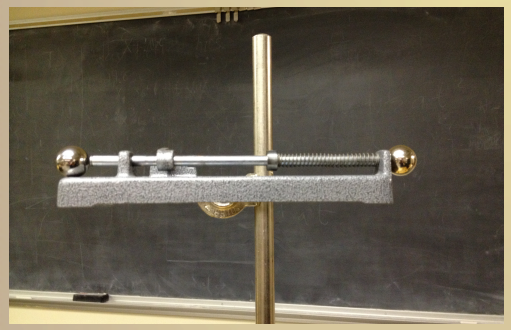
Interactive Lecture Demonstrations (ILDs)

Instructional Sequence:

1. Set Up
2. Think
3. Pair
4. Share
5. Commit
6. See It
7. Agree
8. Transfer

(adapted from Sokoloff & Thornton 1997, 2004)

Example: Which ball will hit first, dropped vertically or shot horizontally?



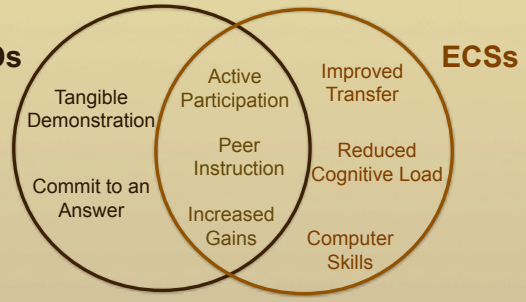
Benefits of ILDs

- Peer instruction – students learn better through helping each other (Crouch & Mazur, 2001; Lasry, et al., 2008)
- Committing to an answer requires students to explicitly state their reasoning (Sokoloff & Thornton, 1997)
- Active engagement – interacting with the material helps students to internalize it (Hake, 1998; LoPresto, 2012)

Overview

Physics instructors have long used demonstrations during lecture time (Sokoloff & Thornton 1997). Astronomy instructors on the other hand have been largely unable to implement tangible demos due specifically to the nature of the content. Many science courses have made extensive use of educational computer simulations, but the setting for these has typically been during labs or as homework assignments where students can each interact with the software individually or in small groups (e.g., Finkelstein, et al., 2005; Meier, et al., 2008). Simulations for astronomy instruction exist (Lee & Slater, 2006), but have not been extensively implemented or studied in astronomy lecture settings.

- ILDs have research-based learning advantages, such as active engagement and peer instruction
- ECSs allow demonstrations of astronomy topics of which we can't do tangible demonstrations
- Few studies of using ECSs as ILDs exist



Next Steps

- Design student prediction sheets for astronomy ILDs using ECSs
- Design instructor guide
- Pilot study of these materials
- Revise as necessary

Final goal

- Student workbook with response sheets
- Instructor guide with links, tips, etc.
- Available free via CAPER website and email list
- Published for wider dissemination

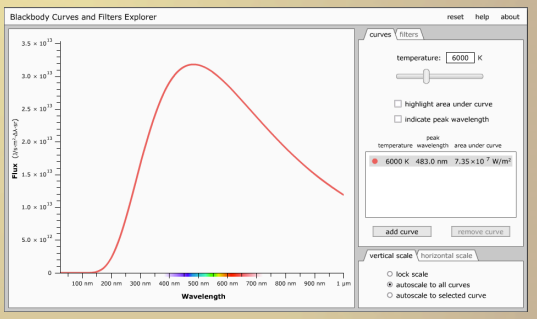
Full references available at
http://physics.uwyo.edu/~aschwortz/

Educational Computer Simulations (ECSs)

1. Represents a real situation in which things happen.
2. User has controls over the problem or situation.
3. Omits distracting/irrelevant variables for the instructional goals.

(adapted from Gagne 1962, as quoted in Lunetta & Hoffstein 1981)

Example: What will happen to a star's spectrum when it gets hotter?



http://astro.unl.edu/classaction/animations/light/bbexplorer.html, NSF grant #2031270, Lee & Slater (2006).

Benefits of ECSs

- Better learning improvement than no instruction (Cox, et al., 2005), lecture (McKagan, et al., 2008), worked problems (demonstrations of how to solve problems, Lee, et al., 2004), tangible labs (Finkelstein, et al., 2005)
- Better transfer – application of learning to new situations (Koops & Hoevenaar, 2012; Meier, et al., 2008)
- Potential for reduced cognitive load – omitting irrelevant aspects allows students to focus on the important parts

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