



Physclips: multi-level, multi-media resources for teaching first year university physics.

Report to the Carrick Institute

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Summary

A set of multi-media learning and teaching materials has been developed for teaching introductory physics. Most of the materials are for mechanics, but there are also materials on electromagnetism. These materials are the deliverables for this project and we refer the reader to them. For students, the principal entry site is

<http://www.physclips.unsw.edu.au/>

This provides interactive multimedia tutorials with links to deeper and broader support material. For use in lessons, teachers may directly download the learning objects from

http://www.physclips.unsw.edu.au/site_map.htm

Because it is aimed mainly at the syllabus for the first part of the academic year, Physclips has only had limited use so far. During the teaching session, Physclips received more than 1000 unique visitors per day, each visitor downloading typically 20 files. Overall there were typically 30,000 hits per day.

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Design philosophy, history and lessons learned.

The authors previously collaborated to create an award winning stand-alone multimedia presentation called 'Einstein Light', which is an introduction to special relativity using a multi-level, multi-media approach (<http://www.phys.unsw.edu.au/einsteinlight>). Einsteinlight evolved from a set of loosely-related animations into a broader collection of film clips, images and animations that were integrated both thematically and through the use of a carefully scripted narration. Feedback from colleagues and students during the production phase further shaped the process.

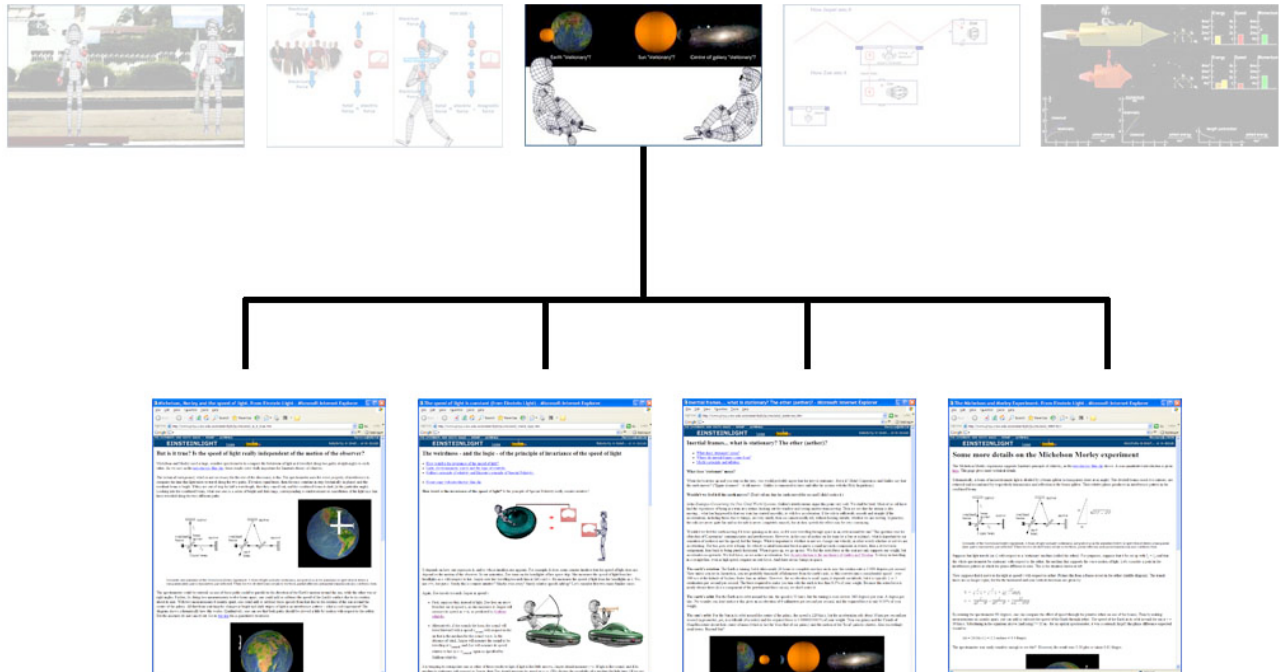


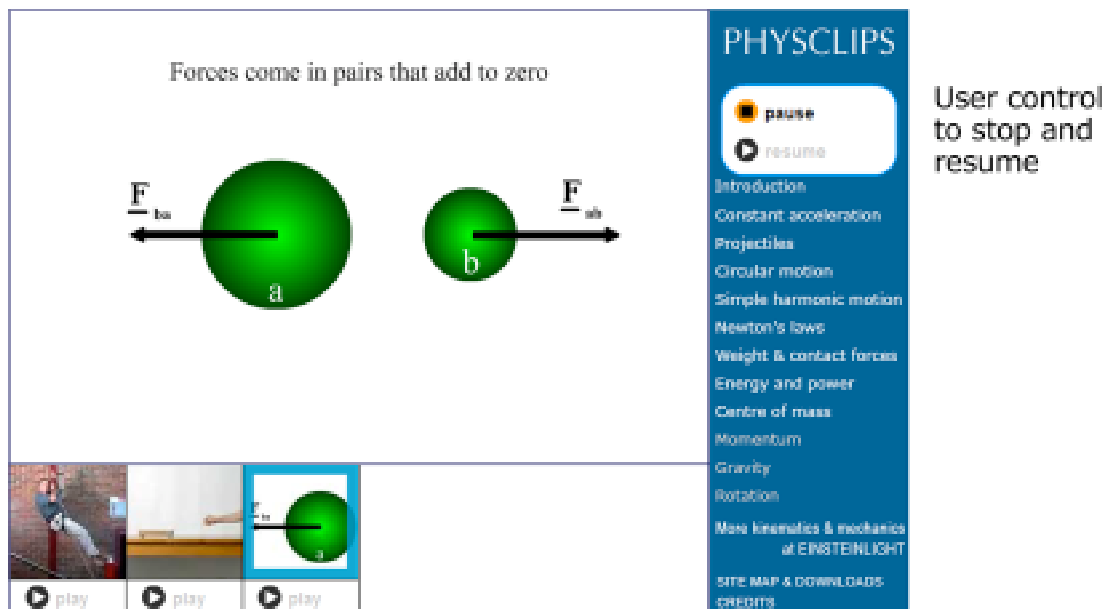
Figure 1: Screen shot from Einsteinlight Multimedia-rich modules provide a narrated overview of key concepts. Hyperlinks(both contextually embedded and at the conclusion of each module) provide access to web-pages that promote deeper understanding whilst also allowing user-control of key animations. This successfully employed bi-level structure was also incorporated in Physclips.

Einsteinlight won a Science and Technology Web Award from *Scientific America* and received highly complimentary reviews in the journals *Science*, *American Scientist*, *Education World*, and in newspapers such as *The Sunday Times*, *USA Today* and *The Sydney Morning Herald*. Meanwhile, physics teaching at universities in parts of Australia was changing. The effects of new high school syllabi with very different emphases became noticeable, with the effect that first year physics and engineering students were finding elementary mechanics as challenging as their predecessors had found relativity. Physclips was designed to attenuate some of these new problems by making multimedia presentations of introductory physics, using and improving upon and extending the techniques of our first collaboration that had gained broad approval.

Feedback and evidence based guidelines in the field of cognitive load theory

Feedback from those who used Einstein Light implied a couple of design modifications that were subsequently incorporated into the design of Physclips:

- More user control of the narrations via segment replay and pause / resume buttons
- Option to download the discrete animations that made up the longer modules
- A site map for easy access by teachers.



Segmentation and replay buttons

Figure 2: Screen shot from PHYSCLIPS The topics are segmented according to key concepts within the material. For self-pacing, individual segments may be replayed (windows at lower left) and pause/resume buttons allow immediate control of delivery rate.

The second avenue explored in terms of improving the instructional design was to examine the literature in relation to research-based findings in the area of multimedia learning, and in particular to cognitive load theory. An appraisal of Einsteinlight revealed that we had “got it right” on a number of counts. The “Modality Principle” (Low and Sweller 2005), which states that novices learn better when visual information is accompanied by a narration rather than on-screen text, was adhered to in that we displayed animations/film clips in synchronicity with a voice-over. Other design considerations that were incorporated in terms of segmenting (Mayer 2005a), worked examples (Renkl 2005), spatial/temporal contiguity (Moreno and Mayer 2000), signalling (Mayer 2005b) and user-control (Betrancourt 2005) were also validated by the existing literature.

Nonetheless there were research findings within the literature that were instructive as to how one might set about approximating an optimal design. The notion of cognitive overload in terms of overloading the working memory and the related consideration of whether the user needs to split their attention “between multiple sources of mutually referring information” prompted the authors to reflect on the amount of information made available at any given point. This strategy to reduce the cognitive load was further facilitated by the presence of the pause/resume functionality.

Deeper and broader

Logical, sequential presentation has its advantages, but it has disadvantages, too. To the novice, a quick overview, such as is provided by our illustrated narrations, seem to be a very useful introduction. But such a brief overview inevitably leaves gaps. Some points will need further explanation and context. Others will raise more profound questions. At various stages, the user may become aware of a need for an important tool (calculus, vectors etc) that has been assumed in the presentation.

One of the great advantages of html is that it allows branching presentation under the user’s control. So we have produced html pages to support, in depth, breadth and background. These use text, rather than narration, and introduce further levels of links. They are illustrated with diagrams, film clips and animations.

The links to the ‘deeper and broader’ pages appear under subheadings on the splash page, at the end of each module, and they appear in the presentations when they are likely to be needed.

Site map and download

We have presented above the point of view of the student user, for whom PhysClips would be a background or reference resource. For the teacher, Physclips is also a collection of catalogued learning objects. For the benefit of teachers, the clips and animations are collected on the site map so that they may be downloaded individually or in sets.

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