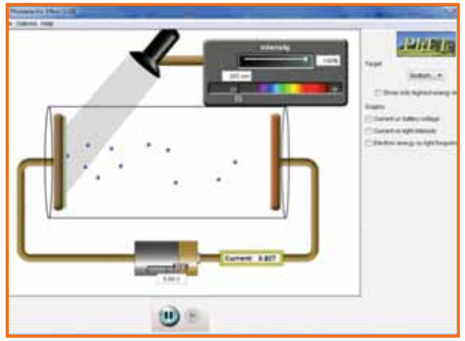
Using ICT and PhET to support Inquiry in Physics Lessons



Summary:

Within an existing CPD course designed to support both specialist and non specialist physics teachers, the PhET is used as a vehicle for their own learning as well as a model for classroom practice with inquiry potential.

Aims:

This is designed to model good classroom practice as well as develop their own understanding.

Main activities:

Group work and discussion around a web based software interface

Narrative:

This session is designed to allow teachers to use the freedom and flexibility that the PhET software provides to explore both their own understanding of the content as well considering ways in which these tools can be used to support inquiry learning back in their own classrooms. They will be provided with a minimum of information and then asked to explore the tools. To help frame their own inquiry, they will also have had the key ideas relating to inquiry based science education presented to them and an opportunity for them to discuss these.

After they have worked individually or in small groups, there will be an opportunity to share reflection and ideas across the group with the aim that these will be collated and shared within the group as well as back in the participants' schools when they return as you would imagine with any CPD activity.

By integrating this IBSE 'module' within an existing CPD event it is hoped that participants will see that IBSE is not simply an 'add-on' and can be effectively integrated into their own practice without significant challenge or barrier.

All simulations provide a number of tools for explorative work. However, many of them also have the opportunity to hide or reduce the availability of particular aspects of the simulation. This hence creates a simpler 'walled garden', which can help with orientation and enables students to develop a confidence with the core conceptual ideas before progressing further. For example, the moving man simulation allows students to look at displacement, velocity and acceleration graphs for the motion of an object, but also allows these to be seen individually and in isolation. This avoids the novice being forced to make sense of all three phenomena at once. The availability of rapid feedback from the simulation can facilitate dialogue between users who could be working on a simulation in pairs or small groups, constructing questions or hypotheses, testing them in the simulation, and then discussing the outcomes (or the observable relationship), with the simulation hence providing a focus and stimulation for peer-peer communication and collaboration. This can operate independently of the teacher's intervention.

PhET is used widely across the physics community, nationally and internationally. It is well regarded, and there is some research evidence about its utility, and it has itself been derived from a research base (http://phet.colorado.edu/en/research)

End user:
Experienced and novice teachers and students aged 11-18

Involved actors:
teacher trainers/CPD leaders and other teachers

Location:
Training venue as appropriate, may be in school or out of school

Languages available:
English

Where to find the application:
Most materials are already available on PhET website

Evaluation parameters:
Teachers complete formal or informal evaluation questionnaires, and the course itself is evaluated and assessed within the network of Science Learning Centers.

Duration:
Likley to be a short sessions of between 45minutes and 70minutes.

Optimum number of participants:
up to 20

Additional information or resources:
The PhET website has extensive resources as well as links to research on its effectiveness
http://phet.colorado.edu/
Screenshots can be taken from the PhET site. Some examples below.

Teachers' Competencies

1	subject matter/content knowledge	x
2	nature of science	
3	Multidisciplinary	
4	knowledge of contemporary science	
5	variety of (especially student-centred) instructional strategies	x
6	lifelong learning	x
7	self-reflection	x
8	teaching/ learning processes within the domain	
9	using laboratories, experiments, projects	
10	common sense knowledge and learning difficulties	
11	use of ICTs	x
12	knowledge, planning and use of curricular materials	x
13	Information and Communication Technologies with Technological Pedagogical Content Knowledge	

Mapping best practices with main principles

PATHWAY

1. Building interest in natural science phenomena and explanations:

The simulations create flexibility for exploration without imposing a rigid structure of discovery. They provide an opportunity for teachers and students to 'play' and explore, hopefully stimulating interest in the phenomena and the underlying explanations.

2. Building up informed citizens: Students understanding the nature of Science & Science in society:

By engaging in an inquiry process within the PhET environment, students and their teachers become more familiar with ideas about the nature of science.

3. Develop multiple goals:

- **understanding big ideas in science including ideas of science, and ideas about science**
- **scientific capabilities concerned with gathering and using evidence**
- **scientific attitudes**

The nature of the simulations in the PhET website are such that they are based upon the theoretical behaviour and relationships of variables to each other, and as such are a virtual manifestation of a perfect model of the relationships. This provides opportunities for students and teachers to explore the nature of models, their value in science education as well as the limitations they have as a replacement for practical work.

4. Understanding students' concepts and learning style about of science phenomena:

The PhET tools enable exploration of modelled scenarios, from which students can collect data and make conclusions but the ways in which they do this are not necessarily prescribed (although could be if the teacher wished). This provides possible multiple routes to understanding that the students can follow.

5. Relevance of the content to daily life of students:

Many of the simulations model the physics of everyday situations. For example, the motion examples are all real life contests such as removal men, people running, springs and static electricity involving balloons and jumpers, all things that they may have encountered in their lives and wondered about.

7. Activities for gaining knowledge, not for entertainment, nor for simple imitating of results:

By using PhET to model situations, teachers and their students develop an understanding of the rules which underpin behaviour of the animations, rather than reciting a simple set of facts, or simply undertaking demonstration practicals.

8. Doing science: experimenting, analyzing, interpreting, redefining explanations:

Most PhET tools do not enable the explicit processing of data sets within the simulation. However, some of them do enable the collection of discrete results, which could be analysed in a supportive similar parallel environment, such as spreadsheet modelling. This could enable predictions to be made, which could then be subsequently tested within the simulation and developed where appropriate.

9. Assessment: formative ~ of students' learning and the summative ~ of their progress:

There are opportunities for teachers to create and save developed versions of the online tools (e.g. specific types of electric circuit), and hence the online tools can be tailored to individual needs or to facilitate exploration of particular questions. This creates a de facto dialogue between teacher and student. Likewise, working together with the online tools can promote students' discussion and peer support.

10. Cooperation among teachers and with experts:

The structure of the course session, collaboration and follow up sharing and development of ideas is specifically designed to harvest the variation of experience and skills within the group to generate something that would not have been possible has they worked individually. The hope is that this will also act to promote this way of working to the participants who may consider it further.