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FYE Showcase Abstracts

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Experiment kit for first year Physics students to undertake practicals at any place and any time

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Context

Experimental work is an essential component of Physics subjects in order to reinforce the concepts covered in lectures and to teach students how to undertake experiments, analyse results and report the findings. For students studying by distance education, there is the difficulty of attending the University campus in order to undertake this experimental work. One option to overcome this is the use of concentrated compulsory residential schools at a set time during the year. The problem with this is the cost to the student in the form of accommodation, travel and time away from work and the family, along with the need to cover a large amount of material in a relatively short period of time. For the on-campus students, there is the difficulty of undertaking the experimental work at a fixed time of the week in a set period. This has the potential to clash with other classes, work requirements and any other commitments.

Action taken

This paper describes a take home experiment kit that was developed at the University of Southern Queensland, Toowoomba to allow students with a variety of educational backgrounds and from different disciplines in a first year Physics subject to undertake the experiments outside of the laboratory at a place and time that suits each individual student (Turner and Parisi, 2008). This can be done by the students at any time at home in any town or country or any other place that suits the student.

The experiments were designed to use low cost readily available equipment and materials. McAlexander (2003) has developed a kit with apparatus for some simple experiments, some of which are observational experiments. In an advanced third year Physics subject, a series of exercises have been developed for students to access, via the internet, data from detectors set up at the University (Parisi, 2005). In this project, the experiments were designed to specifically relate to the concepts in the subject and to allow hands-on use of the apparatus.

The experiment kit developed in this project contained the equipment and the materials required, along with the instructions on the required background reading, how to set up the experiment, measure the relevant variables and analyse the data to achieve the required objectives. All of this was packaged in a small box, referred to as an experiment kit that the students were able to purchase through the University Bookshop. For students living out of town, the Bookshop mails the kit to the students.

Tips and tricks

For a project of this type, it was necessary to keep the total cost of the equipment and materials in the experiment kit as low as possible in order to reduce the students' expense. Prior to the finalisation of the experiment kits, a student undertook the experiments in order to trial the equipment, materials and instructions. Based on the comments provided, the instructions were modified as required.

In order to minimise any possible problems the students may encounter when undertaking the experiments and the results analysis and report writing, they were provided with instructions for report writing, a marking criteria and photographs of example setups of the equipment. During the semester as the students worked on the experiments, it was necessary to monitor on a daily basis the electronic discussion forum in order to provide rapid feedback to any student queries on any particular aspects of the experiments.

Results, evaluation, impact

The project outcome was the development of an experiment kit with six experiments. These were first made available to students enrolled in a first year Physics subject in semester one, 2007 and are still being used for each semester one offer of the first year subject. The students purchase the kit with the equipment and instructions for each experiment from the Bookshop for about $40 (plus GST).

The experiments were designed so that:

- The concepts provided in the lectures were reinforced, allowing students to gain a basic knowledge and understanding of the relevant Physics concepts.
- The students had to undertake further reading on the concept from either the subject text or other relevant reference text.
- There were measurements and recording of the various variables in each experiment.
- Calculations were necessary to be undertaken based on the data.
- It was necessary to undertake some form of plotting of data on graphs, along with analysis of the graphs.

Through the use of simple apparatus and materials that are readily available, the kits introduce the concept that Physics is relevant to aspects in our everyday lives. The details of the experiments are as follows:

- For the Simple Pendulum experiment, students use the force of gravity on a pendulum consisting of a lead sinker on a string to calculate the acceleration due to gravity.
- In the Refraction and Reflection experiment, students develop an understanding of Snell's Law, dispersion of light and light paths, including recording of light paths.
- The Electric Circuits experiment provides the students with a basic knowledge of Ohm's law, voltages, currents, resistors and the use of a multimeter.

- The Spring Constant experiment introduces Hooke's law and concepts of stress, strain and elasticity.
- In the Fluids experiment, students obtain a better understanding of buoyancy and Archimedes Principle and calculate the density of fluids and the density of objects in fluids and apply the concept of Pascal's Principle.
- During the Speed of Sound in Air experiment, students develop an understanding of wavelength, frequency, standing waves and resonance in order to measure the speed of sound.

These experiments develop graphing skills and skills in the interpretation of graphed data, and all experiments require the setting up of the equipment, data measurement and analysis and have extension questions. The reports submitted by the students indicated that the students who completed the reports had obtained an understanding of what was expected in this assessment item.

Furthermore, the experiment kits have provided flexibility in terms of the environment in which the students are able to learn. They allow students to work at their own pace and also repeat any experiments as necessary and also explore any other aspects of the experiment while eliminating the need for a compulsory residential school or timetabled laboratory classes.

Further resources

Further resources and information on the experiment kits described are available in Turner and Parisi (2008).

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