Where is Murdoch University AFFA activity at in June 2012?
Project Summary and a Reflection on the AFFA initiative

Murdoch University Physics & Nanotechnology
Explorations in Enquiry Orientated Learning
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Project Summary June, 2012

We have been trialling inquiry oriented learning activates in several of the units within the School. They are still in the developmental stage but those that have been used with students are proving to be engaging and the students are giving providing positive feedback. The development of these activities has been supported and funded in part by the School.

New activities in PEC120 General Physics

Two inquiry oriented learning activities have been run within the first year, PEC120 General Physics unit tutorials. The first of these was based on investigating projectile motion. The students were given a Nerf Gun (toy foam dart gun) and a ruler and challenged to find out, how high the projectile would go if it was fired straight upwards, and what the muzzle velocity of the projectile was. This pilot activity was run with one set of equipment as part of a larger number of other activities in two PEC120 tutorials. The class was asked to split into four groups of 4 people and the groups were given the aforementioned challenge and asked to find a solution using the supplied equipment or anything else they happened to have available. Each group was given 10mins to collect data and then returned to the tutorial room to calculate their answers.

While one group was out collecting data the others were working on other tutorial activities, refining their approach to the activity or analysing their results and looking for sources of uncertainty or ways they could improve their experimental design.

Feedback from the tutorial groups indicated that while some students were enthused by the challenge and design aspects of this activity others were happier doing standard problem based tutorial activities. A round robin approach, as outlined above, gave students with different learning styles opportunities to learn in their way while allowing them to try a few new things as well.

At the end of the tutorial, when each group had a solution to the challenge, a plenary session was held to see how people approached the challenge, what sort of answers they came up with, and how certain they were of their results.

Overall they activity was met with a very positive response and will be implemented as a standard tutorial activity starting next semester.

A second activity, looking at heat transfer and how best to insulate an object from heat flow, was also trailed. In this activity students groups and given cardboard, aluminium foil, tissue paper, news paper, bubble wrap and other miscellaneous materials. They were then asked to design a structure (as small as possible) that could contain a heat source and insulate it from the outside world. The effectiveness of each of these structures was then investigated using a thermal- imaging camera.

This activity did capture the student's imagination and they designed some good insulating structures which lead to a fruitful plenary discussion session at the end of the activity. The main imitation with this activity is that there is only have one imaging camera but this can be overcome. With some refinement this activity will be used again in further teaching periods.

New activities in PEC621 Renewable Energy Devices

A small, inquiry oriented learning activity, was conducted as part of a tutorial for the Master's level unit, Renewable Energy Devices. This activity asked students to investigate ways to get the most power out of a solar panel. It requires the students to investigate the impact of solar concentration on the power output of a crystalline silicon solar cell, and the effect on the output of the cell due to the orientation of the panel. The activity was very underdeveloped from a teaching perspective but gave rise to a great deal of class discussion and will be used in a more refined version in later iterations of the unit.

Figure 1: PEC 621 Students investigating how to get the most power out of a solar panel

New activities for Schools on Campus events

Building on the activity used in the Renewable Energy Devices tutorials, as discussed above, we have developed a workshop activity for Schools on Campus events. In these events school groups consisting of 20 students or more, come on campus to experience a little bit of university life. This activity is therefore useful for showcasing physics and renewable energy studies. The students, working in small groups, are given the following design brief.

You and your team work for a solar engineering company (Innovative, Original and Unusual Solar Designs Inc (IOUSD)) who specialise in innovative, original and unusual designs for systems that need to be powered by electricity but are not connected to the electricity grid.

The company would like to build mobile phone recharging stations using their standard solar panels and some off-the-shelf electronics to regulate the charging process. These recharging stations can then be placed at outdoor concerts and festivals so people can charge their mobile phones and read our fantastic company logos and slogans. Each station should be able to charge four mobile phones simultaneously. The mobile phones might be held in little lockable cupboards or be attached to extremely long extension cords so people can chill out in bean bags while waiting. Management is not too sure on these details yet.

The students are provided with solar panels, multimeters, mirrors, protractors and wooden blocks. They can also use anything else that they have with them and are challenged to come up with a good design and a proof-of-concept device. The materials and some supplied supplemental information, provides the flexibility for multiple concepts to be investigated. The depth to which the groups go depends on their background knowledge and experience which means the activity should scale in complexity between groups of different backgrounds.

This activity has been trialled with a group of experienced tutors and will be implemented in a future Schools on Campus event. For this activity we also requested survey responses from academics within the school, and collected surveys from the tutors who participated in the trial run. We envisage this could be used as the basis for a journal publication or conference presentation on inquiry oriented learning in science outreach events.

New activities for OUA SCI19 / PEC152 Principles of Physics external students

Murdoch University Physics is known as being, the only university in Australia that has taught Physics in the external mode, since the university inception, which was in 1975. The necessary, hands-on experiential, experimental, aspects of the degree were achieved by sending kits of equipment out tho the students. This modus operandi has become more difficult in recent years as student numbers have increased, the teaching timetable has shrunk and academic staff workloads have changed. It was therefore necessary to find a way to still provide a high quality experimental experience without sending out kits. The open-ended structure of enquiry orientated learning projects provided a way to do this. Several small laboratory projects were developed, that required students to use the equipment they had to hand at home, to demonstrate physics principles. These are:

What is Your Reaction Time?

Catching a dropped ruler where the distance the ruler falls gives you the reaction time.

Acceleration Due to Gravity

In this activity students roll a ball down an incline to get its acceleration and from this determining the vertical acceleration of the ball. This will be less than the acceleration due to gravity as rolling takes energy and therefore there is less energy for translation. This loss of energy is investigated in a later lab session.

Coefficient of Friction

Students rest an object on an incline and increase the steepness of the incline to the point that the object starts to slide. In this way it is possible for the students to work out the maximum value of the coefficient of static friction for the materials in contact and compare this with known standard data.

Moment of Inertia

This lab uses the data from the Acceleration Due to Gravity Lab to investigate the amount of energy given to rolling the ball, assuming resistive forces are insignificant, and hence the moment of inertia of the rolling ball.

Buoyancy

Using liquid volume measurements students are asked to work out the density of some irregular shaped materials that they can find around the home and compare their measurements to known standards.

Magnetic Force

Students are asked to test the strength of a magnet that can be found around the home with the aid of the force of gravity.

A Simple Pendulum

In this lab students are asked to investigate all the variables of a simple pendulums construction to determine what has the most significant effect on the pendulum's period.

In all cases the experimental design was left up to the students. Some ideas for materials were given but the students were not required to use them. Unfortunately the experiments had to be used in their untested form with the OUA students in the recently passed study period. Impressively the students rose to the challenge and

due to their dedication, modifications can be made to the labs for future use with external students in both SCI19 and PEC152.

New activities for PEC152 Principles of Physics internal students

Tutorial sessions in this unit have always had a focus on hands-on as well as communication and traditional problem solving activities. Students today however study in a mixed mode and do not think that they should turn up to lectures and tutorials if the lectures are on-line and the tutorials can be missed without marks penalty. A first attempt at solving this problem was to introduce marks carrying tests to the tutorials hoping that the students would turn up for the tests and stay for the rest of the tutorial session. This worked some of the time. Perhaps an additional approach would be to make the tutorials more engaging by including enquiry orientated activities with corresponding report sheets to demonstrate tutorial participation.

Time constraints surrounding the training and retention of casual tutorial staff also adds weight to the argument to change the format of the tutorials in the unit. Starting from next semester the students will have a whole cohort, two hour tutorial, per week (24hrs in total), as opposed to seven three hour tutorials per semester (21 hrs in total) where the students are split into four small tutorial groups. The whole cohort sessions will be run by one academic with enough tutors so that there is a maximum of twenty students to one supervisor. This will enable small group and plenary session work suitable for enquiry orientated learning. Where possible current tutorial activities will be modified to suit the new learning style because they were originally chosen to work with the content of the unit or to enhance the student's skills in defined areas. Activities could also be sourced from others working with this style of learning, and modified or adapted to suit the needs of the unit and students. There may also be a need to create completely new activities.

The AFFA Initiative – A Reflection

It is hoped that over the next two years, as the changes progress, there will be at least a three refereed papers from this work as well as two conference presentations. This is an important outcome as the workload at the university is such that if there is little evidence of research output staff end up with more teaching duties.

The school, as it is at the moment, is very supportive of these new initiatives because there is a university wide drive to increase retention rates, and anything that can be done to increase the engagement of students in their studies is looked on favourably.

University wide quality assurance measures have recently been developed to ensure government compliance. Benchmarking our learning and teaching activities against those of other universities will be useful in demonstrating the quality of our work.

As mentioned previously the workload of academics in Physics & Nanotechnology at Murdoch University is very high and thus finding the time to make changes to coursework is not tackled with a light heart. Adopting enquiry orientated learning would probably have been little more than a corridor discussion if not for the driving force of Les Kirkup. It is amazing what you can do if you have promised some activity, and Les is flying across Australia to check on your progress. He has also given advice and feedback on the activities we are developing and their implementation. I am sure it will also be very useful to be part of the wider enquiry orientated learning network when we are looking for activities to develop for the PEC152 students next semester.