

Inquiry-oriented Learning in Physics at Murdoch

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At Murdoch University there are two first year Physics mechanics units, one is algebra based, co-ordinated by David Parlevliet and the other is calculus based, co-ordinated by Chris Creagh. Both units have between 70 and 120 students in them, most of whom are not physics students. The continual challenge is to engage the non-physics students at an appropriate level while maintaining a high quality unit that extends the physics major students. One way of doing this is to make the units as student focused as possible. This allows students to achieve at a level they are comfortable with.

There are two traditional mathematical based assignments in each unit. The third assignment is based on students identifying physics in the real world, performing a self-developed proof of concept experiment and producing a scientific paper on the whole activity. There are multiple choice tests on the content in each unit and traditional labs that relate to the content. There are also tutorials which were originally intended to go over assignments but which have been more recently utilised for testing different ways of engaging students in the learning process.

Inquiry-oriented Learning (IOL) activities are the latest and probably the most successful of the initiatives we have been trailing in order to engage students in their own learning. Anecdotally the retention rate in the tutorials is better, there is good working noise during the activities, the students seem brighter and more likely to try an activity and the tutors seem to be enjoying themselves as well. So now we have a mix of activities in the tutorials consisting of the best of each of the past activities.

Some of the IOL tutorial activities were originally developed as labs for external students. In previous years external students were sent a kit of equipment to enable them to do their labs in their own home. This became unwieldy as the numbers of external students increased and the ability of the postal system to get packages to the students decreased. This necessitated creating experiments that students could do with equipment they could find around them i.e. they were the experimental designers. The latest experiment they have been asked to design is "Given that you have a refrigerator and an electric kettle find the specific heat of water".

Other IOL tutorial activities were developed almost on the spot by just reworking the introduction to the activity. "Demonstrate the sharing of voltage across two resistors in series where one resistor has a variable resistance" becomes "Many circuit components are characterised by obtaining their IV curves. Design and build a circuit that can do this for a resistor and then a LED. Compare and contrast the two curves."

We have also developed IOL activities for projectile motion and heat transfer in materials. These have been implemented in small group tutorials with some success.

Although no formal survey on the experience has been conducted as yet, informal feedback from the tutors was very positive. Students reacted favourably and were more engaged during and after the IOL activity than in other traditional tutorial activities.

IOL can be applied outside of the tutorial and classroom for larger scale schools-on-campus activities. We have developed a workshop based on the concept of designing a solar powered mobile phone recharging station. Here small groups are given some materials including solar panels, multimeters and mirrors and asked to design a charging station from a design brief. Supporting materials are provided to help make sure people have the information they need to tackle the activity with confidence. The activity can be scaled to different groups with different backgrounds.

Once we had the basic concept of using IOL activities they started to pop up everywhere we felt students needed to engage more, lectures, on-line discussions and tutorials sometimes with only an hour's notice. Our thought process became "The content is in the previously recorded lectures and in the text book so how do I provide the environment that gets students working with this material rather than passively sitting there waiting to be entertained?"

Even relatively simple IOL activities could be used in traditional lectures to improve audience engagement. Within General Physics towards the second half of second semester active learning and small inquiry-oriented activities (5min in length) were incorporated into the traditional lecture format. No formal survey on this was conducted, but anecdotally the audience came alive and the atmosphere in the lecture lifted. Students were more attentive and willing to engage in discussion and ask questions after these activities.

I have a sneaky feeling we are heading towards flipping the classroom. David has already made some short videos of experiments. Both of us have made them of lecture-demonstrations. I recorded my lectures (PowerPoint and audio) sitting in-front of my computer years ago which has given me room to make my real-time lectures more interactive. I think we are just waiting for a way to record mini lectures that looks semi-professional. We were supposed to get recording rooms this semester but they have been lost in the university reshuffle. It looks like we are going to have to work this one out for ourselves. Next year we start to move to a new and more flexible learning management system and a new lecture capture system which allows desktop editing. It cannot come soon enough. We can then seriously start to work on mixed modal learning and teaching in which IOL can play its significant part.

Where to next? More activities will be incorporated as we move towards a flipped classroom. The engagement and enthusiastic discussion that comes out of IOL activities gives students a good incentive to turn up to lectures and tutorials. Chris is applying for a National Teaching Fellowship that will combine the concept of IOL and the multiple representations an expert uses to communicate their understanding in a "Work It Out" sort of way. In other words we have not finished yet; watch this space!