Learning and Teaching Investment Fund 2011

Final Project Report

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Title of project: Establishing best practice for optimising learning in a Technology Enhanced Active Learning Environment - TEALE

Strategic objective(s) addressed:

The project is global in reach and impact since it is part of a current movement away from traditional classrooms towards an active learning environment. The design is notably different from current designs and the suite of proposed activities (such as shared/remote labs accessed from within the TEALE) is novel. It will therefore add to the scientific data and evaluation of good practice in a developing field. With regards to student impact, there is enough evidence to suggest that with adequate implementation, CES scores, student satisfaction and student retention rates will be improved.

The project is also to be urban in innovation and impact since the teaching space design assumes a (spatial) flow from lecture theatre to adjoining TEALE to adjoining break-out space or informal active learning space. The design recognises the “urban” preference of students to meet in a “café” environment which has been placed close to lecturers’ offices. The emphasis is on informal learning and discussions starting in a designated but informal RMIT space but then continuing outside.

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- James Macnae
- Phillip Wilksch
Executive summary

Several new courses were taught within the Physics TEALE spaces for the first time in 2011. This project was undertaken to support the changes that had to be made in teaching methods, learning materials and to establish at least some pointers to the best practice of teaching a very traditional and formal science such as Physics in a modern space.

Several new activities were designed for the TEALE space: a group workshop on nuclear power, simulation measurements on earthquakes and tsunamis, simulation experiments, demonstration experiments using all possible AV support, experiments where students constructed the apparatus themselves, computer interfaced experiments etc.

Also included in this project is Technology Enhanced Active Learning support for the first year laboratories. Computers and tablets were introduced for three first year courses to improve the report submission processes and to provide immediate feedback on laboratory assignments. All first year laboratory notes were revised and laboratory template reports were prepared.

These initiatives have been reported at three workshops, one national conference and at the SEH L&T forum.

It is clear from student and demonstrator feedback obtained via surveys, focus group discussions and interviews that these changes improved student satisfaction. Some shortcomings were also identified and small changes to the TEALE space are proposed.

1 A list of outcomes

- Initiatives reported at
  - three L&T workshops (2nd June, 15th July, 8th Dec 2011)
  - Tech Tasters at SEH L&T Forum (25th Nov 2011)
  - ACDS Conference Sydney (19th July 2011)
- New activities designed for use in PHYS2124:
  - Freefall simulation (adapted),
  - Solar cell efficiency demonstration experiment,
  - Centripetal force simulation (adapted),
  - Radioactivity (demonstration experiment),
  - Nuclear power workshop and debate
  - Spectroscopy (group experiment)
  - Earthquakes simulation and measurement (adapted)
  - Climate change worksheet
  - X-rays simulation and calculations
  - Electronics computer interfaced experiment
- New activities for PHYS2070
  - 10 new electronic laboratory computer interfaced activities all designed to be completed online in TEALE space
• New laboratory notes for three first year courses
  o 20 revised lab notes, report template, Excel resource spreadsheet for data analysis and presentation, marking rubric
• Automatic rubric designed for use in laboratory report marking
• New activities for Physics service courses
  o 6 new laboratory demonstration experiments making use of rich AV support
• Formal student and demonstrator feedback obtained under ethics approved processes
  o Surveys
  o Focus group discussions
  o Interviews

2 Project outcomes and impacts

2.1 Teaching and Learning Methodology

The new Physics teaching and learning spaces (14.6.16 and 17) necessitate a new approach to ‘lecturing’ for staff. In the active learning spaces, students are expected to participate in activities in order to learn through doing, observing and group discussions. The use of these learning spaces is therefore a mix somewhere between a lecture where the lecturer is normally the sole active participant and a traditional laboratory session where students follow a script to do a laboratory experiment themselves.

It is therefore tempting to design the learning activities during the say two hour session in the following way: a short introduction of the topic followed by an activity on an appropriate subtopic, a class discussion on the subtopic, followed by group discussion before repeating the process on the next subtopic. In such a way, a complex topic consisting of several subtopics can be covered in such a way that students investigate and discuss relevant building blocks separately. The obvious drawback to this approach is that students or groups do not proceed at the same pace – leading to some groups being frustrated at the slow pace or other groups being left behind.

It is probably easier to structure such discussions and pace of the group as a whole in disciplines where there is not a clear cut answer or where several solutions may be offered from which the “best” can be chosen. Unfortunately, in Physics, grasping a very simple idea may take a few seconds or it needs to be explained/discussed at length depending on the individual student.

Therefore the TEALE spaces were used much more for the technological support it provided to facilitate learning and less for the group discussion possibilities it offered. The TEALE period learning structure was also simplified to include a short introduction, then an activity that had to be completed and submitted within the learning period.
This methodology was followed in the TEALE space for the two courses proposed in the grant application: Physics for Leaders and Instrumentation for Scientists and Engineers.

In addition, the first year laboratory (14.4.1,6,7) were equipped with computers and tablets to further support active learning within the School of Applied Sciences. The innovations in the first year laboratory will be listed below as well.

2.2 Resources developed for use in TEALE space – Physics for Leaders

2.2.1 Solar cell demonstration experiment

The solar cell demonstration experiment is a good example of one of the activities within the TEALE space. It started off with a brief introduction to solar cells using animations that are readily available on the Internet (1) (see figure 1 for a screen snapshot).

![Screen snapshot of solar cell animation.](image)

Figure 1: Screen snapshot of solar cell animation.

The following experiment was then performed and the volt- and ammeter readings displayed via several web cameras on the front screens of the TEALE space.
Students were then provided with an Excel spreadsheet as below to enter experimental readings and to answer the accompanying questions.

The completed report was submitted individually at the end of the session. Demonstrators provided feedback during the session but now grading took place. Grading was done before the next session.

Student to demonstrator ratio was approximately 20:1.

2.2.2 Free fall and centripetal force simulation

It is costly and difficult to provide 20 groups with the same working apparatus each week. Simulations provide a satisfactory demonstration and investigation of simple concepts – especially for service teaching groups.
After an introduction (in which “clickers” were used to stimulate discussion before doing the simulation, students performed measurements using a free fall simulation (2) available on the Internet to demonstrate free fall and air resistance as shown in figure 4.

![Figure 4: Schematic of free fall simulation experiment.](image)

Students could choose a small or large ball and measure the time of falling as a function of height.

Similarly, the students could perform a rotation experiment to determine the force required to hold a mass in a circular orbit as a function of radius and speed. (Figure 5)

![Figure 5: Rotation simulation](image)

Students noted their responses in the worksheets as provided below.
2.2.3 Radioactivity demonstration experiment

The radioactivity introduction made use of the Phet simulations (2) developed at the University of Colorado, Boulder, USA. These demonstrations normally show how the subatomic particles are ejected from the nucleus and provide something more than just mathematical expressions (Figure 7).

These simulations were extensively used in the lecture theatre and TEALE space to explain simple or not so simple concepts.

Below is the experimental setup for the radioactivity experiment
Once again the observed values were plotted using the Excel resource shown below:

### 2.2.4 Nuclear energy workshop and presentation

Two weeks were taken up by a workshop and presentation on nuclear energy. It was especially topical since the Fukushima disaster happened only a few weeks before.

In the first week students were given seed material to start preparing a presentation on nuclear energy, its advantages and disadvantages as well as the safety aspects. The class was divided into two groups and the best of the for and against groups presented in a final.

### 2.2.5 Earthquake simulation

Just as topical was the session on earthquakes. In the TEALE session a short introduction using an animation to explain the various types of waves was followed by an activity provided by the geological society of America(3).
Using the Virtual Courseware: Earthquake: Demonstration from (3), the students were able to calculate travel times for the various S and P waves as well as calculating the epicentre and magnitude of the earthquake:
2.2.6 Climate change

A short introduction of the greenhouse effect and the mechanism of photon absorption using the Phet (2) simulations as before, was followed by a student activity balancing the incident and reflected radiation as shown in figure.

Figure 12: Phet simulation of greenhouse effect and photon absorption

Figure 13: Diagram of sunlight radiation as basis for discussion of the energy balance of the earth

2.2.7 X-rays simulation

After a short introduction on the generation of x-rays and the interaction of photons with matter using an animation(4),
the students investigated the diffraction of x-rays using another simulation tool (5).

Figure 15: Java applet to investigate Bragg’s law

<table>
<thead>
<tr>
<th>Lambda</th>
<th>Distance</th>
<th>Theta</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.53</td>
<td>1.53</td>
<td>19.2</td>
</tr>
</tbody>
</table>

2.2.8 Electronics – LED and other diodes

In the last session the solar cell animation was once again used to explain diode behaviour during the short introduction. The students then in a group made measurements on diode behaviour using the ELVIS device shown below.

Readings were obtained via the computer and data analysed in a spreadsheet.
2.3 Resources developed for use in TEALE space – Instrumentation for Scientists and Engineers

Similar resources were developed for use in the second semester course: Instrumentation for Scientists and Engineers. These resources focus on electronics and are therefore not as varied as those developed for Physics for Leaders. One such an example is shown below. Completely new visual laboratory notes were developed:

Part B: Oscilloscope measurements using NI ELVIS II

In Part B you will use the following equipment:

Figure 3: Function Generator

Figure 4: National Instruments ELVIS II with power supply and USB cable

Figure 5: USB cable to ELVIS II

Figure 6: ELVIS II USB cable to computer

The innovative aspect about this course was the development of a worksheet where the responses of the students were checked as they were entered. An example is given below:
Eight such visual laboratory notes and interactive worksheets were developed for use in the TEALE space.

### 2.4 Resources developed for use in the first year enhanced laboratory

Computers and tablets (pen interactive displays were for the first time introduced into the first year laboratory. The main impetus for this change was to support the students to not only gather data during the laboratory session but also to analyse and to present the data in a professional report which could be marked at the experiment station in order to improve feedback to the students. The other advantage was that the reports were submitted individually by the students to Blackboard after completion thereby creating a traceable copy of the work.

During this major revision of the first year laboratory notes, a report template was provided for each experiment. Such a report template with grading rubric is shown below.
### 2.4.1 Report template rubric

<table>
<thead>
<tr>
<th>Criterion</th>
<th>Missing</th>
<th>Low</th>
<th>Medium</th>
<th>High</th>
<th>Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>PRELIMINARY EXERCISES</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Specific charge of electron abstract: Reveals aim of experiment. Gives a brief description of method used. Reports a numerical value for specific charge. Appropriate uncertainty in experimental value is reported. Result is compared to published values. Grammar and spelling correct.</td>
<td>0</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Tabulated results: Is table neatly presented? Is table layout logical? Do columns have appropriate headings? Do variables all have appropriate units? Correct number of significant figures used in all cases? Is table referenced correctly? Is table caption appropriate and descriptive?</td>
<td>0</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Plotted results for B exp versus B cal: Appropriate title for graph? Appropriate labels for axis? Appropriate axis scale(s) chosen? Appropriate legend? Appropriate chart style? Logical choice of (in-) and dependent variables? Graph referenced correctly? Descriptive caption</td>
<td>0</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Discussion of the experimental e/m value found in this experiment and its uncertainty as determined from the linear regression. The relation between the experimental value and the published value and possible systematic errors. (Spelling and grammar correct)</td>
<td>0</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Discussion of the relationship between B exp and B cal and the impact on the accuracy of the experimental e/m value</td>
<td>0</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td><strong>Overall impression</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
2.4.2 Report template

Specific charge of the electron

29 June 2012

Insert student names here

Applied Physics, School of Applied Sciences, RMIT University, Melbourne, Australia

Abstract

Insert abstract here (Rubric item1)

Introduction

An electron moving with velocity \( \mathbf{v} \) in a uniform magnetic field \( \mathbf{B} \) experiences a force

\[
\mathbf{F}_B = -e \mathbf{v} \times \mathbf{B},
\]

causing it to move in a circle with radius \( r \), where

\[
r = \frac{m \mathbf{v}}{e \mathbf{B}}
\]

and \( m \) is the mass of the electron. If the electron is accelerated through a potential \( U \), the last expression may be rearranged as

\[
U = \frac{e}{m} \frac{r^2 B^2}{2}.
\]

A measurement of the acceleration potential, the radius \( r \) of the electron trajectory and the applied magnetic field will then yield \( e / m \) as the gradient of a plot of \( U \) against \( r^2 B^2 / 2 \).

In this experiment as in many other electron measurements, it is not possible to measure the charge and the mass of the electron independently. Only a ratio of the two, \( e / m \) is obtained.

The electron trajectory in the magnetic field can be observed visually due to an argon filled glass tube that houses the electron gun. The energetic electrons excite the argon atoms and produce a faint but visible blue light. The glass tube is placed inside a Helmholtz coil pair that produces a uniform magnetic field inside the coils.
**Experimental**

The experiment was set up as shown below:

![Diagram of experimental setup](image)

The magnetic field produced by the Helmholtz pair (radius ***), was measured using a **** meter. An electron accelerating voltage was chosen between 150V and 250V and the current through the coils adjusted in order for the electrons to hit pillars set at 0.02 to 0.05m from the axis of the electron gun. Voltages for the extraction and accelerating potentials were provided by the ***** power supply.

The narrow beam tube tilt angle was adjusted to avoid helical electron orbits.

Results were obtained for combinations of accelerating voltage $U$ and electron orbit radius $r$. These results are presented and discussed in the next section.

**Results and discussion**

The three parameters $U$, $r$ and $B$ are listed in the table below
The value of $e/m$ is calculated as the gradient of the straight line in figure *** and is found to be *** ± ***. It compares well/does not compare well with the published value of $e/m = 1.759 \times 10^{11}$ As/kg. Comment on the accuracy of the experimental value. Rubric item 4

An extra result from this experiment is the verification of the calculated value of the magnetic field inside the Helmholtz coils,

$$B_{cal} = \left(\frac{4}{5}\right)^{\frac{3}{2}} \mu_0 n \frac{l}{R}.$$ 

Figure *** shows the calculated magnetic field $B_{cal}$ plotted as a function of the experimentally determined magnetic field $B_{exp}$. Comment on the agreement between these two values. Rubric item 6

**Conclusion**

The value of $e/m$ was determined from measurements on the electron orbit inside a uniform magnetic field and was found as etc…

**References**

2.4.3 Resources for insertion into report template

Figure 19: Excel worksheet provided for data analysis – charts were copied directly into the report

2.4.4 Electronic marking of the laboratory report

The reports were all marked within the laboratory session using the pen interactive display at the experiment station. Annotations were made on the report and grading was done according to the rubric that formed part of the submitted report. The annotated and graded report was then uploaded by each student to his/her Blackboard account for archival purposes.

2.5 Interdisciplinary linkages

Several interdisciplinary linkages have been established with Biotechnology and Chemistry that expressed interest in using these principles and techniques. The presentation at the SEH L&T forum attracted a lot of interest.

2.6 Dissemination strategies and outputs

The work or parts thereof has been presented at three T&L workshops within SEH and SAS. It has also been presented at the Australian Deans of Sciences Conference in Sydney.

2.7 Evaluation of project outcomes

2.7.1 Evaluation TEALE activities

Student surveys and focus group discussions provided evaluation of these innovations. Unfortunately, ethics approval was sought and obtained too late to survey these students immediately after the first semester. The data therefore relates to students' impressions at the end of the year.
The presentations summarised previous work and allowed me to understand and complete the activity/experiment.
The activity (Simulation, experiment etc) fitted in with the rest of the course curriculum

Doing the activity/experiment added to my understanding of the course content

Doing the activity/experiment prepared me for later assignments

The activities/experiments were too easy
I learned a lot by doing an experiment ourselves

I learned a lot by attending a tutorial in the TEALE space

I would prefer to attend a formal lecture in a lecture theatre than doing activities/experiments in a TEALE space

I have learnt more in the TEALE space than what I would have done going to lectures alone
The demonstrators were available to answer my questions

The experiments were explained clearly

The classes were well organised

I was kept busy in class and the time seemed to fly
I found the activity/experiment motivated me to want to learn more

I only attend TEALE sessions because I would lose marks if I don't

TEALE sessions activities/experiments are too isolated - I do not know what to expect when I turn up

I learned a lot by doing a simulation experiment on the computer
I would rather work on my own than in a group

The group size of the three students to a computer is too big

I think that TEALE activities/experiments are good for learning completely new concepts

I think that TEALE activities/experiments are good for reinforcing newly learnt concepts
TEALE is just like a normal laboratory - it does not make any difference

[Bar chart showing responses]

In the TEAL space, I would have preferred more interaction with my group

[Bar chart showing responses]

In the TEAL space, I would have preferred more interaction with the class as a whole

[Bar chart showing responses]

In the TEAL space, I would have preferred more interaction with the lecturer

[Bar chart showing responses]
I found that I am always running out of time to complete the activity/experiment

I would have preferred to complete the laboratory/activity report at home rather than rushing through it during the lab/activity session

TEALE helped made the classes more enjoyable

I was able to contribute equally with the other group members
Activity/experiment notes on Blackboard: I found the downloading of several files cumbersome and would have preferred a laboratory manual

I prefer writing a laboratory report on paper to completing a laboratory template on a computer

The laboratory report marking is too slow

The laboratory marking is fair
2.7.2 TEALE student comments

2.7.2.1 Previous exposure

Demonstrator:
- Demonstrator has been exposed to same teaching environment from last semester

Students:
- One student has been exposed to the TEAL environment last semester and this semester, while the other student has only used the TEAL space this semester
2.7.2.2 Process Description:

Demonstrator:

- The TEALE class was much smaller this semester than last semester, having eight students in the class room, with a student per computer, instead of having three students per computer as in last semester.
- Lecturer would go through a demonstration or hints for the prac.
- The TEALE space is set up so that both rooms can be used at the same time, making teaching very effective.
- Demonstrator thought the nuclear debate last semester and the use of the interactive whiteboards with the computers for presentation really enhanced the learning experience for the students.
- Demonstrator thought it was difficult having a large class size in the previous semester as compared to this semester – students not paying attention and difficult for demonstrators to cover the whole class to give the attention students need.
- The TEALE class provided an environment for students to study even out of class.
- In general, the demonstrator thought this semester, being a much smaller class, was handled much easier than the larger size class last semester, although the teaching were different.

QUOTE: “The environment itself with the screens coming down and having the projections all behind it I think is really great. Last semester we were using two rooms at once and that was a bit cumbersome but because we have the microphones to be able to talk in all the rooms and link it all together so the class in this room and the class in the other room could see the same thing, I think that worked really well as well.”

QUOTE: “Another thing I’ve found that’s really good about this is the whiteboards behind every terminal. I find my explanations to students come out so much better if I go “Let’s draw a picture of what’s happening” and you just draw it on there...”

QUOTE: “We did actually use the interactive whiteboards last semester. We had a nuclear debate; so half of them were working on their presentations whether they were for or against nuclear and then we could just put there their screen, they could work on it all together and piece it together on the whiteboard with their computer and then when it was their turn we could put it all on the big screen and they could talk about their thing with the microphones. So that worked really well, like the environment here is amazing. This is a fantastic lab.”

QUOTE: I think the harder part with a larger group is if you’ve got three students sitting at a computer together they goof off a lot more than if you’ve got them one to a computer because they’re on the internet together or they’re just sitting there. But another thing, if you’ve got three people sitting there often you’ve only got one person typing.

QUOTE: As for the numbers of staff, it was hard to go round and make sure that you did have enough time for the students but I think the labs were
set in a way that we had enough time to explain everything and if you have students who raise hands if they want help then they always got help but sometimes students will just sit there not knowing what to do and not asking for help and they are probably the hardest to identify.

QUOTE: The amount of time I walk out there and see an engineering student sitting there and I go “What are you doing over here?” and he’ll go “I just found out this place existed”. You can sit out there and it’s quieter than the library.

Student:

• Students would come in, set up the computers, logging onto projects and going through the simulations. Things are all hands on this semester
• Prac sessions are much more related to the lectures this semester than last semester, while last semester was disjointed.
  o Issue – if students thought the lectures and practicals are not related, they think they could get by going to one or the other
• When asked the question regarding the difference in process between this semester and the last semester, the student it was good working individually and not having to rely on anyone else. Also, able to get a hands-on approach to learning.
• Notes are put up in advance for students to go through before prac.
• Student thought that not only the class size being smaller was more effective, the process whereby the demonstrators mark their assignments at the end of the prac session was really good. Students thought that the instant feedback helped their learning.
• Although the small number of class size is a benefit, both students realised that it would be impossible to run something like this semester with as many students as last semester:
  o Possible solution: offer more time slots, run smaller class size (pair is ok) but more classes

QUOTE: “… and another thing this semester what we cover in the lectures and what we do in the TEAL sessions I guess they’re quite related, whereas, last semester it felt like it was almost two different subjects.”

QUOTE: “So you could get by doing TEAL without doing lectures or doing lectures without doing TEAL and still knowing what was happening, whereas, now you need to be going to lectures to understand what’s happening.”

QUOTE: “this semester it feels a lot better I think, because you’re working individually as well so it means that you really do have to do the work you can’t rely on anyone else, that always happens, there’s always one person in the group that, whether intentional or not they’ll be able to get by without actually knowing what they’re doing and I felt that was really easy last semester but I think it’s really good because it gives you a hands-on approach and you do have to actually learn to get through it, for example, if it was a test or something like that you could just not do well and that would be it, whereas, if you need to do this part by part and I guess it
gives you the bottom knowledge before you can build on it things like that.”

QUOTE: “... now the classes are small I think it’s a lot more effective, especially if they mark it in front of you, so then they can tell you what you’ve done wrong or you’ve lost marks for doing this or something like that, whereas, last semester you would just upload your thing and hope for the best and then the next week you would check on-line, and you’re like oh, I only got 40 out of 50, I wonder where I lost 10 marks, and you don’t know and of course you can go up to your lecturer and ask them but you’re not going to have 50 students walk up and make time to go visit their lecturer about where they lost marks every single week, so I think this is a lot more effective.”

QUOTE: “You could offer it with more, for example, fair enough our class at the moment is quite small but offer more times. So for example, you could run this class five times a week or something like that and when we do our timetable selection you select what times then, I definitely think it’s worth it, as I said there’s always that one dominating person and sometimes it’s good to be that because you know for yourself that you’re working through it but at the same time for other people even if they’re not being lazy they’re going to be like oh, it doesn’t really matter that I don’t fully understand this because the question’s done we can just move on to the next question.”

2.7.2.3 Software/Hardware compatibility

Demonstrator:

- The system seems to take a long time to load, it seems to be a server problem, not so much the hardware or the software themselves.

QUOTE: “The other thing is it takes forever for these things to turn on. Between you pushing the button and you being able to actually do something on it, like open up the internet, it’s about five or ten minutes. I mean I haven’t timed it but it seems like an eternity.”

Student:

- Also thought the computers were very slow.

QUOTE: “I think they’ve been slightly fixed but it was common, maybe once or twice a class for them to just decide to want to turn off, fair enough you would save what you’ve done, you’d save it maybe every ten minutes but the ten minutes where you would have set up a whole circuit and it’s gone or the 20 minutes you waste slowly turning the computer on, loading this program, getting back onto your section, it takes a long time and then again you’re pushed for time.”
2.7.2.4 Likes:

Demonstrator:

- When the demonstrator was asked whether he thought as a student, he would learn better in an environment such as the TEAL space, he thought he would, there's something about the space where he felt comfortable learning.
- Demonstrator also thought it would be good to have utilise the space a bit more, open them up when there are no other classes.

QUOTE: “… rather than hard chairs and the desks and sitting there listening to somebody talking and with the demonstrator being here, just being able to walk around the room and to be able to glance to make sure they’re on the right track. It’s a really good setup. The only drawback I see is it would be great if this was open all the time, of course not during class time, so that people could come in and use it but then you open it to students and someone comes in and steals the computer which is what happened. “

Student:

- Students really liked the hands on learning and would like to incorporate lectures into the TEAL space ie. lectures with activities provide effective learning.

QUOTE: “… I felt the hands-on learning it really is effective for because you can sit in a lecture and stare blankly at a screen for 45 minutes and you’ll finish and you’re oh yeah, and I think a lot of university students, as bad as it sounds, think that if you go to a lecture and stare blankly at the screen you’re learning but you’re not, coming to a place like the TEAL learning space you have to learn you cannot come here, you can’t come here and leave the door not knowing anything, as in by doing the activity whether you realise or not you’re learning.”

QUOTE: “Incorporating lectures into TEAL space would be the best idea as in you feel like you’d have to have some lectures where a lot of it is listening but I think having them talk about it and doing an activity and then talk about it again is a lot more effective because it really puts that association between what you’re learning and what you actually take away from it. Because sometimes you learn things and you just think when am I ever going to use this?”

QUOTE: “I think the lectures could be structured in a TEAL space with maybe twice a week a one hour lecture and then the practical in the same amount of time, so you get the background theory right down and then you get to do it and while the lecturer is speaking about it you can be putting the circles or dealing with what they’re talking about in the computer in front of you to help you move along with it. One of the more difficult things is finding a computer in a computer lab with the same programs like multi-sim that you can practise on..”
2.7.2.5 Dislikes:

Demonstrator:

- Inconsistencies in marking – demonstrator thought each has a different scale on how an assignment is marked, although a marking sheet is available, but it’s still up to the demonstrators’ discretion as to how marks are lost.
- Students being able to dispute their marks while marking in front of them.
- Students haven’t read through pracs before coming in – not so much in this semester, since the class sizes are much smaller, and students have no one to rely on.
  - Possible solution: mark them at the end of the semester on participation, prac notes etc.
- Unreliability of the computers.

QUOTE: “If you say “No this is wrong here” and they’ll try and say “Oh no, what I really meant was this” or after you’ve shown them they’ll say “Oh I did that”. “

QUOTE: “They want to make sure they’re doing it right and feedback’s really valuable for that and that’s what I try to give as valuable as possible, to tell them where they’ve gone wrong, how they could’ve done it better. Sometimes you might give them a bonus mark if they’ve gotten something that’s really, really difficult that you think no student should be able to...but if they’ve figured it out then that’s amazing but you wouldn’t expect them to be able to figure it out if it’s not taught in the class.”

QUOTE: “Some of them are very bad at reading the steps. I think YYYY’s written these experiments so that you should be able to give it to someone off the street who’s never done it before; line one, this is what you need to do, line two, do this step by step but they just sort of gloss over things. They’ll be on page three and they haven’t read the note halfway down page one. So it’s where’s the picture, okay let’s start working. So that’s pretty common.”

QUOTE: “... if you had the group of three you knew that at least one of the people sitting there wasn’t going to do anything unless they were a very active group and there was good ones of course.”

QUOTE: “One other thing about the TIL space that I dislike is the reliability of these things. Two of them have been down in that other room for the whole semester, they’re not working, they just sort of shut off occasionally. Every class we have, one of them just rebooted for no reason, every class.”

Student:

- Students thought that the TEAL space is great the way it’s been set up, but hard to fit a lot of people in the space and difficult to focus on one speaker with computers/monitors in the way.
Possible solution: smaller screens/monitors, perhaps ones that can retract into the desks or manoeuvre to be flat on desks while lecturers are taking place

Students would still prefer to combine TEAL activities with lectures, rather than just lectures on its own

- Advantage: Students will show up to lectures and prac classes if they are combined, instead of not going to lectures, since lecture materials are easily accessible

QUOTE: “If you’re going to go into learning styles it’s good but if you’re going to incorporate a lecture and an activity it’s hard to fit a lot of people in to be paying attention at the one speaker because there’s just computers and things in the way, maybe the room could be structured a little bit better, but other than that it’s pretty good because * all the screens can be turned into the same thing.”

QUOTE: “… my degree is half applied science half education and just I think sitting there and being lectured to, the amount which a person actually retains isn’t that high so fair enough it might seem a little bit like going back to primary and secondary school but I think that is effective learning.”

QUOTE: “I would see the space, the tables I find the computers are probably too big and if you’re trying to work on the computer and see the lecturer and the board at the same time, you’ve got a lot of moving around trying to see that, I would see just rows of benches with a laptop for each person…. With a smaller screen and less to hide behind and one for each person I think it would be better, I think it’s definitely one person one computer; they’re not designed for two people to work on. So in a room of the TEAL space size in one partition you could fit in a lot more people with a smaller screen, you don’t need 40 inch screens, if you had 15/17 inch laptops at each space everybody’s got a computer, they’re not hiding behind their computer and you can incorporate the learning that you’re doing.”

QUOTE: “… in some ways it’s made too easy, here’s the lecture recording, here’s the notes, you don’t have to do anything, so even with the notes in front of me sometimes I find myself not taking the notes that I should. If I was forced to I would be writing it down.”

2.7.2.6 Satisfaction of process

Demonstrator:

- Demonstrator thought the quiz would enhance the students’ learning, rather than just going through the prac step by step, they haven’t learned anything

QUOTE: “… if they’ve just gone through and followed step by step and done it and they haven’t learned anything, that’s where the quiz will actually say here’s the important stuff that’s actually come out of that and that will reinforce okay, this is the stuff that I actually need to know for my exam or to properly explain what’s happening.”
Student:

- Students thought the process was really easy to learn, and especially effective for first year university students
- When compared to last semester, the student thought it was also easy, because it was group work, can be done at home
- Students thought they had to prepare properly, otherwise there will be times that they will be pushed to finish the prac in 3 hours
- Students would like access to the computer software packages so that they can be more proficient at it when they are using it in class
- Attendance of classes should be marked

QUOTE: “... we did a really small task which I think they allow what three hours for it and it probably took an hour and a half but it meant that you knew what sort of stuff you’d be doing, you know that you’re going to come in, you have the notes in front of you and you do a small experiment or something like that and you’ve got to write about it, they mark it, you knew what you were doing. I don’t think it’s hard to grasp at all for anyone especially seeing as you said before it is a lot like primary school high school set up I think, a lot of people especially first year students and people who are new to university or haven’t been to university for a while I think it’s a really effective way to do it.”

QUOTE: “And it’s just a balance and I work out for myself how to deal with that with better preparation to get things, the harder things for me that I might take more time on to fit it in and spend more time on that beforehand so that I could go in there and get it done within the time which suits me fine, that’s life, if you’re not prepared properly then you’re not going to get through it and you shouldn’t get marks just because you complained about there wasn’t enough time, you’ve got to learn to fit that in.”

QUOTE: “… or lease out the programs as well, just something where we can work on them in our own time.”

QUOTE: “Question - Then would it have the danger going back to giving you lectures, lecture notes and everything, if we gave you the software for example, or even a computer with the software, would there be any danger you guys not showing up to a prac class? 
Answer - No, because you have to come into class and have it marked, though if you ask a student, any student, they’ll complain about it being, oh, I have to go to class because they mark attendance, I think it’s the best idea because if you know you have to be there you have to be there, otherwise, in the winter months, oh, it’s a bit cold, it’s raining I don’t want to walk to the bus stop in the rain, I’ll just stay home today and watch it on-line and then they’ll watch it. If you know you have to go and they’re going to mark it, students will be there, they don’t want to lose marks. So I think even if software is provided they’ll be there because they need to have it done.”
2.7.2.7 Improvement of process

Demonstrator:

- Have more simulation prac, which could accommodate bigger crowds, and preliminary questions for students to get to know the session before coming to class

QUOTE: “They were mostly that simulated... XXXX had all these great java programmes or these little programmes that simulated the whole thing. You'd have the earthquake and you'd say “This is where it’s going to originate from and you see the way it’s travelling” and it gives them that wow, I can actually see things bobbing up and down this way, I can see that other one going the other way and all the simulated experiments were really good because they were quick, they didn't have to plug things in. You know that if they got something wrong, they put the wrong number in the wrong box or something like that. You know that it was something to do with them rather than the set up. So that easily helped fault finding, instead of just looking at all these wires sticking out going “Oh, that’s not how I would've done it”.

Student:

- Students would like more access so they can come and work on their projects during times where the rooms aren’t being utilised

QUOTE: “More access, there’s this room here that has plenty of tables and stuff, this should be at least half a computer lab ... came up the other day to see if the labs were open and everything was closed up and I couldn’t get in, so all those computers are sitting there doing nothing and I’m looking for a computer with that software on it and there’s a closed door.”

2.7.2.8 Other comments:

Demonstrator:

QUOTE: “I thought that physics for leaders was an amazing subject. I think it should be a general subject across all disciplines. I think everything that goes through uni and does a bachelor should do that subject because it is protracted enough from physics, protracted enough from the stringent mathematics where we’re talking about these are the important issues, this is what we’re seeing happening but it’s still an experiment. Okay that obeys that principle that we’re thinking exists. We’re not sitting there and stringently going through things and calculating.”

QUOTE: “I think these are the best labs I’ve ever done before and I’ve been through the three years I’ve been here doing labs in different departments and different groups and it made it different because I’m taking the
demonstrating. I think they’re great but I just think every part of it we’ve tried to make good and there is so many good parts about it.”

Student:

QUOTE: “Perhaps more practise questions with the access (TEALE) so that here’s some practical, here’s some related ones that you won’t be graded on but go and play with them, go and do these questions hand them in and the teacher can give back feedback. I know for a lot of people who are in this class even though it’s a small class, people like myself that are physicists that have a little bit of background in electronics but not a huge background that could really benefit from a little bit more in-depth if they want to, and this is optional, you’re not getting graded on it, it’s not part of your assessment, but if you want to come in here’s a list of stuff.”

QUOTE: “Question: On the scale of one to five, you know I always ask this, one being poor and five being excellent, how would you rate this environment? Student 1: Probably a four. Student 2: Yeah, I’d say four, it’s just mainly the computer failing issues and stuff that brought it down, but I would encourage it more broadly across other subjects.”

QUOTE: “Even other disciplines, I think it’s really effective, just the fact that there is the feedback, I got the feedback straight away from your lecturer or demonstrator, you don’t have to go back and oh, what question was that again, you’ll just remember because you’ve just done it, attendance is marked so you know you have to be there, students will have to come and I don’t know, just that it’s really hands-on and you get that in-depth knowledge and understanding right then.”

QUOTE: “… I think just important if they’re going to do it to keep it as either individual work or partners, but make sure there’s enough work for both partners to do and keep the class sizes small because if you have a big class as I said, people are going to, it’s not about being fair but it’s just people are going to get by not knowing anything and they’ll manage to get to third year, sailing through and then they’ll come to a third year subject and have no idea on what anything is.”

2.7.3 Evaluation of TEALE first year laboratory activities

Responses of all students on the use of tablets as feedback mechanism

The electronic assignment submission, electronic mark-up and online feedback process:
I was informed of the electronic assignment submission process at the start of the semester

The use of the tablet and pen display was explained to me in detail at the start of the semester

The process of online submission of assignment was much better than the paper submission

The assignments were easy to submit
It was important for me to be able to see that I have submitted the assignment

I prefer writing a laboratory report on paper to completing a laboratory template on a computer

I would have preferred to complete the laboratory/activity report at home rather than rushing through it during the laboratory/activity
Marking and Feedback

1. I was able to discuss the results of the assignment with the demonstrators

2. I found that being able to discuss the assignment with the demonstrators during marking was useful

3. The feedback provided was clear

4. The quality of the feedback provided was satisfactory
I like the immediate feedback of the report being marked using a tablet

The laboratory report marking is too slow

The laboratory report marking is fair

Using the provided Excel spreadsheets helped me with the data interpretation
Ease of use

The provided Excel spreadsheets for entering data makes the whole laboratory session too easy.

The tablets and pen display were easy to use.

The assignment was easy to upload.

I did not encounter any problems while uploading the assignments.
General

The demonstrators were available to answer my questions

The experiments were explained clearly to me at the start of the class

I was prepared for each of the practical classes

The classes were well organised
I was kept busy in class and the time seemed to fly.

I found the exercises motivated me to want to learn more.

The experiments added to my understanding of the course content.

I found that the whole process worked very well.
2.7.3.1 Student comments

Student interviews and focus groups for Completing the online circle of electronic submission, electronic mark-up and timely feedback – a large-scale study (Semester 2)

Previous exposure:

It seems that neither the demonstrators nor the students interviewed have ever been exposed to this type of process or technology before.

Process Description:

Demonstrator:

- Demonstrators supervise the experiments, be available whenever student needs
- Preliminary exercises were introduced halfway through Semester 2 to ensure that students have read the pracs before attending class
  - Advantage: Students are more prepared for the pracs, and have good grounding
  - Disadvantage: doesn’t always happen!
- Demonstrators are only required to know two of the 10 pracs in the lab. XXXX gave demonstrators all of the documents for the 10 pracs and demonstrators nominate which pracs they would like to take
  - Advantage: Demonstrators are able to specialise in those two pracs and know them well, and demonstrator preferred to focus on a couple of pracs rather than knowing all and not necessarily have all the concepts to answer student questions straight away
  - Disadvantage: if demonstrators have to fill in for another demonstrators, they may not know the other pracs as well
  - Because of this process (where demonstrators are responsible for two pracs), students will have different demonstrators every week
- Students perform the experiments, put results into Excel Spreadsheet or templates given (electronically), save as PDF, demonstrator mark the results while students are present, and give them feedback, then student upload the marked version onto Blackboard. Demonstrators put mark on a piece of paper and give to Lab manager
- One demonstrator initially preferred to have students go through the pracs themselves and ask questions if needed, but realised that the experiments he had took the longest time, so he decided to go through the pracs with them at the start of the session. Although he didn’t like this method of giving them such a prepared excel file, would prefer to give them a blank Excel file and instruction

QUOTE: “… yeah if they do their prelims, then they come in with a really good grounding and they’re ready to start experimenting straightaway, which is really helpful”
QUOTE: “I think for some subjects, especially first years like this one, it’s fair to instead of having some hard problems, give them some help, something simple, some limited amount of help.”

Student:

- Student would read the experiment the night before, work in groups of three to four through the experiment in the lab, results recorded in Excel spreadsheet, once prac’s are complete, demonstrator marks it, results are then uploaded onto Blackboard.
  - Comment: even though with the preliminary reading/exercise, student still found the experiments a bit overwhelming
- Demonstrators are on hand to help whenever the students need
- Student was able to discuss results with the demonstrator
  - Advantage: student liked to discuss throughout the prac as well as at the marking stage, this reassured the student that she was on the right track with the experiment

QUOTE: “...I guess I think I feel like when we start doing these prac’s, we’re like what do we do? Cos I think it’s also being first year students, you don’t expect to be babied, but you always have a little bit of help along the way, so I guess by third year, you will be doing it all on your own, whereas in first year, you need a bit of help?”

QUOTE: “...we also do it (discuss with demonstrator) throughout (the experiments) as well, for each experiments, there’s always the theoretical value, or the calculated value, compared with our experimental, so we’ll sort of discuss it throughout, yeah, we actually find it with probably most of my experiments, which is good, cos it’s good feedback, so we know we’re on the right path. So yeah, I guess that’s one good point to raise, if perhaps once we’ve done the prac’s, just a little bit, a small bit of feedback to say yeah, that was good or even...like we do we feel we could improve on next time...”

Timely feedback of assignments

Demonstrator:

- Demonstrator felt that the advantage of marking at the end of session is that the demonstrator does not have to leave the class with homework and marking in his time.

QUOTE: “…because they have to have it done by the end of their session and it has to be marked by the end of their session, so it’s really good because I don’t leave the class with any homework for me. I don’t have to worry about marking them in my own time. It’s just done during the session and that’s it. So that’s really easy.”
Ease of use of Pen Displays

Demonstrator:

- One demonstrator thought it took some practice to write legibly, and it’s different to writing with pen and paper, needing to get used to it.
- One demonstrator thought the device was “awesome”, no issues uploading, downloading and easy to use.
- When asked about portability of device, demonstrator thought it wasn’t necessary
- A three hour training was given at the start of the semester teaching the demonstrators the experiments and how to use the device

QUOTE: “It took some practice. Last semester was the first time that I used them I didn’t like them at all at first, but then after marking a hundred in a row you got really good at using them and it did become quicker because you could just scribble on the screen and click go and save and it was done, but at first it took some getting used to and some practice at manipulating the pen.”

QUOTE: “You mean the device? They were awesome, there were no problems.”

Student:

- Student said they didn’t really use the device, only the demonstrators used them, but thought it was quite a good tool to use to mark the assignment.
- Student felt that there would be no benefit for them to use the pen with what they need to do at this stage

QUOTE: “I don’t think students would gain any benefit from using the pen. I think the best thing is for the demonstrators to use, that’s the advantage, cos then you’d get the marking done then and there, and that’s the beauty of it in a sense, you don’t have to wait to see your marks, you would know what didn’t I do. So I guess that’s a bonus.”

Software/Hardware compatibility

Demonstrator:

- In terms of portability of device, demonstrator thought that it could be useful for some experiments, so that student can record results without walking between experiment and computer, but it’s not important for demonstrators
- In terms of suitability of the software, they were easy to use, besides some hiccups last semester, with downloading and uploading at times, this semester, they worked fine.

QUOTE: “…if you haven’t had any training or a first year student, or second year, and you haven’t done any scientific experiments, everything is such a huge deal to you. I know it’s clicking on a button on the record and record the pressure and plot, it would take 5mins for me, but for them, everything
is new, like Alice in Wonderland, I guess it’s better to be explained early in the experiment…”

Student:

- Resizing graphs or tables – software not aligning properly
- Student thought the system was easy to navigate, and thought software system was simple enough for the prac
- Submission of assignments was easy once the prac were finished. No problems were encountered once the prac reports were marked and uploaded.

QUOTE: “…actually happened today, when we were bringing the table from the excel spreadsheet into our actual experiment, there was just one corner that was big, it was there, but just wasn’t on the page, so we kept bringing and resizing the column, and it was still over the corner, so we had to in the end, manual put the data in. Well, you can’t sort of show a table with the corner missing…”

QUOTE: “All that was needed was Windows, Excel and the blackboard system to input our data and tables, then load it up onto blackboard. I feel the uni provided sufficient programs to work with for the prac.”

Student Compliance

Demonstrator:

- Demonstrators thought it was easier for students to use electronic submission rather than paper based format, this process helped students submit their assignments within an allocated timeframe, and good for the environment! Also, students being in first year, thought that’s how RMIT does it, therefore they go with the flow.

QUOTE: “So I don’t think it really bothers them. I don’t know that they’re more in tune with it. They’re just adapting to something new. They haven’t been to university before and it’s a new experience for them.”

Student:

- Student thought that submitting online (and having a template) gave them more time to complete the prac instead of completing the report on paper.

QUOTE: “It definitely made a big difference in how we submitted the assignments. I feel it gave us much more time to complete the prac and also complete it neatly, compared to physically writing out the report/assignment and drawing up tables etc. This part definitely improved the convenience of completing the assignment within the allocated time. Paper format can get messy and more times than not students would not have appropriate tools and paper to present a satisfactory assignment for the marker. During most of the prac we would
also type in answers and copy and paste tables which meant the presentation and our work remained legible and consistent.”

Markers Compliance

Demonstrator:

- Demonstrators thought that the time needed to mark the assignment would be the same for electronic or paper copy, while the process itself provided clear and auditable track of submission, and that students benefited with the process of the feedback given.

QUOTE: “For the marking process? Yeah, yeah, definitely. I mean, first of all, you get to have something that can be submitted electronically, and you don’t need to type (or write), so you can just underline some lines that’s it, and it’s really fast.”

Likes:

Demonstrator:

- Having a marking sheet (marking rubric) was a definitely bonus for the demonstrators, who could then let the students know where they had lost marks and how to improve their reports.

QUOTE: “...I get to show them what was their problem, I mean, I would like the students to know what was the problem but just don’t think they should lose marks just because I don’t feel like giving them.”

Student:

- Student thought the whole process is neat and convenient.

QUOTE: “It’s neat. You don’t have to scribble. It is very convenient, I really like it, personally, a lot of people like it, I think if it’s the case of having to write things on paper, it could just get messy and ... it's great too, because a lot of our submissions include data of graph and tables, so it’s just simple cut and paste, bring those across the page. Yeah, I can’t fault it, I think it's great. I like it. There’s nothing really I don’t like ...”

Dislikes:

Demonstrator:

- Negotiation part – demonstrators sometimes felt uncomfortable having the students there negotiating the marks during the marking process
  - Possible solution: having the demonstrators marked the assignment, put the marks into the system first before discussing the results and giving feedback to the students
  - Possible solution: train the demonstrators to be more assertive and not be intimidated by students
Possible solution: make sure the students are aware of the marking system (rubric), so they are aware of how the demonstrators are marking their assignments and possibly reduce debating/negotiating with the demonstrators

QUOTE: “... I also don’t like grading the paper in front of the students and I can understand that from the students perspective that is fantastic because they get the instant feedback and I know when I was a student and I would get prac reports back from two weeks ago and I’d just go oh yeah probably did deserve that, I don’t remember and I’d just throw it away, but now you do the work and you get the grade straightaway and that’s fantastic feedback for them and that would really help them because they know at the time I didn’t work hard enough because I didn’t get above whatever and that’s really good for them. But for me it’s intimidating to sit them with them and say look you’re inadequate, you’re not good enough at this and that’s really intimidating for me, but that’s just because I haven’t been a demonstrator for very long and I’m inexperienced. From the students perspective it’s a really good idea and it’s great for them, but for me it’s a bit...”

QUOTE: “The disputing I think should be kept to a minimum. I really don’t like that part of it when students, especially when they’re aggressive about it or they’re assertive about it and they say but I only did that because of this. It’s like well yeah that’s your excuse, but you still did it wrong, so I’m not giving you the mark. You can make excuses about anything, this is the work you submitted, this is the grade it deserves.”

QUOTE: “The main problem with this, the students get to negotiate their marks, so probably, I mean, I have bunch of group asking why I lose marks here and why I lose marks there in this question, I started to explain it, and they respond to something else and it’s not very good. Probably if you want to improve that, maybe it’s better to, I, as in the demonstrator, first go through the whole report, and submit their marks, so when the marks are submitted, then I can show them the result, and they can ask whatever they want, but they know that this mark has been submitted, and no place for negotiation.”

Having complete Excel templates for the students just to fill in, students not learning how to write a report

QUOTE: “...it’s about physics, not about computers and excels, and stuff, so in some point, it was good, but for some of the experiments, students were not supposed to do anything except for putting in some numbers and everything was not particularly brilliant. I think it’s about the lectures, how they feel like training the students, are they just going to focus on the Physics part, or they want the computer and science students as well.
QUOTE: I dislike the format of it and I think that the students shouldn’t be given a template to just type their numbers into. They should be able to make their own spreadsheets and calculate formulas and know how to use Excel front and back and they don’t. They’re just putting in what we give them, typing in a metre high and they type it in and then all the answers pop out for them and I think that they should know how to apply a formula. It’s not that difficult.

QUOTE: “…in a group of like 5 students, one or two aussie guys or girls, the other three internationals, the international ones doesn’t get to write the report and make their own mistakes writing a passage. “

QUOTE: “If it was up to me, instead of a group of 5 or 6, I would make a group of two, which is the optimum, and they all get to do the experiment, all of them, and they are to produce different reports written. There is no point in writing it in the same time, maybe they can go home, write it and send it to me, and in the following session, when they are doing the next experiment, I mark them on the computer, and give them feedback, so, every two person submit one report, and do it at home, they get to be involved more in the writing.”

QUOTE: “It’s sort of a trade off, between instantaneous feedback and being involved in report writing, I would prefer they would be more involved in report writing.”

• Too many criteria to be met for one experiment
  o Possible solution: less criteria ie. 4-5

QUOTE: “… sometimes there are a lot of criteria to be met for one experiment. I mean, like three or 4 pages of report, and I’m supposed to mark them according to the table 2 pages. For example, if the table was neat enough or not, or if the table figures were accurate enough or not. Sometimes I was marking them and according to the criteria, which was more than enough for such a small report… So maybe we don’t need that much assessment… maybe we don’t need such a big table, maybe just 5 different criteria, if they are doing it right, if they are demonstrating their tables, etc. Maybe 4 or 5 criteria would be enough.

Student:

• Not enough explanation at the start of the pracs, although there are enough demonstrators around to ask for help
  o Possible solution: would like the demonstrators to go through the prac at the start of the session

Satisfaction of feedback (clear and sufficient feedback)
Student:

• Feedback was varied depending on the demonstrators, having different demonstrators for different pracs gave students some idea in what each demonstrator was looking for in their marking scheme.
QUOTE: “... we knew what the particular marker was looking for or how they would critique our prac. I feel we could have discussed the relevant prac in more depth as they were marking it. More times than not they said out loud what grade they will give us for the particular section - and that was it. In addition though most times we were all eager to finish up on the prac because we had all been there for three hours and just wanted the prac to get marked so we could finish completely. I just feel being a first year physics student and still fairly new to the subject I would have really enjoyed the marker discussing our results as they marked the prac. I must give credit to the markers though they still did talk about parts of the prac on occasions whilst working through the prac and checking to see if we were aware of our task at hand.”

Satisfaction of process

Demonstrator:

- As this process is new to the demonstrator, it was thought that the process made the demonstrators’ work easier

Student:

- As the student was involved in the TEALE learning in Semester 1, she was able to compare the group dynamics, ie. Large groups in the TEALE space compared to smaller groups in the Physics learning environment. The student thought the smaller the group, the less reliant it was for other students to do the work.

QUOTE: I guess it’s because of the smaller group, because we have had three, there’s always been the three of us, and sometimes there’s been the two of us, because one didn’t turn up, so I guess it’s more ... I actually felt like I had learn more, from that, because it was down to the two of us. So yeah, I guess in our group, I stuck with the same two people, throughout each of the prac’s, I guess that’s a good thing too, we got to know each other. We knew what we were good at as well, I guess that was another good thing. I don’t think we didn’t just leave it up to one person.

Improvement of process

Demonstrator:

- Demonstrators thought the process/pracs are too easy for them, should be taught how to write a lab report.
  - Possible solution: incorporate report writing
  - Possible solution: not have an Excel template, have the students apply formulas to the numbers that they are measuring on their own

QUOTE: “… if they just open up an Excel document we give them and type some numbers into it and the answer pops out, they don’t really get a clear understanding of the process of scientific work. They don’t understand...”
QUOTE: “Sometimes by using so many technology stuff, you are given them a lot of blankets to sleep. I’m stressing on the excel files. They are supposed to write their tables, they are supposed to insert some figures, and graphs, but everything is prepared, or the formulas are prepared. They are not learning that much. I think you can make the actual science and physics experiments less, instead of two hours, maybe just one hour, but let them write the report and make their excel sheets themselves.”

• Demonstrator mentioned that they don’t have much contact with lecturers, ie. not even numbers to contact in case they are unwell and can not show up to the prac
  o Possible solution: perhaps more interaction between lecturers/course coordinators and demonstrators

• Demonstrators not knowing all the pracs
  o Advantage: can concentrate on the two pracs that were assigned
  o Disadvantage: can not easily replace another demonstrator who can not make it into prac that day
  o Possible solution: focus on two pracs assigned, but know a couple more, and group similar ones together

QUOTE: “Well, I think that’s the best way to utilise the demonstrators, that you have your expertise in your field, but also, you may need to know one or even two of someone else, not that you’ll be demonstrating in there all the time, but if anything happens, they can still call you and say, could you come in or this is next to you, can you do that? So that is actually a benefit, to demonstrate others, then you get to learn a bit more, they get to utilise you a bit more....”

QUOTE: “So maybe instead of picking it as the closest to each other, maybe they can just put similar stuff together, ie. Capacitor, and electronics next to electro-magnetic field, then put same demonstrator for that. Otherwise, I would still prefer to walk into two demonstrations as far away as each other, but in my field of knowledge.”

Student:

• Student thought in order to help with the interpretation of the prac, instead of reading in large chunks of paragraphs, would be putting the pracs in point form.

QUOTE: “I felt a lot of times I was reading large chunks of paragraphs just to understand what the prac involved. I had to then scroll a lot of the time just to get back to where we had to type in our answers. I agree with adding in information about the background and basis of the particular prac. However when you have restricted time it seemed as though i was continually jumping around the document trying to find the appropriate answers in. If the instructions were changed to point form they may be easier to follow and also be easier to see the flow of the prac.”
Training

Demonstrator:

- Demonstrators thought that although training was not provided at the start of semester on how to use the technology provided, it was not necessary, since it was easy to figure out.

QUOTE: “It wasn’t hard to figure out on the fly, it was just go for it.”

QUOTE: “I don’t think training in that process is really necessary because all the demonstrators have come through RMIT and they’re undergraduates, so they know the blackboard system and all of that, but the devices are new so maybe just a session to get to get familiar with them or something to practice, but not really anything intensive is required.”

Other comments:

Student:

QUOTE: “I’ll just add that when I arrived at some of the pracs I felt as though it seemed a little bit ambiguous in what we were supposed to do. I have experienced that in a few pracs in other subjects so I’m not sure whether its organisation or simply being a first year student. I always enjoyed learning the practical side of physics and the markers/tutors were helpful, insightful and were never far away to ask a question if we were stuck.”

Issues and possible solutions:

Issue 1:

- Students not having enough time to finish the prac

Possible Solution 1:

- Somehow ensure (or stress the importance) that the students have done their preliminary exercises and read the pracs before prac session. The demonstrators felt that if the students did that, they would be able to finish the prac well within the three hours allocated.

QUOTE: “If they haven’t done the preliminary exercises and they haven’t read the prac before they’ve come, then they don’t finish on time, but if they have, they get out an hour, an hour and a half early. So it varies widely dependent on the group that you get.”

QUOTE: “... at the start of the semester they didn’t have preliminary exercises, so they wouldn’t read at all, whereas at least now they have them and so at least the majority of them will have read the preliminaries because the prelims count points towards their prac. So that’s their incentive to do it. I think they lose six points out of about 40 if they haven’t done them. So that’s their incentive and there’s not really anything else you can do to force them to do it or make sure that they do it or anything like that.”
Issue 2:

- Similarly in this semester and the previous semester, students tend to follow the instructions, fill in the blanks and not to evaluate their own experiments
- Demonstrators thought that students need to have an understanding of the experiments, write their own reports

Possible Solution 2:

- Having student prepared before class, ie. Quiz on the material need to be read before each prac class
- Give them less template format (fill in exercises), and give them more time to write reports

Issue 3:

- In group situation, one or two students did most of the work, while the other members would sit and watch. Two issues, the students that did the work, would understand more, while the students who sat and watch, would feel left out and/or not learning anything.
- Even though students hand in their own prac online, demonstrators/assessors cannot distinguish who's done which part, and it's all identical, copied from group

Possible Solution 3:

- Practicals should be shared amongst all students, divide the practicals so different students can be responsible to different parts of the experiments

Issue 4:

- Demonstrators also thought that the demonstrators should have a Physics background to teach physics and not from other disciplines ie. Chemistry

Issue 5:

- Although students are happy to be able to discuss with their demonstrators during the marking process and the immediate feedback given, demonstrators feel intimidated and made to give students higher marks than sometimes warranted.

Possible Solution 5:

- Have the demonstrators marked the assignments before discussing with students, to reduce the ‘need’ to argue the results.
- Have the demonstrators discuss the prac with the students on where they went well and where they could improve without giving them the marks until after class (or students can look up their results after end of prac)
2.7.4 Remarks and recommendations

"Teaching is not rocket science ... it is much harder" This remark also highlights the fact that there is no magic action that will suddenly elevate student learning by quantum leaps. Success stories from well known educators largely revolve around the person and his/her drive. In the end, it all does come down to the individual’s commitment and ability to sustain a high level of student engagement.

RMIT’s commitment to provide modern teaching spaces does provide the trigger for lecturers to reconsider how they engage with students. This first venture into teaching in these facilities did show how difficult it is to maintain structure and progress. Our solution (best practice) was to have the balance in the lecture-laboratory mix close to the traditional laboratory activity but with maximum resources support.

It is clear from reading the responses to the surveys and students’ remarks that the TEALE space environment contributed to active learning as envisaged. The second semester course PHYS2070 scored 100% on the CES GTS.

However, some deficiencies were pointed out by the students and lecturers.

1. The choice of the large iMac screens was in hindsight an error. They work excellently for a laboratory environment but inhibit (exclude) discussion around the table. Lecturers and other students feel that students can too easily hide behind the screens. It is therefore recommended that the iMacs be replaced with laptops when the lease runs out – similar to the Bundoora setup.

2. The arms holding the heavy iMacs are substandard and sometimes collapse. It an annoying but non-critical and the issue will be solved when the iMacs are replaced by laptops.

3. The AV system works well but there are some deficiencies when trying to integrate additional cameras used for demonstration purposes. It is a major drawback trying to manipulate one or more cameras through an additional computer.

4. The interactive whiteboards were used predominantly as display screens (worked also excellently in conference poster setup during open days). The students also made use of its traditional whiteboard and marker capability. It does not work well as input device for high resolution writing (such as mathematical equations).

2.8 Acknowledgement

This grant did provide the opportunity to change and improve teaching and learning in a TEALE environment. It was the impetus to produce a large volume of new TEALE specific teaching material and the project leader wants to express his appreciation for the cooperation and effort of the team members and the other staff within the Physics discipline.
2.10 Resources


