Teaching & Educational Development Institute

On the inside: Engaging First Year Physics Students in Classroom Discussion of High-level Concepts: Pre-reading, Reflection and Personalised Feedback

School of Mathematics and Physics

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Overview

Background

Active learning is a term used to describe a range of methods of teaching science. The fundamental principle behind active learning rejects the view that passively listening to a 50-minute lecture on physics teaches a student how to do physics. Instead, it takes the view that the student needs to be actively doing physics with the guidance of an instructor. [1] A useful definition from Prince defines active learning as:

> *Active learning is generally defined as any instructional method that engages in the learning process. In short, active learning requires students to do meaningful learning activities and think about what they doing. While this definition could include traditional activities such as homework, in practice active learning refers to activities that are introduced into the classroom. The core elements of active learning are student activity and engagement in the learning process. Active learning is often contrasted to the traditional lecture where students passively receive information from the instructor.*
>
> (Prince, 2004, p.1)

An essential prerequisite for active learning is that students come to class with some familiarity with the basic material. In the project team's view, regurgitating information provided in a textbook is an inefficient use of contact time with an instructor. A better use of class time is to help students understand the material in the book and begin to apply the concepts.

Educational research has demonstrated that when successfully implemented students taught in this manner make greater gains in their physics abilities as measured before and after instruction (Laws et al., 1999). The principles of active learning have been applied in the teaching of physics at The University of Queensland since 2008. In both 2009 and 2010 it was found that this resulted in improvement of students' abilities equal to the world's best practice, up to 200% greater gain compared to traditionally taught courses.

More recent research in this area has resulted in other examples of improved learning. A small study carried out at the University of British Columbia highlighted the advantages of a process of 'deliberate practice of thinking scientifically' (active problem solving in lectures), the act of moving the 'simple transfer of knowledge outside of class' (pre-reading tasks and online quiz) and feedback from classmates and lecturer (group and class discussion) (Deslauriers et al 2011, p.862).

The following outlines a strategy used to evaluate the impact of the implementation of the active learning process used as the basis for stimulating student learning and engagement in first year physics courses in 2011 and 2012. The active learning system implemented in PHYS1001 in 2011 had the following aims and anticipated benefits:

- to encourage students to develop self-directed learning skills,
- to encourage students to reflect on their reading material,
- to encourage students to reflect on their learning in class and provide feedback, and
- to allow teaching staff to identify the most difficult concepts for students.

An evaluation of student learning in PHYS1001 conducted in 2011 by external reviewers suggested that the system did achieve the aims and did result in the intended benefits.

As a result of these findings, the project team in the School of Physics decided to implement the system across both PHYS1001 and PHYS1002 in 2012.

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[1] From *PHYS1001 – a not so brief guide for 2011*.

Evaluation Outline

While the evaluation strategy used in 2011 sought to evaluate the use of pre reading and online quizzes in PHYS1001, the evaluation conducted in 2012 will focus on the implementation of active learning in PHYS1002. It will also continue to collect data about the efficacy of the active learning process in PHY1001 and is designed to increase across the board base-line data that can be used in other developmental activities proposed for the Physics department.

The evaluation strategy used is a four-phase strategy that makes use of focus groups, pre- and post-surveys of PHYS1001 and PHYS1002 students, lecture observations and analysis of secondary data.

Research problem

The active learning approach might be viewed as a success if students are better able to learn and retain key concepts and if teaching staff are able to identify the most difficult concepts for students and provide more intensive remediation in these areas. Additional benefits would be increased student engagement and retention, increased motivation and more independent learners.

This evaluation sought to test whether the approach does in fact achieve this engagement across two courses of study, PHYS1001 (already using the active learning process) and PHYS1002 (the active learning process recently implemented) given that the courses are delivered by different teachers, involve different curricula and attract different cohorts of students to the classes. In doing this it must be recognised that as Prince (2004) commented:

> …faculty adopting instructional practices with the expectation of seeing results similar to those reported in the literature should be aware of the practical limitations of educational studies. Educational studies tell us what worked, on average, for the populations examined and learning theories suggest why this might be so. However, claiming that faculty who adopt a specific method will see similar results in their own classrooms is simply not possible. Even if faculty master the new instructional method, they cannot control all other variables that affect learning.
>
> (Prince 2004, p.3)

The same might possibly be inferred even within faculties and schools, and across courses within those faculties and schools.

Role of TEDI

The Evaluation Unit (EU) within the Teaching and Educational Development Institute (TEDI) was commissioned by Professor Michael Drinkwater (Physics) to conduct the evaluation as external evaluators. Karen Sheppard (TEDI), project officer from EU, prepared the analysis and report.

Reporting

This report describes the data collection and analysis processes; outlines key findings from the data collected and concludes with a summary emerging from the findings of the learning activities which most engage PHYS1001 and PHYS1002 students. It also identifies areas of strength and weakness of the current programs and the recent implementation of the active learning process in PHYS1002, as reported by PHYS1001 and PHYS1002 students.

Data Collection Process

Phase 1: Surveying first-year experience of PHYS1001/1002

Pre- and post- surveys were conducted with first-year students enrolled in PHYS1001 and PHYS1002 to identify their familiarity with the active learning process and to determine how much this process assists them to acquire core skills and content and maintain engagement. The survey instrument, while similar to the previous year, was modified and included items about other parts of the process.

Sample: The sample for this phase of data collection included all students enrolled in PHYS1001 and PHYS1002 in Semester 1, 2012 resulting in a cohort size of 196 in PHYS1001 and a cohort size of 132 in PHYS1002. To encourage participation rates students were offered the equivalent of two tutorial

participation marks if they completed both the pre and post surveys. A total of 193 students agreed to participate in the survey, providing a 53% response rate. Of the 193, 171 students actually completed the survey, providing a 47% response rate. For the post survey, all students were invited to take part. By using two collectors in the survey platform SurveyMonkey, students who had not completed the survey for the first time were captured in the data set. A total of 147 agreed to take part in the survey, however, only 132 students out of 361 finished the survey, providing a 37% response rate the second time around.

Collection method: The on-line survey based around the Instructional Material Motivational Survey (IMMS) (Keller, 1987) was administered via Survey Monkey. The survey tested students' perceptions of their experiences with the active learning process. The IMMS based survey (See Appendices 1/2) was designed to assess the motivational characteristics of instructional materials using the Attention, Relevance, Confidence and Satisfaction (ARCS) model of motivation (Keller, 2006). The themes focused on how the students felt in response to the lessons they had experienced in the first three weeks of Semester One. The same survey was administered in the final weeks of the semester providing a 'post' measure for comparison purposes. The surveys were available online for approximately two weeks and the students received an initial invitation plus two reminders to take part in the survey.

Analysis: EU collated the data from both surveys. EU collated the data from the surveys and conducted a descriptive analysis

Phase 2: Talking to the students

Sample: The sample for this phase of data collection consisted of students enrolled in PHYS1001 and PHYS1002. 47 students agreed to participate in the focus groups. A total of 11 students, six males and five females, took part in two focus groups conducted over a period of a week. Seven of the students were enrolled in PHYS1001 and four were enrolled in PHYS1002.

Collection methods: The focus groups were conducted at lunchtime during Week 10 of the semester, by an independent investigator, Karen Sheppard. Students were invited to the meeting and their attendance, while requested, was voluntary. Pizza and drinks were provided and each participant received a $30 gift card. The focus groups were conducted using a semi-structured questioning technique and ran for approximately one hour (see Appendix 3 for the focus group guidelines).

Analysis: A thematic analysis of the recordings of the focus groups was conducted.

Phase 3: Observing the classes

Sample: This phase of data collection was carried out in PHYS1001 and PHYS1002 lectures over Week 12 and 13. The PHYS1001 lecture was observed once by two investigators and the PHYS1002 lecture was observed twice, in the first instance by two investigators and in the second by a single investigator. A total of 233 students were observed, 96 in the PHYS1001 lecture and 65 in the first PHYS1002 lecture and 72 in the second PHYS1002 lecture. A total of 233 students were observed, 96 in the first lecture and 65 in the second lecture and 72 in the third lecture.

Collection methods: The lecture observations were conducted during the 11am time slot in general lecture theatres. The observations were carried out by two investigators from the EU. The data was collected using a modified observation guide and ran for approximately 50 minutes (see Appendix 4 for the guide). The observers met prior to the observations to agree on the method of recording and used the same observation form for all observations.

Analysis: Analysis of the observational data was carried out by both observers to improve consistency and reliability.

Phase 4: Analysis of secondary data

Will be provided with the final report.

Meta-Analysis

The survey results and the themes developed from the focus groups and observation data were analysed to explore the links between how the students actually engage in the active learning process and their success in developing the following:

- Self-directed learning skills
- Reflection on reading material
- Reflection on learning in class and providing feedback.

Data was drawn together to identify other possible indicators for the success of the active learning system and the features of the implementation of the program that encouraged improvement in physics abilities in students enrolled in PHYS1001 and now in PHYS1002.

Despite the increased number of informants from the previous year, the findings reported here need to be examined and interpreted with some caution. The findings can only be viewed as a snapshot of the current cohort. However, patterns may be evident when findings presented here are taken into account with other reports.

Key Findings

PHYS1001/1002 Student Experience Surveys

Students were required to respond to a number of items which investigated the students' responses to the learning activities conducted in Week Two and Three of Semester One. Students were asked to rate agreement related to each of the statements in each item. Responses were categorised on a 5-point Likert scale, including 1 (not true), 2 (slightly true), 3 (moderately true), 4 (mostly true) to 5 (very true), with higher scores indicating higher levels of belief. In other instances, they were asked to rate the learning activities as 1 (no help), 2 (a little help), 3 (moderate help), 4 (much help) or 5 (great help). Included below are tables summarising the data collected over the pre- and post-surveys broken down for course and the different learning activities that are part of the courses.

No comparison of data from the 2012 surveys is made with previous year's responses for either PHYS1001 or PHYS1002; instead comparison is made between responses from PHYS1001 students and responses from PHYS1002 students from 2012. The evaluation project team has made the assumption from 2011 findings that the active learning process appears to provide additional learning opportunities for students enrolled in PHYS1001. The second phase of the evaluation now seeks to gather data about the implementation of active learning into a second course in the department.

PHYS1001 Pre and Post survey

The data suggested that PHYS1001 students had similar ratings or slightly higher ratings for all items in the post- survey when compared to the pre-survey.

There was a slight drop in agreement in the following items

- *The variety of reading passages, exercises, illustrations etc. In the assigned reading helped keep my attention on the lesson,*
- *I could relate the content of the assigned reading to things I have seen, done or thought about in my own life,*
- *The online quiz motivates me to complete the assigned reading before class;*
- *I find the in class lecture activities enjoyable;*
- *The content of the assigned reading and the lecture will be useful to me;*
- *It is clear to me how the content of this lesson is contributing to the aims of the course.*

There was a higher level of agreement (≥4.00) in one item in the post survey; this being *The content of the assigned reading helped me understand the lecture.* Students enrolled in PHYS1001 also responded in a positive way for the item *Overall how you would rate the course.*

PHYS1002 Pre and Post survey

Fewer students studying PHYS1002 responded to the survey; however a number of items received lower ratings (≤3.0 slightly or moderately true) on both the pre- and post-survey than the ratings for PHYS1001. These differences; while not always significant as we will see in later analysis; indicate quite a different response to the active learning process in students enrolled in PHYS1002. The reasons behind this less positive response will bear further investigation. The items that were arted less in PHYS1002 than PHYS1001 included:

- *There was something interesting in the assigned reading;*
- *The quality of the writing in the assigned reading helped to hold my attention;*
- *I could relate the content of the assigned reading to things I have seen, done or thought about in my own life;*

- *The assigned reading made me want to know more about this topic.*
- *I really enjoyed the assigned reading activities.*
- *After the introductory information, I felt confident that I knew what I was supposed to learn from this assigned material*
- *I can understand the important bits of the assigned reading without reading all of it.*
- *The wording of feedback after the online quiz, or other comments in this lecture made me feel rewarded for my effort.*
- *I learn best when discussing problems with other students in the lecture*
- *After working on the lesson for a while, I was confident that I would be able to pass a test on it.*

In the post survey for some items there was no increase in positive response; in fact, students indicated some items were less true in the latter part of the PHYS1002 course including (see Table 1) viz:

- *The variety of reading passages, exercises, illustrations etc. in the assigned reading helped keep my attention on the lesson;*
- *I find it hard to identify the important bits of the reading material;*
- *I really enjoyed the assigned reading activities;*
- *The wording of feedback after the online quiz, or other comments in this lecture made me feel rewarded for my effort;*
- *I learn best when discussing problems with other students in the lecture; I find the in class lecture activities enjoyable;*
- *The content of the assigned reading and the lecture will be useful to me;* and *The activities in the lecture were too difficult.*

Table 1: Overall means and standard deviations for all responses to pre-and post-surveys for PHYS1001 and PHYS1002 for all items.

	PHYS1001		*PHYS1002*	
Pre Reading and Lesson feedback	Pre Mean (SD) N= 96	Post Mean (SD) N= 76	Pre Mean (SD) N=75	Post Mean (SD) N=53
Overall how would you rate this course?	3.93 (.73)	3.94 (.78)	3.44 (.86)	3.33 (.93)
There was something interesting in the assigned reading that caught my attention.	3.10 (.92)	3.25 (.97)	3.00 (1.00)	3.13 (1.02)
The quality of the writing helped to hold my attention	3.01 (1.04)	3.04 (1.07)	2.92 (1.06)	3.04 (1.19)
The variety of reading passages, exercises, illustrations etc. In the assigned reading helped keep my attention on the lesson.	3.31 (1.07)	3.28 (1.05)	3.27 (.96)	3.25 (1.02)
I could relate the content of the assigned reading to things I have seen, done or thought about in my own life.	3.67 (1.08)	3.64 (1.03)	2.89 (0.94)	3.23 (1.07)
The assigned reading made me want to know more about this topic.	3.01 (1.02)	3.21 (1.07)	2.75 (1.22)	3.11 (1.19)
I find it hard to identify the important bits of the reading material.	2.54 (1.26)	2.66 (1.33)	3.25 (1.23)	3.19 (1.16)
I really enjoyed the assigned reading activities.	2.33 (0.98)	2.50 (1.01)	2.43 (1.09)	2.42 (1.14)
The content of the assigned reading helped me understand the lecture	3.90 (.90)	4.10 (.87)	3.55 (.93)	3.53 (1.07)
The assigned reading is so abstract that it was hard to keep my attention on it.	1.96 (1.02)	2.12 (1.08)	2.64 (1.18)	2.98 (1.23)

I could not really understand quite a bit of the assigned reading material for this lecture.	1.91 (.99)	2.28 (1.16)	2.59 (1.09)	2.66 (1.22)
After the introductory information, I felt confident that I knew what I was supposed to learn from this assigned material.	3.16 (.95)	3.23 (1.11)	2.95 (.90)	2.93 (.96)
The online quiz motivates me to complete the assigned reading before class.	3.93 (1.30)	3.63 (1.23)	3.32 (1.29)	3.34 (1.34)
I can understand the important bits of the assigned reading without reading all of it.	3.04 (1.20)	3.08 (1.07)	2.73 (1.07)	2.98 (1.08)
I gained understanding by doing the assigned reading.	3.68 (1.07)	3.82 (.87)	3.37 (1.02)	3.44 (1.04)
I would not feel comfortable telling my entire class what I found most difficult with the reading (e.g. on a discussion board).	2.46 (1.37)	2.46 (1.38)	2.80 (1.19)	2.62 (1.26)
The wording of feedback after the online quiz, or other comments in this lecture made me feel rewarded for my effort.	2.92 (1.10)	3.00 (1.06)	2.85 (.99)	2.71 (1.23)
I learn best when discussing problems with other students in the lecture.	3.44 (1.15)	3.45 (1.17)	3.12 (1.18	2.96 (1.36)
I find the in class lecture activities enjoyable.	3.99 (0.98)	3.80 (.94)	3.25 (1.14)	3.06 (1.21)
It is clear to me how the content of the lectures is related to things I already know.	3.73 (.94)	3.73 (.97)	3.15 (.89)	3.21 (.99)
There were stories, pictures or examples in the lectures that showed me how this material could be important to people.	3.49 (.93)	3.72 (.93)	3.32 (.92)	3.29 (1.09)
The content of the assigned reading and the lecture will be useful to me.	3.70 (.80)	3.68 (.99)	3.35 (.91)	3.12 (1.08)
The activities in the lecture were too difficult.	1.69 (.87)	1.92 (.96)	2.28 (1.04)	2.23 (1.16)
After working on the lesson for a while, I was confident that I would be able to pass a test on it.	3.47 (1.08)	3.47 (1.04)	2.90 (1.08)	3.11 (1.08)
The amount of repetition in the lesson caused me to get bored sometimes.	1.81 (.97)	2.07 (1.13)	1.99 (1.07)	2.40 (1.05)
It is clear to me how the content of this lesson is contributing to the aims of the course.	3.76 (1.02)	3.72 (.97)	3.16 (1.03)	3.23 (1.13)
	PHYS1001		*PHYS1002*	
Learning Activity feedback	Pre Mean (SD) N= 96	Post Mean (SD) N= 76	Pre Mean (SD) N=75	Post Mean (SD) N=53
Completing online problems (Mastering Physics)	3.95 (1.09)	3.99 (1.25)	3.27 (1.15)	3.17 (1.13)
Participating in tutorials/concept labs	2.97 (1.45)	3.23 (1.26)	3.50 (1.17)	3.34 (1.28)
Completing practical labs	2.21 (1.72)	3.26 (1.24)	3.32 (1.23)	3.30 (1.22)
The use of “clickers” during the lecture	3.73 (1.33)	3.62 (1.36)	3.66 (1.07)	3.33 (1.21)
Discussing questions with the person next to me during the lecture	3.74 (1.27)	3.65 (1.40)	3.27 (1.24)	3.13 (1.33)
Discussing questions as a whole class during the lecture.	3.79 (1.12)	3.72 (1.29)	3.41 (1.20)	3.25 (1.28)
Doing the assigned reading tasks and online quiz.	3.60 (1.09)	3.56 (1.01)	3.36 (1.24)	3.46 (1.21)
Attending PASS classes.	2.46 (1.74)	2.08 (1.63)	2.23 (1.53)	2.44 (1.67)
	PHYS1001		*PHYS1002*	
General Physics feedback	Pre Mean (SD) N= 96	Post Mean (SD) N= 76	Pre Mean (SD) N=75	Post Mean (SD) N=53
I am enthusiastic about physics	4.04 (.96)	3.88 (1.01)	3.35 (1.09)	3.33 (1.18)
I am interested in taking extra physics classes	3.82 (1.18)	3.64 (1.27)	2.84 (1.08)	2.70 (1.28)
I am confident I understand the course material	3.69 (.92)	3.47 (.95)	3.14 (1.02)	3.11 (.92)
I need to memorise formulae to get a good mark in this class	2.56 (1.05)	2.77 (1.17)	3.42 (1.12)	3.26 (1.14)
I need to understand concepts in physics to get a good mark in this course	4.66 (.71)	4.56 (.64)	4.35 (.82)	4.54 (.66)

I have completed all the assigned reading in this course	3.65 (1.38)	3.29 (1.34)	3.16 (1.32)	3.38 (1.19)

1= *Not true,* 2 = *slightly true,* 3 = *moderately true,* 4 = *Mostly true,* 5= *Very true. Note:* Figures in parentheses represent the standard deviations.

PHYS1001 vs. PHYS1002 Pre-survey and post-survey

When comparing PHYS1001, student responses with PHYS1002 students' responses to the pre- and post-survey, it is evident that overall PHYS1001 students demonstrated higher ratings than PHYS1002 across all of the items. When the survey items were broken down for learning activity and general physics feedback the general trend remained the same. Again, it should be remembered that the post survey sample size is smaller than the pre; however, a series of independent sample t-tests indicated some statistically significant differences between the two courses. Items tested that were statistically significant which are of particular interest to the study included the following in the pre-survey:

- *The online quiz motivates me to complete the assigned reading before class,*
- *The content of the assigned reading helped me understand the lecture,*
- *The assigned reading is so abstract that it was hard to keep my attention on it,*
- *I find the in-class lecture activities enjoyable,*
- *It is clear to me how the content of the lectures is related to things I already know,*
- *It is clear to me how the content of this lesson is contributing to the aims of the course.*

These differences are illustrated in Table 2 below

Table 2: Means and standard deviations of PHYS1001 students pre-survey (n=96) and PHYS1002 students pre-survey (n=75) where PHYS1001 results were statistically significantly different than PHYS1002 results. P is significant at ≤0.05

	PHYS1001	*PHYS1002*	
Pre Reading and Lesson feedback	Pre Mean (SD) N= 96	Pre Mean (SD) N=75	Significance
Overall how would you rate this course?	3.93 (.73)	3.44 (.86)	<.001
There was something interesting in the assigned reading that caught my attention.	3.10 (.92)	3.00 (1.00)	
The quality of the writing helped to hold my attention	3.01 (1.04)	2.92 (1.06)	
The variety of reading passages, exercises, illustrations etc. In the assigned reading helped keep my attention on the lesson.	3.31 (1.07)	3.27 (.96)	
I could relate the content of the assigned reading to things I have seen, done or thought about in my own life.	3.67 (1.08)	2.89 (0.94)	<.001
The assigned reading made me want to know more about this topic.	3.01 (1.02)	2.75 (1.22)	
I find it hard to identify the important bits of the reading material.	2.54 (1.26)	3.25 (1.23)	<.001
I really enjoyed the assigned reading activities.	2.33 (0.98)	2.43 (1.09)	
The content of the assigned reading helped me understand the lecture	3.90 (.90)	3.55 (.93)	.014
The assigned reading is so abstract that it was hard to keep my attention on it.	1.96 (1.02)	2.64 (1.18)	<.001
I could not really understand quite a bit of the assigned reading material for this lecture.	1.91 (.99)	2.59 (1.09)	<.001
After the introductory information, I felt confident that I knew what I was supposed to learn from this assigned material.	3.16 (.95)	2.95 (.90)	
The online quiz motivates me to complete the assigned reading before class.	3.93 (1.30)	3.32 (1.29)	.004
I can understand the important bits of the assigned reading without reading all of it.	3.04 (1.20)	2.73 (1.07)	

I gained understanding by doing the assigned reading.	3.68 (1.07)	3.37 (1.02)	
I would not feel comfortable telling my entire class what I found most difficult with the reading (e.g. on a discussion board).	2.46 (1.37)	2.80 (1.19)	
The wording of feedback after the online quiz, or other comments in this lecture made me feel rewarded for my effort.	2.92 (1.10)	2.85 (.99)	
I learn best when discussing problems with other students in the lecture.	3.44 (1.15)	3.12 (1.18	
I find the in class lecture activities enjoyable.	3.99 (0.98)	3.25 (1.14)	<.001
It is clear to me how the content of the lectures is related to things I already know.	3.73 (.94)	3.15 (.89)	<.001
There were stories, pictures or examples in the lectures that showed me how this material could be important to people.	3.49 (.93)	3.32 (.92)	
The content of the assigned reading and the lecture will be useful to me.	3.70 (.80)	3.35 (.91)	.010
The activities in the lecture were too difficult.	1.69 (.87)	2.28 (1.04)	<.001
After working on the lesson for a while, I was confident that I would be able to pass a test on it.	3.47 (1.08)	2.90 (1.08)	.001
The amount of repetition in the lesson caused me to get bored sometimes.	1.81 (.97)	1.99 (1.07)	
It is clear to me how the content of this lesson is contributing to the aims of the course.	3.76 (1.02)	3.16 (1.03)	<.001

P is significant at ≤0.05

Similarly, items of particular interest to the study that tested as statistically significant included the following in the comparison between PHYS1001 and PHYS1002 post-surveys:

- *The content of the assigned reading helped me understand the lecture,*
- *I gained understanding by doing the assigned reading,*
- *I find the in class lecture activities enjoyable,*
- *I learn best when discussing problems with other students in the lecture,*
- *The content of the assigned reading and the lecture will be useful to me,*
- *It is clear to me how the content of this lesson is contributing to the aims of the course.*

These differences are illustrated in Table 3 below:

Table 3: Means and standard deviations of PHYS1001 students post-survey (n=76) and PHYS1002 students post-survey (n=53) where PHYS1001 results were statistically significantly different than PHYS1002 results.

Pre Reading and Lesson feedback	*PHYS1001* Post Mean (SD) N= 76	*PHYS1002* Post Mean (SD) N=53	Significance
Overall how would you rate this course?	3.94 (.78)	3.33 (.93)	<.001
There was something interesting in the assigned reading that caught my attention.	3.25 (.97)	3.13 (1.02)	
The quality of the writing helped to hold my attention	3.04 (1.07)	3.04 (1.19)	
The variety of reading passages, exercises, illustrations etc. In the assigned reading helped keep my attention on the lesson.	3.28 (1.05)	3.25 (1.02)	
I could relate the content of the assigned reading to things I have seen, done or thought about in my own life.	3.64 (1.03)	3.23 (1.07)	.027
The assigned reading made me want to know more about this topic.	3.21 (1.07)	3.11 (1.19)	
I find it hard to identify the important bits of the reading material.	2.66 (1.33)	3.19 (1.16)	.018
I really enjoyed the assigned reading activities.	2.50 (1.01)	2.42 (1.14)	
The content of the assigned reading helped me understand the lecture	4.10 (.87)	3.53 (1.07)	.002

The assigned reading is so abstract that it was hard to keep my attention on it.	2.12 (1.08)	2.98 (1.23)	<.001
I could not really understand quite a bit of the assigned reading material for this lecture.	2.28 (1.16)	2.66 (1.22)	
After the introductory information, I felt confident that I knew what I was supposed to learn from this assigned material.	3.23 (1.11)	2.93 (.96)	
The online quiz motivates me to complete the assigned reading before class.	3.63 (1.23)	3.34 (1.34)	
I can understand the important bits of the assigned reading without reading all of it.	3.08 (1.07)	2.98 (1.08)	
I gained understanding by doing the assigned reading.	3.82 (.87)	3.44 (1.04)	.030
I would not feel comfortable telling my entire class what I found most difficult with the reading (e.g. on a discussion board).	2.46 (1.38)	2.62 (1.26)	
The wording of feedback after the online quiz, or other comments in this lecture made me feel rewarded for my effort.	3.00 (1.06)	2.71 (1.23)	
I learn best when discussing problems with other students in the lecture.	3.45 (1.17)	2.96 (1.36)	.034
I find the in class lecture activities enjoyable.	3.80 (.94)	3.06 (1.21)	<.001
It is clear to me how the content of the lectures is related to things I already know.	3.73 (.97)	3.21 (.99)	.004
There were stories, pictures or examples in the lectures that showed me how this material could be important to people.	3.72 (.93)	3.29 (1.09)	.019
The content of the assigned reading and the lecture will be useful to me.	3.68 (.99)	3.12 (1.08)	.003
The activities in the lecture were too difficult.	1.92 (.96)	2.23 (1.16)	
After working on the lesson for a while, I was confident that I would be able to pass a test on it.	3.47 (1.04)	3.11 (1.08)	
The amount of repetition in the lesson caused me to get bored sometimes.	2.07 (1.13)	2.40 (1.05)	
It is clear to me how the content of this lesson is contributing to the aims of the course.	3.72 (.97)	3.23 (1.13)	.010

** P is significant at ≤0.05*

Pre vs. Post survey results for both courses for students who completed both surveys

Responses from students who completed both the pre and post surveys for either of the courses were compared by mean. When comparing the same students' responses the second time around there was few significant differences. Paired T-tests were applied to a selection of items from the survey. Items that were significant included a positive increase for the items

- *The content of the assigned reading helped me understand the lecture*
- *Completing practical labs*

A more negative response was found to the item *I find the in class lecture activities enjoyable* for PHYS1001 in the post survey. There were no significant differences when comparing the items selected from the pre and post PHYS1002 surveys. These differences are illustrated in table 4 below.

Table 4: Students who completed both pre and post surveys for PHYS1001 and PHYS1002 tested for items of significance (* P is significant at ≤0.05).

	Pre PHYS1001 n=62	***Post PHYS1001 n=62***	***Sig.***	***1002 n=43***	***1002 n=43***	***Sig.***
Pre Reading and Lesson feedback						
Overall how would you rate this course?	3.97 (.70)	3.93 (.77)	.742	3.28 (.83)	3.35 (.95)	.570
There was something interesting in the assigned reading that caught my attention.	3.06 (.92)	3.29 (.91)	.066	2.84 (.99)	3.09 (99)	.086
The content of the assigned reading helped me understand the lecture	3.83 (.87)	4.10 (.82)	.020 *	3.42 (.88)	3.53 (1.08)	.499
The online quiz motivates me to complete the assigned reading before class.	4.00 (1.25)	3.69 (1.24)	.055	3.49 (1.18)	3.28 (1.32)	.391

I gained understanding by doing the assigned reading.	3.75 (1.25)	3.87 (.85)	.382	3.24 (.93)	3.36 .96)	.482
I learn best when discussing problems with other students in the lecture.	3.42 (1.15)	3.40 (1.15)	.899	2.97 (1.30)	2.90 (1.34)	.674
I find the in class lecture activities enjoyable.	4.05 (.91)	3.75 (.97)	.008 *	3.05 (1.13)	3.05 (1.17)	1.0
The content of the assigned reading and the lecture will be useful to me.	3.74 (.79)	3.66 (1.01)	.505	3.22 (.94)	3.05 (1.05)	.227
Learning Activity feedback						
Completing online problems (Mastering Physics)	3.97 (1.10)	4.14 (1.11)	.213	3.12 (1.06)	3.14 (1.03)	.888
Completing practical labs	2.44 (1.73)	3.16 (1.23)	.002 *	3.17 (1.25)	3.29 (1.15)	.548
The use of "clickers" during the lecture	3.82 (1.26)	3.63 (1.39)	.242	3.57 (1.08)	3.52 (1.17)	.793
Discussing questions with the person next to me during the lecture	3.70 (1.20)	3.70 (1.35)	1.00 0	3.14 (1.18)	3.14 (1.28)	1.000
Discussing questions as a whole class during the lecture.	3.84 (1.28)	3.76 (1.28)	.653	3.34 (1.04)	3.30 (1.27)	.824
Doing the assigned reading tasks and online quiz.	3.60 (1.12)	3.56 (1.05)	.829	3.36 (1.25)	3.55 (.99)	.345

The data collected from the previous year also indicated differences in student responses between PHYS1001 and PHYS1002 and the assumption made was that students in PHYS1001 were responding positively to the active learning process. Course coordinators decided to test this assumption by implementing the active learning process in PHYS1002 in 2012. However, survey responses still indicate a gap in ratings between PHYS1001 and PHYS1002 for most items.

In summary, it appears from the survey data; that despite the implementation of the active learning process in PHYS1002; that some significant differences still exist in the students' perceptions and responses to the course when compared to those experienced by the students in PHYS1001.

Student Experience: Focus groups

The following findings emerged as a result of a thematic analysis of the qualitative responses and content discussed in the focus groups.

1. The whole process

Students in the focus groups appear able to recognise the benefits of the process. Some students are not necessarily able to articulate why they felt it improved their learning, while others were more reflective in their understanding. The reflective students were more able to connect the process with improved learning outcomes, as apparent in the following extracts from the discussions.

> *I wrote lectures and activities first because it is like active learning I guess asking you gets people thinking, lecturers asking questions and instead of just sitting there you are interested, in other lectures you just sit there and there is no interaction … Yeh…and someone throws information at you. And then there is no time to actually think about it. And group partner activities they can be explaining it and if they know it will help to explain it in a different way. And then the person learning will have another person's view on it and that always helps. Same for the lectures and I did prereading because without the prereading you're normally a bit lost and then that helps in the lectures.*

> *I think it helps us learn faster because we don't spend the lecture time looking through the book we have already done that. And we refine our understanding in the lecture and instead of just trying to understand it to start with, it saves time and we get more work done in a shorter amount of time. The reading quizzes help us to focus the learning from the prereading because some time the text is a bit wordy.*

> *I agree with you that it is called active learning because we are all participating in the course, we are not passively learning, sitting there in lectures just daydreaming we are actually sitting there in the lecture and doing clicking questions and talking to people and I think that is good because you can iron out any misconceptions.*

I think it is better than being traditionally taught because in these types of courses we are actively learning we are not passively taught we do the prereading we do the problem sheets we go the lectures we use the clickers and we are not sitting back and observing , we are inside not outside.

2. Individual elements

In the previous study conducted in 2011, emphasis was placed on investigating the process of pre-reading and online quizzes as a method of engaging students in the learning process. Further investigation was considered warranted in order to determine the effect of other aspects of the process on students. In the focus groups conducted in 2012, all elements of the learning process were investigated, as illustrated in the focus group guide (Appendix 4). Students' comments for each of the elements are explored below.

Pre-reading and online quiz

The participants of the focus groups continued to recognise the value of the pre reading tasks and on-line quiz. Having a previous encounter with the concepts before dealing with them in the lecture or examination allowed the students to scaffold their learning. The pre reading and quiz assists the students to develop conceptual frameworks which in turn make learning and problem solving in the lecture easier and more accessible. The feedback from the online quiz also provides a level of response that was more immediate rather than waiting for the results from an assignment or laboratory report.

The explanation and the reading it helped me a lot… I mean I started off with skimming …. because the work load was so huge before the semester break I just skimmed it and then just reading the summaries and then doing the questions and I failed the mid semester and then I started like reading it more in depth and then writing notes as I went along. I found that I actually needed to do that because it doesn't stick otherwise however it is always nice to have something to go back to and you can put it in your own words.

So in other subjects where there is no pre-reading you find yourself trying to read half a textbook for exam prep because you haven't looked at it before.

Constant interaction with the text book means you are not confronted with it when you go to do the exam.

Having the text book in the exam is only useful if you have already engaged with it during the semester. You can't fake it.

So there are two types of feedback one where you are doing quizzes and you can mark straight and the other where you rely on the lecturer to mark and then you get feedback in the lectures.

So the feedback allows the lecturers to correct any misconceptions you might have across the cohort. It kind of helps…

They go over the reading and it usually takes about five minutes to go through and then they go on to the lecture. They usually identify the main concerns in the lecture. Michael usually addresses these and then he will put up the best answers or an answer that should be answered in another way.

The participants again identified the issue of the amount of time required to complete the pre-reading and online quiz activities in both focus groups. While they recognised the benefits of the practice, they also indicated that the work required to complete the activities was more than in other courses.

Sometimes it hard to get organised around the work load.

The pre reading is useful when I'm like… when you do it properly however it is not so easy when there are other forms of assessment as well. So in the beginning it was fine when we did not have much work from the other courses as well. It was easy to find the time to sit down and go through the reading and take notes and to work in the physics room and take time to do it…not so much now.

It is pretty intense in Physics.

Pre reading exercises are great but there is far too much. It is really great how they give us the clicker questions and all the examples however they don't give us much detail and they don't actually teach the stuff (in the lecture). And I get that they want us to get that from the reading however I find it so difficult to get through the reading.

Clicker questions and lecture activities

Students continue to recognise the value of the inclusion of clicker questions and interactive activities in the lecture. Students also felt more confident in lectures, having already engaged with the learning material, when responding to questions both within a small group or when asked direct questions by the lecturer. The use of in class activities and clicker questions prepared the students for "expert explanations" and the development of problem solving skills.

These lecture activities with clicker activities are great when I turn up because it forces you to think about it and sometimes I can tune out during other lectures but in Physics I stay on track.

Lecture activities with the clickers they are really good because there is more examples and then you get a chance to try it then you get a chance to see if your attempt was correct or incorrect and then there is an explanation but as for lectures there is not much content covered because like they barely teach you it so it is all from the reading actually. Participation in lectures like when there is an even mix on the votes and you get people trying to explain it. Group partner activities are OK but what if you get stuck with somebody who is really dumb or doesn't even care then it is just frustrating.

I think the clicker questions are pretty excellent and they can help you work out what is going on. Like if you misunderstand something then you talk to people around you and they have a different understanding of what is happening and then because people do things differently and they might have a clearer way to do something. Then you talk to them and it makes it better. I'm not sure if you would call it team work however it is better than doing it alone.

So if you have a question and then you find out someone else has the same question you feel like you are not alone.

I think the clicker questions are pretty excellent and they can help you work out what is going on. Like if you misunderstand something then you talk to people around you and they have a different understanding of what is happening and then because people do things differently and they might have a clearer way to do something. Then you talk to them and it makes it better. I'm not sure if you would call it team work however it is better than doing it alone.

It should be recognised that not all students responded in a positive way to these teaching methods. Some students preferred not to engage with anyone else in the class and felt "pressured" when the lecturer requested that they pair up with someone else. Others suggested that choosing the right partner who was also engaged in the process was important to ensure appropriate learning outcomes. There were also indications from some students that clickers were not being fully utilised by some of their peers and that because participation was the only requirement some students were just clicking a random response. One student suggested that marks should be given for correct answers not just any response to the problem.

So in lectures there are people who are talking and on the Internet and doing other things and then they realise there is a clicker question and they click in something and then they go back to doing something other than Physics. I think there should be an extra bonus for getting the question right.

I think group and partner activities are the best things I find for learning and reinforcing knowledge but not that you are forced into being in groups because you might get a poor group and it is not beneficial and it can turn you away from the course. But if you do get a group that works really it is great. So I have a bunch of friends and we go and have lunch after the lecture and we basically talk about the physics problems we just had or about the prac coming up and it just reinforces everything and it just sticks better…
People sometimes answer before the question is even up meaning they are not paying any attention.

Another identified issue was if the active learning process was not adhered to in its entirety then there were times when shortcuts were made. For example when students indicated that they did not know the answer via the clickers then it became easier for the lecturer to just tell them rather than let them problem solve independently or within a group. The focus group participants suggested this to be an issue with class size and possibly the ability to manage large groups. Further probing was not able to elicit a more detailed answer.

> *I think that somehow what happens in the lecture theatre… what happens is that the lecturer… if people don't get it they say if well you don't know the answer then I will just tell you what it is. And it is probably just harder with that many people in the lecture.*

> *Mastering Physics is where you can either do it or not. The pre-reading is great but until I get into the lecture I don't start understanding it until they explain it and then I understand what we are focussing on, the partner and group participation activities are good.*

> *I'm enjoying them all, however Physics I think I'm learning much faster because you have to do the prereading because it counts as marks and you have to you are encouraged to do that and the whole going to lectures and you make sure you get there because you miss out on marks whereas the others you miss one here and there. The prereading it does force you to do it is and the teaching style is definitively a lot better than the biology and chemistry because everyone has done the prereading and you do have the whole interactivity of the lecture but then again the class is much smaller than Bio and Chem. How much smaller I think maybe 1500 kids in Chemistry and I'm not sure about the others.*

Feedback for teacher and student- the closing of the loop

One of the strengths of the learning process is the constant feedback into the learning loop by all stakeholders. Through the reading and online quiz the students are able to indicate what areas they are having difficulty with in the course program. The lecturers are able to respond to these issues via email or in the lecture situation. A standard part of the teaching process is a segment at the beginning of each lecture where the lecturer has identified a problem that many of the class are experiencing. The immediacy of the response is the key here; students, who may have experienced some difficulty studying independently, know that their question will be answered in the beginning of the lecture. The continuous feedback from the online quiz and through the lecture activities is also a very powerful tool for the lecturer. It allows the lecturer to tailor the learning program to meet the needs of the students.

> *I have lecture activities and clickers on the top of the list I just find it good in class it is good to get feedback and it is immediate feedback for example like if I get it wrong then well not so much if I get in wrong but if the class gets it wrong then they explain it or we have to talk to the people around us so either explaining it to someone or having them explain it to me helps it quite a bit and it increases my understanding of what is going on.*

> *What was really good for me he actually emailed me back and gave the responses to the questions it is really good to see …that personal feedback.*

> *The lecturer has emailed and told me my responses are not good enough and that I would need to write a bit more detail in the future to receive a mark. You need to be more specific about the formulas he said.*

> *The lecturer goes through the things that people are having problems with at the beginning of the lecture.*

> *Sometimes it seems like it's not that difficult until afterwards after the lecture I would like to ask some questions.*

Observations

The following section is informed by the structure of the Observation Guide (see Appendix 6) and outlines the active learning processes as observed in the lecture theatres of PHYS1001 and

PHYS1002 in Semester One (see Phase Three - Data Collection Process) in table form. The table identifies processes that seemed to be following a more traditional lecture style in the first instance and processes that seem to exemplify active learning in the second instance:

	More traditional lecture style	Active learning lecture style
Student Information	PowerPoint, learning outcomes for the day, feedback from previous lecture	Structured PowerPoint including details about learning outcomes, feedback from the quiz, recognition of issues experienced by students, student quote, connection to outside learning, references to pre reading and a cartoon.
Lecture implementation - resources	Radio microphone, PowerPoint presentation, visualiser, clickers	Real life props and examples, multimedia examples
Lecture implementation - Process	On screen environment visualiser Series of problems with some explanation in between the problem solving. Some definitions and then to a concept problem that the students were directed to discuss with each other if they did not understand it and then to vote. Everyone had polled the answer then worked through the problem on the visualiser providing a long explanation and then the students re-polled. Some discussion followed.	Introduction of idea using a practical example both on the screen and using props. Concept question posed. Student working on the problem individually and voting. Results were polled by the lecturer however not made public. Discussed the results briefly; students were then instructed to talk with peers. The lecture theatre lights went up when students were supposed to talk and dimmed slightly when the lecturer had the floor. The lecturer made use of this moment of freedom and moved around the theatre to engage with single students and small groups. After a prescribed amount of time the students re-polled and the results were discussed as a whole group. At different points of the lecture the lecturer asked questions of the whole group and received responses from a variety of students. Throughout the lecture there were references to the reading that the students had carried out prior to the lecture.
Learning opportunities	• listening and taking notes while lecturer explains problem • answering questions posed by the lecturer to the whole class • answering questions using the clickers after peer discussion • working with a partner or a small group.	• answering questions posed by the lecturer to the whole class • answering questions using the clickers, individually • opportunity to work independently first • able to work with a partner or a small group and • some opportunities to interact with the lecturer one to one.

Student engagement	When asked to talk about the problem students responded quietly in most cases. Some students who were actively engaged, conversing with each other and pointing and drawing diagrams on paper. Students often appeared to be waiting for the first poll to respond, rather than making up their own minds or working through the problem.	Level of engagement across the class higher most of the time. Students became more involved when the lecturer drew them into the problem solving stage. Students worked on the problems as individuals. Students engaged with the students around them during the peer to peer discussion All the students who had clickers responded to the questions. Students engaged with the lecturer as a whole class.

Table 5: Similarities and differences between active learning and other lecturing processes

Overall observations

This section summarises what was particularly effective about the lectures in covering key concepts, the quality of interpersonal interaction between the students and lecturers and general observation.

The active learning nature of the lectures was particularly effective in ensuring the learning outcomes of the lecture were achieved. The lectures were successful because:

- The beginning of the lecture was situated in the context of the prereading, the online quiz and the learning for the day.
- The pre reading and online quiz were highlighted as important aspects of lesson preparation and the lecturer responded to questions and the results of the online quiz. The immediacy of this response to the reading and online quiz is a powerful tool for student engagement.
- The previous lecture was referred to and the links with previous learning made.
- The learning outcomes of the day's lecture were highlighted and reference was made to how the concepts might work in the world.
- The slides were clear, informative and engaging.
- The students understood their role in the lecture process and responded to the visual and verbal cues as provided by the lecturer. They discussed problems when required, responded to questions when asked and generally listened to the lecturer when appropriate. It is important to note that there was time allowed for the individual to work on a question prior to polling and discussion with peers.
- The use of the tablet to control the screen and add to slides allowed the lecturer to interact with the students more readily; the constant "eyeball" contact is a strength of this mode of communication.
- The radio mike allowed the lecturer the freedom to move around the lecture theatre giving him contact with individuals and small groups.
- The use of simple props (a bike pump) grounded the lecture in the real world allowing the students to scaffold their learning and to build a framework in which to develop the necessary concepts.
- In the closing stages of the lecture, reference was made to future lectures and their relevance to the forthcoming examinations.
- There was a very clear end to the lecture.

Other behaviours observed during the lectures were not as clearly part of the active learning process as the observers understood it. Some differences noted by the observers included:

- While the lecturer referred to a previous lecture and completed a problem from that section of work, there was less connection made with the learning that had taken place before.

- There was less emphasis being placed on the pre-reading and online quiz. Students are required to complete the pre reading and online quiz on the basis that the lecture will develop the idea and provide them with more insight. Without the emphasis, the pre reading may become devalued in the students' eyes. Mention was made of it however not to the same extent and not visually on a slide.
- Rather than the clicker question being posed after the development of a concept it was often used as the catalyst. Students were given the question, asked to poll and/or "discuss it with their peers if they wanted to" and then the lecturer would go through the problem on the visualiser. There was not time allowed for individual contemplation or a specified "discuss with your neighbour" time. As a consequence there was less animation and engagement in the lecture audience during this time.
- The use of the visualiser as the primary mode of communication apart the traditional lecture style approach reduced the amount of face to face contact that the students had with the lecturer. Without the focus of the lecturer, students became easily distracted by peers and communication technology.

Conclusion

This interim report sought to evaluate the impact of the implementation of an active learning process that is being used as the basis for stimulating student learning and engagement in PHYS1001 in 2011 and now in both PHYS1001 and PHYS1002 in 2012.

The expected aims and benefits of this system include:

- to encourage students to develop self-directed learning skills,
- to encourage students to reflect on their reading material,
- to encourage students to reflect on their learning in class and provide feedback, and
- to allow teaching staff to identify the most difficult concepts for students,
- To increase student engagement in their learning

There is evidence in the data collected that the continued implementation and refinement of the active learning process does improve learning outcomes for students.

1. *The nature of the active learning process allows for students to interact with each other in the lecture theatre.*
   The students who attended the focus group sessions were generally very positive about the active learning process. Having been exposed to a number of teaching methods in their short time at the university, they were clear about what was working for them.
2. *The data collected from the surveys provides a less clear picture of the benefit of utilising active learning processes in first year physics courses.*
   Comparisons between pre and post survey for both cohorts' data does not provide any clearer understanding in changes in attitude across the semester. Some changes are statistically significant; however, they are not consistent across all the data. Overall, PHYS1001 students are more positive across the entire set of items than PHYS1002 students. The differences in the results between the two courses could be for a number of reasons. The more recent utilisation of the active learning processes in PHYS1002 may mean variations in how the approach is being implemented. Anecdotally, there are suggestions that students perceive PHYS1002 course as more complex and difficult and thus respond accordingly. More investigation into these differences is warranted; a deeper understanding of the two courses and how they are presented may provide answers.
3. *One cannot identify a single aspect of the approach that works above all others in the lecture; it is the integration of all the practices into a coherent process that makes it such a powerful teaching and learning intervention.*
   Most students are engaged from the first moment by a process that utilises; their previously acquired knowledge and knowledge application (the prereading and quiz stage), the challenge of problem solving (clicker questions), the option of the group think (sharing with fellow students) and the general interactions between student and lecturer.
4. *Observations of lectures suggest that more experienced practitioners of active learning teaching are better able to engage the students.*
   Less experienced practitioners are still working to capture the essence of the active learning process and thereby fall somewhere in the middle, not quite able to provide the full benefit of a "traditional lecture" and not yet able to achieve what best practice in the active learning process delivers.

In conclusion, the data gathered suggests that the active learning teaching framework is a valuable one and that, when the integrated instructional practices are adhered to, the active learning process

has the potential to reduce the atmosphere in a full lecture theatre to one that resembles that of a small tutorial with all its inherent intimacy, the promise of student engagement and improved learning outcomes.

Areas for further investigation

The findings from the surveys, observations and focus group identified the following areas that may need some further investigation.

1. *One of the issues raised by students in the previous phase of the evaluation was the amount of time required to complete the pre reading and quiz section of the work.*
   This view was identified in 2011 and continued to be a theme in 2012. While the students agreed that the pre-reading was an integral part of the process, they also found it difficult to finish sometimes, particularly the students who were enrolled in some of the more intensive programs. Further investigation could provide data as to whether the issue was one of time management on the students' behalf or if indeed the reading demands were beyond the time prescribed by university policy.
2. *There was a suggestion in the focus groups that this aspect of being "strongly encouraged" or "made to" to sit with other students was not always welcome and that the forced nature of the group discussion engendered negative feels for some respondents.*
   However, some students were very positive about this aspect of the lecture, to the point where they carried the discussions out of the lecture hall and into what appeared to be an informal 'community of practice' (Lave and Wenger, 1991). These extremes in response could be interesting to investigate given the potentially powerful effects peer interaction can have on student learning (Webb, 1989).
3. *There is a need to support the dissemination and adoption of the teaching practices in other courses.*
   As with the introduction of any new approach, regular monitoring and reflection allows for the refining of the different aspects of the approach. If the active learning approach is to be embedded in first year physics courses, then some standardisation of the process across lecturers and courses could be useful. The production of a brief "how to" guide and some peer observation of what is deemed best practice might be advantageous.
4. *An instructional practice that results in improved learning outcomes in one course may not necessarily provide the same outcomes in a second situation for many reasons.*
   Further investigation into the curriculum design, student population and pedagogy of PHYS1001 and PHYS1002 may provide insight into how active learning principles may best support the delivery of these two courses.

   Finally, this must be considered an interim report, both primary and secondary data is still being analysed and will be included in a summary report at a later date.

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Appendices

APPENDIX 1: PRE - SURVEY

First year physics 2012 (PHYS1001 & PHYS1002)

Participant Information Sheet

Professor Michael Drinkwater and his project team are investigating an alternative method of teaching first year physics (PHYS1001 & PHYS1002). The project entitled "Engaging first year students in classroom discussion of high-level concepts: pre-reading, reflection and personalised feedback" is designed to investigate a process of learning, based around pre-reading tasks, an online quiz, reflection as an individual and in a small group within the lecture and extensive feedback from the lecturer.

You are invited to take part in this project by completing two questionnaires and possibly taking part in a focus group.

For further information, please view the information sheet (PDF). You will need to click on the back button in your browser to return to this survey when you have finished viewing the information sheet.

Your responses will be completely confidential.

If you decline to participate in the research, your response will be removed from the data to be analysed. You will receive participation marks regardless of whether you are consent or decline to participate in the research, but to receive the participation marks, you do need to complete all the questions. Please ensure that you have clicked on next and done at the bottom of the page to progress or complete the activity.

Please indicate whether you consent to take part in the research or not by clicking on the appropriate response.

- ◯ Yes, I give consent to my responses being used in the research
- ◯ No, I do not give consent to my responses being used in the research

Questionnaire

What degree program are you enrolled in?

- ◯ BSc
- ◯ BArts
- ◯ BEng
- ◯ BEng/BSc
- ◯ BEng/BCommerce
- ◯ BSc/BA
- ◯ BSc/BEducation
- ◯ Enhanced Studies Program
- ◯ Other (please specify)

1. What major do you expect to take?

First year physics 2012 (PHYS1001 & PHYS1002)

2. Think about your whole experience of this course so far.

	Very poor	Not so good	Satisfactory	Good	Outstanding
Overall, how would you rate this course?	◯	◯	◯	◯	◯

3. What grade are you expecting to achieve in this course?

◯ 1 ◯ 2 ◯ 3 ◯ 4 ◯ 5 ◯ 6 ◯ 7

4. Assigned reading and online quiz

When responding to the following questions please keep in mind the assigned reading and the online quiz for the lectures in Week 2 & 3 of this semester (March 5-16).

	Not true	Slightly true	Moderately true	Mostly true	Very true
There was something interesting in the assigned reading that got my attention.	◯	◯	◯	◯	◯
The quality of the writing in the assigned reading helped to hold my attention.	◯	◯	◯	◯	◯
The variety of reading passages, exercises, illustrations, etc. in the assigned reading helped keep my attention on the lesson.	◯	◯	◯	◯	◯
I could relate the content of the assigned reading to things I have seen, done or thought about in my own life.	◯	◯	◯	◯	◯
The assigned reading made me want to know more about this topic.	◯	◯	◯	◯	◯
I find it hard to know which are the important bits of the assigned reading material.	◯	◯	◯	◯	◯
I really enjoyed the assigned reading activities.	◯	◯	◯	◯	◯
The content of the assigned reading helped me understand the lecture.	◯	◯	◯	◯	◯
The assigned reading is so abstract that it was hard to keep my attention on it.	◯	◯	◯	◯	◯
I could not really understand quite a bit of the assigned reading material for this lecture.	◯	◯	◯	◯	◯
After reading the introductory information, I felt confident that I knew what I was supposed to learn from this assigned reading material.	◯	◯	◯	◯	◯
The online quiz motivates me to complete the assigned reading before class.	◯	◯	◯	◯	◯
I can understand the important bits of the assigned reading without reading all of it.	◯	◯	◯	◯	◯
I gained understanding by doing the assigned reading	◯	◯	◯	◯	◯
I would not feel comfortable telling in public what I found most difficult with the assigned reading (e.g. on a discussion board)	◯	◯	◯	◯	◯

First year physics 2012 (PHYS1001 & PHYS1002)

5. Lecture activities

When responding to the following questions please keep in mind the lectures in Week 2 & 3 of this semester (March 5-16).

	Not true	Slightly true	Moderately true	Mostly true	Very true
The wording of feedback after the online quiz, or of other comments in this lecture made me feel rewarded for my effort.	◯	◯	◯	◯	◯
I learn best when discussing problems with other students in the lecture.	◯	◯	◯	◯	◯
I found the in-class lecture activities enjoyable.	◯	◯	◯	◯	◯
It is clear to me how the content of the lectures is related to things I already know.	◯	◯	◯	◯	◯
There were stories, pictures or examples in the lectures that showed me how this material could be important to some people.	◯	◯	◯	◯	◯
The content of the assigned reading and the lecture will be useful to me.	◯	◯	◯	◯	◯
The activities in the lecture were too difficult.	◯	◯	◯	◯	◯
After working on the topic for a while, I was confident that I would be able to pass a test on it.	◯	◯	◯	◯	◯
The amount of repetition in the lecture caused me to get bored sometimes.	◯	◯	◯	◯	◯
It is clear to me how the content of this topic is contributing to the aims of the course.	◯	◯	◯	◯	◯

6. So far how much are the following activities HELPING your LEARNING?

	no help	a little help	moderate help	much help	great help	Didn't experience this
Completing online problems (Mastering Physics)	◯	◯	◯	◯	◯	◯
Participating in tutorials/concept labs	◯	◯	◯	◯	◯	◯
Completing practical labs	◯	◯	◯	◯	◯	◯
The use of "clickers" during the lecture	◯	◯	◯	◯	◯	◯
Discussing questions with the person next to me during the lecture	◯	◯	◯	◯	◯	◯
Discussing questions as a whole class during the lecture	◯	◯	◯	◯	◯	◯
Doing the assigned reading tasks and online quiz	◯	◯	◯	◯	◯	◯
Attending PASS classes	◯	◯	◯	◯	◯	◯

First year physics 2012 (PHYS1001 & PHYS1002)

7. As a result of participating in these learning activities so far, rate your level of agreement with the following statements.

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	N/A
I am enthusiastic about physics	◯	◯	◯	◯	◯	◯
I am interested in taking extra physics courses	◯	◯	◯	◯	◯	◯
I am confident that I understand the course material	◯	◯	◯	◯	◯	◯
I need to memorise formulae to get a good mark in this course	◯	◯	◯	◯	◯	◯
I need to understand concepts in physics to get a good mark in this course	◯	◯	◯	◯	◯	◯
I have completed all the assigned reading in this course	◯	◯	◯	◯	◯	◯

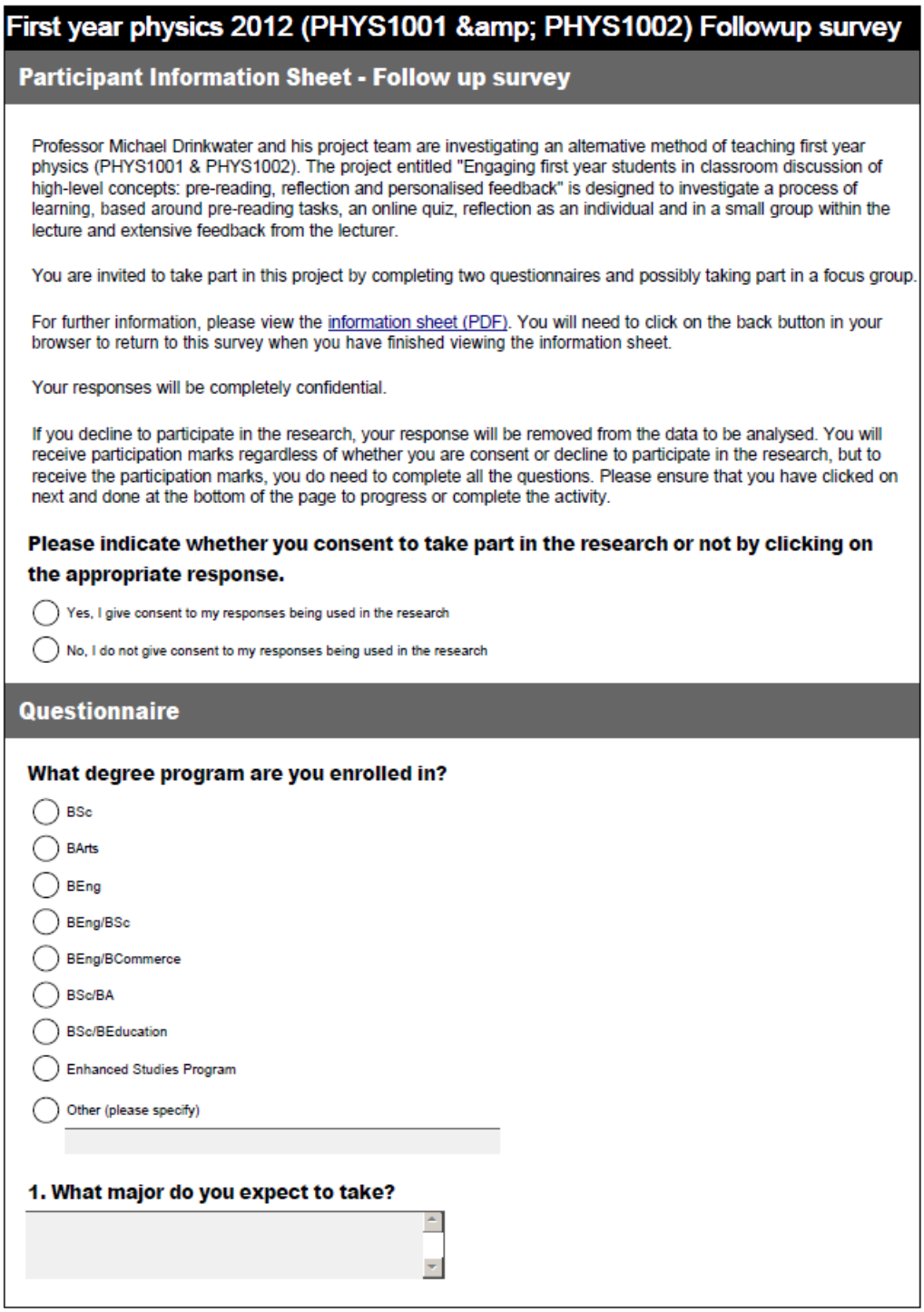
With regard to the focus groups

Please indicate if you would like to take part in a focus group (a meeting where you get to talk about your experiences with an interviewer). Attendees will receive a $30 gift voucher.

◯ I would like to participate in a focus group.

◯ I would not like to participate in a focus group.

APPENDIX 2: Post – Survey



First year physics 2012 (PHYS1001 & PHYS1002) Followup survey

Participant Information Sheet - Follow up survey

Professor Michael Drinkwater and his project team are investigating an alternative method of teaching first year physics (PHYS1001 & PHYS1002). The project entitled "Engaging first year students in classroom discussion of high-level concepts: pre-reading, reflection and personalised feedback" is designed to investigate a process of learning, based around pre-reading tasks, an online quiz, reflection as an individual and in a small group within the lecture and extensive feedback from the lecturer.

You are invited to take part in this project by completing two questionnaires and possibly taking part in a focus group.

For further information, please view the information sheet (PDF). You will need to click on the back button in your browser to return to this survey when you have finished viewing the information sheet.

Your responses will be completely confidential.

If you decline to participate in the research, your response will be removed from the data to be analysed. You will receive participation marks regardless of whether you are consent or decline to participate in the research, but to receive the participation marks, you do need to complete all the questions. Please ensure that you have clicked on next and done at the bottom of the page to progress or complete the activity.

Please indicate whether you consent to take part in the research or not by clicking on the appropriate response.

- ◯ Yes, I give consent to my responses being used in the research
- ◯ No, I do not give consent to my responses being used in the research

Questionnaire

What degree program are you enrolled in?

- ◯ BSc
- ◯ BArts
- ◯ BEng
- ◯ BEng/BSc
- ◯ BEng/BCommerce
- ◯ BSc/BA
- ◯ BSc/BEducation
- ◯ Enhanced Studies Program
- ◯ Other (please specify) _____

1. What major do you expect to take?

First year physics 2012 (PHYS1001 & PHYS1002) Followup survey

2. Think about your whole experience of this course so far.

	Very poor	Not so good	Satisfactory	Good	Outstanding
Overall, how would you rate this course?	◯	◯	◯	◯	◯

3. What grade are you expecting to achieve in this course?

◯ 1 ◯ 2 ◯ 3 ◯ 4 ◯ 5 ◯ 6 ◯ 7

4. Assigned reading and online quiz

When responding to the following questions please keep in mind the assigned reading and the online quiz for the lectures in this semester.

	Not true	Slightly true	Moderately true	Mostly true	Very true
There was something interesting in the assigned reading that got my attention.	◯	◯	◯	◯	◯
The quality of the writing in the assigned reading helped to hold my attention.	◯	◯	◯	◯	◯
The variety of reading passages, exercises, illustrations, etc. in the assigned reading helped keep my attention on the lesson.	◯	◯	◯	◯	◯
I could relate the content of the assigned reading to things I have seen, done or thought about in my own life.	◯	◯	◯	◯	◯
The assigned reading made me want to know more about this topic.	◯	◯	◯	◯	◯
I find it hard to know which are the important bits of the assigned reading material.	◯	◯	◯	◯	◯
I really enjoyed the assigned reading activities.	◯	◯	◯	◯	◯
The content of the assigned reading helped me understand the lecture.	◯	◯	◯	◯	◯
The assigned reading is so abstract that it was hard to keep my attention on it.	◯	◯	◯	◯	◯
I could not really understand quite a bit of the assigned reading material for this lecture.	◯	◯	◯	◯	◯
After reading the introductory information, I felt confident that I knew what I was supposed to learn from this assigned reading material.	◯	◯	◯	◯	◯
The online quiz motivates me to complete the assigned reading before class.	◯	◯	◯	◯	◯
I can understand the important bits of the assigned reading without reading all of it.	◯	◯	◯	◯	◯
I gained understanding by doing the assigned reading	◯	◯	◯	◯	◯
I would not feel comfortable telling in public what I found most difficult with the assigned reading (e.g. on a discussion board)	◯	◯	◯	◯	◯

First year physics 2012 (PHYS1001 & PHYS1002) Followup survey

5. Lecture activities

When responding to the following questions please keep in mind the lectures in this semester.

	Not true	Slightly true	Moderately true	Mostly true	Very true
The wording of feedback after the online quiz, or of other comments in this lecture made me feel rewarded for my effort.	◯	◯	◯	◯	◯
I learn best when discussing problems with other students in the lecture.	◯	◯	◯	◯	◯
I found the in-class lecture activities enjoyable.	◯	◯	◯	◯	◯
It is clear to me how the content of the lectures is related to things I already know.	◯	◯	◯	◯	◯
There were stories, pictures or examples in the lectures that showed me how this material could be important to some people.	◯	◯	◯	◯	◯
The content of the assigned reading and the lecture will be useful to me.	◯	◯	◯	◯	◯
The activities in the lecture were too difficult.	◯	◯	◯	◯	◯
After working on the topic for a while, I was confident that I would be able to pass a test on it.	◯	◯	◯	◯	◯
The amount of repetition in the lecture caused me to get bored sometimes.	◯	◯	◯	◯	◯
It is clear to me how the content of this topic is contributing to the aims of the course.	◯	◯	◯	◯	◯

6. So far how much are the following activities HELPING your LEARNING?

	no help	a little help	moderate help	much help	great help	Didn't experience this
Completing online problems (Mastering Physics)	◯	◯	◯	◯	◯	◯
Participating in tutorials/concept labs	◯	◯	◯	◯	◯	◯
Completing practical labs	◯	◯	◯	◯	◯	◯
The use of "clickers" during the lecture	◯	◯	◯	◯	◯	◯
Discussing questions with the person next to me during the lecture	◯	◯	◯	◯	◯	◯
Discussing questions as a whole class during the lecture	◯	◯	◯	◯	◯	◯
Doing the assigned reading tasks and online quiz	◯	◯	◯	◯	◯	◯
Attending PASS classes	◯	◯	◯	◯	◯	◯

First year physics 2012 (PHYS1001 & PHYS1002) Followup survey

7. As a result of participating in these learning activities so far, rate your level of agreement with the following statements.

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	N/A
I am enthusiastic about physics	◯	◯	◯	◯	◯	◯
I am interested in taking extra physics courses	◯	◯	◯	◯	◯	◯
I am confident that I understand the course material	◯	◯	◯	◯	◯	◯
I need to memorise formulae to get a good mark in this course	◯	◯	◯	◯	◯	◯
I need to understand concepts in physics to get a good mark in this course	◯	◯	◯	◯	◯	◯
I have completed all the assigned reading in this course	◯	◯	◯	◯	◯	◯

APPENDIX 3: FOCUS GROUP DISCUSSION GUIDE

Engaging first year students in classroom discussion of high-level concepts: pre-reading, reflection and personalised feedback.

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1. Introduction

1a. Welcome and introduction of moderator

1b. Objective

The objective of this research is to investigate the effectiveness of an alternative method of teaching introduced in Mechanics & Thermal Physics I (PHYS1001) and Electromagnetism and Modern Physics (PHYS1002). This involves using lecture time for in-class discussion based on pre-reading.

1c. Process

We will be conducting a 1.5 hour focus group with 5 – 7 students who are enrolled on PHYS1001/1002 in semester 1, 2012.

Discussion will focus on

- Your opinion of the text book and pre-reading activities
- Your confidence level in understanding physics
- Your opinions on the learning activities such as Labs, tutorials and weekly problem sheets in PHYS1001/1002
- Your experiences of learning through doing

Pizza and soft drinks are available. Gift cards to the value of $30 will be provided in appreciation of your involvement.

Your permission has been sought to audiotape the proceedings to enable the researcher to revisit the information to ensure accurate analysis.

Any information that is obtained in connection with this study and that could be identified as relating to you will remain confidential and is disclosed only with your permission.

Remember, you are free to withdraw your consent and to discontinue participation at any time without prejudice. Information provided is fed back to the teaching team in report that will include an over view of what has been said, in a de-identified format. Your lecturers will never be able to attribute your response to you and you are welcome to ask for a copy of the report as well.

1d. **Rules** – honest opinions, one at a time, lots of ground to cover, OK to have different opinions

1e. **Introduction** of participants - name, course, career aspiration

Questions

1. OVERALL IMPRESSIONS

'I'm interested first off to find out a bit about your perception about PHYS1001/1002…'

PROMPTS:

- How would you describe this course?
- What were the "learning objectives" of this course, meaning what were you meant to learn, in the big picture sense, from this course?

TASK

- What grade do you think that you will get for this course at the end of the semester? Write down what you think on the post it in front of you – don't let anyone see, fold it up and hand them in to me.
- We'll have a look at them in a few minutes

2. THE PRE-READING TASKS

What I'd like to turn to now is the task of the pre-reading. I'm not sure what that actually entails.

Can some one please describe to me what the pre-reading and quiz is actually about?

- Do you really do it before hand? How long before the lecture? What happens if you don't do it?
- How much time does the pre-reading task and quiz?
- Is that time well spent?
- So what is it that you actually do?

Let's talk about how you go about the task of doing the pre-reading.

TASK

I've got a copy of one of the pre-reading tasks and quizzes here. Can you describe to me how you do this thing?

Prompts:

- Do you note down the points that you have problems with?
- Do you write down the things that you have trouble with? Who goes thorough them with you? Does it help?
- What do you think about the material – does it really help you make sense of complex things?

3. COURSE DESIGN

I'd like to look at the various activities that you do in the course

TASK:

Firstly, I'd like you to arrange the various elements of your course that ware written down on these cards in order of the contribution that they make to helping you understand physics. Put the one that helps the most up the top and rank the rest down to what helps the least

Let's talk about how the pre-reading fits in with the rest of the things that you do

PROMPT:

- How does the reading assist you in:
  - Lecture activities
  - Group activities
  - Tutorial worksheets
  - Weekly problem sheets
  - Labs
  - Pre-reading exercises
- Do you go to the lectures? Why/ why not?
- What helps you 'do" science?

4. ASSESSMENT AND GRADING

'I'd like to hear about your assessment items now in PHYS1001/1002…'

- What forms of assessment are working well for you in PHYS1001/1002? Why?
- Do you think it's fair that the pre-reading quiz is graded?
- Let's look at the grades you wrote down on the post-its. I see that your scores are....
    - Do you think that you would be achieving this without the pre-reading tasks?
    - What contribution to the grade do you think the re-reading task makes?

Conclusion

We are pretty much done; I really appreciate your candid feedback. Before we get to the gift vouchers, is there anything you would like to say about PHYS1001/1002? Anything we did not cover in this session that you feel would benefit us to hear about?

- Thank you for your participation
- Please sign for and collect your debit card

APPENDIX 4: STUDENT FOCUS GROUP CONSENT FORM

Project title: Engaging first year students in classroom discussion of high-level concepts: pre-reading, reflection and personalised feedback.

You are invited to participate in research investigating the effectiveness of an alternative method of teaching introduced in Mechanics & Thermal Physics I (PHYS1001) and Electromagnetism and Modern Physics (1002). This involves using lecture time for in-class discussion based on pre-reading.

The research is being undertaken by Karen Sheppard and Deanne Gannaway from TEDI on behalf of M. Drinkwater, M. Davis, W. Bowen, J. Corney, T. McIntyre & M. Wegener from the School of Mathematics and Physics at The University of Queensland

If you decide to participate, you will take part in one of a series of one-and-a-half hour focus groups with five to seven PHYS1001/1002 University of Queensland students.

Student focus groups will explore the following:

- Your opinion of the text book and pre-reading activities
- Your confidence level in understanding physics
- Your opinions on the learning activities such as Labs, tutorials and weekly problem sheets in PHYS1001/1002
- Your experiences of learning through doing

Pizza will be provided during the focus group. Your permission will be sought to audiotape the proceedings to enable the researcher to revisit the information to ensure accurate analysis. A $30 Debit Gift Card will be provided to participants to acknowledge your participation.

We respect your right to privacy. Our Privacy Policy and its processes ensure that any information that is obtained in connection with this study and that could be identified as relating to you will remain confidential and will be disclosed only with your permission. Your individual responses will never be revealed to your lecturers.

If you decide to participate, you are free to withdraw your consent and to discontinue participation at any time without prejudice.

If you have any questions, please feel free to ask us. If you have any additional questions later, Karen Sheppard, Research Officer, Evaluation Services Unit, TEDI (email: k.sheppard@uq.edu.au) will be happy to answer them.

I have read the information above, and agree to participate in this study.

Name of Participant: ……

Signature of Participant: ……

Date: ……

APPENDIX 5: FURTHER TESTING

Table 1: Means and standard deviations of PHYS1001 students pre-survey (n=96) and PHYS1002 students pre-survey (n=75) where PHYS1001 results were statistically significantly different than PHYS1002 results.

	PHYS1001	*PHYS1002*	*Significance*
Learning Activity feedback	Pre Mean (SD) N= 96	Pre Mean (SD) N=75	
Completing online problems (Mastering Physics)	3.95 (1.09)	3.27 (1.15)	<0.001
Participating in tutorials/concept labs	2.97 (1.45)	3.50 (1.17)	0.013
Completing practical labs	2.21 (1.72)	3.32 (1.23)	<0.001
The use of "clickers" during the lecture	3.73 (1.33)	3.66 (1.07)	
Discussing questions with the person next to me during the lecture	3.74 (1.27)	3.27 (1.24)	.018
Discussing questions as a whole class during the lecture.	3.79 (1.12)	3.41 (1.20)	.046
Doing the assigned reading tasks and online quiz.	3.60 (1.09)	3.36 (1.24)	
Attending PASS classes.	2.46 (1.74)	2.23 (1.53)	

Table 2: Means and standard deviations of PHYS1001 students post-survey (n=76) and PHYS1002 students post-survey (n=53) where PHYS1001 results were statistically significantly different than PHYS1002 results.

	PHYS1001	PHYS1002	
Learning Activity feedback	Post Mean (SD) N= 76	Post Mean (SD) N=53	Significance
Completing online problems (Mastering Physics)	3.99 (1.25)	3.17 (1.13)	<0.001
Participating in tutorials/concept labs	3.23 (1.26)	3.34 (1.28)	
Completing practical labs	3.26 (1.24)	3.30 (1.22)	
The use of "clickers" during the lecture	3.62 (1.36)	3.33 (1.21)	
Discussing questions with the person next to me during the lecture	3.65 (1.40)	3.13 (1.33)	0.022
Discussing questions as a whole class during the lecture.	3.72 (1.29)	3.25 (1.28)	0.046
Doing the assigned reading tasks and online quiz.	3.56 (1.01)	3.46 (1.21)	
Attending PASS classes.	2.08 (1.63)	2.44 (1.67)	

Table 3: Means and standard deviations of PHYS1001 students pre-survey (n=96) and PHYS1002 students pre-survey (n=75) where PHYS1001 results were statistically significantly different than PHYS1002 results.

	PHYS1001	*PHYS1002*	
General Physics feedback	Pre Mean (SD) N= 96	Pre Mean (SD) N=75	Significance
I am enthusiastic about physics	4.04 (.96)	3.35 (1.09)	<0.001
I am interested in taking extra physics classes	3.82 (1.18)	2.84 (1.08)	<0.001
I am confident I understand the course material	3.69	3.14	<0.001

	(.92)	(1.02)	
I need to memorise formulae to get a good mark in this class	2.56 (1.05)	3.42 (1.12)	<0.001
I need to understand concepts in physics to get a good mark in this course	4.66 (.71)	4.35 (.82)	0.010
I have completed all the assigned reading in this course	3.65 (1.38)	3.16 (1.32)	0.024

Table 2: Means and standard deviations of PHYS1001 students post-survey (n=76) and PHYS1002 students post-survey (n=53) where PHYS1001 results were statistically significantly different than PHYS1002 results.

	PHYS1001	PHYS1002	
General Physics feedback	Post Mean (SD) N= 76	Post Mean (SD) N=53	Significance
I am enthusiastic about physics	3.88 (1.01)	3.33 (1.18)	0.003
I am interested in taking extra physics classes	3.64 (1.27)	2.70 (1.28)	<0.001
I am confident I understand the course material	3.47 (.95)	3.11 (.92)	0.030
I need to memorise formulae to get a good mark in this class	2.77 (1.17)	3.26 (1.14)	.018
I need to understand concepts in physics to get a good mark in this course	4.56 (.64)	4.54 (.66)	
I have completed all the assigned reading in this course	3.29 (1.34)	3.38 (1.19)	

APPENDIX 6: **PHYS1001/1002 Observation Guide**

Course:

Observer:

Criteria	Comments
Background Summarise your rationale for choosing this method, how it is planned to inform the evaluation, and its role in supporting other methods. What are the constraints and opportunities influencing your access to the L&T context for observations (e.g. timing of the observation, type of participants involved, type of activities that can be observed etc...)?	
Purpose Summarise the evaluation questions you hope to explore with the observation.	
❑ **What information is given to students about:-** • how, when, with whom, to do the activity etc? • the educational aims, objectives and expected learning outcomes of the activity? • how the activity is expected to help their learning for the course which it forms a part? • how and from whom they can get help if they need it? • what learning resources they can use to help them do the activity and where/how they can get access to them? • how the activity fits into any assessment for the course, and if it is assessed, the marking criteria? • the relevance of the learning beyond meeting the assessment requirements, e.g. in future life, practice etc.?	
❑ **How is the activity implemented?** • who is taking part? • number of participants • nature of the activity and teaching approach • timing and location of the activity • how the activity is organised • how time is used during the activity • roles and responsibilities of participants	

• decisions being made by whom and for whom • resources made available to students e.g. special equipment, learning resources, software, virtual learning environments etc • help available to students • How are the clickers being used?	
❑ **How are the participants behaving?** • How are they undertaking the activity? • How are students using help and resources? • How are students interacting with the learning environment? • Do students appear more motivated, engaged, or better prepared?	
❑ **How are the participants interacting?** • Is there dialogue? • Is the dialogue constructive for learning? • Who is talking/listening? • What is their body language/non-verbal information? • Is there evidence in the dialogue that students are learning? • How are students learning from the dialogue? (e.g. staff-student, peer-peer discussion, group inquiry….etc) • Is there evidence in the dialogue that academic staff/support staff are responding to students' learning needs? • How is feedback being given to students?	
❑ **What is the evidence that students have achieved expected learning outcomes,** • from their completion of activities, assessment? • from their behaviour and dialogue? • from their level of achievement?	
❑ **Other comments**	