UNSW Learning and Teaching Grants and Fellowship Program

Final Report

Grant: Strategic Educational Development

7-Jul-2016

Enhancing a Large Online Course using Interactive Web Technology

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[The completed report should be 8 – 10 pages in length]

1. Acknowledgements

The project team acknowledges support from the project advisory committee (Michael Burton, Louise Lutze-Mann, Joe Wolfe, Elizabeth Angstmann), from Smart Sparrow (Greg Higgins, Zack Belinson, David Rowe) and from the School of Physics IT team (Kristien Clayton and David Jonas). The Head of the School of Physics, Professor Sven Rogge is thanked for his strong support of the project.

2. List of acronyms used

HTML5 — The latest standard developed by the World Wide Web Consortium, which specifies the elements that web browsers need to be able to implement. Content developed in HTML5 can be displayed on any browser without need for plugins.

CATEI — Course and Teaching Evaluation and Improvement (anonymous student surveys used for all UNSW courses)

3. Executive summary

This project involved upgrading a large online course (PHYS 1160 — Introduction to Astronomy and the Search for Life Elsewhere) to use a new set of multimedia presentation material and a new set of interactive assessment activities. This has been successfully completed and the upgraded course ran for the first time in semester 1 2016.

The planned upgrades were based on the student feedback and learning analytics from 5 years experience of running the course together with examination of the latest educational literature. A focus was on increasing active learning and providing improved automatically marked assessment.

The new course material generally proved reliable and was well received by students. The effectiveness of the course upgrades are being evaluated using a combination of student surveys, learning analytics and assessment results. Preliminary results of the evaluation are:

- Students rated the usefulness of the new course materials much higher than that of the video lectures and quizzes they replaced.
- There was a significant increase in average scores on the (unchanged) final test from 70.9% for the old course to 74.4% for the upgraded course.
- Students were much more aware of the role of women in science, and much more likely to choose a female scientist as a subject for an essay question on their “favourite astronomer or astrobiologist”.

We believe the overall course design provides a good model for a high-quality online course and shows how lectures (or videos of lectures) and quizzes can be replaced with more effective alternatives.

4. Key stakeholders

PHYS 1160 Upgrades project team (see list above) — Designed, implemented and evaluated the course upgrades.

PHYS 1160 Upgrades project Advisory Committee (Michael Burton, Louise Lutze-Mann, Joe Wolfe, Elizabeth Angstmann) — Provided advice to the project team and reviewed reports on project progress every three months.

PHYS 1160 Students — Students taking the course in 2015 S2, Summer Session 2015/16 and particularly 2016 S1 helped to evaluate the upgrade through completing pre- and post-course surveys and providing feedback on the new course materials.

5. Project objectives, approach and evaluation

The program of upgrades to PHYS 1160 had a goal of improving student engagement and assessment methods. Our approach is to increase the diversity of learning and assessment activities in the course to match the needs of a very diverse group of students. In general we will replace teacher-centered passive activities with student- centered active-learning activities in line with current best practice. The specific changes carried out were as follows.

1. Update the course materials to bring them fully up to date, and to better focus on the new learning goals (see appendix A).
2. Present the course material in a new format that mixes static text and pictures with rich multimedia content including videos, animations and simulations.
3. Provide a new set of assessment activities developed using an adaptive eLearning framework and built around interactive simulations providing a “virtual lab” environment.
4. Develop a new set of HTML5-based interactive simulations for use in items 2 and 3.
5. Design our multimedia content according to research-based cognitive design principles that help to achieve an efficient learning process.
6. Evaluate the effectiveness of the upgrades through a combination of specially designed student surveys, student feedback through the CATEI system and learning analytics provided by the learning management system and Adaptive eLearning platform.

6. Project outcomes and deliverables

Important deliverables from the project are the PHYS 1160 course material. This includes:

1. about 60 new HTML5 simulations covering the full range of course material including astronomy, astrobiology and basics of biology and earth science. The material was developed in a manner that generally accorded with evidence-based multimedia guidelines.
2. 21 course lessons implemented in the Moodle book format containing a range of multimedia content including videos, animations and simulations.
3. 21 course activities (one associated with each lesson), implemented in the Smart Sparrow adaptive eLearning platform. These are interactive tutorials, which include graded and

automatically marked assessment components. The tutorials incorporate embedded high quality animations and simulations which are used in an integrated and contextually appropriate manner.

4. A set of new videos. These included introductory videos for each lesson that not only provided the student with an overview of the material covered in the upcoming material but also alerted and informed the student with regards to any particularly difficult concepts within the subject matter. We also provided clear instructional advice to the students on optimal study techniques in a video that also provided a general overview to the course.

The materials will be used to continue running the PHYS 1160 course in the future. However, parts of the material could also be used independently for other courses at UNSW or elsewhere. They can also be used to provide a model for others seeking to develop online or blended courses.

We also have a large set of evaluation material we have collected in the form of surveys, and learning analytics, which allow us to compare the upgraded course with the past two semesters of the old course. This will be a valuable resource for ongoing research.

The project has also resulted in a number of publications, reports and presentations on the project as a whole (Bailey et al., 2015; 2016), and focusing on the multimedia design (Hatsidimitris et al., 2016). Further publications are planned when the evaluation is complete.

All project milestones have been achieved except for the completion of the evaluation phase. This depends on the final course surveys that have only just become available. This phase will be completed over the next few months.

However, some preliminary results of the evaluation are as follows:

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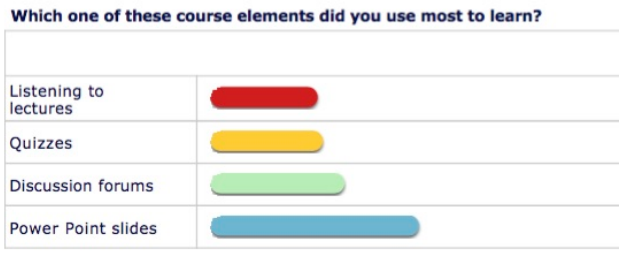
<tr>
<td> 
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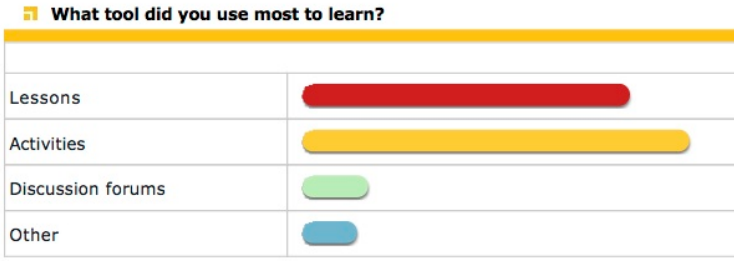
<td> 
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<tr>
<td>Old Course (2015 S2)</td>
<td>Upgraded Course (2016 S1)</td>
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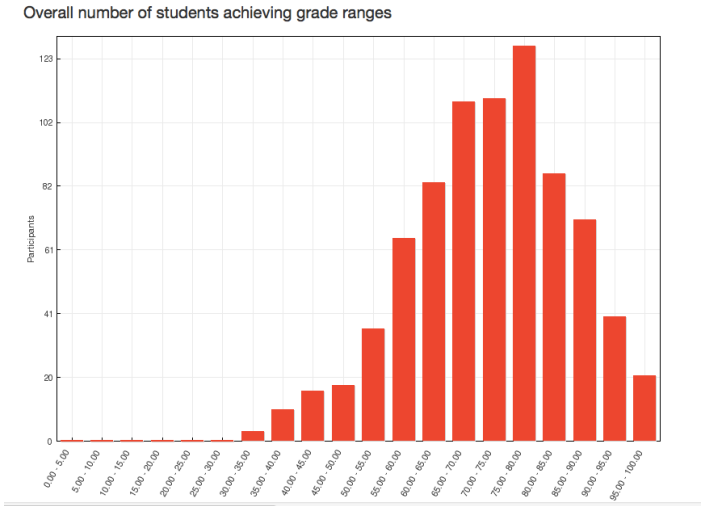
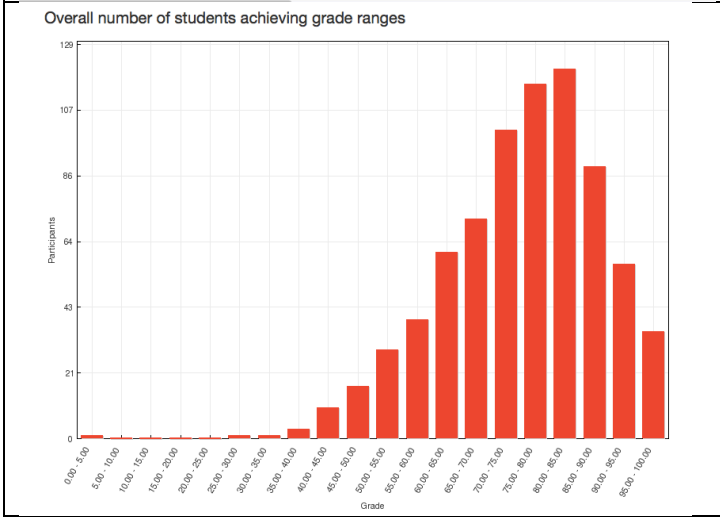
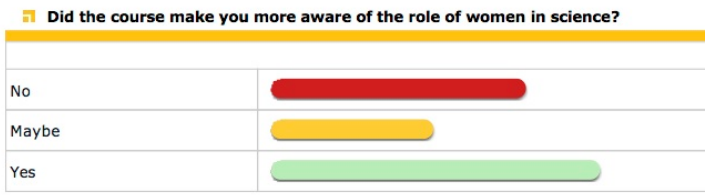
</table>

The new course elements (lessons and activities) were rated much more useful by students than the video lectures and quizzes they replaced. (from anonymous student surveys)

	**Old Course (2015 S1)** **Average 70.92**
	**Upgraded Course (2016 S2)** **Average 74.40**

Students scored a little higher on the (unchanged) final test in the upgraded course.

	
Old Course (2015 S2)	**Upgraded Course (2016 S1)**

Students were much more aware of the role of women in science after the upgraded course. (from anonymous students surveys).

We also tested this through an option in the essay assignment that asked the students to write about their favourite astronomer or astrobiologist that they had learned about during the course. In the upgraded course 2.5 times more students chose a female scientist in response to this question, than in the old course.

7. Sustainability of outcomes

PHYS 1160 has been running successfully for 5 years before this upgrade project. The course upgrades have been designed so that there should be no increase in the staff resources required for running the course, compared with the original design. Indeed in some areas we have made the course easier to run and maintain. One tutor-marked assignment (the short-answer test) has been dropped from the course and replaced by automatically marked assessments using adaptive tutorials. The new course lesson format is easier to update than the video lectures used previously.

The intention is to continue running the course three semesters per year (semester 1, 2, and summer semester) for the foreseeable future. At current enrolment levels this reaches around 2500 students per year across all faculties of the university. For many of these students it will be the only science course they take.

8. Evaluation of Outcomes

Challenges

Completing and testing a complex set of course elements distributed across several platforms (Moodle, Smart Sparrow, YouTube for videos, our own server for simulations) is a significant challenge. While the integration of the various elements worked well, a number of errors found their way into the released course and were only discovered by students. This led to negative perceptions of the course material among a small number of students, which is reflected in CATEI feedback. We will need to use the feedback and analytics from the first semester of operation to iron out remaining issues and expect better feedback when we run the upgraded course for the second semester.

Lessons Learnt

The overall approach and design of our course lessons appears to be well received by students, and provides a good alternative to lectures for online and blended courses. The course activities also worked well, but the effort involved in setting them up was significant.

The use of students to do the programming for our simulations and animations worked very well. All the five programmers we employed did an excellent job and are at the stage of their careers where they need experience, and the work they did for the project will be valuable career development. The cost would have been much higher if professional programmers had been used.

Recommendations

We believe the approach we have used in our upgraded course provides a good model for a high-quality online course which is a step-up from the standard model of videos plus multiple-choice tests, widely used in MOOCs.

However, the work involved in such a project should not be underestimated. Setting up the adaptive tutorials, and testing the course before release are both tasks should have been allocated greater resources.

9. Financial statement acquittal of funds

All expenditure should be reported in whole dollars.

	Budget $	Expenditure Actual $	Expenditure Committed[1] $	Balance $
PERSONNEL				
Content Designer – Level A8 @ 60% + 20.99% on-costs	33,691	33,691		0
Educational Technologist — Level 7 step 4 @ 10% + 28% on-costs	12,149	6,074		6,075
Web Programmers	34,133	30,919		3,214
Subtotal	79,973	70,684		9,289
PROJECT SUPPORT				
Subtotal				
PROJECT ACTIVITIES				
Conference Presentation	4.200	4.200		0
Subtotal	4,200	4,200		0
TOTAL STAGE 3	84,173	74,884		9,289

[1] Committed expenditure represents funds for purchases or personnel costs that have already occurred and are awaiting invoices/payments

We have $9,289 remaining in the project budget at July 4th 2016. We would like to use the remaining funds to continue to support casual staff while we complete the project evaluation phase.

10. References or Bibliography

Bailey, J., et al., 2015, *PHYS 1160 Upgrades Project — Project Definition and Plan*.

Bailey, J., Kedziora-Chudczer, L., Oliver, C., 2016, *A Fully Online Introductory Astronomy Course using Adaptive eLearning*, paper presented at the Astronomical Society of Australia, Annual Scientific Meeting, Sydney, July 7th 2016

Hatsidimitris, G., Bailey, J., Chudczer, L., 2016, *Designing Science-Based Simulations in Accordance with Research-Based Guidelines: A Case Study Approach*, In *Convergence and Divergence*. Paper presented at the Proceedings of the IAFOR International Conference on Technology in the Classroom, Hawaii (pp. 73-79). ISSN: 2432-1222

11. Appendix A

The revised learning goals we adopted for the upgraded course are as follows.

On completion of the course students should:

1. have an understanding of key recent developments and concepts in areas such as astronomy, space exploration, astrobiology and related disciplines,
2. appreciate the interrelatedness of different scientific disciplines,
3. understand scientific method, what it means to study something scientifically and the process of scientific discovery,
4. know that science is a continuing worldwide endeavour, and that scientists are diverse in age, gender, ethnic background and nationality,
5. be competent in using resources on the internet to investigate scientific questions, and in preparing written reports on such investigations.

New learning goals 3 and 4 are based on recognition of the high level of course enrolment, and the variety of students taking the course. For the majority of these students PHYS 1160 is likely to be the only science course they take.

We therefore see it as important that the course leaves them with clear and accurate ideas on what science is, and what it means to be a scientist. A particular focus has been to highlight the role of women in science, and to show that science is a continuing process — not something where all the important work was done many years ago.