Scientia Education Investment Fund Grants

Final Report

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STEM for School teachers

Science

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1. Executive Summary

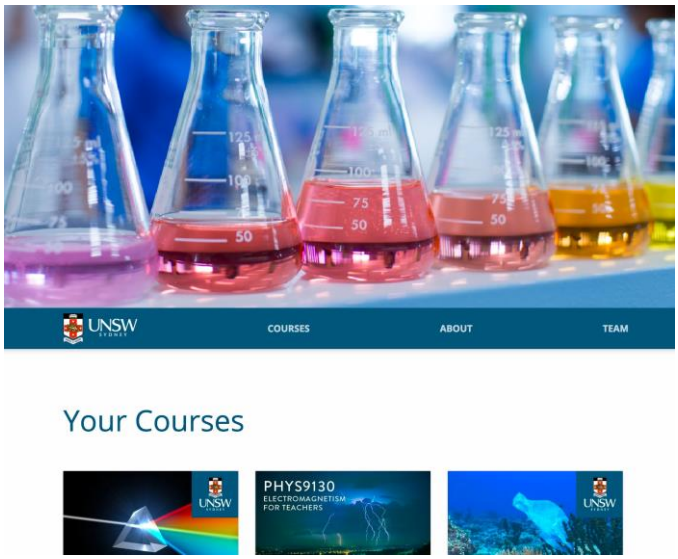
We have created a series of online resources for high school teachers to support the teaching of the new high school science curricula. The resources we have produced include collections of resources to help teachers deliver “depth studies”; these familiarise students with current research at UNSW, and a selection of professional development courses that will teach teachers about new topics in the syllabus and count towards their accreditation. In total we currently have eight sets of depth study resources available with an additional eleven that will be ready by the end of July (and four more coming later in the year). These cover five of the year 11 and 12 science curricula, including physics, chemistry, biology, investigating science and earth and environmental science. We also have one professional development course currently accredited with NESA (NSW Education Standards Authority, responsible for teacher accreditation) and four more that will be released very shortly. These resources are being used in many high schools with more than 700 teacher enrolments in the depth studies and positive feedback from teachers who have utilised the resources. The resources we have produced can be viewed here: https://www.openlearning.com/unswscience

2. Outcomes and impact

- Describe the major achievements of your project in relation to the outcomes and deliverables.

During the course of the project we decided to focus more on “depth study” resources and a little less on professional development course. This was because in our initial release the take up of the depth study resources was very high while the take up of the professional development courses was not. The demand for professional development courses is likely to grow a little over time, this year there have been major issues with the systems tracking of PD hours for teachers. Compulsory PD for teachers was only introduced this year and teachers have five years to meet the requirements. We suspect there will be more demand for these in 2022 when this time interval is ending. The demand for depth study resources this year was high as these are new this year and teachers want help teaching them.

We have delivered an impressive looking portal on Openlearning through which teachers can access our materials. The screenshot below shows part of this portal. It is accessed at: https://www.openlearning.com/unswscience



In our proposal we stated we would deliver:

"A series of depth studies modules which can be used within the syllabus related to the field listed below or as part of the "Investigating Science" curriculum (a 2 unit science course students can do alone or in addition to biology/physics/chemistry or earth and environmental science):

- 6 Physics depth studies
- 5 Biology depth studies
- 2 Earth and environmental science depth studies
- 2 Chemistry depth studies"

We have delivered all this and more. In terms of depth studies we have delivered/are about to :

Depth Study	**Syllabus**	**Progress**
11.1 Sound	Physics	Delivered
11.2 Astronomy	Physics	Delivered
11.3 Series and Parallel Circuits	Physics	Delivered
11.4 A solar oven	Physics	Delivered
12.1 Spectrometry	Physics	Delivered
12.2 Modelling Physical Systems	Physics	End of August
12.3 Exoplanets	Physics	End of August
12.4 Low energy electronics (FLEET)[1]	Physics	At the end of the year
11.1 Optimisation of a chemical reaction	Chemistry	Delivered
11.2 Kinetics to Dye for	Chemistry	End of July
11.3 Nanotechnology- Concepts, Applications and Implications	Chemistry	End of July
11.4 Temperature dependence of everyday reactions using popcorn and glowsticks	Chemistry	End of July
12.1 Analysis of Organic Substances	Chemistry	End of July
12.2 Acids & Bases around the Home	Chemistry	End of July
12.3 Exoplanets[2]	Chemistry	By the end of the year
11.1 Restoring marine habitats	Biology	Delivered
11.2 Cell structure	Biology	Delivered
11.3 Evolution in the modern world	Biology	End of July
12.1 Non-infectious Disease- Type II	Biology	End of July

[1] These resources are being produced by people working at three ARC centres of excellence (ARCSS, CLEX and FLEET). It was not in the initial scope of the project but shows how we have had an impact. ARC research centres have an outreach requirement, following our success they are using our resources as a model.

[2] This is another resource that was not in the initial scope of the project. This is different to the Physics one with a similar title but they are designed so that they can run in parallel. Dr Laura McKemmish is working on this one.

Diabetes and Obesity		
12.2 Infectious Disease - Hepatitis C	Biology	End of July
12.3 Heredity - Genetic Variety and Single Nucleotide Polymorphisms (SNPs)	Biology	End of July
11.1 Astrobiology	Earth and Environmental science	End of July
12.1 Climate Science – Greenhouse effect[1]	Earth and Environmental science	Early July
11.1 Climate Models[1]	Investigating science/ Earth and Environment science	Early July

As discussed previously we have delivered less professional development courses than was initially planned as there was less interest among teachers about these resources than for the depth studies. There have also been problems with the NESA systems. The Professional development courses that are almost complete are:

PD course	**Syllabus**	**Progress**
Doppler Effect	Physics	Available on Openlearning
Standing waves	Physics	In process of accreditation
NMR Spectroscopy	Chemistry	In process of accreditation
Spectroscopy	Chemistry	With Openlearning for graphic design
Thermochemistry	Chemistry	In process of accreditation

- Discuss project impact – how and to what extent has the project impacted students, staff, faculty institution, and higher education as relevant to the project.

The depth study resources have been gratefully received by school teachers. Feedback from teachers has been very positive, for example one of the teachers posted “taking the students to UNSW to do the specific heat capacity experiment is a good idea. We spent 15 hours of class time on our solar ovens which they enjoyed building, but now must move swiftly to complete the course. Perhaps I will run an incursion on electricity to make up time (?) Our assessment was a fusion of the lovely UNSW solar oven depth study and the Pearson Student Skills book depth study. Students worked in groups to design, make and test a solar oven, and submitted individual log books. They also sat a 20 mark in-class test due on the same day (so I can see if they understood how to use the two equations, specific heat capacity and thermal conductivtym to solve problems and write explanations. The ovens have worked well even in winter. We will attempt to roast marshmellows and make smores using the ovens during science week.”; “Excellent. Great to see universities supporting secondary education. Much appreciated.”; and “Thank you for the resources. This has really helped clarify a lot of issues we have been having at our school. “

Currently the number of teachers enrolled in each of the available courses is (Spectroscopy has just been released so is not included here):

Depth Study	Number of enrolled teachers	Potential student impact
Sound	232	2320 - 4640
Astronomy	81	810-1620
Series and Parallel circuits	64	640-1280
Solar oven	68	680-1360
Restoring marine habitats	55	550-1100
Cell structure	64	640-1280
Optimisation of chemical reactions	145	1450-2900

The potential student impact is calculated based on the number of teachers who have already enrolled in the modules. Each teacher will each have at least one science class with 10-20 students and the potential student impact is based on this.

- Include the strategic priorities addressed.

SEIF Priorities (in order of relevance):

2. Allow UNSW to expand offerings to new students;

PD and Depth Studies have been designed with strong UNSW badging with the topics clearly showcasing UNSW researchers and expertise. Some of the depth studies resources incorporated students coming to UNSW to do experiments. Feedback from these students included comments such as: "Please accept me when I'm registering to get a degree at UNSW :)"; "I would love to apply here one day" suggesting that this is allowing us to reach new future students.

5. Develop short discipline specific professional non-award courses linked to micro-credentials;

The professional development courses do this very directly.

3. Incorporate an element of research integrated learning or work integrated learning;

We are helping teachers do this. Our depth study resources allow them to incorporate current research at UNSW into their classrooms. For example, the climate science and climate models depth studies utilises an online simple climate model developed at the climate change research centre for research and education.

2025 Strategy: Theme A2 Educational excellence

2.To admit the most talented students, irrespective of background, consistent with our commitment to a just society. We will have a comprehensive and integrated contextual admission system linked with pathway programs that will ensure we are able to bring to UNSW students who have the potential to succeed within our academic environment, irrespective of background or socioeconomic status.

Our PD course are available to teachers in regional and disadvantaged areas helping them to upskill and better help their students. Being online our depth study resources can help students in schools very distant to UNSW and ensure that these students do not miss out on research opportunities available to students in the city.

4. To establish UNSW as a global leader in technology-enhanced learning, positioning us as a preferred partner for others at the leading edge of innovation in higher education and digital service delivery. We will develop the organisational culture, infrastructure and capabilities necessary to

identify, test and implement the best technology-enhanced learning solutions while at the same time discontinuing those that are less effective.
Through this project we have established UNSW as the leading university in providing online resources to year 11 and 12 high school students. Teachers have commented to Shane Hengst (outreach science officer) that no one else is doing this and that they are very grateful.

2. Dissemination strategies and outputs

- Describe the dissemination activities and events that have been implemented and/or being planned in the future.

On 11th July the team will be presenting our depth studies at the CONASTA conferences. A national science teacher conference in Sydney.
In December Liz Angstmann and David Budden are helping to run a PD course for teachers in Western Australia as part of the Australian Institute of Physics Congress. This will help expand our reach from state based to a more national level.

We have tried printing advertisements in magazines supplied to school teachers and hiring booths at teacher conferences to let teachers know about our materials. We have not found these methods to be very successful (a very low number of teachers signed up for the cost and effort involved).

We have produced a series of fliers that we are handing out to teachers whenever an opportunity presents itself. These opportunities include PD days for teachers at the museum of human diseases and in the school of mathematics and statistics.

We have found Facebook to be an excellent way to disseminate information about these resources. There is a Facebook group called “Science teachers are Awesome” for NSW science teachers which we have posted to. Our posts receive many likes and result in teachers signing up to use our resources. As new depth study resources become available we will also advertise them on the older depth study sites to remind teachers about the older resources as well as informing them about the new ones.

We have also been in contact with people in the science faculty office in order to get the faculty website updated to advertise our resources. This page can be found here:
http://www.science.unsw.edu.au/stemteachers

- Describe the outputs achieved until now and that are likely to occur as a result of this project.

The FLEET ARC centre for excellence is collaborating with us to produce depth study resources to communicate their research to schools. The two climate science ARC Centres of Excellence housed at UNSW (ARCCSS and CLEX) have also contributed resource and staff to the climate depth studies and are committed to supporting further resources on this platform. They appreciate that we have a model and platform that they can utilise to share resources with teachers. Laura McKemmish is also planning to use this same platform in her role as outreach coordinator for the school of chemistry. We have also shown these resources to Derek Williamson at the Museum for Human diseases.

Once the resources for the graduate certificate in physics for science teachers are complete we plan on micro-credentialing parts of these to create more professional development courses. There has

not been as much time for this this year as hoped, as producing the resources for the graduate certificate has been the priority.

3. Evaluation of project outcomes

- Describe the evaluation strategy (formative/summative), tools and actions.

So far, our evaluation has been through teacher feedback and numbers of teachers using our resources. So far these results have been pleasing. We have also received lots of likes on Facebook. Going forward, as the high school students using these resources start up at university it would be good to survey them to see if this had any impact on their decision of where and what to study.

We plan on interviewing a number of teachers to find out about their experiences using our resources and use this feedback to improve our resources and hence increase their impact.

- Include any results of data collection or analysis.

Number of teachers accessing resources is included above.

- Provide an evaluation report on the approach and outcomes.

We changed our approach a little over the course of the project. Initially we had planned on having teachers do a lot of the work. This worked well in physics where we have a teaching fellow on staff who could put time into this project. It did not work well in the other subject areas. Teachers are very time poor and many of them did not communicate in a timely fashion. In place of this we started using PhD students and post docs to help develop materials. This was much more efficient. These materials were then checked by past or current teachers to ensure that they were suitable for use with classes.

At present a comprehensive evaluation of the project is difficult as the resources have only recently been released. In 12 months time it we will look into how they are being used by soliciting feedback from teachers and students.