

REMSTEP project activity report: Monash University

Project overview

- **Project name**

SCI3910 *Schools Science Project* and *Monash Science Squad* website

- **Who was involved**

- Dr David Overton
- Professor Cristina Varsavsky
- Professor Deborah Corrigan
- Mr Greg Lancaster
- Ms Joanne Burke
- Ms Lisa Fazio
- Ms Kelly-Anne Twist

- **What was done**

Two resources were produced – a new unit, SCI3910 and the interactive website *Monash Science Squad* (MSS).

1. The new unit was introduced by the Faculties of Science and Education as an elective for Bachelor of Science students (SCI3910 *Schools Science Project*). The unit was trialed in Semester 2, 2015, and refined for its second offering in Semester 2, 2016. The unit was developed within the framework of work integrated learning to support student exploration of careers for science graduates and preparation for the world of work. Specifically, the unit provides an opportunity to explore teaching as a career.

In this unit students further develop employability skills through a placement in a school. Each student is required to research, develop, manage and deliver (teach) a science-based module that matches the learning outcomes specified to him or her by their client (supervising teacher). Prior to their school placement, students participate in a series of workshops on: understanding and catering for different learning styles, motivation, team work, goal setting, planning, management, leadership, effective communication and presentation skills, asking the right questions and reflection. While there is an emphasis on how the students can directly apply this knowledge in the short term (during their school placements), they are also required to reflect how they will transfer this learning into their future workplaces.

The unit aims for students to be able to:

- Demonstrate they have identified and further developed the generic skills for the workplace: effective communication with a range of audiences, analyse and solve problems, develop new innovative ideas, learn new skills, effective teamwork, lead and motivate small teams, think on their feet and cope with the pressures of working in a professional environment where 'conditions' are constantly changing;

- Correctly interpret the brief from their client (supervising teacher). Research, design and deliver an individually tailored learning project that specifically meets the desired outcomes within the available scope;
- Appropriately manage: client expectations, schedules, resources, risk, personnel (school students') skill and knowledge levels, personal travel to and from site (allocated school), as well as their other commitments;
- Assess their own understanding of the fundamental science principles relevant to a project. Design activities and explanations that will assist lay personnel (their students) to understand and accurately use these principles;
- Actively seek out and act upon constructive feedback.

The SCI3910 *School Science Project* elective unit was initially aimed at Bachelor of Science undergraduates of which 47 took part in 2015. The success of the unit stimulated interest from the School of Biomedical Science. Some of Bachelor of Biomedical Science students participated in 2016 when 36 students enrolled (approximately 50:50 science/biomedical students). The unit had been capped at 60 students due to availability of suitable school placements, however, this cap may be raised with further partnership work by the Faculty of Education with schools. That figure has already been reached for 2017 delivery.

2. The second part of this project was the development of the Monash Science Squad (MSS), a secure, interactive website, <http://sciencesquad.apps.monash.edu/>. This initiative emerged from SCI3910. SCI3910 students wanted more opportunities to excite primary school students to keep learning about science.

MSS is a platform that supports schools students' engagement with science. It is also a vehicle for enabling undergraduate science students to engage with school children participating in a range of science activities, and hence giving these undergraduates opportunities to engage with children in more informal science learning experiences. Primary school students use the platform to reflect on and ask questions about science activities they encounter outside their normal classroom program. Some of this science will be learned in school outside of the normal school day, e.g. as an extracurricular club (supervised by their teachers) or through activities delivered by external science specialist providers. But most of the learning will take place outside of school during evenings, weekends and holidays, e.g. through visits to museums, parks and discovery centres. It is hoped that parents will support their children in their learning and in overseeing the activities.

Children record their science-related learning experiences on the website. Volunteer undergraduate science students monitor the site and respond to the children's questions and give appropriate feedback via the website.

At the end of the year, children, their parents and their teachers are invited to celebration events on a Monash University campus where the children's efforts are showcased and acknowledged through the awarding of certificates.

Project rationale: what is the intention?

- **Is there a theoretical basis or model, or literature that informed the project?**

Much has been written about the shortage of quality science teachers, which in term is proffered as one of the root causes of poor engagement with STEM subjects in primary and

secondary schools. This was indeed the premise on which the ETMST program was funded. This project attempts to build a pathway for science teachers through giving undergraduate science students teaching experiences that will allow them to consider teaching as a career.

On the other hand, science graduates face difficulties with finding a job within the first months after graduation, with national statistics showing that science graduate employment outcomes are declining and below the national average for all graduates (GCA, 2015). These outcomes undoubtedly depend on the employment market, but they also depend on the quality of the graduates and what they have to offer to industry and employers. A recent report commissioned by the Chief Scientist of Australia calls for universities to re-imagine science education for a future where science is central (Prinsley & Baranyai, 2015b). The report also highlights the importance of work integrated learning to develop employability skills that make graduates work ready. At the same time, an Australian study found that science students have very limited access to work integrated learning opportunities suggesting that their university training is largely disconnected from the world of work (Edwards, 2015). This project attempts to address this shortcoming through a collaboration between the Faculties of Science and Education building on the existing university-school partnerships to expand the number of authentic placements available to science undergraduates.

Further to the impacts on science undergraduate students outlined above, is the impact that outreach programs can have on the professional development of in-service teachers. Research in the UK has recognized the positive effect on in-service teachers' professional development when they engage with university personnel through outreach programs (Shallcross, Harrison, Obey, Croker & Norman, 2013).

Lastly, MSS encourages children to learn about science outside the classroom. A UK report (DCMS & DfEE, 2000) suggests that informal learning allows learners to 're-package' themselves as learners and to increase their self-confidence. The learners in this instance is not only students but can also include teachers (particularly primary teachers). Lack of confidence is often put forward as a reason why some teachers do not teach STEM subjects effectively. Wellington and Ireson (2012, p. 283) assert that 'the realm of informal learning in science is an under-used and under-studied area. If we knew more about it, or simply took more notice of it, children's science education would be greatly enhanced'.

- **What gaps do you see are addressed with this project?**

Firstly, the project created an opportunity for undergraduate science students to be inspired by working with school children and their teachers. The experience of teaching a science module gave them an insight into what teaching is like, and an opportunity to consider teaching as a career.

Secondly, and more generally, science undergraduates immersed themselves in an authentic and safe environment to put in practice and further develop skills that better equip them for the world of work. As stated above, such opportunities are scarce for science undergraduates.

Thirdly, MSS gave science undergraduate students the opportunity to volunteer their time and to continue encouraging children to learn science. The undergraduate students continued to develop their employability skills and their science communication skills by

responding to questions from this audience. MSS is not geographically dependent and thus both local, urban and regional schools can use the website, promoting science learning widely.

Project activities

- **What was the nature of the activities – provide examples.**

1. At the beginning of the semester, science undergraduates were supported by the Unit Coordinator with workshops and activities to (i) develop an understanding of how students learn and effective teaching approaches that foster learning, and (ii) reflect on their employability skill set and gaps they needed to address.

After completing the preliminary workshops science students were put in groups to visit their allocated primary school and negotiate with the teachers the science module to be delivered to their school children. Science students then had two to three weeks to plan for and develop the module which they delivered in sessions over four to five consecutive weeks.

After the placement in school was completed, the science undergraduates completed the final assessments: an oral presentation on their school experience, and a reflective assignment with particular focus on aspects of their employability trait development.

2. The *Monash University Science Squad* website was planned, designed, developed, and implemented by a trial with six select primary schools supported by undergraduate science students and educators from the faculties.

The children collected learning credits linked to each hour of science-related learning that they undertook. Accreditation of learning was limited or 'capped' (over a time period governed by presentation of awards at celebration events) in order to encourage children to sample a range of different learning environments.

Special science events can be promoted through the MSS website. For example, the primary children and their parents were invited to a Science outreach event hosted by the John Monash Science School held in October, 2016.

At the end of the year, children, their parents and their teachers are invited to a celebration event where the children's efforts are showcased and acknowledged through the awarding of certificates. This year the celebration event was at Monash University Clayton Campus on December 7, 2016. Children, parents and teachers from 3 participating schools from the SCI3910 unit attended the event (85 children in attendance and in excess of 200 people overall).

- **What was the nature of engagement of PSTs or teachers with contemporary science/mathematics practices?**

Undergraduate science students, some of whom are likely to become PSTs in the future, were able to practice and rehearse their skills and knowledge of science concepts by communicating them to various audiences. They also had the opportunity to put in practice enquiry-based teaching and learning approaches.

School teachers benefited from “fresh” science brought to their schools by the undergraduate students. The activities delivered by the undergraduate students provided professional development *in situ* for the teachers who learned new science and/or new ways of engaging children with science.

- **What aspects of science/mathematics practice were represented to the PSTs? How was this orchestrated? In what sense do you regard this as innovative or significant?**

Not applicable here. Undergraduate science students were involved with the SCI3910 unit and MSS, not PSTs. These students and the in-service teachers whose classrooms were visited, were introduced to contextualized, collaborative inquiry-based pedagogy.

- **What changed curriculum / classroom practices are envisaged, flowing from the project? By what means were these changes supported?**

1. It is hoped that the school teachers involved will be inspired to undertake or develop further the approaches presented by the science undergraduates. The teachers expanded experience of how contextualized, collaborative inquiry-based science pedagogy is achievable and easily resourced in the primary classroom is an important outcome of this project.

2. MSS: It is envisaged that children’s aspirations in science learning will be raised. They will undertake a more informal, learner-centred approach and it is hoped that acquired motivation to learn science will be brought to their daily experiences in the classroom.

In 2017, 299 children made 658 science activity-related posts on the website during the first semester of operation. It is also hoped that parental partnership in learning will be enhanced. All 13 parents surveyed at the Celebration Event strongly agreed or agreed that the Squad had increased children’s enjoyment of science and increased participation outside of school. All parents would recommend the Squad to others. The teachers will have the opportunity to observe children’s learning preferences through monitoring children’s reflections on the website. The 3 teachers surveyed at the Celebration Event all agreed that the *Monash Science Squad* had a positive impact on children’s interest and would have a long-term impact on the children’s future aspirations.

- **What opportunities were there for science/mathematics students (undergrad or HDR) to re-conceptualise their perceptions of school science or mathematics learning and teaching?**

1. Effective practice was modeled by the Unit Coordinator during the workshops preceding the placements in schools. University science students had the opportunity to rehearse approaches during workshops and to undertake formative evaluation. There was much more emphasis on inquiry and collaborative practice with appropriate use of authentic contexts for learning. Undergraduate science students gained an understanding of the complexity associated with the communication of science to others (in an education setting, in relation to their future work places or more generally). The resultant approaches were applied in the classroom setting and evaluated by teachers providing undergraduate students the opportunity for immediate constructive feedback that they could respond to across the weeks of this experience and hence refine their understanding further.

2. MSS: The undergraduate students will be able to interrogate data that will provide indications of suitable contexts to use as stimuli for learning in science. They will be able to couple this with approaches acquired through the SCI3910 *School Science Project* unit in order to extend their understanding and use of appropriate science learning experiences.

Results

Experience of participants

- **What was the experience of PSTs or science and mathematics students, school students, teachers, scientists, teacher educators?**

1. The **science undergraduates** reacted in a positive way towards all of the experiences encountered during the unit. Their enthusiasm was overwhelming and they were motivated, on the whole, to 'go the extra mile';

Student 2, post-delivery, session 2 – "I feel amazing; I've never felt this good before. It went well. I've never had such a successful semester. And it is sad that it is my last semester though."

The students' rationale for enrolling in SCI3910 were diverse. Many students stated that they enrolled in the unit as they hoped to gain employability skills. Some students indicated that they were looking for something "left-field" or "completely different" to "broaden experiences" before completing a degree. Four of the sixteen students indicated that they chose the unit to experience classroom teaching as they were considering a career in education. One student commented on how this was a fairly recent consideration;

Student 6, pre-delivery, session 1 - "I had never really considered teaching, but I thought actually maybe... I had a discussion with someone and I said you know people are just not teaching science right and they said why don't you ..."

Another student stated that she was looking for something that was more "world-focussed" and had an altruistic view of the teaching component of the course;

"I am really for promoting STEM, especially for women"

At the end of the unit, students were highly enthusiastic about their experiences. Some students were inspired to seriously consider a career in teaching:

Student 2, post-delivery, session 1 - "It has just made me consider teaching as a career because, despite the fact that I hated lesson plans, actually getting into a classroom and feeling like allowing someone else to understand something that they otherwise wouldn't have and seeing the progress even over just for lessons and then being really involved in not knowing that they could be so involved. That was really inspiring."

And,

Student 2, post-delivery, session 1 - "I had thought it might be kind of boring like reiterating stuff that you know but you don't take into account the children are variable and that they have different ideas and actually are learning things."

And,

Student 1, post-delivery, session 2 - "I was definitely interested to begin with, but then I was still unsure, that's why picked a science degree with science education."

But then after doing this it has definitely made me consider coming back to do an education degree."

Other students spoke of the impact of the unit in terms of professional experience and learning about responsibility:

Student 1, post-delivery, session 2 - "you are very much personally responsible.... You cannot just stand in front of the class unprepared and say sorry just give me a bad mark I am just going to cop this one on the chin. Like it really forces you to, if you don't have time management, you're stuffed. If you don't deal with it. It puts you in this real- life situation when you genuinely have no choice and you totally have to be responsible."

School children fully engaged with the learning experiences provided and were very appreciative of being taught by "scientists" from the university;

Child 1 - "I personally think, it is a great opportunity for us to learn much more stuff. Because teachers teach us stuff but having an actual scientist come in and teach us and show us, especially because they are older than us, is just a really good advantage for us. For when you grow up. It will be a good step for me when I have to go to college and all that.";

And

Child 2 - "It is fun that they teach us. Because we don't have to always be just sitting there at the desk. And being so bored out of our minds. They actually make us do activities. That we can learn."

And had the opportunity to see "scientists" in action and to be inspired;

Teacher E – "they might be a bit young to be thinking ahead five or six years to perhaps what they want to study. But it is broadening their horizon this horizons, and it is opening their minds to the thought that perhaps science could be a career, in the future."

Participating teachers welcomed the collaboration and saw benefits for the children;

Teacher B – "I have to say that the children are very engaged the students themselves are very professionally presented. They ask enticing questions which catch the novelty of children and want them to explore and acquire further."

And their own professional development;

Teacher B –

"And I have to say, we didn't have much experience of science at Teachers' College. So, for me this is a real reinvigoration of what I have learnt in the past. And I hope that I can build on it."

"I'd like to become more proficient and feel confident about my teaching about the concepts of science. It is the responsibility of the curriculum that we teach it, so in the past I have probably been the person who tries to engage the children. But to the best of my teaching I've probably been more the director and I've been the person

who is out the front giving the information to the children. Whereas, this sort of experience lends itself to the children enquiring more. I think this is the way to go”.

The **Unit Coordinator**, a former UK teacher educator, valued the insight gained in observing the state of science education in Australian schools. Positive working relationships were forged with many school teachers.

2. Science undergraduates who engaged with school children through the website were able to benefit from the motivation stimulated by children’s pursuit of personalised voluntary science learning. Participating teachers observed that MSS had positively impacted their students’ interest in science related activities, and had inspired children to be curious about science related careers. Parents also indicated that their child had enjoyed participating in MSS and would recommend others participate.

- **What evidence is available to identify the experience? (surveys, notes, video, etc?)**

1. SCI3910 *Schools Science* Project. A range of evidence has been gathered arising from the two offerings of the unit. These include pre- and post-unit surveys, focus group interviews (principally with science students but also with teachers and children), video footage, paper drafts, paper presentations, unsolicited email feedback from students and teachers, and student unit evaluations.

The unit was formally evaluated in both offerings. The evaluation plan included qualitative and quantitative data, including pre- and post-delivery surveys and interviews. Qualitative data include:

First offering: two focus group interviews to 20 science students.

Second offering: Most science students participated in pre-and post-delivery group interviews about their expectations and experiences of the unit. Three pairs of students were also interviewed while on placement at primary schools. The evaluator also made observational notes of one student pair as they delivered two sessions of science lessons. In addition, five in-service teacher partners were interviewed to gain their impressions of the effectiveness of the science undergraduate students engaging with primary school children. Finally, the experiences of some of the primary school children at a participating host school were captured in a recorded interview.

There was a low response rate to the surveys administered pre- and post-delivery of the unit, and so the greatest insights were gained from the qualitative data.

2. *Monash Science Squad*. Anecdotal notes, personal communications, survey of primary school teachers, survey of primary school students, survey of parents were collected. Data from the website include use of the website by primary school students including reflections on activities.

The formal evaluation consisted of paper based surveys which were distributed to parents and teachers who attended the *Science Squad Celebration* event at Monash University. Fourteen parents and three teachers returned their responses. The survey consisted of nine Likert-scale items and one open-ended response section. For the Likert scale section, respondents were asked to indicate the degree to which they agreed or disagreed with a statement about the impact of the Science Squad website. In the open-ended section, respondents were asked for comments on how any aspect of the *Monash Science Squad* program could be improved. Teachers and parents had identical surveys except that

teachers' surveys referred to "students'" experiences whereas the parents' surveys referred to their "child's" experience.

Project outputs

- **What resources were produced and what is their quality (and where can they be found)?**

1. The unit site on the university learning management system.
2. Website <http://sciencesquad.apps.monash.edu/>

- **What understandings or models have resulted, concerning how to engage PSTs with contemporary science and mathematics practice?**

Not applicable to this project.

Project outcomes: What were the outcomes for the different players?

- **Is there evidence of a cultural shift in the way education and science faculty staff inter-relate as a result of this project?**

The collaborative nature of the ReMSTEP project has required members of both the Education and Science Faculties to meet on a regular basis to plan and assist with each of the Monash project initiatives. This has promoted the sharing of insights across the diverse projects and the sharing of both expert knowledge and resources. All project members acknowledge the mutual benefits of this collaborative initiative. Central to this planning has been the mutual recognition of the need to develop sustainable initiatives that will persist beyond the life of the ReMSTEP project.

- **What have research scientists or mathematicians gained by participating in the REMSTEP project? Have their views about teaching and learning science and mathematics changed as a result of the project?**

Not applicable to this project.

- **What have science or mathematics undergraduate or HDR students gained by participating in the project? Is there evidence of a shift in science or mathematics students' perception of teaching as a worthwhile career path?**

Participating science students were often impressed by the approaches to science education which were modelled. They often commented that they had had little experience of science in schools as learners. It became clear that their experience in learning science had too much emphasis on content and they responded to, and applied, the notion of inquiry-based learning and collaborative learning in a true sense.

Student 1, post-delivery interview, session 2 – "It was clear that the sort of science that we do at university wasn't really pushed in the primary years, but it was a lot more of your bugs and bees, and that sort of thing. It was probably easier to learn and to teach. But I think that when we brought in something new, a bit more advanced concepts that they really did understand it. So it would be good to get that still at the younger age."

And

Student 1, post-delivery interview, session 2 – “in primary school you are taught science has a single answer subject. It is taught that this is the right answer and this is the wrong answer and I think that needs to change completely. Even in high schools. Because as soon as you come to university it’s like ‘no no no’, it is just about exploring and thinking and discovering. Where is in primary school and high school it’s more of a tick or a cross.”

Students reflected on the value of teaching as a career and of STEM in general;

Student 1, post-delivery interview, session 2 – “And I was thinking you never get told, ‘oh you would be a great teacher’. You get told you be a great this, that and the other, scientist, musician, lawyers, never you would be a great teacher.”

And

Student 1, post-delivery interview, session 2 – “I know that Australia is putting a lot of money to getting people into STEM careers to come from overseas. And it makes me sad that like a higher level of science is still not really pushed in schools. There are concepts that I wish that I wish... like we learn in in late high school, that I certainly think primary age school kid would understand. And I wish that Australia was further ahead, it just makes me sad that it is not. That we don't have such intense, exciting high-quality science all the time. This is just a one-off for them.”

As indicated above, a good number of students were motivated to consider taking up one of the available pathways to teaching as a career;

Student 2, post-delivery interview, session 1 – “It has just made me consider teaching as a career because despite the fact that I hated lesson plans actually getting into a classroom and feeling like allowing someone else to understand something that they otherwise wouldn't have, and seeing the progress even over just for lessons and then being really involved in not knowing that they could be so involved. That was really inspiring”.

Some students initially fostered ideas of becoming secondary teachers but changed their focus to possible careers in primary education (schools participating in the Project were all primary schools);

Student B, pair 1 – “but now it is something that I would consider -actually going into teaching. Personally I thought it wouldn't be as much primary school teaching, just because generally the teachers do not specialise as much in just one field as they do in high school teaching. Yeah, but now I would actually consider teaching a younger group than before.”

What evidence is there of improved learning and engagement of PSTs, or of teachers, as a result of the project? What did PSTs learn about the nature of science, or how to incorporate science/mathematics practices into the curriculum?

The school teachers gained much in terms of professional development, particularly in terms of inquiry-based learning, collaboration, dialogic teaching and contextualized experiences;

Teacher E – “I wish it was going for longer than two weeks. They are very engaging. Both the Monash students, the way they interact with the children as lovely. And for

myself, I have enjoyed, I have almost been a student with the students. Watching and listening and getting involved in that way.”

And

Teacher B - “We didn't have much experience of science at Teachers' College. So, for me this is a real reinvigoration invigoration of what I have learnt in the past. And I hope that I can build on it.”

Teachers were keen to pursue more extensive collaboration outside of the unit, including but limited to the *Monash Science Squad*.

- **What has been learnt about the efficacy of incorporating contemporary science/mathematics practices in the school curriculum? What evidence is there of improved learning and engagement of school students, as a result of the project?**

The pedagogies alluded to above and delivered by science undergraduates attracted positive comments from teachers;

Teacher A – “The girls I have this morning are doing speed and introducing some very hard concepts like resistance. And I was thinking when they started “oh God, how is this going to go?” Because of the EAL-ness¹ of our kids, but they all got it in the end. So I was very impressed.”

And

Teacher E – “...they are giving the theory behind experiments and then they are actually letting the children see an experiment happening in front of them. And then the children have to give feedback. I particularly liked that last week. The last part of the session was that the children had to write down their own feedback and thoughts on the session that they did last Tuesday”.

- **What principles can be taken from the project concerning processes for bringing contemporary science and mathematics research and development practices into teacher education?**

This has not been a particular focus of the SCI3910 unit.

Concluding discussion

Challenges

- **What was the nature of challenges to successful implementation?**

1. The initial challenge was to engage science students with pedagogies such as inquiry-based learning with which they were not familiar. They were also not familiar with collaboration in a true sense, only as group work (during which tasks were allocated, followed by independent learning with subsequent coming together to report outcomes).

The unit was logistically difficult to manage in terms of matching student’s availability (work and timetable constraints) with timings prescribed by host schools.

¹ EAL-ness refers to the language diversity in our classroom (English as second language)

2. Technical issues relating to bespoke website development and delays in timescale resulting in a situation of 'catch-up' in implementation by participating schools.

- **What changes were made, from which we can learn?**

1. The unit modelled practice that enhances student learning and engagement in science. Only minor refinements were made to the unit for the second offering. These focused primarily in supporting students more closely through the process of reflecting about their learning and their skill gaps.

2. Build in longer period for development and implementation arising from knowledge gained in overcoming barriers presented (above).

Impact

- **What is the short/medium term impact of the project (ongoing processes, commitments, existence of resources, over a 1-3 year projection)?**

1. The SCI3910 unit will continue to be offered beyond the life of the ReMSTEP project. It is popular with science students. It is well received by schools and it is hoped that the number of host schools can be increased. There is an extensive bank of equipment for use in schools. This will need to be supplemented with 'consumable' resources.

2. Unknown and dependent on successful uptake by 'pilot' schools. Commitment needed from the faculties to support volunteer undergraduate students in maintaining the website and responding to children's questions.

- **What are the longer-term implications?**

1. Increased demand from undergraduate science students and, consequently, schools as awareness continues to be raised.

2. Ability of website to cope with any heavy demand.

Sustainability

- **What has been learnt about processes for incorporating contemporary science and mathematics practices in teacher education?**

This has not been a particular focus of the SCI3910 unit.

- **In what sense is the project sustainable?**

1. The SCI3910 unit has been set up to be sustainable beyond the life of the ReMSTEP project. It is credit bearing unit and so it can be delivered with the revenue raised by student fees.

2. *Monash Science Squad*. Sustainability is dependent on ability of website to cope with volume of traffic, with teachers commitment to input student names/logins and with University management and support of site and data.

Scalability

- **What is the possibility of the project processes and outcomes being reproduced at scale?**

The SCI3910 approach has been presented at several conference and has been received positively. Several academics made inquiries about adapting the approach to their own context of undergraduate science programs.

There is a huge market in terms of value to students and schools. The limiting factor is planned ongoing collaboration between staff in each Faculty with the skills necessary to deliver the unit and the development of appropriate university-school partnerships to support the placement.

References

DCMS & DfEE (2000). The learning power of museums – A vision for museum education. London: Department of Culture, Media and Sport.

Edwards., D, Perkins, K., Pearce, J. and Hong J. (2015). *Work Integrated Learning in STEM in Australian Universities*. Australian Council for Educational Research (ACER).

GCA (2015). *The Australian Graduate Survey Report 2014*. Graduate Careers Australia, Melbourne, Accessed Oct 8 from www.graduatecareers.com.au/research/researchreports

Prinsley, R. and Baranyai, K. (2015b). *STEM-trained and job ready*. Office of the Chief Scientist of Australia, Occasional Paper Series, 12, Aug 2015 Accessed Oct 20, 2015 from www.chiefscientist.gov.au/wp-content/uploads/P\OPS12-WIL_web.pdf .

Shallcross, D.E., Harrison, T.G., Obey, T.M., Croker, S.J. & Norman, N.C. (2013). Outreach within the Bristol ChemLabs CETL (Centre for Excellence in Teaching and Learning). *Higher Education Studies* , 3. 39-49.

Wellington, J. J., & Ireson, G. (2012). *Science learning, science teaching*. Milton Park, Abingdon, Oxon: Routledge.