ReMSTEP
Reconceptualising Mathematics and Science Teacher Education Programs

REMSTEP project report Inquiry Science

Project overview

Scientists as Partners in Education

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- What was done (in broad terms)?

In the first instance of Scientists as Partners in Education (SPiEs), in 2015, a PST collaborated with a scientist to create a classroom activity for primary school students. In the second iteration, scientists delivered a lesson introducing themselves, their science, and the relevance to the community. This included leading a hands-on activity which was analogous to their work, maps to the curriculum, and can easily be done in the classroom.

Project rationale: what is the intention?

The rational for introducing scientists to working with PSTs and in-service teachers was that the scientists training and experience can be used to enhance the classroom activities of the teachers and the experience of the student, which should maintain both the students and the teachers interest in science.

One of the most common questions asked in a science classroom is “”Why?”” This project seeks to enhance the way teachers can approach this question by enabling the teacher to provide answers which are engaging, contemporary and are at the cutting edge of scientific research as practiced.

Project activities

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

The initial project (Grime Detectives) involved a research scientist collaborating with a PST to design and deliver an activity for grade 5/6 students. This activity was structured around the 5Es model of teaching and involved students identifying surfaces which may have high bacterial loads, and using using cotton swabs and agar plates to determine which is the most “grimy”. This activity was deemed to be a success on the basis of student engagement learning outcomes. However, it is very time intensive for a single PST; some equipment involved (agar plates) is specialised and requires a careful risk assessment.

The second iteration of the project involved creating a series of public seminars to a live audience of PSTs and in-service teachers that would be also recorded for wider dissemination. The seminars had three parts. Firstly, a senior scientist would introduce their work and their life journey they have taken to get to where they are, highlighting aspects illustrating that most scientists do not take a direct (or effortless) path from school into research and academia. In the second part, the scientist then introduces and demonstrates an activity, analogous to their work, that the teachers could easily do in their own classroom. Finally, the seminar host (a scientist) led a discussion between the audience and the scientist about the usefulness or otherwise of the presentation. The first part of the seminar aims both to provide authentic evidence of Science as a Human Endeavour, and to provide context and motivation for the

activity (“why are we doing this?”). The final part helped provide feedback and evidence for the aims of the seminar.

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

PSTs and teachers were engaged with contemporary science practices through their direct contact with the scientist providing the seminar. During the seminar the activity that is introduced is directly related to the research conducted by the scientist. Such an example of this is during the seminar delivered by Dr. Lakshmi Wijeyewickrema whose work is on using enzymes to fight diarrhoea in pigs; she created an experiment where the enzymes in fresh pineapple digest the gelatine in jelly, whereas tinned pineapple does not.

- 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?

Various aspects of science practice have been represented to PSTs. These include molecular modelling (computational chemistry), biochemistry (enzymes), structural biology (synchrotrons and protein crystallization), the chemistry of coffee (chemistry),

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

Curriculum and classroom practices that are envisaged to change as a result of these seminars are:

- PSTs and in-service teachers should now be able to provide authentic and specific examples of the contemporary science that they are teaching;
- Increased quality and duration of hands on activities
- A richer way than textbook examples to illustrate the unit of work linked with the topics of the seminars;
- A conceptual starting point to find resources for further work by PSTs, in-service teachers and students.

These new practices are supported by lesson plans, resources recorded created by the scientists in collaboration with teachers and made available online.

Results

Experience of participants

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

The experiences of the above mentioned varied from polite interest to passionate engagement. The audience of the seminars ranged from primary school teachers though to VCE teachers as well as PSTs, and under- and post-graduate science students.

Pre-service Teachers noted that they would be able to use some of the anecdotes provided by the scientists in their teaching as well as some of the experiments and resources presented by the scientists.

In-service teachers noted that some of the concepts and content were too advanced for their students to comprehend without significant preparation. They also noted that experiments needed to be more specific to a year level (and the curriculum therein) rather than just generally explaining it to the audience.

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

This was gathered from the surveys after the first seminar and feedback from the participants after the sessions, between the audience and either Nick Tran or David Hoxley.

Project outputs

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

All of the seminars have been recorded and will be made available through the ReMSTEP website as well as procedures for the experiments shown in the seminar and curriculum links for the topics.

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

The model that has been created is to engage PSTs and teachers though "typical" means of seminars to deliver Professional Development on contemporary science practice, using scientists that are leaders in their fields who have developed experiments designed in collaboration with an experienced teacher.

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?

No. The project was organised by the science faculty and used the existing links though ReMSTEP to market the project to PSTs and teachers. It is interesting to note the lack of interest in the seminar series from the School of education, beyond allowing access to their students for publicity purposes. In future, it is hoped that the seminar series might be further integrated into the MTeach, e.g. by assessment.

- 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?

The research scientists gained experience in delivering their recent research findings to an educated, but non-expert audience. While the seminar style of delivery is standard for scientists, they were forced to frame their work to allow PSTs and In-service teachers to pass it on to school students in a way that is relatable to the current Australian curriculum.

- 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?

The under or postgraduate students have gained an insight into how they can incorporate their current or prior education into their teaching at the university

(current or future), or into primary or secondary teaching should they decide to pursue a career in education. It also introduces them to the complexities and challenges of the teaching landscape.

- 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?

Nil evidence of improved learning and engagement of PSTs. PSTs learnt about the aforementioned areas of contemporary science research, and experiments or demonstrations that link with the current curriculum .

- 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 scientists found that incorporating aspects of their work into the school curriculum is easy enough once the technically intricate parts of their work has been removed. The fundamental principles of their research are easily grasped by PSTs and teachers; it is hoped that this extends to students as well, though the teacher's experiences. Due to the seminar nature of the final project the learning and engagement of school students was not able to be evaluated.

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

The process that was employed for bringing contemporary research and development practices into teacher education was to create a collaborative working group to find ways to ''bridge the gap''. Specifically, scientists tend to describe their work using a large amount of technical detail (both concepts and language). Through this project an experienced teacher with a science background was engaged to work on the linking documents to the science as practiced, the curriculum, and how students learn, to support the PSTs and Teachers.

Concluding discussion

Challenges

- What was the nature of challenges to successful implementation?

The challenges that were present in this project were;

1. Low attendance by both PSTs and teachers. Due to PST practicum occurring during semester, most were not able to make the seminar at 5 pm in Bundoora. Despite high acceptance rates, in-service teachers found travelling after school to Bundoora an issue.
2. Getting the scientists involved. This was overcome by using and experienced teacher to connect the topics and experimental work to the curriculum, which alleviated the concern of having to put in a large amount of time.
3. Getting feedback on the project i.e surveys

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

Going forward if this project were to run again, this would be done as a full day conference or formal Professional Development instead of afterhours in Bundoora, and using a more central location to the CBD (e.g. the Royal Society) than Bundoora.

Impact

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

The short-term impacts are; a pool of resources have been produced that will be able to be accessed by PSTs and teachers for their use in their classrooms.

This would hopefully increase the efficacy of teaching science and allow them to answer the question "why are we learning this?"

- What are the longer-term implications?

Should this continue to go ahead, a great number of resources will be produced and would by a large set of resources for teachers to draw upon for teaching contemporary science in the classroom.

Sustainability

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

We have learnt that the process can be easy on the scientists, PSTs and teachers time, if delivered in this format. This could be integrated into science methods teaching in the future but for now will continue to be an extra curricula activity.

- In what sense is the project sustainable?

The project is sustainable if there is someone to organise the speakers, seminar logistics do the back-end work of connecting the experimental activities to the curriculum and helping the scientist understand their audience (PSTs and Teachers) as well as recruiting the scientists.

Scalability

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

The possibility of the project being reproduced at scale is possible. The project would have to be run in a more central location and take into account the timetables of teachers and PSTs. This could take the format of a one day PD/conference held in a central location. Making the resources created available online and accessible to everyone for free will increase the reach of the project.