ReMSTEP
Reconceptualising Mathematics and Science Teacher Education Programs

REMSTEP project report: Contemporary Biology and Environmental Education

Project overview

- *Project name:* Contemporary Biology Multi-media Resources
- *Who was involved?*
  This project involves pre-service biology education students interacting with contemporary science and scientists and developing school biology activities based on this: PSTs in Biology Unit ESS 467 (2015-20 students) and ESS 767 (2015-50 students, 2016-60 students in Trimester 2), TFA M.Teach students in ESS 741 (2015-20 students , 2016 – 20 students in Trimester 3), approximately.
- *What was done (in broad terms)?*
  There are 2 parts to the project. Part 1 is using Digi Explanations, which is an OLT project (http://www.digiexplanations.com/). It was part of the Biology PSTs' assessment of the methods unit, including an interview a scientist on a contemporary biology research topic. Biology and Environment Education students focused on a concept and created a 3-5 minute multimedia presentation. In addition, this activity connected with the REMSTEP project where students were asked to engage with a scientist in a related area. To do this, students needed to identify, contact and interview a scientist. Initially, in 2015, the B.Ed students were not confident in contacting a scientist for this purpose as they didn't not have prior networks, whereas the M. Teach students, with their prior professional background were more confident in connecting with science professionals in this way. For example, ome of them had established careers in medical science prior to teaching. Thus, the requirement to include a scientist with the Digi explanation was removed for the B.Ed students. The overall goal was to encourage students to develop networks with scientific community, and the confidence to create these.

  The second part involved developing a video of a contemporary ecologist, Dr Anneka Veenstra, and her work as an exemplar of contemporary science practice. This is presented as part of an online video resource for teachers and PSTs. It was constructed through a video-based interview with her about the local field trips she leads. This footage could be edited as an additional teaching resource for Biology and Environmental Education students to exemplify field trips at a VCE level.

  Also, in the 2016 ESS 467, the first assessment change from a Digi toward a practical investigation where students designed an presented a poster on a science topic, then develop a resource to support them to do both of these things with their students. One of the students designed an App, which is very unique and contemporary. We will be working with Anneka and Ian to develop that app and prepare for publication. This was an emergent outcome from the initial assessment.

Project rationale: what is the intention?

- *Is there a theoretical basis or model, or literature that informed the project?* Similar to the Digi Explanations, working with Dr. Wendy Nielson at the University of Woolongong, who is doing research into Digi explanation. Together they are looking at doing a project using animation in the University of Melbourne SLRC, which will help teacher educators understand how that strategy supports students' understanding. Complement VCE Biology, which is very complex. Useful to have animation strategies to support that work would be beneficial.
- *What gaps do you see are addressed with this project?* See information on animation as above.

Project activities

- *What was the nature of the activities – provide examples.* From the Digi explanations project were 5-minute multimedia presentations on a concept. We are working on adapting them so they are copyright appropriate for presentation in a public space. They will require additional preparation, post-assessment to bring them up to that production level.
- What was the nature of engagement of PSTs or teachers with contemporary science/mathematics practices? The PSTs were required to interview a scientist and infuse contemporary science into their explanation of a biological concept.
- *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?* PSTs had to identify a concept they wanted to explain, from the VCE study design, locate a researcher who was doing research in that area, then negotiate the conversation with the scientist, which included interviewing the scientist using video and audio recording technologies. Then, they had to integrate that in a meaningful way into the Digi explanation. Each step required decision making to ensure quality criteria were met at each stage of the process for a useful educational resource.
- *What changed curriculum / classroom practices are envisaged, flowing from the project? By what means were these changes supported?* Teachers in schools will use these resources have strong conceptual content and they are easily accessible. If teachers find value in using animations and Digi explanation, that would then effect change in practice. In the case of educating PSTs, classroom practice has changed because infusion of contemporary science as being something the students are excited about. They see real value in bringing current and cutting edge into the classroom: It's engaging, it's exciting, it involves real people to talk to, its often industry linked, there is research that is happening right now. It also models the understanding that science is not all known, or contained within a textbook. It's that science is a process. This work enables school students to see that

science can be very exciting, creative, require critical thinking, and reframes it as a possible career choice – particularly as it challenges the traditional conception of how science is practiced.

- *What opportunities were there for science/mathematics students (undergrad or HDR) to reconceptualise their perceptions of school science or mathematics learning and teaching?*
  See Contemporary science connections: Finding ways to infuse school-science with contemporary science. The strategies include using contemporary pedagogies to infuse contemporary science, particularly digital and multimedia resources. The findings Digi Explanation, the outcomes of the research support these very same strategies: through their experience with the process, PSTs have personal experience with the tools and more likely to use with their students, in addition to knowing the concepts well enough to make the decisions needed to produce a coherent product (i.e., video). They need to make decisions on how to represents material: in what order, what concepts, what media, timing resulting in a rich strategy, matching conetmporary science practices with contemporary strategiess.

Results

Experience of participants

- *What was the experience of PSTs or science and mathematics students, school students, teachers, scientists, teacher educators?*
  PSTs found the initial request of this multimedia resource confronting. However, students have since expressed (via video) that they enjoyed learning multimedia skills, were proud of their finished products, and were interested in using similar strategies in other courses in their degree. Their initial reaction has caused the teacher educator (Dr. Peta White) to modify the resources to support the students. This includes providing good examples that the instructor is also modelling (i.e., personally engaging in the strategy). Also, the assessment addresses the requirements for copyright in a public space. And finally, the ultimate testimonial from the PSTs comes from their choice to apply this same strategy in other courses.

Rebecca, is an M.Teach student with a prior career medical science and a passion for Biology. She worked with a a scientist to develop lesson sequences around contemporary science and link the scientists' in current research into the VCE curriculum. She commented on the value of bringing that applied knowledge to the classroom: "A lot of students have the 'why am I doing this?' and 'how can I use this knowledge in careers related to science?'"

The assignment enabled her to display her passion and to show her students how biology can go beyond the classroom: "There is meaning to why we teach these difficult complex ideas".

Through her experience in doing this assignment, Rebecca emphasized the importance of connecting teachers with industry, particularly those who don't have an industry background: I guess, industry experience verses classroom experience,

bringing the two together and being able to pool resources is very valuable in the classroom.

Alison, an M.Teach student worked on developing a lesson sequence with a scientist, integrating contemporary science research. Unlike her fellow students, she did not have a background in medical science so found the assignments useful but very challenging: "…because not only do I have to go and fully understand the content behind it - and brush up on some very old biology which has been very good for me - I also had to then have to understand the science behind all their research. I have read lots of their publications, and then see how they fit together and then make sure that it fits within the scope of VCE. And then kinda of almost rewrite it in a language that is understandable by 16 or 17-year old students."

- *What evidence is available to identify the experience? (surveys, notes, video, etc?)*
  Students completed short videos sharing their response to the activity. See video interviews with Chris and Meg (REMSTEP Conference 2015). Audio-based interviews with M.Teach students (see Rebecca and Alison).

Project outputs

- *What resources were produced and what is their quality (and where can they be found)?*
  Several Digi explanations of scientists' work and activities as examples of the representation of contemporary biology/environmental research in the VCE Study Design, featured on the REMSTEP website. Also, there will be a fieldwork video-based resource featured on the REMSTEP website. For both, the quality is commensurate with copyright regulations and both will have undergone a publication process (post-assessment).
- *What understandings or models have resulted, concerning how to engage PSTs with contemporary science and mathematics practice?*
  Modification to the 467 (Bachelor level) assessment occurred in the second year to exclude the scientist interview as many students were not prepared to confidently engage with scientists. The activity, run in this way, was more successful with the Masters level students who were more mature and prepared to interact at a conceptual level with scientists.

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?*
  Absolutely! Dr. Peta White has established strong networks with science faculty, and is currently involved in discussions regarding the next phase of REMSTEP, building on the cross-faculty engagement. The combination of cross-faculty and PST engagement has been the best outcomes of this project. We have now built up a network of science academics and HDR students who have expressed enjoyment, anecdotally and through their willingness to engage multiple times, with the activity. At some point, this outcome would need to become recognized at a more formal level in respective faculties to ensure support and sustainability (i.e. cultural shift).

- *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?*
  Many of them are really interested in school, and are often called into schools- from personal connections (e.g, their children). They are developing understanding of how they can contribute to formal classroom environments, growing capacity to adapt their research and their language to the school-level, and identify appropriate resources and tools to support them.
- *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?*
  Whether a scientist or an HDR students, the research was the focal point of interest so it is likely the experiences from both groups would be similar.
- *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?*
  Their pride around the resources, and enthusiasm to prepare post-production cycle in preparation for the website suggested that students see value in this activity. Students will receive recognition, have their work featured on a public website, received formal acknowledgment for their contributions, and develop skills throughout this process. The Nature of Science is developed through infusing contemporary science into school science such that it becomes mainstream; it becomes a practice PSTs embody and will want to maintain.

A survey conducted of the 2016 cohort of students yielded the following responses in terms of the % of students agreeing and strongly agreeing with the statements:

Statement	% A	% SA
From the activity I gained new insights into scientists' research and development practices and roles.	47	20
From the activity I learnt some useful and interesting biology concepts.	47	33
From the activity I was engaged in new and interesting approaches to teaching science and biology	40	27
From the activity I gained ideas for how to bring contemporary science practices into the school	60	13
I gained valuable ideas about how to support students to learn about what science professionals do, and their thinking	53	27

In each case between 67% and 80% of students were positive about aspects of the activity concerning biology knowledge, supporting students and bringing contemporary science into the classroom. Students were generally very positive about the multi media resource although a few expressed concern about the time it took to create and the practicality of a teacher doing this sort of activity. Some of the comments about the resource production, and engagement with scientists, were:

> I think one of the best aspects of the digi is that it forces you to think about why you are teaching a topic/concept. It brings relevance to the curriculum both for the teachers and the students. Sometimes teaching science can feel like you are just regurgitating the curriculum. Producing a digi brings perspective.
>
> Bringing in scientists in the field of study is a really engaging way to include the 'real world' in the classroom.
>
> It's great to be able to show students the type of interesting work they could get into if they want to continue in the science pathway by giving them an insight into their work

Rebecca, an M.Teach student, recognized the importance of linking industry and contemporary research with the curriculum. She found that finding reliable resources was challenging and working directly with scientists added significantly to the quality and credibility of the content: "You need to be able to find resources that are reliable and true. You want factual resources because a lot of them out there are like: 'hang on a minute, that's not right!' So you do have to be mindful and careful of that. That was one part of the learning is that making sure the resources are current and true. Anyone can Google any sort of information but its not necessarily correct." In addition, she noted the convenience of being able to access quality resources online.

Rebecca also found it useful to learn how to productively integrate technology, particular since technology is now a regular part of students' lives: So our students they are driven by technology these days. They know how to use everything. I've got a two-year old who knows how to use an iPad.

For her own classroom, Rebecca was enthusiastic about using these resources and approach, and particularly suited to support personalized learning and student learning at their own pace: "They've got to have these resources available for extension and enrichment. So, having resources like this, gives the students an opportunity to extend. And we as teachers need to be able to give the students the opportunity to extend.".

Alison, an M.Teach student, learned not only about the content and gained confidence in teaching a difficult concept: "I have to say I'm pretty ok with immunology and immunotherapy now. I'd be pretty comfortable teaching it. And I supposed that's an added benefit as a pre-service teacher, I now have a lot more confidence especially in an area that kids have a lot of difficulty understanding. I know that immunology is one of the harder concepts in VCE."

She also commented on the importance of integrating contemporary science into the classroom, particularly as there are not a lot of appropriate resources suited for the VCE content and in a language that is accessible to the students: "I think there is a need to continue with getting that kind of data and information into a format for school kids. I think it's important. I think there is a real lack of connection between the VCE expectations, around what is expected for people to understand, and then having that as something that is contemporary, and what we are currently doing in Australia - kind of promoting science in Australia."

Alison also included the limitations of textbooks, with a disconnect between classroom science and actual research:"…there's very little links in the literature in the textbook to contemporary science. Like I found a little bit. But it more like an

excerpt of 'this is how its implemented within the industry', rather than using it as a tool to text a content."

Finally, Alison also explained that having connections with researchers is critical in designing such resources, but also challenging in accessing researchers. She notes that most teachers like her do not have an industry background, nor do they have connections with current researchers. Because of that, her involvement in creating this resource was particularly relevant: "A resource that is almost already done is useful for pre-service teachers, it's a good learning experience for all of us. And it produces great resources for teachers that are already in the field that may not have all those connections."

Re: challenges with designing contemporary science lessons

- *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?*
  Teachers have commented that they like the like and use the resource, however there is not student-level data per se.
- *What principles can be taken from the project concerning processes for bringing contemporary science and mathematics research and development practices into teacher education?*
  See above re: the PSTs engagement.

Concluding discussion

Challenges

- *What was the nature of challenges to successful implementation?*
  Dr. Peta White had to learn to use the multimedia resources, which was a valuable experience. It was challenge to develop networks with scientists, but now that it is in place, it will be easier to continue learning with and expanding the community. The initial research for this activity was "groundtruthed" with teacher though a special half-day focus group. This workshop took place on a Saturday morning where 6 teachers discussed the value of multimedia resources, what those resources would look like and how teachers would use them. From that conversation, the assessment was better positioned as an end product and process for PSTs.
- *What changes were made, from which we can learn?*
  Adaptation of the B.Ed assessment to suit audience (re B.Ed vs. MTeach). Also, Dr. Peta White adapted her mode of communicating with scientists. Initially, she facilitated the connections, but then eventually encouraged students to do so themselves. This was mostly as a result of adapted it to the B.Ed. students.

Impact

- *What is the short/medium term impact of the project (ongoing processes, commitments, existence of resources, over a 1-3 year projection)?*
  For the short term, there are several fantastic products publicly available. For the medium term, we have PSTs who are pedagogically and scientifically engagement with contemporary practices.
- *What are the longer-term implications?*
  There is the provision of examples with information about the strategy will infuse into the classroom. How much and how far is difficult to determine at this point.

Sustainability

- *What has been learnt about processes for incorporating contemporary science and mathematics practices in teacher education?*
  A strategy based in the course assessment is useful to foreground this new practice in context, particularly as it was a complex assignment and much time was needed to fine-tune it to suit the learner and for the learner to create a quality resource.
- *In what sense is the project sustainable?*
  The assessments will remain in units, and the process will be shared with colleagues through publications.

Scalability

- *What is the possibility of the project processes and outcomes being reproduced at scale?*
  It is the hope that PSTs will integrate this is a strategy for their practice. M.Teach students in particular see this as a beneficial pedagogical strategy, and are able to appreciate the complexity of infusing the interview with the scientists with the Digi explanation, making the strategy useful in two ways.