Premier’s Adobe Information and Communication Technologies Scholarship

Personalising Learning in the Age of Knowledge

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Dapto High School

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*The greatest history book ever written is the one hidden in our DNA.*

—Dr Spencer Wells

My study tour focused on the potential of new and emerging technologies – such as non-medical DNA analysis and information and communication technologies, including Adobe products – to be employed ethically in an effort to genuinely personalise learning for students. Increasingly, it is desirable to have an interdisciplinary approach to quality teaching and learning across the curriculum– already encouraged by the cross-curriculum priorities and general capabilities in the Year 7–10 syllabuses – that can be shared by teachers across the curriculum and state.

The educational institutions I visited were:

* City College of New York
* American Museum of Natural History
* Spitzer Hall of Human Origins
* Columbia University
* New York Genome Centre
* Poughkeepsie Day School
* Oceanside High School
* DNA Learning Centre, Cold Spring Harbor
* New York Botanical Gardens
* National Geographic HQ
* Smithsonian Institution
* National Museum of Natural History
* American History Museum
* Newseum
* USA Holocaust Memorial Museum
* National Human Genome Research Institute
* Adobe – San Francisco
* Adobe - Sydney
* Macquarie University
* The Big History Institute
* University of Wollongong
* SERAP, Department of Education

Key contacts/experts I consulted were:

* Prof. Mike Hickerson
* Tyler Joseph
* Mitch Bickman
* Todd Nusson
* Jason Manning
* Josie Holford
* Brent Boscarino
* Jonathan Heiles
* Mary Ellen Kenny
* Laura Graceffa
* Victoria Mayes
* Shirley Rinaldi
* Amanda McBrien
* Dr Sophie Zaaijer on behalf of
* Dr Yaniv Erlich
* Katie Barry
* Prof. Alan Finkel\*
* Prof. Allan Cooper\*
* Dr James Boye
* Dr Briana Pobiner
* Dr Brian Schilder
* Dr Bennet Greenspan\*
* Dr Miguel Vilar
* Prof. Eric D Green
* Dr Carla Easter
* Tacy Trowbridge
* Johnson Fung
* Terry Fortescue
* Andrew McKenna
* Tracy Sullivan
* Prof. Peter Hiscock\*
* Prof. Bert Roberts
* Thomas Sutikna
* Prof. Bernard A Wood
* Allan Booth
* Dr Robert Stevens
* Kim McKay\*
* Prof. Graham Durant\*

\* Skype, phone and/or email

More detail than what this report contains can be found in the scholarship-related posts at my [blog](http://www.darcymoore.net/tag/pts/)

Significant learning

My original conception of citizen science (the practice of public participation and collaboration in scientific research to increase scientific knowledge) in high schools has developed and expanded through dialogue, observation and reading on this study tour and my beliefs about the central importance of information and communication technologies, interdisciplinary learning and collaboration have been further strengthened and confirmed.

It is clear that the Department of Education (DoE) can further foster innovative learning opportunities using the support of strategic, long-term partnerships with institutions and a variety of other organisations in both Australia and the United States. Visits to National Geographic Headquarters and the National Human Genome Research Institute in Washington were particularly fruitful.

The Genographic Project has been a successful citizen science project sponsored by National Geographic for more than a decade. Focused on population genetics, the project maps the ancient migratory patterns of our earliest ancestors by collecting DNA via cheek swabs contributed by volunteers who pay for the Geno 2.0 kit. There is an education/student discount, but the kit is still too expensive for wider use by schools. \*\*

I discussed following ideas with Miguel Vilar (The Genographic Project) and Kim McKay (Director of the Australian Museum and collaborator on the early Genographic Project) and ideally could be supported more formally by DoE. In short:

* + Geno 2.0 kit prices for students/schools could be significantly reduced by minimising packaging and offering bulk discounts to large education systems such as the NSW Department of Education.
  + Educators should be able to log into a portal at the Genographic website allowing student names (as appropriate) and email addresses to be uploaded as well as confirming parental agreement, which would be much better than the current emailing system for schools to access the project.
  + An improved online payment system for educators/students with international currencies in mind needs to be developed.
  + More interactivity generally is needed at the website, including activities for students. For example, with some minor tweaking at the backend of the site class groups could see their ancestral route(s) out of Africa by haplogroup. This should allow them to see each individual’s ancestral route visually in the context of their class group.

My study tour has extended my understanding of the potential of citizen science and DNA analysis. It was amazing to discover that DNA sequencing is increasingly mobile with tools like the MinION mobile DNA sequencer that is being trialled in a high school in New York City by Dr Sophie Zaaijer (New York Genome Centre). Dr Zaaijer has agreed to share her findings and is happy to assist in any ways she can that will benefit Australian students and teachers.

In the future students and teachers could be using mobile DNA sequencers in the classroom to analyse data. Students already are able to do increasingly sophisticated analysis as technology reduces in price (Moore’s Law). DoE needs to prepare now to ensure that students and teachers can genuinely participate in STEM (Science, Technology, Engineering and Mathematics) and avoid faux programs that lack authenticity. This is an area for urgent further investigation.

When discussing the potential of this mobile DNA sequencer, Professor Eric Green, Director of the National Human Genome Research Institute, showed me his MinION and how small this device is, and we discussed the potential for using it in classrooms. Our discussion ranged over many topics, including the importance of students learning about the health implications of what their genome analysis revealed. Professor Green was in favour of students learning about this by using personal and family data. He said he would have not had the same view when commencing his current job, but advances in the field have been so swift and wide-reaching that our education systems must adapt.

\*\* Students at Dapto High participated in the project via funding from Professor Bert Roberts and the Centre for Archaeological Science at the University of Wollongong. A second trial is underway.

*Darcy, you are skating to where the puck is going to be…*

—Professor Eric D Green

Recent journal articles considering the ethics of having students participate in analysing health data at American Ivy League universities are worth considering (see ‘Participatory Genomic Testing as an Educational Experience’ in the bibliography).

The National Human Genome Research Institute funds and operates some impressive educational websites. Genome: [Unlocking Life's Code](https://unlockinglifescode.org) and the [National DNA Day](https://www.genome.gov/10506367/national-dna-day/) (25th April) website are particularly impressive with quality teaching and learning materials. Dr Carla Easter, Chief of the Education and Community Involvement Branch, is enthusiastic about supporting Australian schools. For example, making DNA Day an international event is currently being considered.

Observing and teaching Big History classes at Oceanside High School emphasised how fundamental Bring Your Device (BYOD) is for contemporary education. Students all accessed the Massive Open Online Course (MOOC) and used Twitter and YouTube in class. The metalanguage of learning, cooperation and connectivity is always fundamentally important in classrooms.

One example of the challenges for an interdisciplinary course like Big History is that teachers are required to teach a subject syllabus that is limited in scope. This school taught Big History as part of the World History subject, which is externally examined thus limiting what was possible to teach in class.

*From its inception, a PDS education was founded on relationships and learning by doing; it valued play as creative cognitive growth and working together as a means of effective progress and the promotion of democratic values. It was about openness to opportunity and growth rather than right answers and closed minds …*

—Poughkeepsie Day School website

Poughkeepsie Day School (PDS) has an enviable educational ethos, and citizen science was on display during my visit. In fact, it was almost incidental to discover a teacher heading out of the school with students to continue a very authentic and long-running project on aquatic ecology. This same teacher had been involved with very practical lessons all day, including dissections and outdoor lab work. The teacher was accomplished in the field of citizen science and the level of motivation for his very practical, real lessons encouraged was writ large and very observable. (see bibliography).

It is clear that citizen science has the potential to engage, but the teacher emphasised that it cannot be ‘…just another lesson keeping students busy; there must be an authentic purpose.’ Discussions with those lucky enough to learn at PDS revealed the very high level of engagement, collaboration and sense of purpose the school was able to instil in staff and students. Values clearly informed their practice.

Conclusions

My findings and further recommendations are:

* 1. Citizen science is an opportunity that needs to be supported by many players, including governments, educational authorities, institutions, NGOs and businesses, to help teachers provide authentic, cutting-edge opportunities for their students. It would be wise for DoE to ensure that a very senior officer is given authority to work on partnerships and ensures dissemination of the ever-growing opportunities that exist for teachers to provide students with avenues to participate in citizen science.
  2. Opportunities exist to partner with National Geographic to provide inexpensive non-medical DNA analysis in classrooms via citizen science projects like The Genographic Project.
  3. Students and teachers mostly have smartphones at school every day and most can provide a tablet or laptop if permitted. These are essential tools for accessing experts and citizen science apps and to document/share learning. BYOD is fundamental to contemporary schooling and needs to be supported practically. Social media is essential for connecting with experts and sharing. It is recommended that the current blocking/filtering of Twitter and YouTube that prevents easy access to MOOCs and experts be reviewed and ceased as a matter of urgency.
  4. Emerging technologies like mobile DNA sequencing – if supported – can provide exciting opportunities for students and teachers in classroom settings as Moore’s Law takes effect. A trial of MinIon Mobile DNA Sequencers to support citizen science is recommended.
  5. Tools and technologies come and go, but Adobe Spark mobile apps are likely to engage students in telling their citizen science stories and sharing them effectively. They can now log in into these free apps using their NSW school email accounts, Facebook, Google or their Adobe account. This should be widely advertised and supported.
  6. The National Human Genome Research Institute supports National DNA Day (25th April) with educational resources and publicity. The DoE should consider the support that has been offered from this institute to promote the day in Australia.
  7. The focus on non-medical DNA analysis in education should be broadened to considering aspects of what medical analysis can offer. This is a vexed issue, but healthcare in the 21st century will use increasingly complex data – our own and our families’ – to assist with the best outcomes for wellbeing. There is a golden opportunity to engage students with understanding this data. DoE should ‘skate to where the puck is going to be’ by further investigating the practical and ethical issues of using medical DNA analysis in schooling.

My study tour has been an invaluable professional experience as I crave intellectual stimulation and new experiences that can be shared with colleagues, parents and students. Some of the people I met were very generous with their time and expertise. In some cases they have become friends who will visit me in Australia as we share great enthusiasm for similar areas of research and learning.

This learning will continue to be disseminated in a range of forums, which include but are not limited to:

* + Yammer
  + Adobe Spark
  + My blog
  + Kiama and District History Association
  + Annual State Deputy Principals Conference
  + CNI Stem Group workshops
  + Twitter
  + Big History Conference
  + Education magazine
  + ABC radio interviews
  + The Illawarra Mercury local newspaper

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