THE WINSTON CHURCHILL MEMORIAL TRUST OF AUSTRALIA

REPORT BY MALCOLM MCINERNEY 2007 CHURCHILL FELLOW

To investigate the use of spatial technology in education at the system and school level. The project involves the exploration of materials used and methodologies employed to ensure successful classroom implementation of spatial technology by teachers in Hong Kong, United States, Canada and the United Kingdom.

Signed: Malcolm McInerney   **Dated: 15/11/07**

For more detail on this Fellowship trip and photographs refer to the trip blog at http://www.spatialworlds.blogspot.com

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Introduction

The focus of the project was to investigate the use of spatial technology in education at the system and school level. The project involved the exploration of materials used and methodologies employed to ensure successful classroom implementation of spatial technology by teachers. It was hoped by visiting spatial education experts and stakeholders in Hong Kong, the United States, Canada and the United Kingdom that an awareness of how spatial education implementation has been successfully undertaken in schools. The project aimed to develop templates of good classroom and system practice to use in in-service activities and teaching materials in Australia.

Background to the project

Spatial technology in the classroom has been happening in various schools around Australia since 1997 in a disparate and ad hoc way dependent on groups of motivated and passionate educators keen to see the introduction of spatial technologies into the classroom for their students. In the early days there was much discussion about why we should bother with spatial technology in the classroom and the impediments for it to happen. Today the world has changed and there are few who argue that we shouldn't use spatial technology in schools and the impediments of cost and resources available have rapidly diminished. The acceleration in interest in spatial technology has been further enhanced by the increasing accessibility of GIS orientated materials on the Internet such as Google Earth and the accelerating all pervasiveness of GIS technology in our everyday life's. In short educators are starting to open their eyes to the possibilities of spatial technology in schools to enhance spatial literacy and are looking around for support and expertise from those in the know. The purpose of this Churchill Fellowship was to explore what can and has been done around the world to enhance and support the uptake of spatial technology in schools.

Guiding questions for the Fellowship

These questions were sent to all those I planned to meet with during my Fellowship prior to the trip.

1. How widespread is the use of spatial technology in schools in your country?
2. What type of software is most commonly used?
3. What teaching resources are available using spatial technology in schools?
4. Have local curriculum materials been developed for schools to use spatial technology to enhance spatial literacy?
5. Can schools access local, regional and national data easily?
6. What are the major impediments to the implementation of spatial technology at the school and system level?
7. What teacher training models are employed? What resources are available to train teachers in the area of spatial technology and spatial literacy? Who undertakes the teacher training?
8. Has the inservice of teachers in spatial technology been taken up positively by teachers and schools?
9. How have students responded to the technology?
10. Is there school based evidence and research that spatial technology significantly enhances the spatial literacy of students?
11. Is the term spatial literacy widely used in your country and if so what resources are available to help teachers delineate and comprehend the concepts involved?
12. Has the vocational aspect between the teaching of spatial literacy and use of spatial technology been linked with the opportunities in the spatial industry in your country i.e. vocational education programme in schools.

13. Is there a general awareness and acceptance by educational authorities of the need for spatial literacy and the use of the associated spatial technologies in schools? Moreover do the authorities and schools see the opportunities such technologies provide for student employment and classroom practice?

14. Is there a sense of frustration by the spatial industry and teacher's presently using spatial technology in schools on the rate of uptake of the technology and the priority placement of spatial thinking in schools?

15. Is the use of spatial technology limited to geography or is it employed across the curriculum?

16. Are there 'model schools' demonstrating good spatial technology practices in your country which could be used as implementation templates for other parts of the world?

17. What is planned in your country to enhance student spatial literacy and/or the comprehensive use of spatial technologies in schools for the future?

Acknowledgements

Executive summary

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Positions held

Immediate past President of the South Australian Geography Teacher's Association, Vice President of the Australian Geography Teachers Association and the Geography Senior at Findon High School in Adelaide.

Involvement in Spatial education

 I have been involved in teaching and developing classroom materials using spatial technologies and interactive media since 1997. In 2000 and 2002 my students won the Research and Investigation prize in the University of New South Wales Sustainable Living Competition and from 2001-2007 my students have won the South Australian section of the Spatial Science Institute 'Spatial technology in Schools' competition.   In an effort to introduce GIS into classrooms around Australia I have developed a "GIS Skill Development Course" for Secondary students and a range of across the curriculum resource materials for Geography, Science, History and Tourism studies. These materials are being used in over 500 schools across Australasia and were awarded Australian Geography Teachers Associations (AGTA) Geographical publication Awards in 2002, 2004 and 2006. .

During the years 2001-2007 I have become increasingly involved in the 'teaching the teachers' process across Australia. To this end, I have trained over 500 teachers via three day workshops, conference workshops and GIS Roadshows across Australia since 2001. In January 2006 I was the convener of the first 'Australian ESRI Education Users Conference' in Launceston in conjunction with the AGTA Annual Conference.

My work with introducing spatial technology into schools across Australia was recognised in 2002 by a National Excellence in Teaching Award and this Churchill Fellowship in 2007.

The reason I applied for the Churchill Fellowship was to see if what we are doing in Australia is on the correct path and whether those overseas have encountered the same problems of implementation of spatial technology which we are presently encountering. Most importantly it was hoped that those I met during the Fellowship could supply some suggestions/answers to how we overcome the implementation difficulties we are presently encountering in Australia.

Highlights of the Fellowship

I have identified the following events/meetings as the most worthwhile and enlightening of my trip in regards to my project goals:

 1. The American Council of Geographers Conference in Oklahoma City really broadened my perspective on the webserver future of GIS delivery into schools and the incredible growth in free on-line programmes and resources.

2. Visiting schools in Virginia was excellent to see the community application of student GIS projects. Visiting the schools and talking to the students really gave me an insight into the community potential of GIS and the diversity of applications which can be of use to the community.

3. The meeting with the Digital Worlds team provided a conceptual future for GIS in the classroom in Australia which could make the 'learning curve' for teachers more achievable. The meeting provided a workable framework for the development of a simpler software implementation strategy in Australia in the future.

4. The time with Bob Kolvoord and Kathryn Keranen was very useful to see how teacher training can be tackled with the support of the education system. This gave me some ideas about how we can discuss a potential implementation plan with the education authorities in Australia.

5. The meeting with Roger Jeans at the Ordnance Survey in the UK provided a very positive implementation support template to take to Government Departments in Australia.

6. The discussions with those involved in the Hong Kong curriculum and training innovation was very enlightening and provided an opportunity to follow up GIS implementation with a nearby Asian neighbor in the future.

7. All my discussions affirmed my belief that what we need to tackle in a coordinated way in Australia is teacher awareness and training re: spatial literacy and technology. Most importantly the training <u>must</u> address the teaching methodologies required to successfully use spatial technology in the classroom and not just the technological skills to be attained by teachers via their professional development.

Although I have identified these as highlights, all my meetings added to the implementation jigsaw and helped me to crystalise my thoughts on the strategies that could be employed in Australia via a coherent implementation plan in the future.

Synopsis of lessons and conclusions

* ❖ Overall the Fellowship was affirming that what we are doing In Australia is of world standard and in some ways ahead of the rest. This is true particularly in the areas of teacher training and across the curriculum implementation.
* ❖ What was very useful was to create a network of the spatial technology in schools leaders/advocates around the world which will be very useful for implementation in Australia as the years go by. The Fellowship enabled me to meet face to face with these people and discuss issues and possibilities of cooperation for the future. The Fellowship also gave me the opportunity to promote spatial technology across Australia by developing the spatialworlds blog for my trip. The blog has been frequently hit across Australia by teachers interested in spatial technology and will be an ongoing initiative.
* ❖ On the learning front, new resources were gathered, curriculum development ideas explored, data delivery options investigated and teacher training alternatives discussed. All of these aspects will be incorporated into the planning of spatial technology implementation by the Australian Geography Teachers Association and other geography teacher associations in Australia in the near future.
* ❖ In 1996 there were many impediments to the implementation of spatial technology in schools. My discussion with GIS teachers during my Fellowship made it clear that there are only two impediments left. These are the areas of:
  1. Teacher and education authorities exposure to the area of spatial literacy and the use of spatial technology in society in general and the opportunities created by the technology in a vocational and citizenship sense
  2. The area of teacher training in the technology and the associated pedagogies required for successful use in the classroom.
  In short the key to the implementation of spatial technology in schools is the development of a spatial technology awareness programme amongst teachers, followed by a well constructed and achievable professional development programme. This programme <u>must</u> deal with the teaching methodologies required to use spatial technology in the classroom and in turn <u>must</u> address the issue of 'risk taking' teacher behaviour (the teacher being comfortable at not being the expert but a facilitator of the technology) and the need to develop peer supportive classroom methods of instruction.
* ❖ The major lesson I leant is that the issues we are grappling with in Australian in regards to spatial technology in schools are the same worldwide and thus a worldwide approach is relevant to overcoming the present implementation hiatus.

PROGRAMME AND TRIP SUMMARY

Itinerary

Date	Time	Activity	Contact Details
8/10/07	1045	Flight: QF740/QF127 Travel to Hong Kong Depart Adelaide 8/10/07: Arrive Hong Kong 8/10/07	
		Meeting with Hong Kong University Establishment of links with Hong Kong Education Bureau : Mr W Wong	Professor Lai pclai@hkuss.hku.hk Mr W Wong wangfaiwong@edb.gov.hk
		Meeting with Hong Kong International School	Pauline Bunce pbunce@pacific.net.hk
13/10/07	1320	Flight:CX884/CX7624/AA11030 Travel to Dallas Depart Hong Kong 13/10/07: Arrive Dallas 13/10/07	
		Meeting with ESRI US education:	George Dailey gdailey@esri.com
		Meetings in Dallas Brad baker (Bishop Dunne School), Jennifer Stitt (Emmett Conrad School), Scott Sires at Brookhaven College (Ellison Miles Geotechnology Institute), Roger and Anita Palmer (GIS Education Consultancy) and the Ted Polk Middle School.	Kate Dailey kdailey@bdhs.org Brad Baker bbaker@bdhs.org Jennifer Stitt jstitt@dallasisd.org Christine Voigt cvoigt@bdhs.org Scott Sires Anita Palmer gisetc@gmail.com
		Meeting with the American Association of Geographers at their National Conference Meetings with Dr Tom Baker (ESRI US), Dr Joseph Kerski, (ESRI US) Dr Shannon White (University of Southern Florida), Marsha Alibrandi (Fairfield University), Dr Phil Gersmehi (Centre for Geographical learning), Charlie Fitzpatrick (ESRI US)	American Association of Geographers gaia@aag.org
20/10/07	0905	Flight: AA1678/AA1956 Travel to Washington Depart Dallas 20/7/07: Arrive Washington 20/10/07	
		Meetings with Bob Kolvoord (Madison University), Kathryn Keranen (GIS Consultancy), Ron Vickers (Rappahnnock County High School), Yvonne Griggs (Fairfax County Public School Authority), Ryan Miller(Washington-Lee High School), Jay Ruffa (Hopewell High School), Bill Ryan (Colonial heights High School), Paul Tittenhouse (Western Albemarle High School)	Dr Bob Kolvoord kolvoord@mac.com Kathryn Keranen Yvonne Griggs Yvonne.Griggs@tcps.edu
25/10/07	1535	Flight: AA4551 Travel to Toronto Depart Washington 25/10/07:Arrive Toronto 25/10/07	
		Meetings with:	Jean Tong

		Jean Tong (ESRI Canada K-12 Education Manager), Mark Lowry (Education Authorities Geography Policy Officer), Geography Faculty at the Central Technical School in Toronto.	jtong@esricanada.com Mark Lowry Mark.lowry@tdsb.on.au
31/10/07	2015	Flight: AA108 Travel to London Depart Toronto 31/10/07: Arrive London 1/11/07	
		Meeting at the Royal Geographical Society with Judith Mansell (RGS), Noel Jenkins (Digital geography) and David Rayner (UK Education).	Judith Mansell j.mansell@RGS.org Noel Jenkins noel@juicygeography.co.uk David Rayner David.raynor@blueyonder.co.uk
		Meeting with Digital Worlds Jason Sawle and Richard Pole	Jason Sawle j.sawle@digital worlds.co.uk
		Meeting with UK Geography Association	Diana freeman Diana.freeman@advisory.unit.org.uk
		Computers in Education Diana Freeman	Diana Freeman diana.freeman@advisory-unit.org.uk
		Meeting with ESRI UK	Angela Baker abaker@esriuk.com
		Meeting with UK Ordnance Education Unit	Roger Jeans Roger.Jeans@ordnancesurvey.co.uk
13/11/07	0810	Flight: QF10 / QF675 Travel to Adelaide Depart London 13/11/07: Arrive Adelaide 15/11/07	

Stop 1. Hong Kong

During my stay in Hong Kong I have visited the Hong Kong International School and the Hong Kong University (HKU). Doctor Lai from the HKU Geography Department has been involved in encouraging schools to use GIS in their geography teaching since 1999. Her comments on the situation mirrors much of what has been happening with GIS implementation in Australia but naturally more complex because of issues of population size, the role of vendors and language barriers. Firstly some quick comments on my visit to the Hong Kong International School on Monday, October 9th.

Hong Kong International School
On a previous visit to Hong Kong I made the acquaintance of Pauline Bunce a Geography teacher from Perth who teachers at the Hong Kong International School. Pauline is keen to embark on the GIS learning and implementation curve but as yet HKIS has not got GIS up and running. When she knew I was coming to Hong Kong Pauline asked if I would run a session with students showing them the applications and potential of GIS. So first thing on Tuesday morning I went out to HKIS to meet Pauline and her students. The sessions with the students were enjoyable but what did strike me was the resources and atmosphere in the school. It certainly was a different world, with coffee shops, refectory, full size pool, data projectors in the classrooms, incredible gymnasiums and an amazing view over the harbour from the classroom windows. A few photos from around the school are above.

Although not answering any of my project questions it did confirm to me that the implementation of spatial technology is not just about resources. Here is a school with all the 'bells and whistles' providing a great education for its students but the GIS learning curve is still to be negotiated. Implementation needs are really about teacher awareness and willingness to embrace the technology and its worth. Those in the know are convinced of its worth and in many cases presume all others are equally up to date with this societal and all-pervasive technological tool in our society. That certainly seems to be not the case with teachers around the world. Already on my trip I am hearing the same comments relating to the difficulty of teachers embracing the technology. Furthermore in many cases students are aware of the technology and indeed use it but are not aware of it societal use and application. It also seems that students are also not aware of how the technology can enhance their learning in a range of subjects. The trip to HKIS was an eye opener to how schools can be resourced and also confirmed my belief that the work ahead with implementation is to convince teachers and administrators in schools of the worth of spatial technology in the school setting. As I was to find out the next day, in Hong Kong they actually now have curriculum and resource support from the Hong Kong Education Bureau in real terms. However, as is the case in Australia many teachers are still needing to embrace the technology as something not only desirable but essential to the teaching of geography in the 21st Century.
Thanks to Pauline Bunce and the Hong Kong International School for having me visit and meet their students.

GIS in schools in Hong Kong
As mentioned I have previously had contact with Dr P C Lai from the Geography Department of Hong Kong University. Dr Lai heads up an innovative and passionate group of post graduate geographers who are using GIS in a wide range of applications. Dr Lai has done an enormous amount of work in trying to encourage schools in Hong Kong to take on GIS as part of their teaching programme. If we go back to the post about the South Australian experience, Dr Lai has been involved in Stage 1: Basic awareness of the motivated in particular. Over the past few years there have been 5 pilot schools which have done some great work on GIS with their students in Hong Kong. In fact many of those motivated in the pilot schools are Dr Lai's students from Hong Kong University who are now teaching in Hong Kong schools.

Over the past few years the Education Management Board of Hong Kong (Education Bureau) has taken the lead in writing the use of GIS into the new geography curriculum. To this end the new geography curriculum to be implemented in 2009 has a requirement of schools to use GIS in the teaching of geography.

Go to http://www.edb.gov.hk/FileManager/EN/Content_5185/nss_e_geog%20_pfd.pdf to have a look at this new geography curriculum for 2009 with overt references to GIS.

As was the case in South Australia in 2003 when GIS became a compulsory part of Year 11 geography, this curriculum initiative (Stage 2 of implementation) has caused a frenzy of teacher training and in some case anxiety about the ability of teachers to embrace the technology considering the plethora of demands on their time. That is where the similarity with the process in South Australia ends. In South Australia Stage 3 was teaching the teachers by teachers but with little system support in real terms. In Hong Kong there is system support with funds allocated for resource development, tenders for teacher training by private companies and the University and funds to support the technology requirements. This last resourcing factor involved the Education Bureau negotiating an ESRI license for all Hong Kong schools. At this point it is worth noting that those involved in the Hong Kong implementation of GIS are just like us in South Australia; concerned about the learning curve and extra difficulties associated with the use of ArcGIS 9 compared to Arcview 3x. In Australia it has been an ongoing debate about the merit of pushing ArcGIS onto schools considering the increased complexity of the programme. As a result ESRI Australia has continued to supply ArcView 3x to schools. In Hong Kong ESRI HK has not supplied ArcView to schools for many years and ArcGIS has been the only option. Whether this issue is a significant impediment to implementation is still debated but it seems in Hong Kong that it is a non-issue considering the stance of ESRI HK. A Chinese proverb comes to my mind in relation to this situation; "You don't need to kill a chicken using a knife to kill a cow". Think about it!

Dr Lai's team is presently writing some great materials for schools to help teachers and students to learn GIS and already I am pleased to say they have incorporated some of my GIS teaching materials/ideas into the resource package. I hope we can continue to cooperate with Hong Kong teachers as they battle the learning curve as we have continued to do so in Australia. This material will go up on the Hong Kong Education site (early in 2008, so it would be worth Australian teacher keeping an eye out for them (if accessible)

http://www.edb.gov.hk/index.aspx?langno=1&nodeid=3229

Presently the education Bureau is running a comprehensive training programme for teachers (3 day workshops and after hours) and it is envisaged that by implementation day in 2009 the 2000 Hong Kong geography teachers will be trained in GIS. An ambitious task and I wish them well. During my visit I made contact with Mr W Wong from the Hong Kong Education Bureau who is responsible for the GIS implementation plan. I hope to meet again with Mr Wong in the future to see how their progamme progresses.

The work of Hong Kong University Geography Department

During my visit I was also fortunate to view the work of Dr Lai's team and a brief summary of the projects gives an insight into the enormous variety of GIS applications.

The projects are:

* Poets footprints: Tracing the journeys of the poets from the Tang and Sung Dynasty and describing in the maps the geography indicated in the verse.
* Mapping air pollution: mapping respiration diseases such as asthma and trying to correlate the disease levels with air pollution (particulate matter levels)
* Study of the environmental factors on elderly falls: mapping where elderly people fall down and identifying hot spots (wet markets, uneven surfaces and female public toilets)
* Spatial epidemiology: Using GIS to study to study disease distribution and then trying to correlate with socio-economic factors as well as environmental factors such as transport networks and pollution.
* Obesity and the relationship to distance from school and adjacency to fast food outlets etc.

Dr Lai also pointed me in the direction of these two sites which are certainly worth a look to see some fantastic example of GIS applications.

In the first site, an animation of the 2003 SARS outbreak:
http://geog.hku.hk/pclai/kernal/index/
User name: kernel   Password: \flash

Another useful site from the UK is: http://www.casa.ucl.ac.uk/blogs/urban.asp

Finally I would like to thank Dr Lai and her colleagues for their time on the day and the lovely lunch in the University refectory. A great group of really talented and motivated geographers.

Stop 2. United States

Dallas visits
Brookhaven College
Today I visited Scott Sires at Brookhaven College. Scott is in the Geographic Information Systems faculty, Mathematics/Science Division. The facility I visited is in the Ellison Miles Geotechnology Institute (EMGI) and the programme Scott is involved in is the Geospatial Technology. It was a real eye opener to view the great resources available for teaching GIS at the Institute. As a year 13/14 College the Institute provides an enormous number of courses focussed on the use of GIS. Courses such GIS for educators, GIS for golf course management, GIS for landscape management, GIS for engineers and GIS for municipalities particularly caught my attention. The Institute normally conducts the courses after 3pm and Scott has developed an excellent GIS laboratory with all the hardware and equipment one would dream about in their classroom. From what I can gather such a college is somewhere between TAFE and University in Australia and offers a stepping stone to either employment and/or University. For more information on the programmes offered at EMGI go to www.BrookhavenCollege.edu.EMGI.   Whilst checking out the Brookhaven GIS courses a quick look at the College of the mainland in Texas City at http://www.com.edu/teams/cidt/pg_pro_gis.html is worthwhile to augment ones understanding of the diversity of GIS courses offered at this level.
While talking to Scott we explored issues of teacher training and the complexities of teachers embracing and in turn learning the technology. Scott emphasised the need to work from where teachers are and take well considered and achievable steps. The brochure advertising the courses refers to the opportunities in the Geospatial technology area includes those in real estate development, land use, homeland security, environmental security, social services, emergency management and municipal agencies. Go to http://www.com.edu/newsdesk/news.cfm?newsid=493 for more on the demand for GIS technicians.

Bishop John Dunne Catholic College
I have spent the day at Bishop Dunne Catholic School, a school of 620 students committed to providing a high quality education firmly integrated with the use of technology. Bishop Dunne has been consistently mentioned to me as a great example of using GIS, so the opportunity to visit the school for a day was too good to miss. The Principal of the school is an Australian, Kate Dailey who just happens to be the wife of George Dailey my ESRI contact in the US. Kate, with the assistance of George has been able to develop a great GIS programme at the school headed up by Brad Baker. I visited Brad's class in the morning and saw first hand the excellent problem solving work of his students. This week they are, believe it or not, mapping an historical grave site using Ground Penetrating Radar (GPR technology. The project is a real community effort to make sure that an area of historical significance containing graves is not developed without due care. The students have gone out to the site and collected the data of the possible grave locations using GPR technology and are presently producing maps to represent their findings. Brad's class is also using aerial photographs of a lake to do some real CSI work on a crime scene from the 70's involving a truck and body. What I was impressed with Brad's work is that his students are involved in real problem solving GIS in the community and builds on much of the other work he has done with the Dallas Police Department. If interested in the work of Brad's students go to

http://www.wfaa.com/sharedcontent/dws/wfaa/localnews/news8/stories/wfaa071012_lj_hawkins.163bc77
3d.html
Although not GIS alone I was also pleased to see the smart technology called synchroneyes which
enables the instructor to block the computers any time to ensure that students turn around and listen to
instruction when required. That pesky habit of students (and teachers during training)tapping away when
you want them to listen is solved! What a good idea. The technology is cheap and available at
http://www2.smarttech.com/st/en-US/Products/SynchronEyes+Classroom+Management+Software/

During my visit I also had the pleasure of visiting the class of Kyle Stephens who is using some great
technology in his classes. Of particular interest is the class blogging site of http://classblogmeister.com/.
To get the class involved this technology is a great way to encourage discussion on issues within the
class and across the globe. To see an example of Kyle's class blogging go to
http://classblogmeister.com/blog.php?blogger_id=21053 Kyle also mentioned the Discovery Channel site
 http://streaming.discoveryeducation.com/index.cfm for some great teaching resources with the students
are using IPods in a wide variety of ways. Kyle is also using photostory for story telling and project work,
which is available as a free download from
http://www.microsoft.com/windowsxp/using/digitalphotography/photostory/default.mspx
I would like to thank Kate Dailey for organizing a lunch time meeting with key teachers in the school
related to technology. The session involved chatting about the use of GIS in the classroom and some of
their observations about the uptake of the technology by teachers, the response of students to the
technology and perceived futures. I would also like to thank Christine Voigt who works at Bishop Dunne
for showing me around on the day. Christine is one of the authors of the ESRI "Mapping Our World
"series which is used in hundreds of schools across Australia.

Schools in Dallas with Roger and Anita Palmer – Early adopter innovators.

Many Australians know Roger and Anita and are aware of their GIS consultancy work and authoring
efforts. In particular those who are users of the "Mapping our world" books will be aware that Anita was
also one of the authors of the books. Roger and Anita live in an amazing housing development in
downtown Dallas (only 2 kilometres from Dallas centre) which is in an old warehouse building. The area
is one of urban renewal and the development Anita and Roger live in is a wonderful example of taken an
old building and creating a thriving urban community of over 1000 people all living in harmony with a real
sense of association. The block even has a pool and gym on the roof where regular movie nights and
events are conducted. Pictures of the development are shown above. Roger and Anita work out of their
lovely apartment office and I had the pleasure of doing my blog as they worked and would you believe
listening to a John Williamson album. Roger and Anita are busy writing the next set of ESRI publication
books on the use of GIS in the classroom called "Analysing Our World Using GIS" and "Mapping our
World book 2"   . These books look like they will be a really valuable adjunct to the resources available to
teachers in schools and I am really looking forward to their release. The other aspect of Roger and
Anita's consultancy is running workshops with teachers in the US and also organizing teacher trips to
places such as Costa Rica to enhance the use of spatial technology. At the Oklahoma City NCGE
Conference I went to several of Rogers and Anita's workshop and really found them valuable.   In
particular the workshop on using GPS in cahoots with the   website was a really good example of
teachers teaching teachers in a really clear and purposeful way.
I visited several schools of good practice with Roger and Anita. They were Emmett Conrad High School
and the Ted Polk Middle School. Both of these schools showed great use of GIS in the classroom and
most impressively the integration of the class activities with the community.
Jennifer Stitt at Emmett Conrad gave some excellent insights into the present difficulties with
implementation when she said:
"The major impediments are:
   a. *Money (funding)*
   b. *Lacking of communication and information from admin to teacher. Most of the administration
      doesn't understand what GIS is.*
   c. *Lack of content specific professional development for teachers. Most of the professional
      development offered and required deals more with classroom management, dealing with English
      language learners, and how to start a club. We are not offered any career or content specific
      training. Although it is out there, but he school districts will not fund the money.*

d. *Lack of teachers trained in the technology.*
e. *Being able to control your own computer lab and being on a separate server. I know when I worked in Industry we had a separate server with our Aerial photos for the county. That data is very heavy and requires a GIS IT professional to keep it up and running. Maybe there needs to be equipment IT specific element that keeps GIS labs running in schools. You know most of the government levels, city, county and state, have GIS departments, it only makes sense for the school district to have a GIS department. One side of the department could run the actual school district needs and the other be the helpers to implementing the class inside of schools and keep it up and running. That way maybe even our senior level students could learn ArcSDE, ArcIMS, etc."*

Jennifer went on to say that despite the impediments as listed, she thinks

"there is a lot of positive buzz surrounding GIS. However, if teachers don't understand what it is, and a professional tries to explain it to them they just sort of nod and smile. I have a lot of passion behind GIS and I try to give good examples how it fits in to every teacher's content. I don't think there is any negativity behind GIS in schools, just a lack of information about what it can do for a school. Maybe we need to address the higher powers that be and "sell" the idea to them, so it comes down from the government into classrooms. Again only small pockets of spatial education occur in Texas. I think selling the idea to the larger powers may be the way to go. We could start with City, then move to State government and then beyond."

What was impressive at the Ted Polk Middle School was the week long 'GIS Summer Camps' the school conducts for students and the innovative way that the school is trying to get students and teachers involved in using GIS in their work. The Summer Camps have been a huge success but such summer activities are embedded into the education approach in the US and I cannot not see a real application to Australia other than the general out of school programme they conduct at the camps.

Stop 3: Oklahoma City

The National Council for Geography Education (NCGE) Conference Oklahoma City, October 18th-21st.

Coincidently this conference was on at the same time that I had planned to visit George and the others in Dallas. The council is the long established mouthpiece and professional body for geography educators in the US and each year conducts an incredibly detailed and comprehensive conference. Even though the conference theme was focused on the Native American Culture the workshops covered a wide range of geographical content, methodology and aspects. Go to the NCGE site at http://ncge.org/events/meetings/currAMdetails.cfm for information on the conference programme. Naturally I spent most of my time in the GIS and technology workshops and found them very valuable. In particular I enjoyed the workshops on the free web mapping software, ESRI AEJEE free product, podcasting and related technology and the demonstration of a practical approach using GPS with free Internet mapping software. I also attended at 6.30 on the Friday morning a discussion group on GIS education research which was exploring the question of what are the research needs for the implementation of GIS in education and spatial thinking in particular. What amazed me from this discussion with the key GIS players in the US was that they were facing the same difficult questions of how we get teachers and educational authorities to embrace the technology and see spatial thinking not as an add-on but an imperative when discussing the needs of citizens in the 21st Century. ESRI US held the discussion group because they are considering supporting a range of research in an effort to highlight the nature of spatial thinking in schools and the needs for a coordinated and effective approach to the area of GIS implementation in the classroom. In particular they are looking for supporting research which will show that spatial technology does enhance spatial learning for students. No answers from the discussion but again affirmation that in Australia we are asking the same questions and hopefully finding some of the answers. Such research would be very useful for us to convince educational authorities in Australia about the need for spatial thinking skills for students and the associated use of spatial technology.

One of the highlights for me at the conference was viewing the work of the 4H students who have worked on GIS projects in their community. 4H is a US Government youth community based programme which was developed in 1907 to enhance leadership, citizenship and life skills amongst youth. Go to more

information on 4H at http://www.4husa.org/. The students were so enthusiastic and had done some great work on local recreational facilities, bushfire precaution via hydrant locations, mapping of heritage buildings and rubbish location. What was impressive is that all their projects are linked into the local councils who see the students work as a way to improve their local government area. The students came from all over Oklahoma and had a really unique way of presenting their ideas and thoughts on the use of GIS.

Instead of just writing up the workshops in detail I have selected 10 of the top things I learnt from the conference in terms of resources, observations and perceptions.

1.The US standards in education expectations and national assessment (called SOL – Stanards of learning) procedures are making it very hard for schools to innovate and introduce spatial technology into the curriculum (these are called TEKS in Texas and stands for Texas Essential Knowledge and Skills at http://www.tea.state.tx.us/teks/)

2.The early adapters of GIS in US schools talk about the difficulty of getting teachers to learn the technology due to it not being formally in the curriculum and embedded in Standards. Again teacher training and the need to do so is a huge issue. Even at this conference of 600 geographers, I would estimate no more than 50 participated in the excellent GIS workshops provided.

3.I met Dr Shannon White from the University of Florida. She is doing some very interesting work traveling Florida on a weekly basis with a traveling technology roadshow show, training teachers in the use of technology in the classroom. This includes not just GIS but also podcasting and many other innovative technology ideas. For more information on Shannon's work go to swhite@coedu.usf.edu andhttp://etc.usf.edu/fde/FDE%20-%20program.pdf. The initiative is supported by Florida education authorities and seems an interesting model of technology diffusion.

4.Here are some great webmapping sites all free and very applicable to the classroom. Some are US focused but still of great use.
Lists are found at http://edcommunity.esri.com/software/webmapping/ and http://www.geocomm.com/channel/webmap/featuredsite.html.

5.Although I had a quick look at AEJEE when Mick Law mentioned it in August I have not sat down and done the tutorial work. This is a great resource that does as much as many classes require with the exception of creating and manipulating data tables. This is a great free programme for primary schools and junior high schools to use if they do not wish to invest in GIS technology. Great data is included in the download. Just go to the ESRI Edu Community at http://www.esri.com/software/arcexplorer/download.html for more info on AEJEE and the free download pathway.

6.Whilst on the ESRI Edu community (http://edcommunity.esri.com/), this site just continues to grow in value for teachers. In particular the blog the ESRI Education team (George Daily, Charlie Fitzpatrick, Tom Baker and Joseph Kerski and others) are doing on a regular basis is just full of ideas and resources which should be looked at on a daily basis. For the blog go to http://blogs.esri.com/Info/blogs/gisedcom/. Also take the time to look at (http://edcommunity.esri.com/data/download/)for all the data which exists on the site – amazing.

7.Here are some sites which are some must check out locations with a brief description for each:
* http://www.arcwebservices.com/awx and http://www.lerdorf.com/php/ymap/yquakes.php shows all world earthquakes every day.
* http://lifehacker.com/software/maps/technophilia-top-ten-nongoogle-map-innovations-211149.php - a great technology innovation site called Technophilia.
* http://etc.usf.edu/maps an amazing collection of maps available for free on this site
* http://etc.usf.edu/te_win.html -Tech-ease, quick answers to classroom technology questions and tons more resources for the use of technology in the classroom.
* http://www.apple.com/downloads/ - an interesting programme called Geophoto.
* http://veryspatial.com/?page_id=6 - Spatial podcasts available called "Very spatial"

8.Of special mention is the USGS site of Landsat image over time. These can be ordered for free via http://www.usgs.gov/pubprod/aerial.html. Also download the free global visualization viewer called TerraLook at http://terralook.cr.usgs.gov/. These free satellite downloads provide images over time which is great for change analysis.

9.The GIS community is really a very supportive group of motivated and passionate educators. I really enjoyed the opportunity to immerse myself in their world in the US and be accepted so readily as one to

share ideas and resources. Their enthusiasm is infectious. The day after the conference some of them were heading off on a confluence excursion as if they were off to the latest "Wally World". With such enthusiastic individuals heading up GIS education in the US I am sure eventually the powers to be will start listening. Particularly with the ever increasing focus on ICT, homeland security, environmental management/monitoring and the need for engaging methodologies in the classroom.

10. The Geography Network Services facility hosted by ESRI which enables you to use data directly from the Internet instead of loading the data on your network. Go to   for information on this great facility.

A great conference well worth attending for the learning and social networking.

Stop 4: Virginia and Washington

Geospatial technology classes in Virginia

Today I had the good fortune of Bob Kolvoord from James Madison University to take me to Washington-Lee High School in Arlington to meet Ryan Miller in his Geospatial class and Ron Vickers teaching his Geospatial Technology Programme at Rappahannock County High School in Virginia.

Ryan started his lesson (after the oath of allegiance by the students facing the US flag in the classroom and a moment of silence by the class - done every day in the school via the TV intra-school system – a little different to the start of home group in Australian schools!) showing a news item on the Californian bushfires presently raging on the west coast of the US- described as the perfect storm by the news coverage. After the film Ryan asked the students to develop a list of GIS attributes they could acquire for insurance, environment and fire fighting purposes. I thought this was a great way to link the GIS skills the students were learning into a real life situation.

Ron at Rappahannock showed me the great maps his students have produced in the area of Civil War History, stream heritage criteria and school routes. Again it was evident that the GIS was 'real' in Ron's class because all the student projects were linked into the local community and demonstrated a team problem-solving approach. I also participated in a GPS activity outside the classroom to determine the circumference of the earth. It is becoming evident that GPS is used extensively in these types of GIS courses from a very early stage, so as to engage the students in the technology whilst teaching them some very important spatial concepts.

From Rappahannock Bob and I had a lovely drive through the Virginia countryside with the autumn leafs in their full glory as we traveled to James Madison University. At the University I observed Bob's GIS and the environment course. I found particularly interesting the students presentations on good and bad maps and their project development discussions. For more information on Bob's impressive work in the University and with K-12 schools go to the following sites.

* http://www.isat.jmu.edu/stem/ - James Madison University Geospatial Technology page.
* http://www.isat.jmu.edu/common/projects/godi/ - a project on fire assessment
* http://www.isat.jmu.edu/common/projects/vism/curric.htm - science and mathematics based use of GIS

Of particular note is Bob's site at http://www.isat.jmu.edu/stem/curriculum.html. This site has some great classroom materials developed for using GIS in the classroom under various topics. Much of Bob's work over the past ten years has been in the area of teacher training and he and Kathryn Keranen have trained over 400 teachers in the techniques of introducing spatial thinking and skills into their K-12 classrooms. If interested in the work of Bob go to https://sharepoint.cisat.jmu.edu/isat/kolvoora/default.aspx.

Virginian schools

Dr Bob Kolvoord continued his visitations of geospatial schools in Virginia today and I was fortunate to tag along to see the progress of the programme. It really pelted down all day but the folks here were pretty happy about it because they also have had a very dry year. Made for some pretty hairy conditions on the freeways though! Anyway, let's get to the purpose of the day.

Bob and Kathryn Keranen are working with 13 High Schools across Virginia who have volunteered to be part of the programme supported by the James Madison University in co-operation with local education authorities and participating schools. The schools are visited at least once a fortnight by Bob or Kathryn

to mentor and support the participating teachers and students. This is an amazing effort considering the schools are spread over an enormous area and traveling time is considerable. The students range from 16-17 years and by doing the programme have the opportunity to enrol in the James Madison University specially developed school based GIS course called 'Geospatial tools and techniques'.

We started the day visiting Jay Ruffa at Hopewell High School. Jay has a very innovative GIS programme underway where his students have done some high level project work such as developing an emergency plan for the city planning department and geocoding the seats in the school theatre and the school bus routes for school use. A very useful GIS technique Jay was teaching his students for comparing layers was using the 'Swipe' tool in ArcGIS. This is a great way for students to see similarities and differences between layers in a fun and simple way. To access the tool go to the 'View' toolbar → 'Toolbars' → 'Effect'→ drag 'Effects' on to the map and begin swiping between layers.   There is so much to learn with GIS, we tend to only skim the top of the iceberg but when a tool is demonstrated it makes one wonder what else we can find out about!

At Colonial Heights High School we met with Bill Ryan who had a very focussed and capable class who were doing the template project on a chlorine spill in an effort to develop a personalised adaptation of the evacuation techniques for emergency services in the community. Bills students were also working on maps of planning zones for the local community. Again, everything very community orientated and accountable.

The final school for the day was Western Albemarle High School in Crozet. The teacher Paul Rittenhouse had the students out in the field using the high tech Trimble Recom GPS units. This was an amazing effort considerable it has rained heavily all day and the students were soaked. Despite the conditions the students were willing to get wet and do the work outside. An amazingly motivated and happy group of GIS students really enjoying their work. Paul showed us the project his students undertook last year in mapping impervious surfaces, comparing the raster and digitising techniques.

Several points about what I observed at all the schools today:

* All the geospatial schools must present their projects to a community meeting at the end of the course. This certainly makes the students accountable for their work.

* At all the schools visited the students work had been printed on plotters and laminated to make their work look highly professional.

* The teachers I have met using GIS are predominately Earth Science teachers. I am yet to meet a geography teacher as we know them in Australia.

A very busy day with over 6oo kilometers covered. A huge effort by Bob and Kathryn and to think they visit these schools every fortnight!

Summary of Virginia visits

Tues. am - Ryan Miller, Washington and Lee High School, Arlington, VA
Tues. pm - Ron Vickers, Rappahannock High School, Washington, VA

Wed. am - Jay Ruffa, Hopewell High School, Hopewell, VA
Wed. noon - Bill Ryan, Colonial Heights High School, Colonial
Heights, VA
Wed. pm - Paul Rittenhouse, Western Albemarle High School, Crozet, VA

Fairfax County School District in Virginia – support from above

It was time today to visit the Fairfax County Public Schools Office to discuss the support that has been provided to schools to introduce spatial technology. As most people reading this blog know, the drive to introduce GIS into the classroom in Australia has come very much from the grassroots. That is, motivated and innovative teachers have become early adopters and in cahoots with Australian geography teacher associations have developed the resources and training for teachers to use GIS in the classroom. Whilst there have been instances of system support via curriculum development and in Queensland the ICT Innovation Centre, overall there has been minimal investment by educational authorities in terms of license purchases, teacher training, advisory support, hardware purchases and

teaching material development. The situation is quite reversed in the Fairfax School District of Virginia, with the District investing enormous amount of energy and money into GIS implementation in its high schools and trying to take teachers and schools with them to the promised land!

Here are a few facts to set the scene:

* The Fairfax County Public School District is the 14th largest in the US containing 29 High Schools.
* The district office is considered as a progressive system open to innovation and change.
* All the way back in 1992 the district redeveloped Earth Science as Geosystems with a systems approach and GIS as the keystone technology. It was considered that GIS would provide a visualisation capability which would enhance the learning of the students in the area of earth science education.
* In 1996 the state of Virginia bought a statewide ESRI license for ArcView 3 and the Spatial analyst extension. This enabled all 6-12 schools to have access to the ESRI product and as a first stage of implementation they equipped all High Schools with Geosystems labs.
* The cost of the statewide license in schools was dependant on the number of schools and students. In Fairfax District it involved 889 teacher and student seats according to the license agreement. With each computer alone costing approx $800 this alone was and significant investment in the technology by the district.
* The Fairfax County GIS Department gave the school their local Virginia data for classroom use. This data plus all the supplied ESRI data means that schools have access to 4.5 gigs of data for their programmes.
* Each lab was equipped with 15 computers, scanners and at least 8 GPS units.
* Teachers were also given laptops to use at school and home to learn the programme.
* The District also bought 3 support packages from so as to provide technical support to teachers and technology personnel in schools.
* The establishment of Geosystem labs was supported with an extensive teacher training programme with the expectation that all Geosystems teachers to be trained.
* All schools in the Fairfax District have appointed a School based technology specialist who has the brief to train staff in technology and be a trouble shooter in the school. These specialists must have teacher registration. They are not the information technology technician but rather teacher support by a teacher.

As can be seen this was an expansive programme with significant coordination and investment. The person I talked to in the District Office was Yvonne Griggs, the High School Instructional Technology Specialist (www.fcps.edu/DIS/OHSICS/index.htm).   Yvonne has been intimately involved in the process over the past years and in 2006 began a new push to speed up implementation. As a result new labs have been established and the ESRI ArcGIS 9.2 programme has been rolled out to all schools in association with a new teacher training initiative. The training and teacher resource material have been predominantly established by Kathryn Keranen and Bob Kolvoord, my hosts of the past few days. The teacher training has involved 5 night time sessions called Academy classes (this is PD tied in with the renewal of teacher registration). The training course includes work on the provinces of the US, weather, DEM models, plate tectonics, climate, GPS and a school based projects. As is the case with many of those involved in driving the GIS initiative in schools, Kathryn has enormous passion and energy for the implementation of GIS in schools. Kathryn was kind enough to give me copies of her 5 CD's titled 'Geospatial Instructional Applications Workshop'. These will be interesting viewing to see how Kathryn's approach compares with ours in Australia to teacher training. Kathryn can be contacted. Yvonne also said as part of this new push that it is hoped to introduce GIS into the middle schools over the next year.

I found the meeting at the Fairfax County Public Schools Office with Yvonne and Kathryn to be of enormous value as a model of system implementation. Such support is what many of us in Australia who are trying to implement from below dream about! However despite all the support, I think Yvonne and Kathryn would agree that the uptake by teachers and schools is still spotty and much more needs to be done in the area of teacher training and curriculum integration. As mentioned in previous blogs, the introduction of the SOL testing in US schools over recent years has slowed down the implementation process and in some places actually put the skids on the innovation of GIS into classrooms. A meeting is actually being held at James Madison University tomorrow with the folks I

have met and other key players such as ESRI to discuss the future of GIS in schools in Virginia and the established programmes in particular. I am sure with the energy and commitment of all of those I have met over the past 4 days in Virginia, the implementation curve will continue to happen in Virginia.

An interesting observation made in our meeting today was that we are really not just talking about a technology with GIS but really a change in teaching methodology involving problem solving and deeper thinking skills focused on student participation. Such a change is more than just a 'click and go' goal but one which involves some fundamental pedagogical changes for teachers. No wonder it is being seen as such difficult tasks everywhere I have gone on this trip with the same commentary about the need to develop effective teacher training and support.

That is the end of my time looking at the US educational system and the implementation of spatial technology.

Stop 5. Canada: Toronto

Geospatial technology in Canada

Toronto: N: 43º 39.391'   W: 079º 22.833'

During the two days I have been in Toronto I have been checking out the spatial technology scene in Canada to see if the commentary will be any different to what I found in the US in regards to the implementation of GIS into schools. Whilst the story seems slightly different much of the discussion still revolved around the difficulties in getting the use of spatial technology integrated in a meaningful way across the curriculum and the difficulty in getting teachers up to speed with the technology.

This morning I ventured out on the subway to the ESRI Canada offices to meet Jean Tong, ESRI Canada K-12 Industry Manager. Like Mick Law in Australia, Jean is a teacher who has recently taken the plunge out of the classroom to work in the area of GIS education within the spatial industry. Jean arranged for one of the key players in GIS Education in Canada, Mark Lowry to meet with us over lunch and back at the office. Mark is the Geography, Geotechnology and Civics Instructional Leader with the Toronto District School Board. As well as developing teaching materials, writing courses and training teachers in GIS across Ontario, Mark has also been working in Hong Kong and Jordon in the Middle East developing GIS based curriculum and training teachers. The breadth of Marks involvement in GIS education over many years was a real eye opener and his philosophy meshed very well with what we have been thinking in Australia about the place and approach to spatial technology in schools. Mark and Jean shared their thoughts on the successes, limitations and future of spatial technology in Canadian schools. Here is a brief summary of the discussion:

Successes

• Ontario is the eighth largest school district in North America with over 2 million students. Hence the fact that the Ontario District School Board has purchased a state site license is a great start. Other states with a state wide license are British Columbia (600,000 students), Manitoba (200,000 students) and Nova Scotia (35,000 students).   In Australia our states have not broached the statewide license with ESRI but it certainly would provide a head start if each school had access to the software without convincing the school budget committee that it is a necessary purchase.

•The ESRI Canada website is well used and provides enormous support to teacher implementing GIS. It is worth having a look at the site at http://www.esricanada.com/english/3478.asp   Plenty of lessons, free downloadable data and resources at http://www.esricanada.com/english/3780.asp

•Jean and her education team have been involved in producing a really useful DVD provided to all ESRI site license schools called ArcCanada 3.0. The DVD provides heaps of Canadian and world data for the classroom. Another CD available to Canadian schools using ESRI products is

the Atlas Ontario product (http://www.esricanada.com/english/3715.asp) which provides a collection of data and lesson ideas aimed at supporting the new Geography curriculum in Ontario.

•The Ontario District School Board has overtly written the knowledge of GIS into the 6-12 curriculum which has provided to a certain extent the sanction and stimulus to train teachers. For example it is quoted saying "... identify and describe the technologies used in geographic enquiry e.g.geographic information systems, gps etc"

* Mark went through the new Geography 11-12 curriculum which has a wide variety of geography course options. One of these is called Geomatics and focusses on the use of spatial technology. For more information on these courses go to http://www.edu.gov.on.ca/eng/curriculum/secondary/canworld1112curr.pdf

*Year 8 and 9 geography and Year 10 history is mandatory in Ontario (http://www.edu.gov.on.ca/eng/curriculum/elementary/sstudies78ex/). This gives plenty of opportunity for all students to be exposed to GIS. Interestingly much of the same language and focus is evident in the curriculum documents to what we have in Society and Environment across Australia (as was the case in Hong Kong as well). There seems a universal history, geography and civics educational "speak". It seems the approach is where the difference often exists and in turn teacher interpretation of the document and resulting pedagogy.

Limitations

* Even though GIS is overtly mentioned in the 6-12 curriculum documents the reference can involve only a cursory treatment of spatial technology by schools if so desired. GIS is not an assessment item and the treatment is not specified in any way other than awareness of the technology and not necessarily its application in the classroom.

* With Year 10 history being mandatory very few schools do Year 10 geography.

* Even though there is a plethora (16 courses in total) of great geography/history courses available at year 11-12, 85% of students choose the 'World Issues' and 'Travel and Tourism' units. Geography numbers are holding in year 11 and 12 but not increasing.

* Mark and others have been busy training teachers but there is still limited penetration across the teaching spectrum. Again, the training is mainly of the motivated and energised with many teachers finding it difficult to find the time to commence the learning curve. Sounds a familiar tale for this blog!

The future

* We spent some time looking at the free downloadable ArcGIS Explorer programme. Although the coverage of data for Australia is limited, shapefiles can be imported into the programme to cover Australia. This is a great programme free for those not aware. It can be downloaded from http://www.esri.com/software/arcgis/explorer/index.html . Although free at the moment it seems very likely that the future of delivery to schools could be via such a webserver facility (data already is being made available to schools via the ESRI webserver as mentioned in a previous blog posting). Naturally such a download would be at a cost to schools but able to be frequently updated, easy to use instead of complex installation and cheaper for ESRI to deliver as a product and hopefully cheaper to schools.

* We also talked about the need to focus on spatial literacy and visual literacy skills and not just mapmaking by students. Such skills require a framework of problem solving and creative methodology by teachers as has been frequently discussed by others on my journey. Hopefully a focus on spatial literacy and associated teaching methods is the wedge to convince schools to take on spatial technology as a tool for learning. More on that later!

A school visit in Toronto

Today I visited the Central Technical School in Toronto. This school is recognised as one of the leading Geotechnology school in Ontario and was a most interesting place to visit. It is no

coincidence that Mark Lowry was the HOD of geography at the school before he moved on to the District Board job I discussed in the last blog. Mark has developed a geography faculty of GIS trained teachers who are doing some great work. It was great to see a geography faculty of 6 keen GIS trained geographers all doing some great geotechnology work from years 8-12. The school itself is massive (over 2000 students) and the buildings have a lot of lived in character (old and not pristine as I saw in the US schools). The school had a completely different atmosphere to the US schools, being more relaxed re: security and more casual like Australian schools. The atmosphere was further enhanced because today is Halloween and the students were dressed in all sorts of different garb. It was like a casual day with a horror/fancy dress theme. I spent some time observing the Year 11 Geomatics class and a year 9 geography class using GIS. The faculty members gave me copies of their practical learning activities using GIS which seemed to be innovative and meaningful to the student learning. I will have a good look at these when I get home.

I also spent a lot of time at the school talking to Mark about the structure of the curriculum and the school in general. For example

* the students had an hour lunch at 11.45 with no recess which I was surprised with (same starting and finishing times the same as us).

* The 4 key components of learning the students are assessed on are knowledge, thinking, communication and application.

* Assessment is criterion based with the measures being at 4 levels of achievement.

* There is state based testing of numeracy and literacy at years 3, 6 and 9.

* There are no senior exit exams with the universities doing their own testing.

* Compared to the US and its broad standards assessment in each state this system is more open to innovation in general but still is constrained by the developed criterion based assessment expectations.

On the GIS front Mark and I shared our thoughts on the difficulty of ESL students learning GIS. The Central Technical School has an incredible mix of ethnic groups, as does Toronto in general. These students find it very hard to meet the literacy requirement of following GIS instructions and Mark showed me a technique he uses at the beginning of the courses to help students to follow process. I was also shown the 100 gigs of data in the District Board server which all Ontario schools have access to. The data is amazing and their educational authorities make it all available via their webserver.

What was affirming for me were two things Mark emphasised:

1. We are not computer teachers and therefore not the experts. Again, the type of teacher required to show their vulnerability to students as not the expert.

2. The 3b4me rule he uses. That is all students to ask three others in the class before asking the teacher. This sanctions student cooperation and group work, the greatest by-products of GIS in the classroom.

Mark has also produced in cahoots with some of the staff at Central Technical School, a very useful CD titles the 'The Geographers workbench' for use in senior school geography. I have a copy and some of the activities and powerpoints will be of interest to teachers new to geography teaching.

In regards to Civics and citizenship, the Toronto District Board has developed a curriculum which is worth having a look at in South Australia. The Central Technical School has channeled much of their citizenship activities into programmes such as the Toscan Foundation, Free the children and Adopt a village. A practical and meaningful approach to citizenship education for students.

I really enjoyed the day with fellow geographers using GIS and as always learnt plenty of new things to try out with students.

Finally a useful resource I came across is the website of the Ontario Geography Association located at http://www.oagee.org/. Also check out the Canadian Council for Geographic

Education resources on the International Polar Year resources at
http://www.rcgs.org/ccge/english/Newsletter/newsletter_current.asp
Also the 'World in spatial terms' website is worth a look at
http://home.istar.ca/~whamilto/ccge/world_in_spatial_terms.htm
Now a bit of a break until a busy week on GIS in London next week!

Stop 6. United Kingdom
A meeting with ESRIUK and Digiworlds

London: N: 51º 31.022'   W: 000º 10.103'
What a great setting for a meeting. Angela Baker from ESRIUK arranged for me to meet her and Jason Sawle and Richard Pole from Digital Worlds in the central hall area of the British Museum. It was a really lively meeting with some great discussions on the issues facing GIS implementation in the United Kingdom and the efforts being made by ESRIUK in collaboration with Digital Worlds to move forward with introducing GIS into schools. It would be fair to say that the conversation was similar to what I have had in Hong Kong, the US and Canada. That is, industry and key educationalists are working busily in breaking down data, software and technical barriers whilst developing resources for teachers to use in the classroom. However there seems to be a barrier we have all reached at moving forward. I think it has surprised all I have spoken to that the huge development which has happened with software, curriculum support and resources has not seen schools in large numbers rushing to the door of vendors and trainers demanding to get going with GIS in the classroom. It seems that the problem with implementation is the difficulty in getting teachers wanting to be trained and to generally embrace the technology as an integral part of the future of classroom practice. After attempts to interest all UK teachers in the technology the focus has shifted to the geography teachers in particular to see if that group can effect change. In Australia, geography teachers and associations have driven GIS in schools forward and it seems that in the UK the same strategy is presently being employed. I was very interested in the implementation model the Digital Worlds team presented, which puts a new spin on the process of implementation and the implementation chasm that some say we are presently in. The model roughly translates as:
Stage 1: Innovators and early early adapters (5%) (teachers willing to take a risk)
Stage 2: Late early adaptors (10%): (teachers who hear of successes and want to be involved.
   ***a chasm of implementation is identified as between Stage 1 ad 2 and it is suggested that we are presently just on the edge of the chasm (Stage 1 and 2 accounts for 10% of the teachers and thus 90% of the teaching force still not touched by GIS).
Stage 3: Early majority (35%): the next group of teachers to embrace the technology need very solid reasons why they should be involved. Vocational and curriculum push and pull factors involved in this stage.
Stage 4: Late majority (30%): This group is no longer prepared to see other schools have significant success stories and reputation from their efforts and see that they must be involved to be seen as keeping up with change.
Stage 5: The laggards (20%): teachers who need very solid academic and vocational reasons of why they need to use the technology and even some degree of system sanction.

The question is whether this model is real and if so, is the frustration many of those I have spoken to due to the pending chasm of implementation. If true, how do we breach the chasm and move on with implementation without falling in a hole? I feel there are a lot of Indiana Jones's out there ready to try! The Digital Worlds team has been working at a way to move forward and bridge the chasm by providing the 'missing link' with implementation. They consider that a more "teacher user friendly" programme is required to ease teachers along the learning curve. Jason and Richard have developed a product with ESRI support and blessing which has "trimmed much of the fat" off the full blown ArcGIS product. Their product 'Digital Worlds GIS' has been designed to combat the one-size fits all approach in education with a product customised for the classroom setting.

My purpose here is not to review the programme but just make some observations, signpost further reading and summarise some of the key discussion points:

*'Digital worlds GIS' uses the ArcGIS interface with many of the functions removed, icons made easier to relate to and language more explicit.   Despite this customising, Digital Worlds GIS still undertakes the GIS functions and skills that are required in over 95% of classrooms using GIS. It can create Thematic maps, query databases, create tables, edit tables, hotlink, swipe, import GPS points and all the other day to day functions of classroom GIS.

* As mentioned, the motivation of the Digital world's team was to create a programme which was easy for teachers to use and provide a link between the ESRI AEJEE (free GIS- see Dallas blog posting) and industry standard ESRI ArcGIS 9 programme. They suggest that when the teacher feels confident with their programme and want to go further they can invest in ArcGIS and move forward with minimum disruption because of the commonality between the two programmes.

* The philosophy of Angela, Jason and Richard was affirming in that they see GIS as a tool to enhance classroom learning and not an ICT focus alone.

* The approach we discussed in relation to teacher methodology using GIS was also in synch. I thought the quote that the teacher needs to stop being a "Sage on the stage and a guide on the side" summed up extremely well the teaching methodology to be employed by a teacher using GIS.

* Angela said that there has been a massive acceleration in teacher ICT skills since 2001 in the UK due to a government initiative to train teachers in ICT. Such an increase in teacher computer literacy was hoped to flow over to the use of GIS but as yet it has been patchy. This and the writing of GIS into the National curriculum ages 11-14 (to be introduced in September 2008) and ages 15-16 by 2009 should see positive results in the implementation of GIS.

i.e. *The curriculum should provide opportunities for pupils to: use varied resources, including maps, visual media and geographical information systems (Qualifications & Curriculum Authority, Programme of Study: Geography Key Stage 3)*

*In 2003 the Jason and Richard began work on an Anglo-French project (*European Regional Development Fund Interreg IIIa community initiative) *to examine and develop a GIS programme in Kent and Haute Normandie. The project was designed to break down the barriers for GIS implementation in schools in these areas. The project involved teacher training, software support and the development of a website for these schools to access local data.* This includes a variety of digital data, including: aerial photography; large and small-scale maps; administrative boundaries with census, social and economic data; historical maps; satellite images; environmental data; and 3D Digital Elevation Models (DEM). In addition, the site also hosts a series of unique Digital Information Portals (DIP's) in the form of virtual tours for a number of key sites within the Interreg IIIa region. *For more information on the project go to* http://www.dakini.eu.com/

* Part of my fellowship goals was to find relevant research and documentation on spatial literacy and spatial thinking. When asking this question I have been frequently referred to the "Learning to think spatially' book. It seems to be the major resource available in an area which everyone agrees needs to be further developed.   For information on this resource (including a podcast) go to the National academic press at http://www.nap.edu/catalog.php?record_id=11019

* ESRIUK has been very active on GIS Day each year and has developed resources to support the promotion of GIS. Go to ESRIUK website at http://www.esriuk.com/gisday/ideasresources.asp for GIS Day downloads.

* Check out the Digital worlds GIS site: I am not sure about the availability of the free demo CD but go to http://www.digitalworlds.co.uk/ for the free video and newsletter from the team. If interested it is worth looking at www.schoolzone.co.uk . This educational intelligence website has evaluated the Digitalworlds GIS software
http://www.schoolzone.co.uk/resources/evaluations/evaluation.asp?evalid=4406

The 6 hours of enjoyable GIS discussion with like-minded souls was very enjoyable after a few days of just walking and not talking. Plenty of food for thought on the implementation of GIS in schools. Again, plenty of parallels with the situation in Australia.

A day out of the city: Hatfield and the Computers in Education Advisory Unit at the Innovation Centre

Hatfield: N: 51° 45.854'   W: 000° 12.928'

Today I had the opportunity to travel by fast train out of the big city to Hatfield, about 45 kilometers of central London. I visited Diana Freeman who heads up the Computers in Education Advisory Unit. Diana has been involved in GIS in schools since 1991 and was one of the pioneers of trying to get GIS into schools. She certainly had plenty of interesting ideas on the matter and was quite positive about the present direction. The Computers in Education Advisory Unit is responsible for the development of the AEGIS (An education GIS) programme. The programme has been designed to be a user friendly mashup type of GIS layout product for students to use in their studies. The programme interface is quite different to other GIS programmes I have worked with because the interface is in a layout mode (called an interactive worksheet) containing digital maps, data tables, pictures, text, legends and titles. The programme can undertake all the GIS processes such as thematic mapping, data searching, data table creation, data table editing, hotlinking, importing of excel worksheets, swipe tool plus all the day to day operational components of a school based GIS programme.

Again, it is not my role or place to make commentary on the pro's and con's of various programmes and make comparisons. My purpose with my research is to get a variety of views on the issues of GIS implementation and spatial literacy. What can be said is that AEGIS seems to be another effort by another group of individuals to make GIS accessible and achievable for teachers to use.

Diana has been heavily involved in teacher training and I was very interested in the network of teacher consultants (experienced GIS teachers) her group has established across the UK to mentor and support other schools in implementation. As well as training of individuals Diana believes that training days need to be followed up rapidly with faculty training time in the school. Whilst time and personnel intense, such an approach is definitely the ideal way to go if meaningful implementation is going to happen in schools in an embedded and sustainable fashion. As I mentioned in the implementation stages earlier in the blog, teachers training teachers is a critical stage of the implementation process. To date, 1000 of the 6000 secondary schools in the UK are using the AEGIS programme which makes AEGIS the most widespread GIS programme in the UK. Recently the Advisory Centre has been awarded the tender to implement GIS in SSAT (specialist school and Academic Trust) schools.

The Advisory Unit has also been working closely with the Geographical Association in the process of introducing GIS into schools over the years and has contributed a think piece on GIS to the association's website www.geography.org.uk.

Diana considers a key driver of change is the QCA (Qualification and Curriculum Authority-http://www.qca.org.uk/) who as the body responsible for setting all curriculum and assessment criteria in the UK are supportive of using ICT's such as GIS in the curriculum.

On the methodology front the Advisory Unit has an approach which is based on using GIS for geographical enquiry so as to question, think critically, collect, record and display information, analyse, apply skills and understand concepts to solve problems and make decisions. The unit also sees fieldwork and out of class learning, visual literacy and geographical communication as key components of using spatial technology in schools.

The units approach to learning the GIS skills and concepts in general for teachers and students is also compatible with many others I have spoken to over the past weeks. The Advisory Units document states the following process to attain GIS skills using AEGIS:

1. Use prepared samples to map and search data
2. Practise different digital mapping techniques
3. Add data and images to existing maps and tables
4. Use digital data gathering methods
5. Understand different digital map formats
6. Create GIS case studies for individual enquiries

The unit is also working with the British Educational and Community Technology Agency (BECTA - http://about.becta.org.uk/) and the Ordnance Survey to make large scale maps accessible for classroom projects. At this stage the map delivery is limited to only 40 state schools as a pilot but hopefully in the future it will be extended to all schools. www.emapsite.com is the commercial site for map delivery.

The Advisory Unit considers that teacher attainment of the skills is an achievable goal in the near future with teacher training and advisory support. In fact they consider that because enquiry learning is quite embedded in the UK teaching and learning school environment, teachers are looking at the opportunity to develop personalised learning which GIS is able to provide.

The AEGIS web site at www.advisory-unit.org.uk/aegis3/welcome_to_aegis_3.html has a free AEGIS viewer to download with a range of AEGIS projects and on-line tutorials.

The contact details for Diana Freeman is The Advisory Unit: Computers in Education
diana.freeman@advisory-unit.org.uk

It was great to get out of London and see a bit of the London green belt to the north. Tomorrow I head south to Southampton to visit the Ordnance Survey.

A day in the land of maps: Ordnance Survey in Southampton
Southampton: N: 50º 54.453'   W: 001º 24.723'

Today I travelled one and a half hours by train to Southampton to visit Roger Jeans, Education Manager at the UK Ordnance Survey (OS) offices. The Ordnance Survey (http://www.ordnancesurvey.co.uk/oswebsite/) is known to many teachers in Australia due to their excellent GIS Zone and MapZone website facility. My purpose to meet Roger was to see how such a pro-active and "student friendly" website came about and to see what the role has been of such a government agency in the introduction of GIS in schools. In all my other meetings in the UK the OS has repeatedly been mentioned as a major player and "go to place" for schools, vendors and associations interested in introducing GIS into schools. I found out much more than just this from Roger and really enjoyed seeing the home of UK mapping and data. Seeing the historical map facility was a real treat!

As background, the UK Ordnance Survey goes all the way back to 1746 and has played a key role during UK military and civilian history of the country. In particular their role during the fires of London, blitz years, tax systems gives an insight into the role of the Ordnance Survey (http://www.ordnancesurvey.co.uk/oswebsite/aboutus/history/index.html). The OS is a self funding government agency which naturally has to sell its data and maps to maintain its considerable facility and product base. Today there are approximately 1200 people working in the agency (was over 5000 prior to the digital world) which has seen the amazing transition from hand drawn maps, though scribed maps to today's digital maps.

In 1991 the OS embarked on its education involvement due to their concern about the quantity and quality of map skills amongst school age children and the perceived future needs of the spatial industry. Hence, the pro-active and networking role they have played in education in the UK. This focus has continued into the 21st century because of a concern that young people are still not aware of the job opportunities available in the industry and the need to raise community awareness of the work of the Ordnance Survey.

Roger heads up an education team which uses the considerable data, map and expertise capacity of the OS to develop educational materials for schools. Here are some of the activities/initiatives they have been involved in an effort to create a GIS friendly environment in schools.

1. 'Mastermap' (http://www.ordnancesurvey.co.uk/oswebsite/site/login.html) is an intelligent set of data available to schools under license. The data is licensed to local authorities across the UK and then becomes available free to state schools. Private schools need to pay a license fee for the data as a separate arrangement. The previously mentioned emapsite (www.emapsite.com) is the site that schools go to download the data. The site aims to provide a one-stop data shop for schools to access UK and their local data in particular. Such a facility saves school chasing local authorities and councils for data. The data sets include topographic, transport network, administration boundary, street, and postcode layers as well as raster data at a variety of scales.

2. The OS has become a 'critical friend' to the geographical education community in the UK being able to network with other government agencies and members of parliament about the importance of spatial skills for students. To this end the OS has organised a meeting in the Speakers House in the House of Parliament on November 22nd to address the question of geography in schools. Michael Palin has been invited with other prominent community members to participate in the presentation.

3. The Survey is soon to conduct its Map Pilot programme which is hoped to provide a webserver facility for schools. If the initial project works then other government agencies could feed their data into the webserver for schools to create an evolving and comprehensive facility for all schools in the UK.

4. To increase the profile of the OS and to ensure all young people in schools have exposure to topographic maps the Survey instituted the 'Free map scheme' in 2002 (http://freemaps.ordnancesurvey.co.uk/freemapsfor11yearolds/). The scheme is an amazing commitment to spatial literacy in schools and involves every year 7 students in the UK receiving a free full size topographic map of their local area. All schools have to do is to register their interest and provide student numbers to the OS. 1 teacher map is provided for every 25 students in the school. Even being free with no strings attached only 70-80% of UK schools take up this offer! The maps are worth $20 each and the programme costs approximately A$800,000 annually for the OS to implement. The maps are supported with a student map skills book and a sticker for the students to locate their home with on the map. I am sure all geography teachers would love such a scheme in Australia for their students and it really shows the degree the Ordnance Survey are prepared to go to support spatial literacy in schools.

5. As many already know the Map Zone (http://mapzone.ordnancesurvey.co.uk/mapzone/) and GIS Zone (http://mapzone.ordnancesurvey.co.uk/mapzone/giszone.html) of the OS website is great to use with students but it is worth noting these few other education links on the site (http://www.ordnancesurvey.co.uk/oswebsite   ):
Go to the Education tab at http://www.ordnancesurvey.co.uk/oswebsite/education/ and check out the following:
   * A website workshop document can be downloaded from
   http://www.ordnancesurvey.co.uk/oswebsite/education/pdf/webworkshop.pdf
   * The GTE (Geography Teachers Educators) information page at
   http://www.ordnancesurvey.co.uk/oswebsite/education/gteresources/index.html has other Powerpoints to help teacher introduce GIS into their classroom, an AEGIS viewer workshops materials, the 'Mapping news' publication and much more.

6. The OS has also funded and supported GIS days for teachers over the years and this year could only cater for 60 of the 120 teachers who applied.

7. The OS Mapping news is brought out twice and year and can be downloaded as described above. I highly recommend the publication and the information in the following two editions summarising software available to schools (http://www.ordnancesurvey.co.uk/oswebsite/education/mappingnews/previouseditions/32/GISforschool.pdf) and helping young people learn about maps (http://www.ordnancesurvey.co.uk/oswebsite/education/mappingnews/previouseditions/32/MappingNews32.pdf) are particularly useful.

8. The OS website has had a new addition since October which is really a great resource for UK teachers and those GIS mad. This is the Explore Portal at https://explore.ordnancesurvey.co.uk/account/login .   What is great about the portal is that it involves maps, GPS, data collection, field observations, image importing and blogging for students and others to use and experience. What a great idea and a really good template for a similar facility in Australia for schools to use. More to explore on that one! Have a good look at it and think of its potential to enhance student involvement in GIS and fieldwork.

As for GIS implementation, Roger considers the digital divide is a great challenge for many teachers to overcome and that considerable work still needs to be done to upgrade the ICT skills of teachers. What the OS is doing is to help support those trying to introduce GIS into schools with accessible data, resources, networking and general support. The OS supplies an interesting role model for us to discuss back in Australia and thanks to Roger for spending the day explaining the role and work of the OS to me.

Geography HQ: A visit to the Royal Geographical Society

Today I had the pleasure of visiting the Royal Geographical Society in London to meet with Judith Mansell (RGS Education Officer), David Rayner (National Subject Lead in Geography) and Noel Jenkins (Court Fields Community School and of Juicy Geography blog fame). It was a very thought provoking meeting with David given his perspective on the educational state of geography in the UK, Judith describing the work of the RGS with GIS implementation and Noel passionately advocating the use of a range of technologies in the classroom. Our discussion was so broad and at times tangential it is hard to summarise what was said but I will just pick out some of the things that stuck in my mind and applied directly to my work in Australia (both with GIS and geography in the curriculum).

* Noel talked about his efforts to use technology such as blogs to help broaden the horizons of students to help them see themselves as a part of the globalised world. He sees all technology as an enabler for students to share and interact across the globe.

* I was interested in the term that seems to be used in the education circles in the UK; "compelling learning experiences". I am sure this term will turn up in Australia and most definitely relates to the use of technologies such as GIS in the classroom.

* Our discussion on the impediments for innovation and change inevitably moved on to thoughts on the structure of schools and the need to be creative and innovative with timetabling. I was interested in the concept of collapsing school days so that one day a week is not timetabled but rather allocated to faculties to conduct full day activities in and outside of the school.

* We explored the reasons why many teachers find new technology threatening and what is the 'make-up' of the teacher who takes up the challenge compared to the teacher who puts 'up the shutters' to change and learning new things. Maybe we need to do some psychological profiling of change receptive teachers and work out ways to support all teachers tackle change and overcome technology anxiety.

* Noel demonstrated the use his students make of movie making in geography with geo-referenced links and other spatial components. He uses free software such as iMovie (http://www.apple.com/ilife/imovie/) and Windows movie maker (http://www.microsoft.com/windowsxp/using/moviemaker/default.mspx) for students to make their own geography based movies. To see some of Noels students work at his previous school go to http://www.geography.ndo.co.uk/   As you will see on this site, Noel is keen to integrate spatial understanding across the curriculum, involving English and art for example in his geography lessons. A centerpiece of Noels teaching is personalising geography for students and encouraging students to make a personal connection with what they are studying. To this end Noel is keen for Youtube to be used as a source of some great geography but is having issues with the use of this technology in schools. More of Noels students work will be appearing on his new student blog site at http://noeljenkins.wordpress.com/ over coming months.

* David Rayner as the Geography Lead has the responsibility to roll out Geography in the new National Curriculum. He sees this as a great challenge and is keen to have geography seen as a vibrant and positive area of study. Since GIS has been overtly written into Stage 3 of the National Curriculum, David sees this as a great opportunity to move GIS forward in schools. The issue in relation to this is whether the wording of the references to GIS are strong enough to ensure the use of GIS in a meaningful way in the classroom or will just see teachers undertake a cursory treatment of GIS applications.

* The Royal Geographical Society has taken the lead in GIS training in the UK and continues to conduct GIS workshops for teachers. Over the last 5 years the RGS has been funded by Becta and the The Department for Children, Schools and Families (http://www.dfes.gov.uk/) to provide support and guidance to encourage the use of GIS in the classroom. The RGS workshops called 'GIS made easy' have generally been at the awareness stage of GIS implementation with the plethora of software available being demonstrated during one day and evening workshops.

* As many know in Australia, Noel has been extremely innovative in his use of Google Earth. His websites http://www.digitalgeography.co.uk & http://www.juicygeography.co.uk & http://noeljenkins.wordpress.com are fantastic examples of the innovative use of spatial technology by a classroom teacher.

* David has been also innovative over the years developing excellent teacher resource sites such as the Staffordshire Learning Network (http://www.sln.org.uk/geography/) and a teacher sharing website called Geointeractive (http://www.geointeractive.co.uk/)

* The Royal Geographical Society has taken an important role with the Geography Action Plan which was a UK Government programme to promote geography with a range of initiatives. The RGS has been involved in developing geography career resources, Ambassador Schemes, Chartered geographer credentials and establishing quality geography department marks. More on the plan can be found at http://www.geographyteachingtoday.org.uk/

* We finished the day with Noel outlining his vision on the massive changes which will happen in the next 5 years. In particular he sees all GIS software and associated data being served via the web and drastic changes occurring with the nature of the hardware used. Such a vision was only the tip of Noels vision of the future and I suggest put Noels website http://www.digitalgeography.co.uk in your favourites because I am sure he will be posting his thoughts regularly on the issue of our technological future. The question is whether schools (more specifically teachers) will be able to adapt and change to accommodate the massive technological changes which will rapidly descend on us over the next decade; changes which our students readily embrace in their everyday life. Traditionally education is slow to react to technological change in society as demonstrated by the introduction of spatial technology. Can we afford not to keep up?

Overall a lot is happening and with enthusiastic and innovative people such as Judith, Noel and David I am sure things will continue to move forward with spatial technology in schools in the UK.

The Churchill Fellowship meetings are over but I am sure the contacts I have made will continue into the future. Hopefully the sharing and networking will help GIS implementation in schools back in Australia. For those who have been reading this blog I hope the information has been useful. As I mentioned at the beginning, the blog documentation will go towards my Churchill Fellowship report. What I need to now answer are those questions I posed in that very first blog. Maybe on the pane home I can start to crystallise my thoughts on the important issue of the implementation of spatial technology in schools to enhance spatial literacy.

CONCLUSIONS AND FINDINGS

As mentioned in the Introduction I had some key questions to guide my fellowship. Having just returned, for the purpose of this report I will attempt to develop some conclusions in relation to the questions. However I am still processing much of what I have learnt and I am sure more succinct answers will develop as time progresses.

1. How widespread is the use of spatial technology in schools in the countries visited?
Finding: Generally spatial technology is not widely used in any of the countries I visited. If anything we have a broader implementation in areas of Australia. The implementation is patchy in the countries because of issues related to standards and assessment requirements, curriculum sanction and teacher expertise. Implementation is in pockets and very much reliant on individual teachers taking on the technology rather than the system embracing it. Having said that, Hong Kong is embarking on an implementation model in all high schools, Fairfax County has had a statewide strategy and the UK has written spatial technology into their curriculum. Despite similar efforts around the world in the past, the uptake of spatial technology has only been patchy and superficial.   Whether the new initiatives are more successful is going to be interesting to see. As in Australia, there seems to be a 'missing link' to enable the technology diffusion of spatial technology into schools.

2. What type of software is most commonly used?
Finding: In Hong Kong, US and Canada it is ESRI ArcGIS. In the UK there is a plethora of competing software which has muddied the waters for schools trying to get started. Products such as AEGIS have the front running but the new Digital Worlds software (ESRI based) seems to be the future in the UK. Other softwares are really very minor players in the countries visited. ESRI is dominating the market in the countries visited because of their investment in education which has put them in the box seat to capture the educational market in the future across the world.

3. What teaching resources are available using spatial technologies in schools?
Finding: ESRI continues to supply the bulk of the educational resources for schools via their Mapping our World and website resources. ESRI are presently working on four new publications for schools which are due to be released in 2008.   In the UK, AEGIS have produced some teaching resources and individuals are working on various website based lessons (i.e. Digital Geography, Madison University teacher training materials etc). I was surprised by the lack of innovative 'student friendly' classroom resources such as the 'Making GIS happen' resources in Australia.   It certainly is an area which needs to be developed.

4. Have local curriculum materials been developed for schools to use spatial technology to enhance spatial literacy?
Finding: All of the teaching resources have been developed by vendors and individuals conducting teacher training. I did not come across any teaching material developed for the classroom developed by curriculum authorities. There is a great need to have some official curriculum exemplars on GIS from education authorities to give credence and status to the use of spatial technology in schools.

5. Can schools access local, regional and national data easily?
Finding: This question was a constant point of discussion in my meetings. In Hong Kong the education authorities are working at putting together data for schools. In the US, government data is free in many cases and ESRI have developed a webserver facility for all schools using ESRI software. Canada is also working at accessing local data for it's schools but is very much a Province responsibility. Toronto has developed a data package for the schools, since they have a state license for all schools. In the UK the Ordnance Survey is developing a Mapserver facility for schools but there seems to be a degree of frustration at the speed of the process. So, the issue of data is being dealt with and despite the difficulties seems to be a part of the implementation jigsaw which can be put in place.

6. What are the major impediments to the implementation of spatial technology at the school and system level?
Finding: Generally the systems are starting to recognize the area of spatial technology. In all the places I visited it has been written into the curriculum and in Virginia, Toronto and Hong Kong there are educational authority licenses giving all schools access. In Dallas and the UK it is a school based decision to buy the software if desired. Hong Kong, Virginia and Toronto have developed teacher training programmes and have allocated money to implement. The UK and most US States have an ad hoc teacher training model reliant on vendors and teacher associations/geography associations.

7. What teacher training models are employed? What resources are available to train teachers in the area of spatial technology and spatial literacy? Who undertakes the teacher training?
Finding: Despite training being conducted in Virginia, Hong Kong and to a limited extent in Dallas and the UK I did not see a coherent teacher training model. The closest to a coordinated comprehensive strategy was that conducted by Madison University but it seems that the book has not been written yet providing the appropriate spatial technology professional development model and methodology of training for teachers. In the UK the professional development activities has not really gone past the awareness raising stage although the AEGIS team has set up a teacher mentor training programme which has great potential as a possible model for professional development in the area.

8. Has the in-service of teachers in spatial technology been taken up positively by teachers and schools?
Finding: Everyone I spoke to said that the teachers who come to the training are generally positive but overwhelmed by the learning curve. They may do the training but often hit a roadblock when they get back to their school. Overall the commentary was that it is hard to get teachers to embrace the technology and invest the time and energy into coming to professional development activities. It is a bit of a Catch 22 situation though, with teachers reluctant to embrace the professional development but if the professional development is not of a structured learning model with well thought out strategies supported by the authorities they are overwhelmed and reluctant after a few contacts. There is an urgent need to develop a professional training model with supporting materials. The answer is somewhere between the materials developed by Madison University and the teacher mentor scheme employed by AEGIS. This is something which Hong Kong says it is looking at as it rolls out its spatial technology training to 2000 teachers over the next 2 years.

10. How have students responded to the technology?
Finding: Overwhelmingly those I have visited and the students I spoke to had no problem using the technology. However it was frequently mentioned that a text book approach can kill the interest quickly. The methodology using the technology must be creative and linked into the community or 'real world' so that students see it as meaningful and worthwhile. Just being in front of a computer is not instant student engagement in the 21st Century. The task must be meaningful and seen as worthwhile if the use of spatial technology is a success in the classroom. Hence the community linked programmes observed in Dallas and Virginia are examples of good practice to be promoted in Australia.

11. Is there school based evidence and research that spatial technology significantly enhances the spatial literacy of students?
Finding: The answer is basically no. All evidence is anecdotal and not based on valid research. ESRI have actually recognised the gap in research and have allocated funds in 2008 to support such research but the amount is very small. Educational authorities really need to take this research on board and I am sure there may be some potential PhD's on this topic in the near future.

12. Is the term spatial literacy widely used in your country and if so what resources are available to help teachers delineate and comprehend the concepts involved?
Finding: Again the term spatial literacy is not used in most places I visited, nor is there coherent documentation on what is required to enhance spatial literacy in adolescence. There is plenty of research on early childhood spatiality but again there is a gap in the research and documentation on spatial thinking amongst school age children. There are some papers I was referred to but again it is

basically discussional and anecdotal and not solid research which could be used to plead the case of spatial literacy in schools. Unfortunately my journey did not succeed in finding anything of worth on spatial literacy at this stage but the people I met and the conversations started on the topic could be fertile ground for future research and documentation in the area.

13. Has the vocational aspect between the teaching of spatial literacy and use of spatial technology been linked with the opportunities in the spatial industry in your country i.e. vocational education programme in schools.

Finding: There was significant awareness of the need to have young people aware of the opportunities in the spatial industry but except for the geotechnology initiatives in Virginia and Dallas there was a lack of vocational orientated courses. There was a general frustration in getting the education community and parents aware of the industry and its opportunities. Again our VET Spatial Information Services initiatives are ahead of anything I saw in my travels.

14. Is there a general awareness and acceptance by educational authorities of the need for spatial literacy and the use of the associated spatial technologies in schools? Moreover do the authorities and schools see the opportunities such technologies provide for student employment and classroom practice?

Finding: In Virginia and Toronto the educational authorities are very aware of the issues and are investing in real terms in GIS implementation. Despite this top down approach they are not having the success they expected once they poured the money in. It seems that a successful implementation needs to be a combination of grass roots need and system sanction. It can be said that around the world the examples of GIS implementation are not uniform across a region but rather there are examples of pilot schools which are the early adapters who are doing some great practice. However they are not due to system implementation but rather individual teacher passion and dedication to the cause of using spatial technology in their classroom.

15. Is there a sense of frustration by the spatial industry and teacher's presently using spatial technology in schools on the rate of uptake of the technology and the priority placement of spatial thinking in schools?

Finding: Yes there is frustration evident in those I visited (with the exception of the AEGIS team). It was amazing how repetitive and similar the commentary was between countries and vastly different education systems. Generally the early adopters are surprised why others are not readily and enthusiastically taking up the challenge. The early adopters have done a lot of the 'hack work' in regards to software development, hardware access, resource development and teacher training opportunities. The question is, what has caused this hesitation of mass implementation? The Digital Worlds team talked about the chasm of implementation after early adoption. The area of teachers embracing the technology and being willing and able to learn the technology and associated methodology is identified as the hurdle to overcome. The issue of teaching methodology as a stumbling block was frequently mentioned and the teacher profile as a risk taker and innovator was identified as critical (as well as being enthusiastic and prepared to invest time and energy to learn the technology).

16. Is the use of spatial technology limited to geography or is it employed across the curriculum?

Finding: In the US the Earth Science teachers have been the ones to take up the use of spatial technology. This is partially due to the paucity of geography as a stand alone subject in the States and the strength of the Earth Sciences. In all other countries visited, geography is the lead subject and almost 100% is employed in the geography classroom. There has been minimal effort to introduce spatial technology into history, math and science classrooms in Canada, Hong Kong and the UK. Despite the lack of effort the success rate has been very low in developing across the curriculum use of spatial technology. The few examples I came across were very much based on a group of teachers co-operating to use the technology in their subject but certainly no system evidence of the approach.

*1**7. Are there 'model schools' demonstrating good spatial technology practices in your country which could be used as implementation templates for other parts of the world?***

Finding: I visited schools in the US and Canada who were doing some great work. The Bishop Dunne School was certainly doing some wonderful innovative community linked work, as was Ted Polk in Dallas. The Geotechnology course at Hopewell High School had students in the field using GPS for a purpose and the Central technical School in Toronto had a faculty using spatial technology in the curriculum in a meaningful way. If all of these examples were put together into one school we would have a wonderful use of spatial technology in the classroom. What impressed me about the Toronto school was that the entire faculty was involved from year 8-12 and the students were involved in using spatial technology in a wide a range of learning activities and content. I was told there were many other cases of such good practice but most agreed it was individual teacher based instead of a whole school approach. The Toronto school is the exception because the advisory work of Mark Lowry, the Toronto consultant in geography who was once at the school and has influenced and supported the faculty implementation approach. Such an advisory service and in-situ support is the key to implementation if we are serious about meaningful and embedded implementation of spatial technology in schools.

18. What is planned in your country to enhance student spatial literacy and/or the comprehensive use of spatial technologies in schools for the future?

Finding: In all the places I visited there are plans to push forward the use of spatial technology. In Hong Kong the new curriculum incorporating GIS has caused a comprehensive teacher programme to be put in place for 2007-8. In the US the future seems much more disparate as a result of the stifling influence of the standards phenomena in each state of the US. In Canada the future seems more positive in several of the provinces with people aware of the issues and putting curriculum and teacher initiatives in place. In the UK the new National Curriculum includes a treatment of GIS but the depth of the treatment required is cursory and open to superficiality and there does not seem at this stage a comprehensive approach to teacher training. There seems to be a lack of direction in regards to software and professional development leadership in the UK. The work of the Ordnance Survey as an ally to the education sector is a positive for the UK and may be the major driver in the long term when the software issue is resolved. The work of Digital Worlds is a positive also for the future of UK GIS.

RECOMMENDATIONS

In response to my findings I would like paint the ideal spatial technology in schools world which could be developed from all the best practice I have observed on my travels.

Across the curriculum
Geographic Information Systems would be used across the curriculum in all learning areas and disciplines. Science could be doing work on volcanoes, Home Economics mapping fast food intake, Mathematics developing databases, History mapping socio-economic data from the past and English mapping dialect differences across a region. What is important regarding GIS across the curriculum is that GIS is a suitable tool to use in a wide range of study areas. It is not just the property of Geography. However the spatial learning and concepts associated with the use of GIS skills and applications is very much the domain of the discipline of Geography.
Fellowship learning regarding this goal: *Limited and few examples mentioned or evidenced of across the curriculum innovation.*

Data provision
Data to be "user friendly" and accessible to schools for the purpose of GIS applications and spatial learning. The data also would be varied and diverse in nature and not just geographically orientated. That is, the data to be of a scientific origin, socio-economic nature or in many other permutations. This would enhance the use of GIS in all Learning Areas. The data to be viewed by the schools and delivered via the Internet from a central data bank upon request. No need for individual schools to negotiate with Government bodies for data and user agreements since that has already been done by the System.
Fellowship learning regarding this goal: *The work of the Ordnance Survey in the UK and ESRI in the US are great models for us to look at in Australia. The webserver option for schools seems the best way with schools accessing all their data via the Internet. Data can be updated and current at all times and not clog up the school server or have the expectation of IT support at the school to load data.*

Teacher training
All teachers in schools seeing a relevance of GIS to their Learning Area to be trained in the use of GIS and exposed to a variety of application uses. This training to be free to schools and provided with some release time for teachers as part of school professional development programmes. Not just geography teachers trained but teachers from a wide range of faculty areas.
Fellowship learning regarding this goal: *The work of Bob Kolvoord and Kathryn Kerenan in Virginia was impressive and their training material very interesting. The work of Anita and Roger Palmer and their new teaching materials will provide a useful template for teacher training. The teacher mentor scheme as mentioned by Diana Freeman of Computers in Education is the way to go back in the school. Such advisory scheme is very labour intensive but is the ideal model to work in situ for a short time with the teachers trying to introduce spatial technology into their classroom.*

Community links
Schools to use the community for data, expertise and project applications. In particular the local council to play an important role in the GIS programme in the local school. The community, including businesses should be the laboratory for the use of GIS. Some of the data collected and project work conducted could be used in turn by the community. Such two-way traffic in data is the ideal for the development of effective working relationships between schools and the community.
Fellowship learning regarding this goal: *The Bishop Dunne School cemetery heritage mapping, the Hampstead School crime project in the UK, the Disaster planning project at Hopewell High and the 4H local park project in Oklahoma provided excellent templates of how to conduct community relevant project and how to meaningfully to present the work of the students to the community.*

Skill development
GIS skills should not just be taught during senior secondary years. The skills are to be taught in middle, if not primary years. By the time students get to the senior years they should have well developed GIS operational skills, so that their senior school years can focus on the areas of project design and analysis.
Fellowship learning regarding this goal: Did not see a coordinated curriculum approach as suggested above. Because the use of spatial technology is primarily vendor or University initiated there does not seem a coordinated process of year level implementation by curriculum bodies. Possibly the exception here was the Toronto school with it skills based approach...

Teacher networks
Teachers are supported by the education system in the form of GIS technical expertise and support. The ideal world would have mobile technical officers that could troubleshoot GIS problems in schools. Teacher hub groups would also be developed that provide regular professional support for teachers.
Fellowship learning regarding this goal: The Computers in Education model was along these lines but otherwise it was just a few individuals running around doing out of school training with little in-school work. Where it was done such as in Virginia it was very effective with a group of teachers and in Toronto with a limited number of schools.

Curriculum materials
A group of teachers to develop Australian based GIS curriculum materials that enhance the use of GIS in the classroom. These personnel to in-service teachers in schools on the use of the materials within the various curriculum framework.
Fellowship learning regarding this goal: The material developed by ESRI in the US which is written by teachers is the best example of teaching material developed by teacher for teachers. Otherwise the developed of materials is limited and mostly project based examples on the Internet such as the Digital Geography website.

Levels of competencies supported with research
A set of GIS and spatial competencies developed for levels of schooling. Such ICT and spatial competencies would give guidance to the use of GIS throughout schooling within the broad framework of student ICT competencies.
Fellowship learning regarding this goal: No evidence of such an approach evidenced in the places visited.

Resources
Educational bureaucracies take the lead in negotiating with data and software providers. Instead of schools trying to negotiate with bureaucracies and industry, appropriate officers within the bureaucracies, aware of the needs of schools, lobby on behalf of schools to ensure achievable prices and access to resources.
Fellowship learning regarding this goal: Fairfax County was an excellent example of this approach by an educational authority. The Ordnance Survey was an excellent example of a Government Department using such an approach.

The Spatial industry and Government agencies
The spatial industry to be encouraged by educational bureaucracies to be involved in schools. Liaison at the highest level between spatial industry key players and educational bureaucracies to ascertain the potential of the industry to provide expertise, resources and training to schools.
Fellowship learning regarding this goal: Limited examples other than the co-operation with vendors such as ESRI and AEGIS. If Government departments are classified as the spatial industry then the ordnance survey was a great model. Limited evidence of the other members of the spatial industry being involved in schools.

Equity
GIS is used across the state regardless of location. Schools in the country and disadvantaged areas of the metropolitan area to have equal uptake in the use of GIS in their curriculum. Gender, location, ethnicity and socio-economic status should not impede students having access to the use of GIS.
Fellowship learning regarding this goal: In the US it seemed to be mainly boys using the technology and the issue of state versus private schools was not seen as an issue on uptake at this stage in any of the countries. Because of the disparity of implementation such issues of equity (if researched and evident) have not yet been seen as issues needing to be addressed.

School/Education authorities priority setting
Schools to see GIS of equal status to other technology demanding areas of the curriculum. Students learning in GIS based pedagogies will have access to appropriate computer hardware and software. Such priority setting decision-making would also apply to the purchase of software and investment in training. Schools will also need to re-examine where ICT hardware is located in a school and how the hardware is accessed and used.
Fellowship learning regarding this goal: Generally the schools doing GIS have suitable access to computers and in many cases a dedicated room. However for most schools the battle still existed to get access to computers. In Fairfax County for example all geotechnology classrooms were provided with computers but no such scheme was seen in other places. Such an interventionist strategy by the education authorities to get spatial technology into schools and circumvent the age-old computer room issue would be the ideal.

Tertiary sector
The development of close working relationships with the Tertiary sector. Universities and TAFE to provide expertise and technical support to schools to enhance the awareness of GIS in the school educational bureaucracies and the Tertiary sector.
Fellowship learning regarding this goal: Madison University, Hong Kong University and Brookhaven College in Dallas are closely involved with schools through projects and training opportunities. Generally the tertiary sector are receptive to involvement because of the 'student numbers' motivation factor. However whether they are the people we want to train teachers is another question and not the ideal. As mentors yes but not as the conductors of professional development activities on classroom methodology.

Spatial Learning
The use of GIS in schools is not only about the use of a new technology but rather the use of a technology to enhance the development of high quality spatial learning amongst students. The emphasis is to be more on spatial cognition and understanding than GIS manipulation skills.
Fellowship learning regarding this goal: Whilst most I talked to agreed about this aspect, they could not point me in the way of research or to coherent examples of how spatial technology enhances spatial learning. In many cases because of the teacher feeling uncomfortable with the technology, I saw the technology taught and not the creative spatial decision making we all agree it is all about. Maybe that comes with confidence and awareness of the use of the technology.

Vocational education
The skills and educational applications of GIS in the curriculum to be seen as a realistic vocational option for students. GIS courses to have a "real world" vocational focus, mirroring the types of work and activities GIS is used for in the workforce and in the community generally. To enhance this aspect of GIS education, strong links are to be built with the TAFE sector. Another advantage of GIS in the curriculum is that it provides a meaningful link between the academic disciplines and vocational learning.
Fellowship learning regarding this goal: Other than giving examples of how spatial technology is used in the world, I saw limited formalising of the links between industry and curriculum as evidenced by the VET programme. The closest to this was the work of Brookhaven College in vocational training.

NEXT STEPS AND DISSEMINATION

Areas that need to be investigated for the future as a result of the findings of the Fellowship:

- ➢ **Training opportunities for teachers**: Use some of the training materials from Virginia to enhance our present training for teachers. Try to incorporate a teacher mentor scheme as demonstrated by the Computers in education team in the UK.
- ➢ **Software and data access**: Begin work on the delivery of data to schools via a webserver such as evidenced in the US with ESRI and in the UK with the Ordnance Survey. Meet with ESRI Australia and the Australian Bureau of Statistics to discuss this facility in Australia.
- ➢ **Development of relevant classroom activities and resources**: Develop teaching material using the Digital Worlds programme. This programme is much more achievable for Australian teachers as a programme and could be the answer to cross the implementation chasm.
- ➢ **System support for the implementation of GIS in schools**: Approach education authorities in each state in cahoots with ESRI Australia to see if a state site license like Fairfax County could be negotiated for all schools.
- ➢ **Links between Spatial Industry, Universities, TAFE and schools**: Continue work with the Spatial Science Institute to bring the Spatial Industry into schools.
- ➢ **The across the curriculum use of GIS in schools and even Primary schools in the future**: Use some of the US Earth Science resources to get Science teachers in particular interested in spatial technology. Run workshops at Science teacher's conferences on spatial technology in the field of Science.
- ➢ **The development of support networks with teachers supporting teachers with the implementation of GIS:** Try to incorporate a teacher mentor scheme as demonstrated by the Computers in education team in the UK.
- ➢ **Initiate some research in Australia** via the Universities on the nature of spatial literacy and how spatial technology enhances spatial literacy. Meet with Neil Coffee and David Bruce at the University of Adelaide and University of South Australia to discuss future research project sat the Universities.
- ➢ **Conduct workshops at all the geography and Science conferences in Australia in 2008** on my findings from the Fellowship.
- ➢ **Share the resources via the developed spatialworlds blog** (http://ww.spatialworlds.blogspot.com) Add to the blog now that the trip is finished and continue to update resources from the networks established during the Fellowship.
- ➢ **Keep in contact with the key educational players in spatial education** I have met on the trip. In particular, Mr Wong in Hong Kong, George Dailey in Texas, Bob Kolvoord in Virginia, Mark Lowry in Toronto and David Raynor and Angela Baker in the UK. Invite all these people to the Australian Geography Conference in 2008 and try to get partial funding of their attendance by AGTA.