GIS IN YEARS 7 – 13 SOCIAL SCIENCES EDUCATION: A NEW ZEALAND PERSPECTIVE

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Abstract:
GIS is slowly gaining ground as a teaching tool in Geography, History and Social Studies in New Zealand schools. This paper presents examples of current applications, factors that are encouraging teachers to use GIS and factors acting as barriers to its use. GIS in school geography is examined and the experiences of one school are described.

Setting the scene

New Zealand has a population of 4 million, 86% of whom live in urban areas (Statistics New Zealand 2004). Our school education system starts at age 5 with Year 1 and ends with Year 13. Primary schools cater for Years 1 – 6, intermediates for years 7 – 8 and secondary (high schools/colleges) teach years 9 – 13. Some schools are composites offering two or all three levels of schooling.

In 2003 there were 469 secondary and composite schools offering secondary education (Ministry of Education 2004).

One way in which schools are described is by their decile rating. A number between 1(low) and 10 (high), it is derived from aggregating census information for several socio-economic indicators. A rating of 10 indicates a school serving a relatively affluent community.

GIS in New Zealand schools appears to be used almost exclusively by Social Sciences teachers (Olsen GIS users 2004). This presentation looks mainly at Geography, one of the four subjects comprising this subject grouping; Economics, History and Social Studies are the others.

Geography is a subject offered at Years 11 – 13. However in almost all schools it is an option subject; a chosen rather than compulsory subject.

New Zealand has a national Geography syllabus. Although the syllabus prescribes what topics must be covered, the case studies and examples used are chosen by individual schools.

A new national system of standards based assessment (commonly called NCEA) introduced in 2002 is having an impact on the teaching of the syllabus. Students no longer have to be assessed on all topics. One consequence is that schools are choosing not to offer some topics.

ESRI and Mapinfo are the GIS products known to be used in New Zealand schools. ESRI GIS products were first formally promoted to schools in 1994. It is not known when MapInfo was first offered to schools although it was available to schools by 1998.

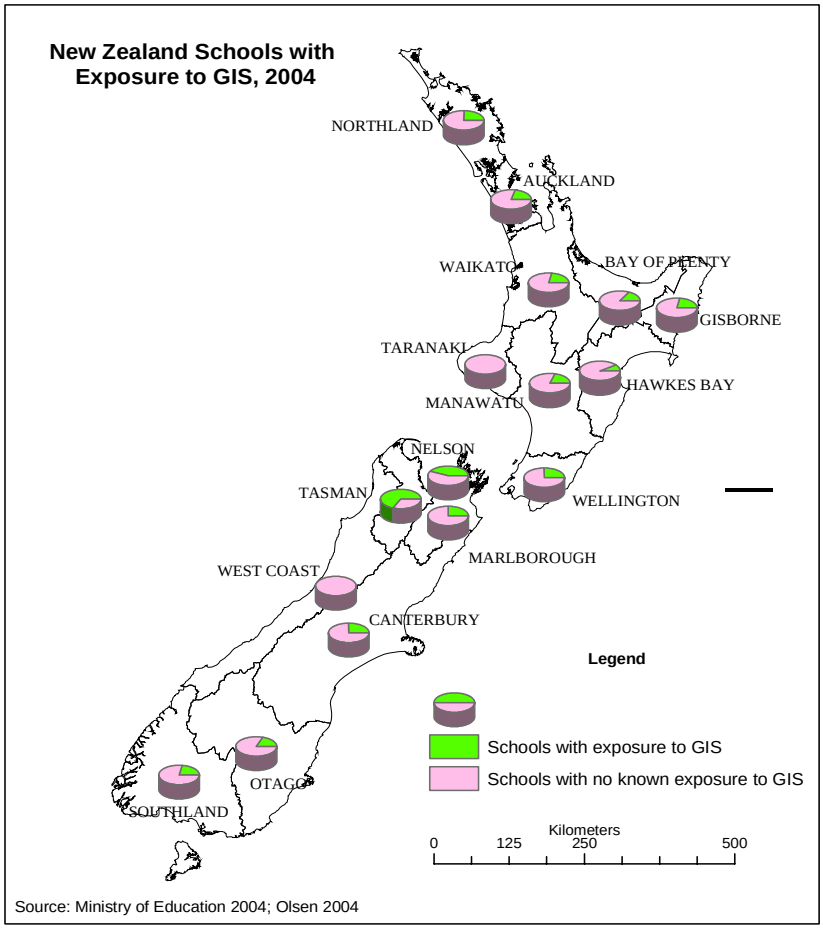
While aware of Baker and Bednarz's (2003) call for data gathered as a result of rigorous research to be the basis on which the efficacy of GIS as an educational tool is evaluated, this presentation is a personal perspective. As in the United States, there has been little research in New Zealand into its efficacy.

Who's doing what, where?

Where?

Fig. 1 shows the present regional distribution of schools who are using GIS and/or have had contact with GISMAPED, a training provider of GIS for schools run by teachers Anne Olsen and Stephanie Eddy. Numbers range from 23 schools in the Auckland region to 0 in Taranaki and the West Coast. (Olsen GIS users 2004).

Fig. 1



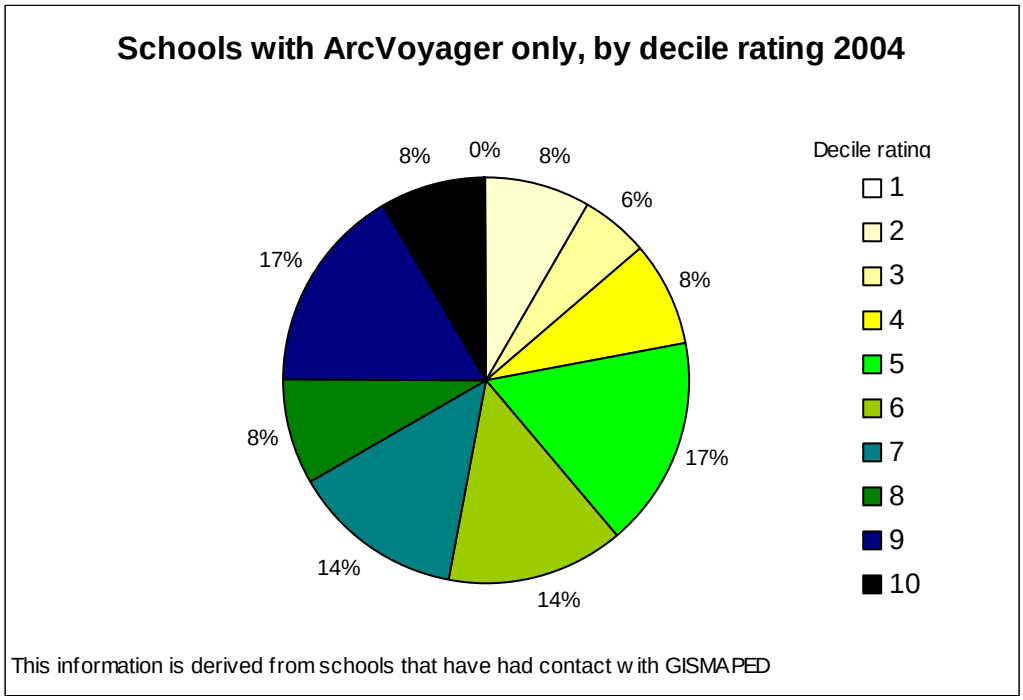
Accurately gauging the number of schools actually using GIS is hard. While the number of schools who have been sponsored or who have purchased GIS software is known, the number who have free versions of ArcVoyager is unknown. Likewise how many schools who have ArcView and or ArcVoyager and are using it is not known. A guesstimate for 2003 ranges between 18% and 32% of all secondary and composite schools, an increase from 6% in 1997 (Olsen GIS users 2004).

School contact with GIS is concentrated in urban areas but it is occurring throughout the country.

Secondary/composite schools are the main users at present but some primary and intermediate schools possess software.

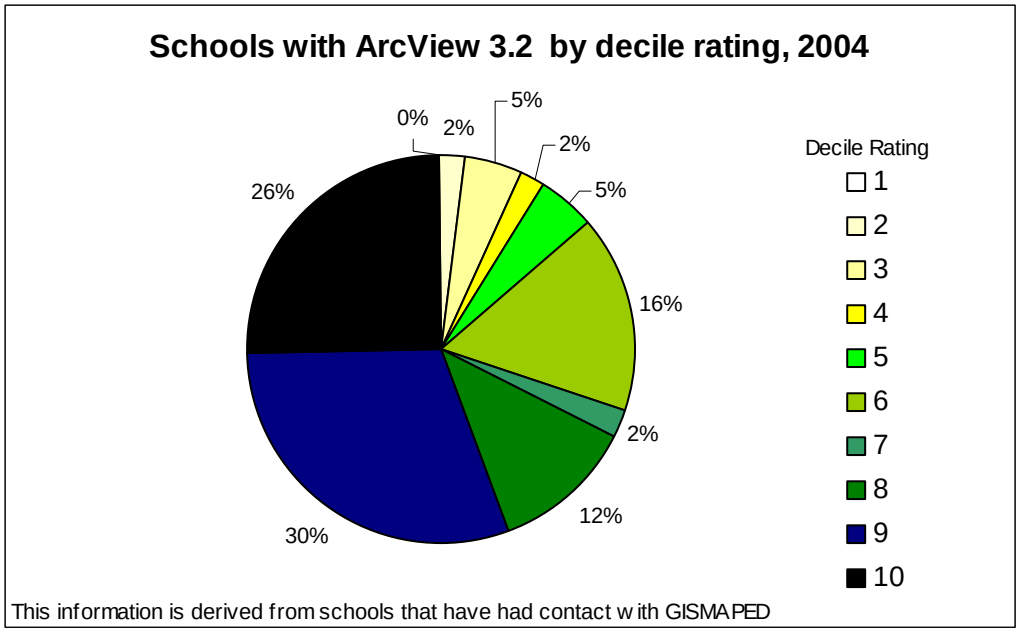
Figs. 2 and 3 show schools that are known to have ArcVoyager or ArcView 3.2, by decile rating. It is not surprising because it is free, that ArcVoyager is more widely spread across different decile ratings.

Fig. 2



However the situation with ArcView 3.2 is interesting. Sponsorship is available to acquire this package, so there is no cost to schools. For several years the Ministry of Education has provided extra funding for low decile schools and most schools have computer rooms. Therefore why is its acquisition restricted to mainly higher decile schools?

Fig. 3



Who?

Anecdotal evidence suggests that GIS is only being used by Social Science teachers. All the attendees at GISMAPED courses have been Social Science teachers. While there may be teachers from other subject areas using GIS, they are not making their presence known.

At the various training courses and GIS support groups that I have attended over the last six years, more experienced, older, teachers have predominated. There is no obvious gender bias.

What?

Most teachers are teaching with GIS rather than about GIS; it is very much viewed as a tool with which to teach Geography and Social Studies.

Activities being offered in class include:

- teachers demonstrating the use of GIS using data projectors. This is due to lack of computer room access.
- using ArcVoyager to learn about physical and cultural features of China, Japan and Korea (Yr 9 Studies Social)
- investigating the pattern of voting in a general election (Yr10 Social Studies)
- using the Auckland Regional Council's IMS facility to learn about the growth of Auckland's urban area (Yr 12 Geography)
- a tutorial about the geography of New Zealand (Social Studies/Geography)

- using the ARC's IMS to learn about the likely impact of another volcanic eruption in Auckland (Yr 11 geography)
- The global pattern of MacDonalds and how it relates to global inequalities
- How accessibility affects the location of businesses (Yr 12 Geography)
- Characteristics of Monsoon Asia's population (Yr 11 Geography)
- Viability of trains as a means of public transport (Yr 12 Geography)
- Creating an island as a means of applying knowledge of basic physical and cultural geography (Social Studies)
- Where do students eat their lunch? (Geography)

A range of GIS techniques are used in these studies. Many take students through the introductory stages of using ArcView 3.2. Others use more sophisticated techniques. The study about where students eat their lunch requires collection of data using a GPS, digitising from an aerial photograph and creating a 3D image (Kerski, Olsen and Eddy 2003). The experience of the teacher in using GIS is a key factor in the techniques being used.

Activities outside the classroom include:

- Small groups of students working in a "club" to produce entries for the annual AURISA Schools GIS competition eg predicting the fire hazard in gorse on a local hillside
- Schools being invited to attend GIS Day activities by local organisations that use GIS

These have provided the incentive for several schools to begin using GIS, providing free software and data and an opportunity for teachers to make contacts with industry users.

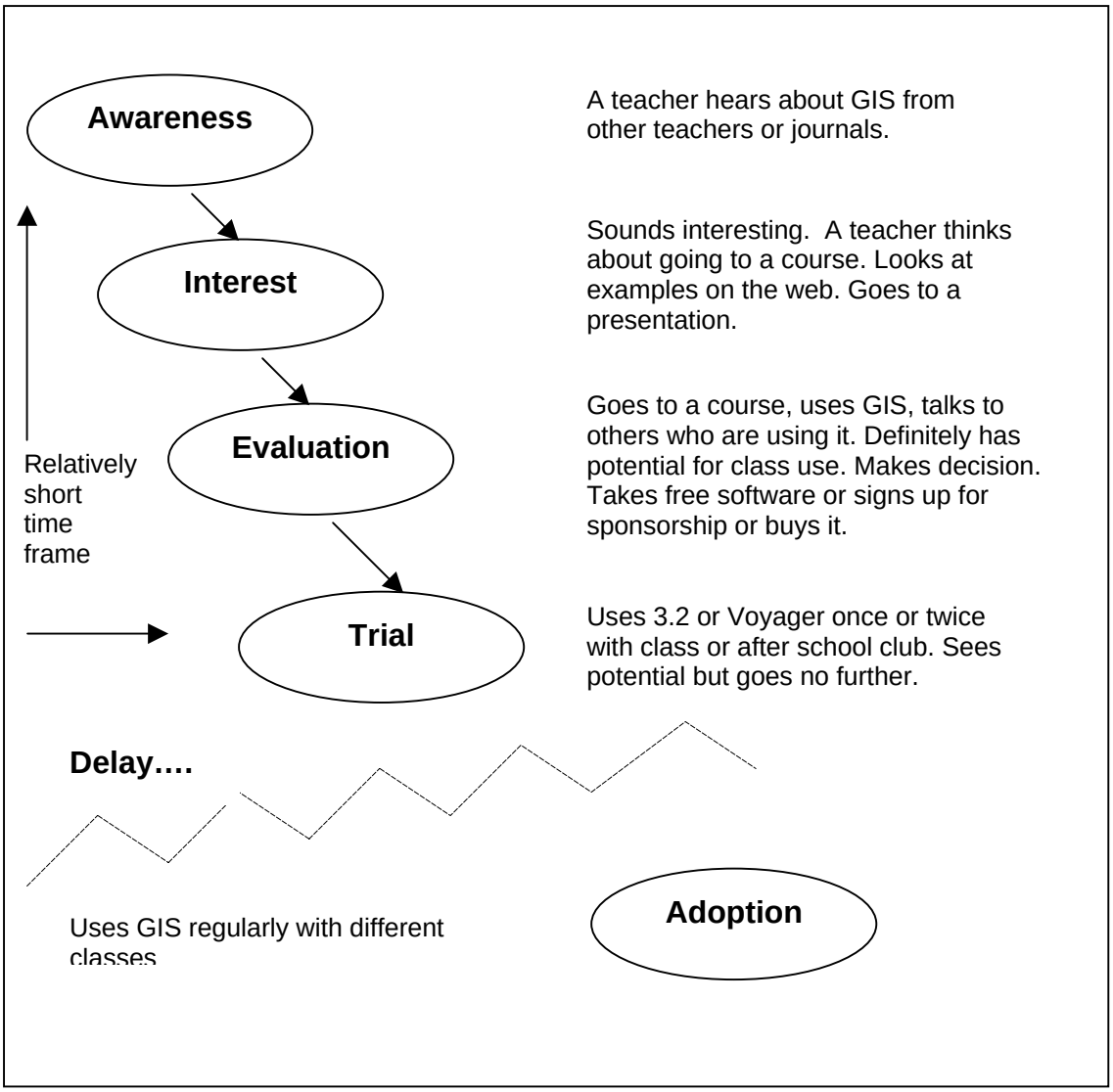
Obstacles and opportunities

Obstacles

ESRI GIS products were first offered to schools in 1994 at presentations that outlined some of their capabilities and uses. I, like many other teachers, thought it was something that my school just had to have – particularly since it was free. All I had to do was to write my name on a list. The packages duly arrived…. and sat on a shelf for some time.

Several years later the advent of ArcView 3.2 and ArcVoyager resulted in a similar situation for myself and other teachers. Fig. 4 shows an adapted version of a model used in Marketing that sums up the experience.

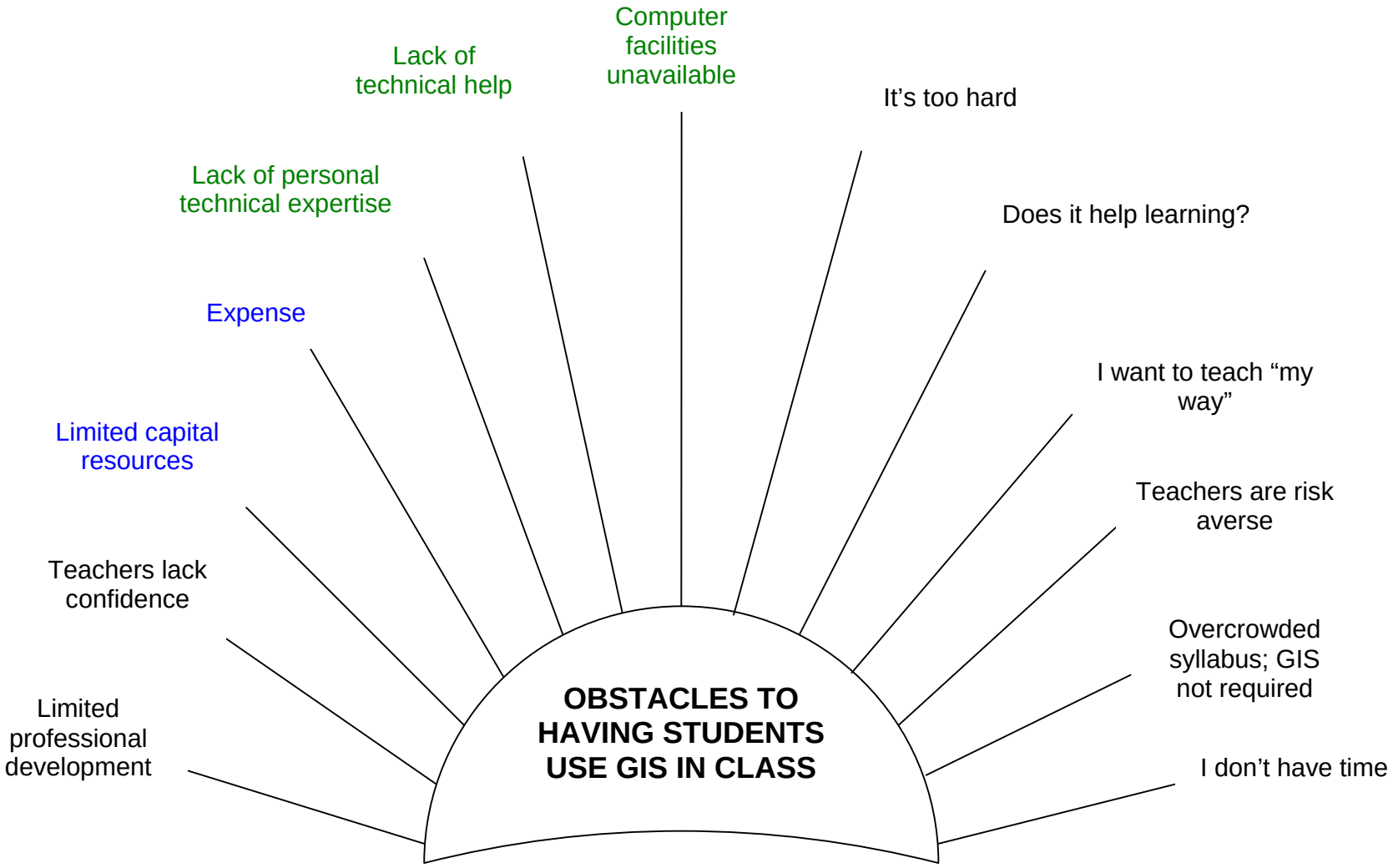
Fig. 4: The adoption of GIS: a new teaching and learning tool
(Source: adapted from Walters 1997 p156)



GIS was/is not necessarily rejected, but a number of factors intervened that prevented teachers from realizing their earlier enthusiasm.

New Zealand teachers interested in using GIS have similar reasons for wanting to teach about and use it to those already documented by ESRI (1995), Kerski (2003) and McInerney (2002), but why have relatively few schools and teachers actually got to the “adoption” stage? Fig. 5 Outlines some of the major obstacles to its use in New Zealand schools.

Figure 5. Obstacles to students using GIS in the classroom



When weighing up the factors involved in introducing GIS, the key question in my experience is “will it be worth the time?”. Time is a scarce resource:

- time for teachers to learn to use GIS. Most teachers want to do a good job; we do not want to be seen to fail. Without time to learn to use GIS and as a result, a lack of self confidence, it may be better not to take the risk.
- time to write/prepare lessons with GIS content
- time in the unit of work where something can be removed and GIS used instead
- time available in the computer room

GIS is not something that must be done and faced with several questions about its usefulness and ease of use, it is not used.

Opportunities

Rather than dwell on the obstacles, which are similar to those faced in other countries, I would like to look at the opportunities that are encouraging interest in and the use of GIS in New Zealand schools. Although the number of schools using GIS is still small, the percentage growth in the number of schools exposed to GIS has been at least 200% in the last 6 years (6% to 18% - a conservative approach).

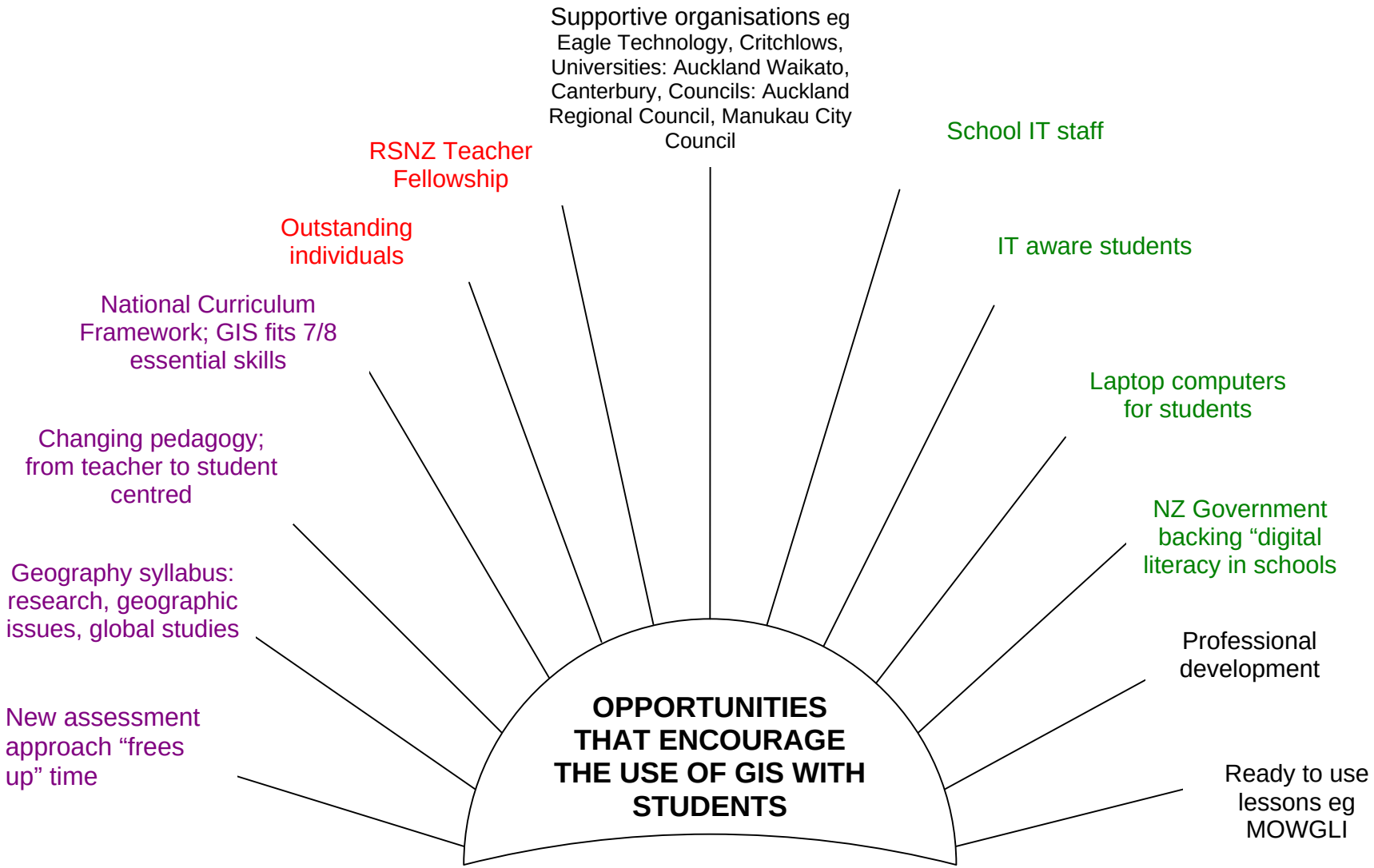
Fig. 6 outlines some of the main opportunities that should encourage the use of GIS as a teaching and learning tool.

The two opportunities that have the potential to have the most effect on the use of GIS in schools are the “outstanding individuals” and the change in our national school assessment system. These two elements are more significant than others because they have an impact over a wider area and have a more immediate effect.

There are several “outstanding individuals” who are playing a key role, and the distribution of GIS users reflects their influence. If a key person has been omitted from what follows, it is my omission and I apologise.

Although Auckland is the largest urban centre and has the greatest number of schools, it does not follow that it will necessarily have the greatest number of schools using GIS. The support of Tony Batistich at the Auckland Regional Council who has provided workshops, tuition and data for interested schools has provided much of the impetus for interest in and use of GIS in the Auckland region.

Figure 6. Opportunities that encourage the use of GIS with students



In the Waikato region, Lex Chalmers at The University of Waikato and Kim Green have also run workshops for teachers and made themselves available to help with queries. Steve Critchlow (Critchlow Associates) and Andrew Smith (formerly with the Wellington Regional Council) have been key supporters in Wellington while John Thyne at Canterbury University has similarly been supporting schools in Canterbury.

Reinforcing and adding to the work of these individuals has been Wellington based Anne Olsen who with Stephanie Eddy (Auckland), both full time teachers, now runs training courses in several of the main urban centres. Their generous provision of data and ready to use New Zealand oriented lessons further add to the opportunity to use GIS.

These individuals inform other teachers about resources available. Being able to talk to these enthusiastic and knowledgeable people and gain immediate help, provides encouragement to others to use GIS. The GIS in Schools web site http://egis.eagle.co.nz/schools/index.htm is an extension of this.

The work of these people is supported and underpinned by the provision of data and software from commercial and non-commercial organisations. In particular, Critchlow Associates (MapInfo) and Eagle Technology (ESRI) have provided software, technical support and considerable amounts of data to the participants in the “GIS in Schools Programme”.

Another, smaller scale example of personal contact that is assisting in the increasing use of GIS, are the teachers fortunate enough to be awarded a New Zealand Science, Mathematics and Technology Teacher Fellowship.

This is a scheme, administered by the Royal Society of New Zealand that enables teachers to spend up to a year (on leave with full pay from their school) investigating an area of interest. Between 2001 – 2004 there have been six Geography teachers awarded Fellowships to learn about GIS. Each person has taken a different approach. For example work experience with an organisation using GIS; research into GIS resources and how to use it while hosted by a tertiary organisation; industry visits to see different applications of GIS, result in more experience in, and understanding of, how to use GIS (techniques) and how it is being applied to solve problems, provide services and products.

These teachers are helping others learn how to use GIS and sharing their experiences and resources.

The second major opportunity is the new national school assessment system. Previously Geography students could gain 34% of their marks from internally assessed work; the remaining 66% from an external end of year examination. There was pressure to cover the syllabus for the end of year examination.

The implementation of standards based assessment with 24 credits for a full course in Geography, has 13 credits for externally assessed achievement standards and 11 for internally assessed standards.

Students taking a full year's programme in each subject, will have a heavy workload and far more credits than the 80 needed to gain a certificate at each level. Therefore schools no longer have to cover the entire course, which partly addresses the issue of lack of time as an obstacle to using GIS. A number of schools are opting to offer all of the internal achievement standards but not offer one or two of the external standards.

At each of the three levels of Geography the internally assessed achievement standards require students to carry out geographic research, examine a geographic issue and analyse a global study. Assessment can take a variety of forms. These standards are ideally suited to using GIS as a tool to enhance learning. This is particularly the case for conducting research and examining a geographic issue since they lend themselves to students collecting their own data out in the field.

The internally assessed achievement standards assess the geography of the topic but there is also a unit standard available that assesses knowledge of the GIS. This could be used with the same unit of work.

With a greater number of credits available for internally assessed work and possibly more time, there is the opportunity to use GIS and see students gain a reward for their efforts.

GIS at Diocesan School for Girls

Diocesan School for Girls was not using GIS when I was appointed as Head of the Humanities Department in 1998. I had been aware of and interested in the potential of GIS as a teaching tool for several years.

The availability of technical help from a full time dedicated IT help team and free MapInfo software made it possible for us to jump into GIS in 1998, entering the AURISA GIS in Schools Competition. A group of six students worked after school to produce an entry that investigated how a sample of students who could and another who could not drive, travelled to and from school and the reasons behind this.

In 1999 we bought ESRI ArcView 3.2 and in 2000 used it with Year 12 Geography students to look at local land use patterns.

In 2000 a group of four students entered the AURISA competition plotting the patterns of burglaries in part of Auckland to see if there were more during school holidays and in areas with lower median incomes.

2001 saw an attempt at a Social Studies class creating their own historic trail around the neighbourhood but problems saving their work saw this abandoned as time ran out. Year 12 Geography students worked at mapping

socio-economic indicators of the USA and used GIS to see if Auckland's urban growth could be controlled.

At that point we had reached the "trial" phase of the model in Fig.4. The last two years we have been in the GIS wilderness due to lack of time as we implemented NCEA. This year we have begun to use ArcVoyager and modules from "Mapping our World" but are still not in the "adoption" phase of the model.

I have a Teacher Fellowship for 2004. Part of the year has been spent with councils where I have used GIS. Industry visits have enabled me to see other applications and at the University of Auckland I am working on a "Geography of Diocesan School for Girls" to celebrate the School's Centennial. This will result in a set of GIS resources on computer for girls to use and a printed set of resources for display including:

- The location of the homes of the first 25 students at the School and those of the present 1500
- Maps showing the horse drawn and electric tram routes of 1904 and modern rail and motorways
- Census data for the area adjacent to the School
- Vertical aerial photographs of the area from different years to show change eg increasing subdivision and impermeable surfaces

The intention is for these to provide the base for a range of GIS activities clearly related to various topics we teach in Social Studies (Years 7 – 10) and Geography.

What have we learnt?

GIS as an example of computer technology must be aligned with our curriculum goals. There is insufficient time to use GIS simply for "fun". GIS is a tool with which to enhance teaching and learning and its use should be driven by the pedagogy of the parent subject.

When implementing GIS "buy in" is needed from all the staff in the department. The purpose of using GIS must be clearly explained and good examples provided of how it can be used. Staff need to see that they can still teach in their particular manner; GIS will be another tool to use. A positive decision to get involved is needed rather than having the use of GIS imposed on an unwilling staff.

Careful preparation is needed to show how GIS fits into a unit of work and the actual steps in using it. Where students are likely to encounter problems needs to be anticipated and prepared for.

Teaching about "global" GIS concepts such as map projections early on, does not work. While it is desirable for students to understand some of the

important concepts behind what they see on screen, at the start it does not interest most of them and they have too little GIS experience to attach it to. It is better to teach specific techniques and concepts as they are needed.

Rapid results for both students and staff create a greater degree of acceptance, interest and enthusiasm.

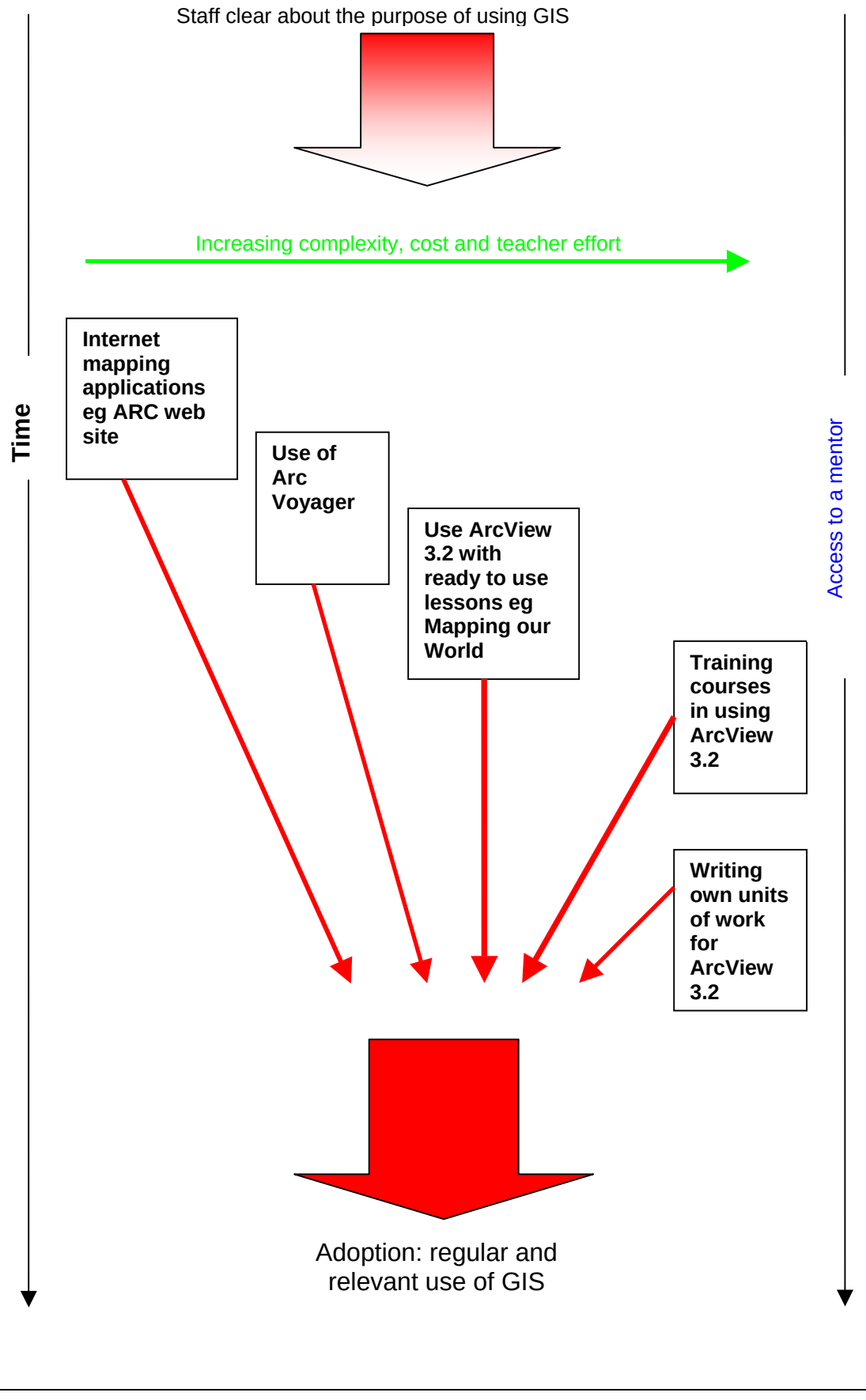
Many New Zealand Geography teachers are unfamiliar with GIS. Teachers already stretched by the demands of their job and unfamiliar with GIS are unlikely to have/find the time to make use of GIS.

Therefore:

- Begin by using existing resources that require little or no cost and relatively little teacher effort but which introduce students to some of the basic functions of a GIS.
- Develop short units of work that produce rapid results, provide students with feedback quickly and are more likely to be able to be booked into the school's computer rooms.
- Implement GIS in small steps.

Fig. 7 suggests an approach for introducing GIS into a department's teaching programme.

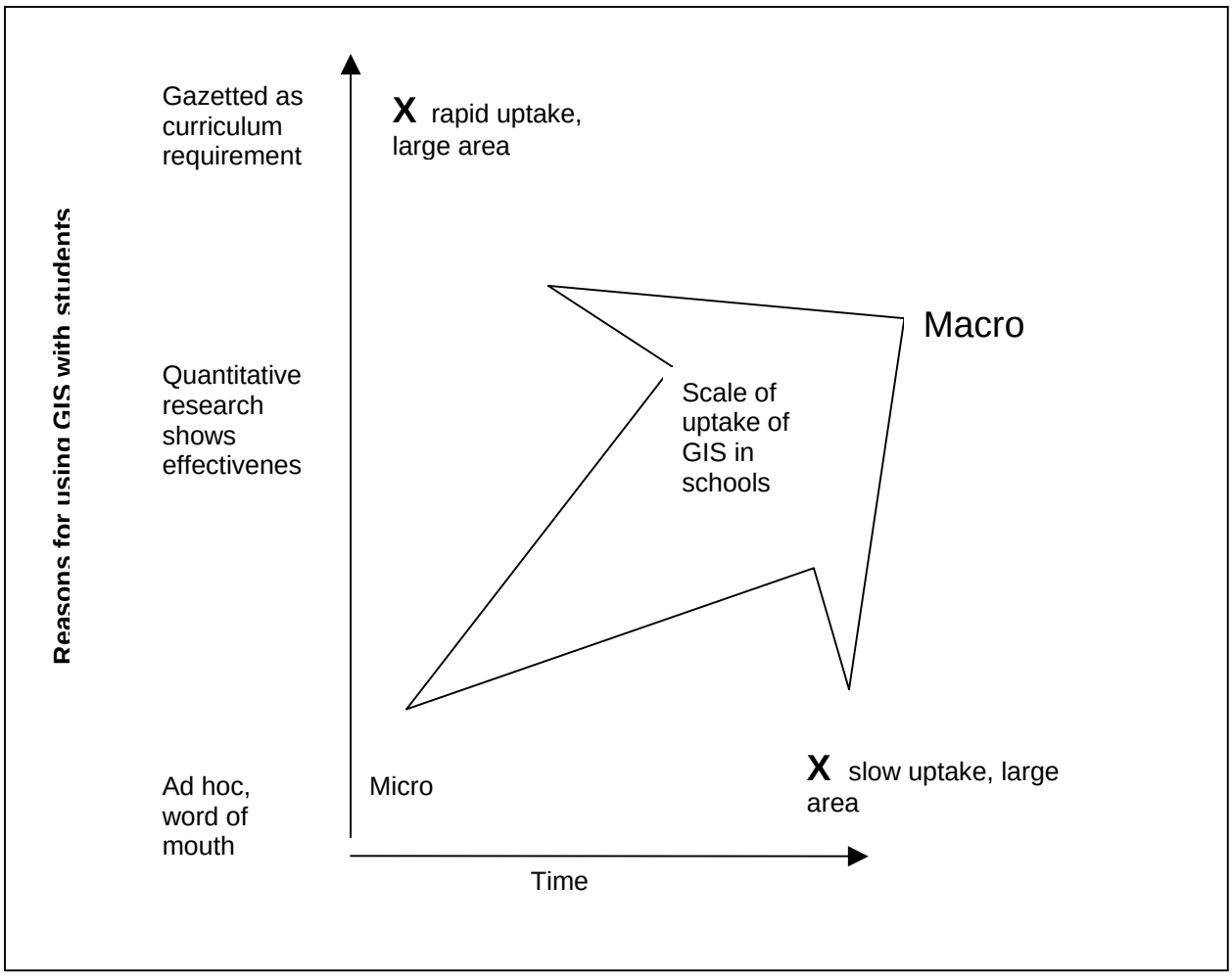
Fig.7 Introducing GIS into a teaching programme



Where to from here?

Baker and Bednarz (2003) suggest that the number of schools using GIS is likely to remain small until research illustrating the effectiveness of GIS as a teaching and learning tool is available. I would suggest that different factors operate at different scales and that in New Zealand the smaller number of teachers and schools means that word of mouth about successful personal experience in using GIS with students is likely to have a more immediate effect than the results of research. In the longer term and at a macro scale, research may well have the greater influence. Fig. 8 suggests how different elements may affect the uptake of GIS at different scales.

Fig.8 The evolution of GIS uptake in schools



The use of GIS as a teaching tool will probably continue to diffuse slowly through New Zealand schools. Hopefully the committed individuals who have given their time and resources will continue to do so and hopefully others will join them. Word of mouth about success with GIS, good resources and good people who will help, will see more teachers make use of GIS.

The issue of lack of time is the key factor to be addressed. Use of internet mapping, ready to use lessons and the possibility to reorganise the year's Geography programme as a result of the new assessment system should also encourage more teachers to use GIS.

As teachers we need to make good use of relevant computer software applications that provide interest and challenge to students to show that Geography is up with the play, "to update parents' and business people's (and thus politicians'?) perceptions of what modern Geography is about so that fewer stay in the capes and bays era." (Macaulay 1994). We need to find ways around the obstacles so that GIS provides an opportunity to do this.

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Appendix: Useful web sites:

The Auckland Regional Council GIS in Schools Team has put together two very good resources for schools, using an internet mapping application:

The volcanoes of Auckland
www.arc.govt.nz/volcanic

Understanding our region: urban settlements
http://maps.arc.govt.nz/website/maps/default.htm

To see the Geography achievement standards and matrix that outlines them go to:
NCEA - Achievement Standards and Matrices
www.minedu.govt.nz/index.cfm?layout=document&documentid=7019&data=l

Statistics New Zealand site has a wealth of information and the ability to build customised tables of data and to show maps of some of this data:

www.stats,govt,nz

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