

1998

How the Internet is Used in a Secondary Mathematics Classroom

Megan B. West
Edith Cowan University

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**HOW THE INTERNET IS USED IN A SECONDARY
MATHEMATICS CLASSROOM**

MEGAN B. WEST, B.ED.

**A thesis submitted for the degree of Bachelor of Education with Honours
at
Edith Cowan University,
Mount Lawley, W.A.**

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ABSTRACT

This project was designed to study how the Internet was used in a secondary mathematics classroom. It looks at a Year 12 Mathematical Modelling class and how the Internet is used by the students and teacher in their mathematics lessons.

The study consisted of observing and interviewing students to determine how they felt about using the Internet in a secondary mathematics classroom and how they used the Internet. Analysis of observations and the audio-taped interviews involved categorizing the students' usage of the Internet, the types of activities the Internet was used for, the length of time spent on the Internet, the organisation of the students with the computers, and how the students interpreted and used the teacher's instructions. Documents were also collected to illustrate the Internet's use in the mathematics classroom.

The research found that the Internet was used for research purposes. It was used to gather information for projects in Modelling with Mathematics. The students also used the Internet to 'surf' when the projects were completed. They would look up information that reflected their interests.

The research also found that there were mixed responses in the attitudes to using the Internet in a secondary mathematics classroom. All students agreed that the Internet would be used more in the future of mathematics education, especially in Modelling with Mathematics (Year 12) and Mathematics in Practice (Year 11). They highlighted

many advantages and disadvantages of using the Internet in the secondary mathematics classroom and agreed that the advantages out-weighed the disadvantages.

The research has found that the Internet has been successfully implemented into a secondary mathematics classroom and provides some ideas of how other teachers can implement the Internet into their classrooms.

DECLARATION

I certify that this thesis does not, to the best of my knowledge and belief:

- (i) incorporate without acknowledgment any material previously submitted for a degree or diploma in any institution of higher education;
- (ii) does not contain any material previously published or written by another person except where due reference is made in the text; or
- (iii) contain any defamatory material.

Signature



Date

12-01-98

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CHAPTER 1: INTRODUCTION

Background

The Internet has been around for 25 years (Ingvarson, 1995a). It is only in the last few years that interest in the 'net' and therefore awareness of it has increased tremendously. "Originally it was restricted to the computer department with only a few e-mail addresses for the University. ... As a result, only a select few in the university made any real use of access" (Ingvarson, 1995a, p. 47). As the availability of technology with computers has increased, a lot of the general population is being exposed to the Internet and the World Wide Web of information.

The Internet is a "global lattice of national, regional and local computer networks" (Carvin, 1997, p. 1), which has rapidly gained popularity within the general population. The first real use of the Internet was for e-mail, for lecturers, students and researchers to speak to each other via computer, but initially "the Internet was incomprehensible to the vast majority of users" (Carvin, 1997, p. 1).

The Internet has become more accessible to the everyday user because of the multimedia capabilities that have been added to the computer. The need to be able to design and show multimedia documents on the Internet required the formulation of a new protocol. In 1989 the World Wide Web was born. The Web allowed people to view video, photographs, and text on the same page. It offered links to other documents on the Internet by clicking on highlighted text on a page. "The Web

interconnects with computers around the world, creating a new dimension to cyberspace, full of images, sound and ideas" (Carvin, 1997, p. 2).

The Web, however, could still be very difficult to navigate and to find information. The Web was designed to organise documents on the Internet, not help find information directly. In 1993, Mosaic, a web browser was released to make the web more accessible to novice and casual users. Other web browsers have since been developed and the two most common, which are used today are Netscape and Internet Explorer. "The World Wide Web, originally envisioned to allow researchers and computer enthusiasts better access to each other's information, has now turned into a powerful force on the Information highway" (Carvin, 1997, p. 2).

Students are gaining access to the Internet at home and many schools are beginning to link up to the Internet thus exposing their students to the latest technology. It is estimated that "children's use of the Web is expected to increase by 1400% to 14.5 million users over the next five years" (Owston, 1997, p. 30). With estimations and predictions of the success and use of the Internet by children, it is to be expected that schools link up.

With the rapid implementation of the Internet into society and the workforce, it becomes necessary that educators begin to show and train students to learn the skills required to succeed in our ever-changing technological world. "The drive to keep pace with technological development and to equip students with a computer literacy

which will enable them to cope in today's world is paramount" (Denison, 1997b, p. 33). The skills that the students are taught in schools of "data handling and retrieval today, will prove to be invaluable tomorrow" (Brunner & Resch, 1997, p. 549).

The impact of the Internet on education is increasing every year. The more that is learnt about the Internet, the more educators believe it will benefit students.

Everyone recognises the value of the Internet and the World Wide Web for teaching and education. Why? It is just so obvious. ... After all, aren't all New South Wales schools in the process of being connected. And you can be sure the rest of the country is not far behind.

(Denison, 1997a, p. 41)

With schools connecting and looking to be connected by the end of the 20th Century, the usage of the Internet needs to be documented. "The debate about access to digital networks has now reached the highest levels of government in Australia" (Ingvarson, 1995d, p. 11). Spender comments that many radio callers believe the Internet is the latest 'fad' and its popularity will decline in a few years and that the Internet "is interfering with their (children's) real education" (Spender, 1997c, p. 4). However, the Internet's potential for use in the classroom is very genuine. It can provide real, up to date data that can be used immediately by students. "The potential of the Internet as an educational tool has helped to focus their efforts and should, in turn, lead to a much richer Internet environment" (Denison, 1997b, p. 33).

1997, it seems, is the year of the Internet. Everywhere we look we are confronted by images of electronic communication: in advertising, sport, government and

especially in schools. ... So much has changed in just the last 12 months that there are now few schools which do NOT have access to the Internet in at least some form—even if that form is a single computer linked to a modem in the school library.

(Arnold, 1997, p. 4)

It is the "availability of the Internet and easier access to information as well as to educational activities that provides educators and learners with new options and choices" (Pitt & Stuckman, 1997, p. 140). For educators there are a wide variety of uses for the Internet including teacher resources, student resources, e-mail and web sites with information about almost any topic.

The Internet can allow for 'hands-on' interactive learning to take place. The Internet should "not be passively co-opted by the system as with past technologies but it should be used to help transform the process of education into a collaborative exploration" (Denison, 1997a, p. 42). The use of the Internet in education and the possibilities that it brings are "far richer than those of reading someone else's static research. It can lead to collaborative projects that educators could previously only dream of and provide a rich and exciting environment for students in our schools" (Denison, 1997b, p. 25).

There are several difficulties that need to be taken into consideration when schools become online. The implementation into schools is an expensive and therefore slow process. It will take time before all schools have adequate access for their students, but it is through the school that many students will gain access to the Internet, as they may be unable to afford the modem and computer through their homes.

A need clearly arises for research to be completed on how the Internet is used in education and how its use could change the way in which students learn. Many articles and books have been written about the Internet and how it could be used if schools have access, but very few articles can be found about research conducted on, how the Internet *is* being used. "Clearly, the opportunities for education are being explored by numerous groups across the country. How pervasive is it? It is not possible to say" (Denison, 1997a, p. 44) although many researchers are beginning to see the need to find out.

The aim of this project is to determine how the Internet is used in a secondary mathematics classroom. This project will examine in what ways the Internet is used and how often it is used. It will also examine the students' and teacher's attitudes toward using the Internet in mathematics.

The research undertaken consisted of two parts: observing the students' and teacher's use of the Internet in a secondary mathematics classroom, and interviewing the students and teacher who used the Internet in mathematics.

The following chapter describes in more detail the current literature on aspects of the research.

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

In this chapter, the literature concerned with the Internet and its introduction and development is examined. In particular literature related to the Internet and education and mathematics education is considered.

2.2 Definition of Terms

The Internet or 'Net' is "made up of thousands of digital networks joined together by a common set of protocols and tools to form the world's largest network" (Burchill, 1996, p. 4). It is a global interface where people from all around the world, seem to be next door, where they can appear on the screen for a chat.

The World Wide Web, 'Web' or WWW is "a unique way of linking text, images, sound and video resources on computers connected to the Internet" (Owston, 1997). "Typically, Web information on a computer screen appears as 'pages' of formatted text with picture and graphics. By clicking with the mouse on highlighted text or an icon, the user seamlessly links to another page" (Owston, 1997, p. 33).

An address is the information required to send mail or transfer files to another person or computer. Each Internet address is unique. It refers to the electronic address. An example of an email address is: bqhyxs@echidna.stu.cowan.edu.au

A bookmark is a marker that you can keep in your own personal collection using WWW so that you can automatically connect to the resource at a later time.

E-mail or email is electronic mail, which involves messages that are transmitted electronically.

The *home page* is the first page you encounter when you access a WWW site.

Http refers to Hypertext Transport Protocol, that is the protocol which is used by the Web to move data from place to place (Hahn & Stout, 1994).

Hypertext is highlighted text that when selected by clicking on it has the capability to link a word or phrase in one document to another related document on the WWW.

The *modem* is the device that allows a computer to transmit information over a phone line.

A *network* is a group of computers connected together.

A '*Net Nanny*' is a device that filters censored information so that students cannot access it.

A *search engine* is software that allows you to search for resources on the Internet.

Surfing is a slang word for leisurely browsing the Internet.

The *URL or Uniform Resource Locator* is an address for a site on the Internet expressed in a standard format.

2.3 The Internet

In the world of the 21st Century the sole use of pen and paper no longer exists as we need to come to terms with the present thrust of technology, especially the use of the Internet.

Today the Internet is part of our everyday lives. ... Yet it didn't appear instantly in a single bold product launch and its

development is far from over. Like the networks that comprise it, the Internet has gradually evolved over many years and will continue to do so in the future.

(Kent, 1995, p. 76)

The Internet's development began years before it was actually born. During 1960 - 1967, "electronic computing becomes well established with routine production of solid-state digital computers. The price and capabilities of the machines make them useful tools for government bodies, academic institutions, companies and research bodies. Early experiments in computer networking take place" (Kent, 1995, p. 76). The initial experiments that occurred throughout this period, became the founders of the world's most vast communication tool, the Internet.

ARPAnet was its original name, and it came from the Advanced Research Projects Agency, a research body funded by the US military. In 1973, ARPA became DARPA, the Defence Advanced Research Projects Agency and it began to investigate the idea of linking local computer networks together to form larger international networks.

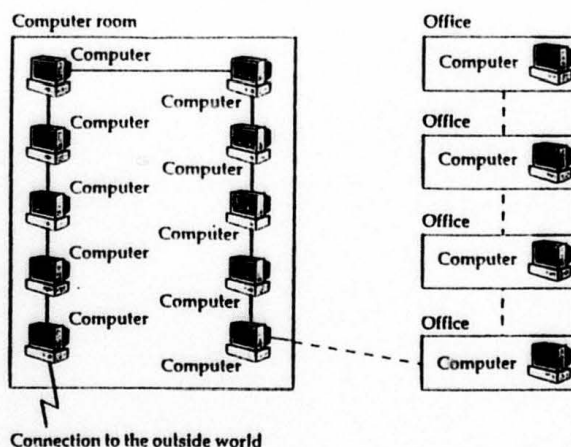


FIGURE 2.2.1: A Local Area Network (Hahn & Stout, 1994, p. 11).

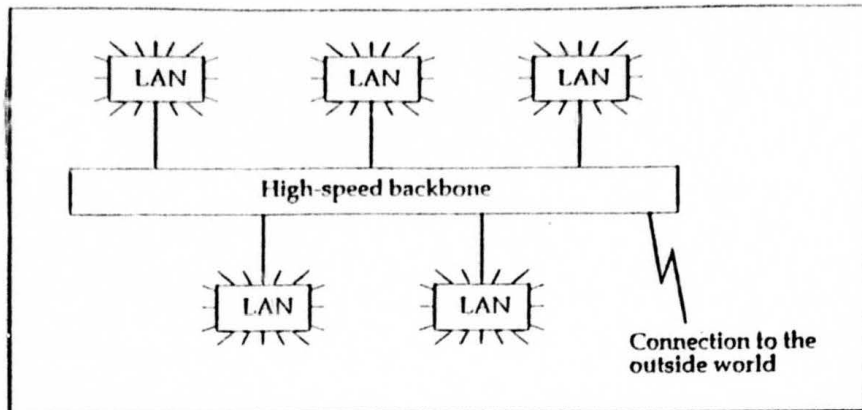


FIGURE 2.2.2 A Wide Area Network (Hahn & Stout, 1994, p. 12)

"ARPAnet itself receives its first international connection, one to England, another to Norway" (Kent, 1995, p. 77). The developments continue when in 1983 "the Internet is now a recognised network system in its own right. In Europe, EUnet (European Unix network) is created and offers e-mail and Usenet" (Kent, 1995, p. 77). In 1983 the first server is used. The users could now connect without needing to know the path to the other systems, the server provided all the information.

The World Wide Web was introduced in 1989 to help organise information on the Internet into an orderly fashion, but it became something more. The WWW "allows Internet publishers to intertwine information in multiple directions and layers" (Carvin, 1997, p. 2). Millions of Web pages could be linked to one another by clicking on highlighted text. The Web also allows for all multimedia to be displayed or heard. Web pages can include graphics, video and sound. The ease at which information can be attained is phenomenal.

This is perhaps one of the main attractions of the Internet, anyone and everyone can use it. Through the 90s it has been pushed into the spotlight and labelled the Information Superhighway. "The Superhighway ... is a concept: the ability to turn on your computer and freely access information through thousands of public access databases from Moscow to New York, from Berlin to Darwin" (Burchill, 1996, p. 4).

It is the continual evolution of the Internet that will allow all people, of all ages and vocations to explore or 'surf' the Internet. "The Internet provides you with unlimited opportunities to locate information and correspond with people whose interests are similar to your own" (Burgstohler, 1997, p. xiii). It also provides information that is vast and up to date. "Members of almost any occupation can be found using a connection" (Jones, 1995b, p. 28) to the Internet. Events, as they happen, appear on the Internet for all to read and see.

The Internet, to most people, is the Information Superhighway, "which has been in existence for several decades and is now receiving an enormous amount of media coverage" (Buckby, 1996, p. 14). The hype and interest surrounding the Internet has developed due to the belief that the Internet "has something for everyone" (Buckby, 1996, p. 14) and is easily accessed by people with little computer knowledge. The most popular and frequently used parts of the Internet are the World Wide Web (WWW) and electronic mail (e-mail). The WWW displays friendly interfaces, which are linked by hypertext, allowing the user to visit many web sites. These sites

include the news, sports, music, videos, education, and games and the not-so-worthwhile sites of drugs, crime and pornography.

There has been an enormous increase in interest in the Internet, from when the Internet was "truly born ... and is fully operational" (Kent, 1995, p. 76) in 1970 to 1995 where the "Internet encompasses more than 2 million computers ... used by up to 40 million people" (Burchill, 1996, p. 4). Many people have access to the Internet at home and it seems only natural that schools begin to gain access or the situation may arise where students will be left behind. It is at this time in our education development that educators must question whether the Internet has "a role to play in schools, and how can teachers find out whether it would be of use to them?" (Buckby, 1996, p. 14).

2.4 The Internet and Education

The potential capacity to use the Internet in education and our schools is enormous. This capacity it seems has not yet been fully realised by educators. They agree that the Internet is important and will play a part in the future of the education of our students, but not specifically how large a role it will play. "Five major reports have indicated that network technologies will be very important to Australia's future education" (Ingvarson, 1995d, p. 11).

**Of all the recent developments in advanced computer networking,
it is the World Wide Web that has truly captured the imaginations**

of millions of technophiles and information buffs. Since its popularization in 1993, WWW ... has caught on like wildfire in business, research and academia, and many users now tout it as the first real step to the creation of an 'information superhighway'. But for all of its profit making and curiosity seeking potential, WWW has largely been ignored as a powerful educational tool. Scattered throughout cyberspace, one can find occasional examples of educators, students and researchers experimenting with WWW as a way to teach and to empower students with newfound creative ability. Yet as a whole, online classrooms are few and far between, with recent reports suggesting that less than three percent of schools have Internet access.

(Open Learning Technology Corporation Limited, 1995, p. 3)

Since this article was written, a lot more involvement with the Internet and education has developed. "The use of the Internet within schools is just being explored and its consequences for curriculum development and teaching are only just being recognised" (Denison, 1997a, p. 44). The Federal government has allowed each State government to determine what their needs are in terms of access to the Internet and education. The Western Australian government believes the Internet has a role to play in the future of our education. It has consequently developed a major initiative dubbed "*Technology 2000 — Internet in the curriculum*", through which all schools are being given the opportunity to connect" (Denison, 1997b, p. 26).

The full impact of the Internet on education has yet to be discovered. We do know, however, that it will and is having an impact on the education of our students. With the whole world available at the touch of a few buttons, some authors argue that it is important that teachers begin to implement its use into the classrooms. They argue that "the use of the Internet is important for building students' skills in computers, communication, collaboration, information organisation, and providing a real

audience for their work" (Ingvarson, 1995a, p. 48) and that the Internet "is expected to have a profound influence on society" (De Diana & White, 1994, p. 93). "Information from the Internet (particularly via the World Wide Web) provides a resource for research, guided learning and a broader point of view" (Ingvarson, 1995c, p. 22). It will provide students in mathematics with "a real world focus and the motivation to try something new" (Ingvarson, 1995b, p. 60).

Connecting classrooms and therefore students to the "Internet is an exciting and innovative method to help our students become active network citizens in a global community by training them to access and explore the World Wide Web and its myraid of resources on the Internet" (Hattler, 1997, p. 231). Students now have the potential to "match their learning path to their own preferred learning style" (Moont, 1996, p. 69). However, a lot of teachers have not changed their methods of teaching to accommodate for these new approaches. "Many of the teachers are daunted by the new technology. Older teachers, in particular, often lack the confidence working with computers" (Hickman, 1997, p. 6). "The extensive investment of resources in computer technology has resulted in only slight changes of instructional practices in the public school" (Bitter & Frederick, 1989). Even though concerted effort has been made over the past decade to shift teaching and learning practices to a more investigative, student-centred approach it still remains largely teacher directed. "One reason teachers are having such trouble in today's classroom is the way that the techno generation makes sense of the world is out of

synch with the medium of instruction in the conventional classroom" (Spender, 1997b, p. 4).

All facets of education are undertaking some sort of program to integrate the Internet into the classroom, even the state governments. The Western Australian government has taken a combination of approaches of integrating the Internet into classrooms. "It has adopted an overall strategy which focuses on issues such as curriculum, responsiveness, flexibility in schooling, staff professionalism, and working relationships, resource management, and assuring quality in education" (Denison, 1997b, p. 26).

The roles of the teachers, students and classrooms are changing and evolving as education moves into the 21st Century. "Information and communication technologies, which were novelties for a while, have become commonplace and their inclusion as major tools for learning have to be incorporated into the culture of education and in professional development programs" (Open Learning Technology Corporation Limited, 1995, p. 1). The most significant change is the role of the teacher from 'centre stage' to the facilitator of knowledge and learning. "In a shift from a teacher-centred to learner-centred environment, the change in the role of the educator will necessitate a change in the role of the learner" (Pitt & Stuckman, 1997, p. 143). The integration of technology shifts the focus to the students, as they become more responsible for their learning. The 'new' style of learning allows for collaboration between students as "the use of computer offers a catalyst to the

introduction of project-based learning" (Open Learning Technology Corporation Limited, 1995, p. 2).

The integration of the Internet into classrooms is not meant to replace teachers and the curriculum, but complement it. The Internet is another tool that students should have access to, to enable them to "keep pace with the changes in information" (Spender, 1997a, p. 4). The Internet can take the emphasis off the teacher to consistently provide interesting and motivating lessons, by allowing the students to interact directly with the computer. "It does not matter how good a talker you are, the computer will be 100 times more interesting" (Lyall, 1997, p. 1). Students are able to link up with other students around the world to work on projects. "The idea of virtual communities of school children from all over the world chatting in real time—with pictures—sounds far more exciting than the dreary days of chalk-and-talk that we were forced to endure" (Bogle, 1997, p. 4). The concept of being able to video conference in the classroom, as well as being able to e-mail people throughout the world for help on all different topics, is spell binding, and the Internet has the capability to do this. It provides action for the students as the "computer and mouse are hands on technologies" (Spender, 1997e, p. 4). The notion of interaction can promote an enjoyable learning environment for our students, where they can become functioning, self-directed learners because "students of all ages learn better when they are actively engaged in a process" (Ingvarson, 1995c, p. 72) of learning.

There are several ways that the Internet can be used in our classrooms, these include:

Teacher Resource Sites

These sites are specifically designed to supply information for teachers. They are "didactic teaching, that is, supplying course contents, posting assignments or other information germane to coursework" (Pitt & Stuckman, 1997, p. 144).

Student Resource Sites

These sites are designed to allow students to interact with the computer interface.

E-mail

Electronic mail. "The real power of the Internet lies in its role as a place where people go to 'talk' to others. Students and teachers can discuss projects with people from all around the world. It can also allow teachers to send one message to the entire class" (Sorg & Truman, 1997, p. 383).

General Web Sites

"The metaphor most people have of the Internet is that of a 'look it up' place: a place where people go to find information. Certainly, it offers a huge resource" (Arnold, 1997, p. 4), for everyone to use. It allows students to find information on almost every topic they could think of.

Oz Projects provides a good place to start. Each year, every Australian school is sent a glossy calender for the year which features a wide variety of Internet-based project activities designed for students from K-12. ... They vary from the popular 'Travel Buddies' project (in which, this year, students send and receive email messages to and from their soft toy 'buddies' aboard the endeavor replica, while it is sailing the around the world) to Project Atmosphere, from CSIRO

Scientists OnLine to the Net Gig, where students create their own music and then have it performed via the Internet to a world wide audience.

(Arnold, 1997, pp.4-5)

"It is important that teachers have a variety of sites they want the students to explore. ... However, teachers must not limit the scope of student research" (Broughton, 1997, p. 1103), to sites that only they have explored. The wide range of Web sites and Internet tools that are available to our students and teachers can provide them with opportunities to "discuss real problems and gather information from other students and experts in relevant areas" (Brehm, 1997, p. 1136). By viewing the "Internet as a global classroom and learning center, teachers and students can begin using these resources to enrich lessons" (Land, 1997, p. 1167). In summary the Internet can be viewed "as a source of

- Lessons and Lesson Plans
- Classroom and Curriculum Activities and Resources
- Content Area Resources
- Online Libraries, Museums, Field Trips, Tutorials and Periodicals
- Assessment and Evaluation Resources
- Teacher Support and Information

(Land, 1997, p. 1167)

The implementation into schools is an expensive and therefore slow process. It will take time before all schools have adequate access for their students. In Western Australia

A total of \$2.5 million has been set aside for project for the period 1996/97 with the money to be transferred to schools as special purpose grants at the beginning of the first term of 1997. Each school has been provided with a grant of \$2 020 to enable them to lease a computer, purchase a modem, install a dedicated telephone line and pay connection fees.

(Denison, 1997b, p. 26)

It is a long and expensive process to develop the resources required to implement the Internet into schools. The cost for the Western Australian government is \$2.5 million, and should this support be continued? If we are to increase the computer to students' ratio, as well as increase how much time each student gets to work on the Net, Denison (1997b) suggests that the government must maintain funding on a continuing basis, (or) the goal of equity of opportunity will be near impossible to achieve. The schools provide the experiences for the students to gain the skills to be lifelong learners with technology. "As the costs of hardware and Internet subscription continue to fall, and the quality of on-line information increases, the Internet could and should become an integral part of your school's resource base" (Buckby, 1996, p. 15).

The Internet, in all its potential and positives, has a very serious issue that needs to be addressed in education when schools link up, that is censorship. With the information on the Internet available for all to access, there is material that we would not want students to see. There is, however, no guaranteed solution because not all unwanted material can be stopped from entering the computer screen before getting to students. It is suggested that the schools therefore become responsible for developing a policy statement on the use of the Internet by their students. This

statement should "demonstrate that those in charge are doing all that can reasonably be expected of them both to prevent access to undesirable material and to prevent undesirable behaviour on the part of the students" (Denison, 1997b, p. 28).

The Internet is such a new and innovative tool in society that apparently little or no research has looked at how teachers use the Internet in their classrooms. Many articles have been written about what teachers could do with the Internet in the classroom, but no systematic research study has been documented. Some research has taken place on the Net where people have been surveyed to indicate what they use the web for. For example:

According to a survey by Internet research group [www.consult](http://www.consult.com.au), which polled 11 000 Australian Netizens last November, the highest primary use of the Internet is entertainment at 21 per cent. The next popular use is e-mail (15 per cent), followed by general research (12 per cent).

(O'Neill, 1997, p. 1)

Many people might say that of all the school subjects, mathematics might be the less effected by the introduction of the Internet, because of its formulae, rules and abstract concepts. They could be mistaken as the Internet in mathematics has the potential to take the topic to new areas, for example fractals. The ability for students to be able to complete complex tasks will increase. Students can have access to a powerful tool, a tool that could enable them to solve almost any problem, that is the Internet.

2.5 The Internet and Mathematics Education

The call for the "use of technology in mathematics classrooms has increased extensively during the past two decades and has been encouraged by the National Council of Teachers of Mathematics" (Wentworth & Monroe, 1996, p. 128). The use of computers can vary in several ways, from information delivery, drill and practice exercises to an environment of problem solving for students (Papert, 1992, 1980). Computers have always had the potential for students to be allowed to work at their own pace and take their own direction. In the past this has been achieved through the creation of a structured environment which allows for choice. There is no structure to the Internet and students can go anywhere.

With the introduction of the Internet it is presumed that it will cause a drastic change in the instructional practices that are presented to students. "The rules have changed with the focus moving from teacher to student and that in a multimedia world the students is no longer the receiver, but the maker of information. Six thousand teachers are being retrained to meet the new demands" (Spender, 1997d, p. 4). The Internet provides the opportunity for students to deal with any numbers they like. "Before calculators we used to teach division with numbers that could divide easily. Then with logarithm tables we used numbers we could find there. Now, with computers" (Lyll, 1997, p. 4) and in particular the Internet, the information available is enormous.

In the Information Age, middle school students must be intelligent consumers of information. To instill critical thinking with respect to statistical data, the interpretation and creation of graphs are essential. Although vast amounts of information can be gleaned from traditional text sources, the World Wide Web (WWW) offers information that is updated far more frequently than most printed materials.

(Dixon & Falba, 1997 p. 299)

The use of the Web allows students to deal with real data, in real time. It exposes students to different situations, where they must learn to examine and interpret information, instead of simply reproducing data. "The questions are open-ended and may lead to further investigations and heated discussions" (Dixon & Falba, 1997, p. 302). Students are able to research topics, by searching the Web through search engines and obtaining results almost immediately, rather than spending hours in the library. "Research for school projects is now only a few keystrokes away, but importantly, it is now fun looking up subjects instead of taking ages going through books" (Sheppard, 1997, p. 7). The view that "this huge wealth of information, lying somewhere just beyond my modem holds all the facts and figures I will ever need and millions more" (Butler, 1997, p. 6) reflects some of the current thinking about the Internet. Mathematical processes and exercises that only a few centuries ago challenged even the brightest scholars, are completed by students everyday (Spender, 1997f).

There appears to be a variety of ways in which teachers can benefit from this technology. One way is to use the Web as a teacher resource where one can access information such as lesson activities. Another way is to access sites that engage students in some form of mathematical activity. Some web sites offer a wide selection of information and activities for teachers and students.

(Herrington & West, 1997, p. 2)

Some examples of mathematics education sites are included below with a brief description of each one, including the web address of each.

Teacher Resources

Australian Association of Mathematics Teachers Inc. (AAMT): <http://www.aamt.edu.au>

It provides mathematics teachers of Australia with information of AAMT activities, products and services.

The Mathematics Association of Western Australia Inc. (MAWA):
<http://www.cowan.edu.au/MAWA/>

This site provides mathematics teachers of Australia, with information of MAWA activities, products and services.

Mathematics Education On the Web. (MEOW):
<http://www.cowan.edu.au/education/meow/meow.html>

"This site provides three main attractions: a place where you can find challenging mathematical activities according to year level; a list of interesting web sites ... ; and a section that highlights teacher resources" (Herrington & West, 1997, p. 3).

Student Resources

Ask DR Math: <http://www.forum.swarthmore.edu/dr.mathematics/tocs/projects.elem.html>

This site is where students (and teachers) can go to ask any mathematical question they can think of. Responses are e-mailed back to the students.

Problem Solving Task Centre: <http://www.srl.rmit.edu.au/mav/PSTC/index.html>

This Australian site has several different menus that the students can choose from, one of which contains the 'Problem of the month'. There are many problem-solving activities that the students can answer in groups or on their own.

MathDen: <http://www.actden.com/>

Allows students to answer mathematics questions online. They are multiple choice questions with four levels of 20 sets of 20 questions. Once the set has been completed students can submit their answers for marking. The students receive instantaneous results. The site also keeps a record of the sets completed and the marks obtained. The site also contains a 'Problem of the Week' where students can submit answers with the opportunity for their answer to be displayed on the Web.

Other Web Sites

These sites provide information that could be used by either teachers or students.

History of Mathematics archive: <http://www-groups.dsc.st-and.ac.uk:80/~history/>

This site contains biographies of more than 1100 mathematicians, which can be accessed in several ways including by birthplace, by topic or alphabetically.

Stockmarket: <http://www.stockmaster.com/>

Provides information about the stockmarket.

NASA: http://www.nasa.gov/NASA_homepage.html

Gives detailed information about NASA.

"The challenge is for schools and Education departments to seize the opportunity and to move beyond perceiving the Internet as an e-mail system, and to realize the potential benefits of better communication, collaboration and coordination of our education system" (Ingvarson, 1997a, p. 49). In order to do this we must investigate how teachers, who do have access to the Internet, are using it in their classrooms. "Educators need clear and concise documentation that permits them to make informed choices regarding the development of on-line activities" (Pitt & Stuckman, 1997, p. 144). It is important that educators "discover and develop how to implement new technologies into the learning environments" (Brunner & Resch, 1997, p. 549) as the Internet's use could benefit students now and in the future.

By researching how the Internet is used in classrooms, the results will enable other teachers to successfully implement the Internet into their classrooms. "It is hoped that it will allow for the development of a wide range of activities and sharing of curriculum materials" (Brunner & Resch, 1997, p. 549). This research will describe the use of the Internet in one classroom and identify the attitudes a teacher and students have towards using it in the classroom. One of the advantages of the research will be the ability to learn from the successes and mistakes that are made by others.

2.6 Research Questions

- 1. How does a teacher and students use the Internet in a secondary mathematics classroom?**

2. What are the teacher's and students' attitudes to using the Internet in a secondary mathematics classroom?

2.7 Conclusion

To summarise the results of the literature, it is clear that the Internet is now part of our everyday existence. The use of the Internet in education is becoming more and more popular due to the vast amount of information that is available at the click of the mouse. "A society that wants to survive needs to give every child the best education that child can handle. We must put Internet access into every classroom" (Jones, 1995a, p. 26).

How it is being used in Education is unclear, as little research has been done in the area, particularly in relation to mathematics. The Internet can allow the students to gain many new skills, as they must learn to navigate effectively through this huge database of information. It is vital that research be conducted to identify the success of different types of usage of the Internet in education and in particular mathematics education and classrooms.

CHAPTER 3: METHODOLOGY

3.1 Introduction

Eleven students from a metropolitan school, who used the Internet in their mathematics classroom, were chosen to participate in the study. The students were from a Year 12 Modelling with Mathematics class who had access to the Internet for every mathematics lesson. The subject requires them to complete research projects, emphasizing the mathematics required to complete them. The teacher of the class has been teaching for 16 years, five years in primary schools and 11 years in high schools. During this time he has taught both computing and mathematics. His knowledge of computers is very extensive as he has been computer coordinator and advisor, and on computing and information technology committees at various schools. The students in the class were currently completing year 12, with most of them not planning to complete the TEE but going on to study at TAFE. There are three main blocks in the school, of which each has access to at least one computer laboratory, consisting of approximately 20 computers.

The students and the teacher in the class used the Internet on a regular basis. These students were observed using the Internet over a period of nine weeks. Toward the end of the observational period students and teacher were interviewed about their use of the Internet and their attitudes towards using the Internet in a mathematics classroom. Any relevant documents were collected to illustrate the use of the

Internet. These three methods of data collection were used to answer the two research questions.

3.2 The design of the study

After obtaining the ethics clearance, a letter was sent to the principal of the school to ask for permission to conduct the research. A second letter was sent home to the parents and students in the class of the study, to enable them to participate in the study. A copy of the letters can be found in Appendices 1 and 2.

The study collected qualitative data and took place over a nine-week period, for six 40-minute periods a week, during the school term three of 1997. Only lessons where the Internet and information from the Internet were used, were observed.

The method that was employed in the design of the study was an observational case study. "These studies often focus on a classroom, group, teacher or pupil often using a variety of observation and interview methods as their major tools" (Burns, 1995, p. 315). The main sources of data collection were through interviews, observations and document collection, as described in section 3.4.

Observations were relied on primarily to gather the data to answer research question one, while the interviews were used to gather data to answer research question one

and research question two. Documents collected throughout the research period were used to gather data to answer research question one.

3.3 The setting

The current mathematics syllabus *Modelling with Mathematics* (1995) focuses on developing students' mathematics skills that they require in every day life. "The role of *Modelling with Mathematics* is to provide students with relevant and rewarding preparation for post school situations in which mathematics is used. ... The course reflects current technological developments by assuming the use of computers in the teaching and learning program" (Secondary Education Authority, 1995, p.45). The group of Year 12 students were given mathematics projects every three weeks, which required them to research a topic and present mathematical solutions to real-life mathematical problems. The students worked in small groups of two or three or by themselves to complete the set tasks.

The students were required to complete mathematical exercises, which would enable them to complete the set projects, with the aid of some research on a topic. The first project that was observed was the Holiday project, figure 3.3.1.

The students received notes and examples of the exercises at the beginning of the three-week period, along with the project. These introductory periods allowed the students to ask the teacher questions about the mathematical concepts they were required to use. Some examples of introductory exercises the students completed at

the beginning of the project were change of currency, and exchange rates. The students were then able to change their Australian dollars to American dollars.

You and two friends are planning a trip to the U.S.A. lasting about 5 weeks and taking you through at least 3 cities. Your finances are limited so you will be sharing expenses with your friends and staying in budget class hotels.

- Prepare
1. a budget for the total cost of the holiday including all possible expenses envisaged e.g. passports, airfares, accommodation, food, etc. Show exchange rate calculations explaining the effects of fluctuations in these, on your costs.
 2. a detailed Itinerary of the cities being visited, attractions to see and any sight seeing tours taken.
 3. an analysis of the three means of finance available to be used on your holiday, (credit card, travellers cheques and cash) explaining the advantages and disadvantages of each.

You plan to use a credit card which has a limit of \$6000 as well as savings of \$3000 for your holiday. Include in your budget (1), estimates for interest charged on the credit card.

Figure 3.3.1. Holiday Project

The class took place in two rooms, the classroom and the computer laboratory. The classroom was located approximately 10-15 metres from the computer laboratory. Students were free to go between the two rooms, making use of the computer facilities, as they needed them. See Figure 3.3.2 for layout of the classrooms.

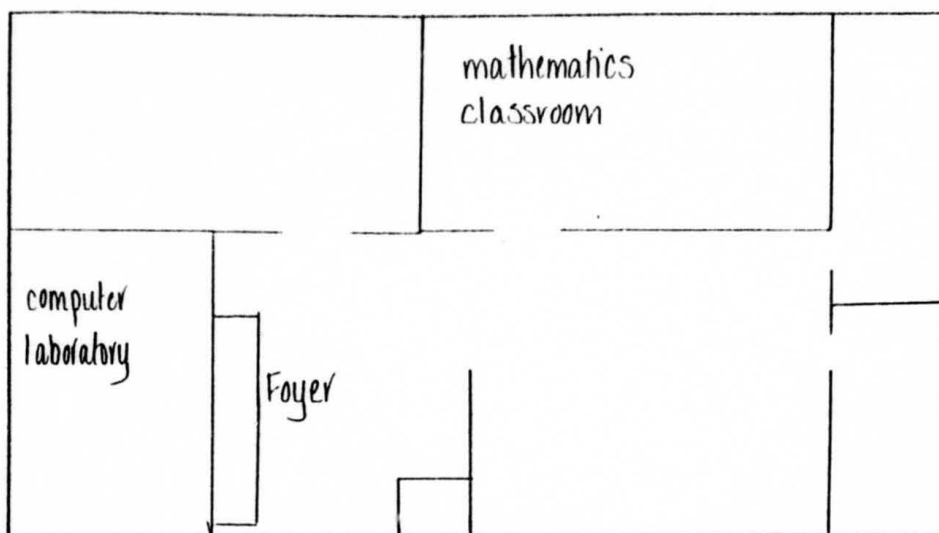


Figure 3.3.2. The layout of the mathematics block and the location of the computer laboratory to the classroom.

The teacher had the ability and facilities to explain something about the Internet and how to use it in both the classroom and the computer laboratory. Each room was located close enough together so that if the teacher need be he could bring the class together to illustrate an idea. He was also able to walk quickly between the two rooms to explain and put notes on each of the boards in the rooms. If the teacher had to explain something in the computer laboratory about the Internet he would then relay this information to the students in the classroom.

The computer laboratory was booked for the six 40-minute periods, which resulted in no-one else being able to book and use the room. The teacher moved freely between the two classes to help students with the Internet and the computers and with the mathematics exercises within the classroom. When the students stayed in the classroom they completed the mathematics exercises as well as organising who

would do what for the project and also reading through the information they had received off the Internet. The students who used the computer laboratory made extensive use of the Internet and also made some use of the word processing package for the presentation of the projects.

The computer laboratory was set up with 17 computers, all linked to the Internet. The students worked individually on the computers, as there was enough for them to have one each. The computers were set up in an 'M' shape, refer to figure 3.3.3, allowing the students to still communicate freely with each other as they searched for information. There were two printers located in the laboratory, in the south-west corner. The students could print the information they required from the Internet as they found it or they could save it and print it out when they needed it. There was a whiteboard located at the front of the laboratory, which was used to give addresses of web sites, and hints or tips for searching the web.

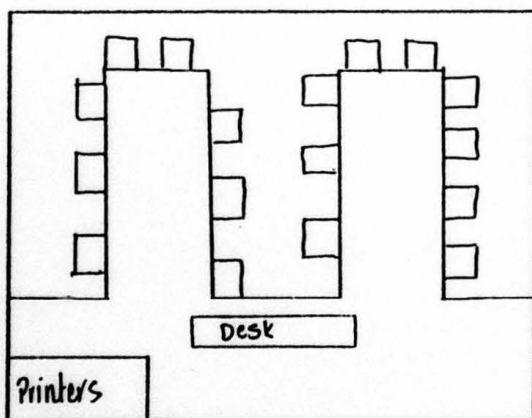


Figure 3.3.3. The layout of the computers in the computer laboratory.

The classroom was set up with four individual rows of six desks and two rows of four desks (refer to figure 3.3.4). The students sat where they wished, usually next to or fairly close to their partner or other members of the group. They were free to move around the room and to sit with their group to allow for discussion of the project.

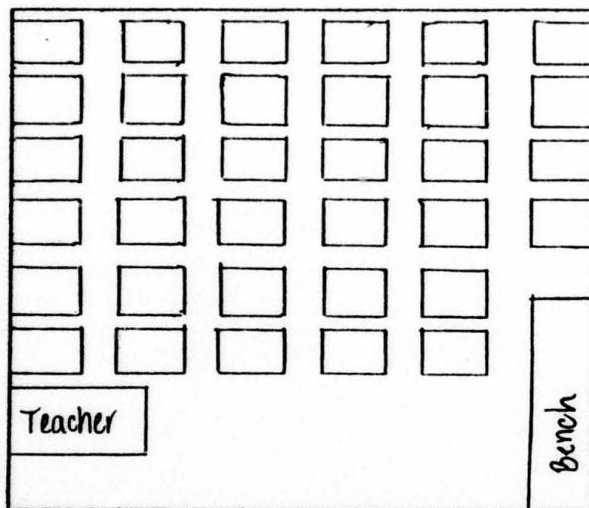


Figure 3.3.4. The set up of the mathematics classroom.

3.4 The sample

Eleven students and their classroom teacher took part in the nine-week study. The students who participated in the study were year 12 mathematical modelling students in a metropolitan government school. There were eight females and three males in the class.

3.5 Research Techniques

There were three techniques used to collect data for the research. These were interviews, observational records and document collection.

Interviews

The students were interviewed toward the end of the research period and an interview guide was developed for that part of the study. The questions were directed to the students and teacher to answer the study's two research questions. Appendices 3-6 illustrate the basic layout of the questions asked. These questions provided a framework for the interviews, but questions were added or taken out as deemed appropriate by the author. This was particularly the case with the questions directly relating to a specific lesson. Questions often resulted from responses from the interviewee. The teacher was interviewed following the same procedure as the students. The interviews were semi-structured.

Some of the questions in the interview were structured to stimulate the participants' memory by including examples of activities that had taken place during the observations. These questions were directed to answer research question one.

The other questions that were asked during the interviews were directed at answering research question two. The questions asked were related to the attitudes

and beliefs of the students and teacher toward using the Internet in the mathematics classroom. They were also asked questions relating to their background use of the Internet. This enabled the author to determine how much exposure each student had with the Internet at home and at school. They were also asked questions relating to how they thought the Internet could be used in the future of education.

Interviews were used because they "are an essential source of case study evidence because most case studies are about people and their activities. These need to be reported and interpreted through the eyes of the interviewees who provide important insights and identify other sources of evidence" (Burns, 1995, p. 320). The interviews were semi-structured based on protocols that I developed. The questions did not have fixed wording or a strict order, permitting greater flexibility of answers while still covering the crucial issues of the study (Burns, 1995). The questions were, however, grouped into sections, which would hopefully be generalisable—for example classroom organisation and content. The focus of the interviews and discussions in this project was to provide the teacher and students with opportunities to describe their experiences and express their views on a range of important matters associated with their access and use of the Internet in their classrooms. The interviews were be audiotaped and transcribed. The interviews of the teacher and students took place near the end of the observation period.

Observations

Twenty-One lessons where the Internet was being used were observed. A framework for researching classroom observation was developed, based on the structure of a 'typical' mathematics lesson, where the teacher gives instruction, the students' react in some way, activities are completed and students' interaction occurs with the computers. The template of the observation record can be found in Appendix 7. The record was developed with no preconceptions about what would happen in the classroom and how the Internet would be used by the students and teacher.

During the observations written notes were taken to record such things as verbal instructions and non-verbal communication between the teacher and students, and students with other students. Observational records were made of the teacher and students using the Internet in the mathematics classroom and how the students and teacher interacted with the Internet to obtain the relevant information. These were added to and altered as the study progressed.

Observations were used because "observational evidence is often useful in providing additional information about the topic being studied" (Yin, 1994, p. 87).

Documentation

All handouts were collected and copied throughout the research period as well as examples of the students' work, which illustrated how they used the Internet in the

secondary mathematics classroom. These documents assisted in the categorisation of how the Internet was used by the teacher and students.

The documents were collected because they allowed for verification of data already accumulated through the interviews and observations. "The most important use of documents is to corroborate and augment evidence from the other sources" (Yin, 1994, p. 81).

3.6 Procedures

The written notes, recorded interviews and collected documents were analysed as the study progressed. The use of multiple sources of evidence in case studies allows the investigator to "address a broader range of historical, attitudinal, and behavioural issues" (Yin, 1994, p. 92). However, the most important advantage of using multiple sources of evidence "is the development of converging lines of inquiry. ... Thus any finding or conclusion in a case study is likely to be much more convincing and accurate if it is based on several different sources of information, following a corroboratory mode" (Yin, 1994, p. 92).

3.7 Conclusion

The research techniques explained above were used to gather relevant data about how a Year 12 Mathematical Modelling class used the Internet during a nine-week

observational period. This data will now be documented and analysed to provide possible answers to the two research questions.