The use of computer technology in secondary mathematics teaching in New Zealand schools:
A survey of teachers

A descriptive study

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The use of computer technology in secondary mathematics teaching in New Zealand schools: A survey of teachers

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In the name of God
The most Gracious the most Merciful

"GOD WILL EXALT IN DEGREE THOSE OF YOU WHO BELIEVE, AND THOSE WHO HAVE BEEN GRANTED KNOWLEDGE"

(The Holly Qura’n, Chapter 58, verse 11)

This effort is dedicated as a sign of respect to my

Grandfather
Hasan

Who planted seeds of seeking knowledge in me,

to my

Parents
Anna & Mohammad

Who have carefully being nurturing the growth of those seeds for several decades,

and to my

Wife and children
Abba, Mohannad, Bava’, Suhail, & Danah

Who have always been strong supporters
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Acknowledgement

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Abstract:

Information technology development has driven many New Zealand educational initiatives. Projects have been undertaken, and strategies released to integrate computers into classroom teaching and learning processes. Pre-eminent among them was *Interactive Education: An Information and Communication Technologies Strategy for Schools* setting out a 'National Strategy' for integrating computer technology in schools. Other initiatives included: (a) *The New Zealand Curriculum Framework*, released in 1993, defining official policy for teaching, learning and assessment in New Zealand schools. (b) The statement of *Mathematics in New Zealand Curriculum* (MiNZC) (c) *Information Technology Professional Development* (ITPD) initiative to fund schools to organise and manage their own training and development. (d) *Financial Assistance Scheme* (FAS) to provide schools with at least half of the cost of approved cabling projects for local area networking, and (e) *NetDay* to provide practical help for schools wanting to create local area network.

Extensive funds were allocated to implement these and other projects and initiatives. However there is a need for further research to reveal to what extent teachers of mathematics and other subjects are actually making use of computers. This is because since the release of the National Strategy no nationwide studies, specifically related to mathematics, have been carried out to investigate the achievement of its goals in the field of secondary mathematics teaching. Now, three years later, this present research attempts to fill that gap, and to provide government, educators, and all concerned people with deeper insight into current practice and application of computer use in the daily teaching of secondary mathematics. This research aims to contribute towards a solid foundation for further research and future planning.

This research attempts to answer these questions:

- To what extent and for what purposes are computers being used in secondary mathematics teaching?
- How do teachers envision the use of computers in the classroom teaching-learning process?

This research explores consistency between computer usage and Ministry goals as stated in MiNZC and other official statements on Information and Communication Technologies in teaching and learning.

This research reveals that actual use of computers in classroom processes for the teaching and learning of mathematics remains small, comprising less than 1% of actual teaching time. Their use tends to be devoted to extending or practising pre-taught material, and serves mostly the statistics strand within the curriculum. Students seem to have unequal opportunities for use of computers. Junior students’ teachers are, in general, more likely to use computers than senior students’ teachers. The higher thinking mathematical process skills such as reasoning, exploring and discovering are unlikely to play a vital role in the use of computers. Results also indicate that a large majority of teachers have positive attitudes and perceive a constructive role for computers in the teaching of classroom mathematics. However, they remain cautious and are mindful of barriers to computer usage such as hardware availability, accessibility, software suitability, and professional training.

The Ministry of Education hopes to achieve several goals from its computer initiatives. The most important of these is to provide opportunities for students to gain confidence and become competent users of computers in mathematical contexts to prepare them for a technology permeated future. On present evidence this goal is not currently being achieved in many classrooms.

In summary, this research indicates that the use of computers in classroom teaching of mathematics is not fully meeting the governments’ goals. To clarify and overcome obstacles, and to align classroom practice in using computers to teach mathematics with government goals, still requires further research, debate, cooperation, and determination.
Chapter (1)

Introduction
Chapter (1)
Introduction

1.1 Computer technology and education: the endless debate

"This is the year of the computer. So was last year. And so it will be next year. Indeed every year seems to be the year of the computer. A never ending string of innovative applications of computer and information technology continues to affect virtually every thing we do" (Long and Long, 1993, p. 3)

Information Technologies have had an accelerating impact on human society. They have penetrated most domains of daily life: Computers, scanners, Internet, e-mail, cellular phones, digital cameras, fax, and video, are now in shopping stores, companies, factories, homes, kitchens, clinics, real estate agencies, hospitals and many other places. We see them everywhere around us, playing a vital role in providing people with ‘better’ facilities contributing to success, joy, or comfort in daily living.

Schools are no exception. On the contrary, information technologies, including computers, have received a special consideration in education rarely to be found in any other sector. They have brought about endless debate among educators regarding their role and benefit in terms of the knowledge to be taught, the teaching environment and the outcomes of the teaching - learning processes. The debate is continuing while the gap between the integration of information technologies, especially computers, in education and other societal sectors is widening (Strommen and Lincoln, 1992).
There is no common viewpoint regarding the integration of information technologies, and particularly computers, into the teaching-learning processes. Advocates see this as a necessity, which should be done as soon as it is possible (Licklider, 1983; Ornstein and Hunkins, 1998). Others call for caution in this process. They claim that while using computers for teaching purposes is useful they are given more importance than they deserve. They argue that computers have not had the sort of impacts on teaching-learning processes that their advocates claimed. This doubt has developed to the extent that some authors ask if computers make a bad situation worse (Blackstock and Miller, 1989; Olson, 1992).

Many educators believe that computers will have profound and positive impacts on education. They argue that computers have the potential to facilitate the teaching and learning process, and to enhance education outcomes (Papert, 1980; Bork, 1987; Hood, 1998). Accordingly, they call for their incorporation in schools to narrow the gap between education and other societal sectors in this regard.

Papert (1980) argues that learning how to use computers could change peoples’ way of learning everything else. Licklider (1983) sees the computer leading to new roles for teachers. He sees the teacher as a resources manager who optimises and integrates them, and who motivates students to use them as well. Educators predict new directions for the future curriculum (Ornstein and Hunkins, 1998). Schooling; the school day, and the geographical location of classrooms and their construction are all predicted to be all affected in a substantial way by information technology (Beare, 1998). Others go as far as to predict that computers will revolutionize our schools (Bork, 1987).

Different reasons stand behind this belief. Educators believe that through the editing facility for example, such as erasing and retyping, computers increase student pleasure in being taught and save time for other significant aspects of learning. Stolurow (1969) claims that computers have two features no other teaching aid can provide. These are a large memory and a flexible logic. Computers are a new tool with an interactive capacity not available to learners before (Rigney, 1962). The capacity to handle data and to store
and retrieve information, which would be difficult, time-consuming, or too costly to set up by other tools, is a very important educational use for computers (National Council for Educational Technology, 1969). Papert (1980) and Amarel (1983) argue that computers can redirect the emphasis towards thinking skills. Hood (1998) contended, "Information technology can allow students to learn best in their own ways, and to explore and develop their individual areas of interest" (p. 122).

Available literature gives clear evidence of the slow pace of adopting computers in the classroom teaching and learning process. It shows that the expectations of thirty years ago have not been fully met. Riley (1996), the U.S. Secretary of Education, expressed that explicitly when he said: "Technology is rapidly changing the way we work and the way we live - everywhere that is, except in very many of our schools".

Riley pointed to the fact that only three percent of American instructional rooms are linked to the Internet and four percent of schools have a computer for every five students. Balacheff and Kaput (1996) observed that computer use remains a relatively small part of classroom practice. And Morrison, Lowther and DeMeulle (1999) observed that the majority of students are still taught the same way students were 20 years or more ago. Smith and O’Malley (1996, p. 1) said:

“When the personal computer first entered the classroom three decades ago, prophets of the information age foretold a marvellous revolution ... computers are indeed everywhere in American schools, but they are generally used as little more than electronic workbooks. The promised revolution has failed to materialize”

However, the slow pace of incorporating computers into the classroom teaching process has given a reason for other educators to challenge this belief. These educators see the computer’s role in the teaching process as overestimated. They argue that computers have not had the kind of impact on teaching that their advocates have claimed for two decades or more, and they have said that computers do not make much difference to
learning outcomes (Blackstock and Miller, 1988; Burnett, Blackstock, Miller and Warkentin 1989; Olson, 1984, 1988, 1992). Some advocates of this trend advise caution about the predictions associated with new technologies (Bowers, 1988; Cuban, 1986). Others raise many questions concerning the unrealised potential of computers (Brophy and Hannon, 1984; Olson, 1984). Just as some advocates of the use of computers used exciting words and titles in the literature such as ‘revolution’, ‘powerful ideas’, ‘micro worlds’, ‘the tomorrow makers’ and ‘touch tomorrow today’, so doubters equally use emotionally charged language to express their views with phrases like ‘mind over machine’, and ‘doubting technology’ (Dreyfus and Dreyfus, 1986; Zerzan and Carnes, 1991; Postman, 1992). Other critics see computers as an intrusion entering the classroom (Baker, 1983, 1985).

Ornstein and Hunkins (1998) argue that we live in an “Information Age” in which the amount of information and the capacity to process information is exploding. They contend that the capacity of the computer chip to process data is doubling every year. The Secretary of Education in the United States said: “computers are the ‘new basic’ of American education and the Internet is the blackboard of the future” (Riley, 1996, p. 1). But everywhere the question remains! Do schools live in that same information age?

1.2 Computer technology and teaching mathematics

In mathematics education a similar argument exists. Literature shows evidence to support both points of view. Many educators believe that computers have the potential to enhance teaching and learning mathematics (Gentile, Clements & Battista, 1994). Tall (2000) claims that computer technologies “offer new ways of operation to utilize our versatile thinking processes in more powerful ways” (p. 34). It has been suggested also that computer use can enhance students’ mathematical processes (Zbiek, 1998; Sandholtz, Ringstaff & Dwyer, 1997). Other educators however argue that information technologies, including computers, have no abnormal influence on teaching and learning processes, including mathematics. They argue that these technologies do not make much

Available research has supported both points of view. Many studies concluded that student motivation and their positive attitudes towards learning are enhanced through the use of information technology (McKinnon, 1995; Podmore and Craig, 1989; Rowe, 1993; Shears, 1995). Other studies reported that social interaction and co-operation between students are facilitated by use of information technology (Chamberlain and Kennedy, 1991; Philips, 1995; Podmore and Craig, 1989). A Northern Ireland study covering 235 primary and junior secondary students in 9 schools concluded that there was an obvious enhancement of students’ information technology skills and information technology - related learning (Gardner, Morrison, Jarman, Reilly, and McNally, 1992). An English study, The Impact Report, came to the same conclusion (Watson, 1993). A change from a teacher-centred classroom management to a student-centred style was reported by several studies (Shears, 1995; Watson, 1993; Gardner et al., 1992). Shears (1995) in his study, which included ten Australian Schools, concluded that the use of spreadsheets in graph drawing had provided more time for use in interpreting students’ work. McKinnon (1995) reported in his study, the Freyberg Integrated Studies Project, that students involved in the integrated curriculum programme, linked by the use of computers achieved better level in School Certificate examinations compared with their peers in the traditional programme.

On the other hand, many studies showed some evidence to support the other point of view. In Chamberlain and Kennedy’s survey (1991) it is mentioned that teachers were not certain whether student achievement levels could be increased through the use of computers. In Gardner’s et al. study (1992) it is reported that curriculum-related learning enhancement was not very obvious and hard to measure. The researchers who carried out The Impact Report (Watson, 1993) concluded that the contribution of information technology to student learning was not consistent across the range of ages and subject areas in the project. Shears (1995), when summarising the results of his project, concluded that not enough “hard” evidence was available to say that the use of
computers enhanced student learning. In the Australian study, Sunrise project, Rowe (1993) concluded that achievement as measured by tests in area of mathematics had no significant difference between the Sunrise students who benefited from the use of computers in learning and the non-Sunrise control group.

Despite this debate, there is general acceptance of computer technology as a new factor in the teaching learning process, which has potential to enhance its outcomes. The high expectations for computer technology in education have even lead some educators, politicians, and a wide sector of the public to convince their governments to support establishing computer-rich learning environments for students. Some of these countries are Spain (Estremad, 1995), the United States (Morrison et al, 1999), the United Kingdom (Aston, 1995), Australia (McRobbie, Nason, Jamieson-Proctor, Norton, and Cooper, 2000), and New Zealand (Harris, 1999; Ministry of Education, 1998).

1.3 The New Zealand experience; where do we stand?

As in most western countries, New Zealand education was influenced by rapid developments in information technology. Its experience of the use of computers in the classroom teaching learning process has grown over the time. I identify three distinct periods for this experience.

Before 1992

The use of computers in education in New Zealand is an old trend. Its roots go to the 1970’s. The report of the Consultative Committee on Computers in Schools (CCCS), which was formed by the Minister of Education in 1980 stated that computing, in 1974, had been an option in Form 7 (year 13) applied mathematics. And in 1981 three thousand five hundred students studied this option. It added that several schools offered
courses related to computers, mostly within mathematics departments (Department of Education, 1982).

A survey of computers in schools undertaken in 1981 showed that there were then 229 computers in 141 secondary schools. It was clear that the predominant use of computers was widely regarded as being within mathematics in most schools. Out of 121 schools that provided information about the main subject areas where computers were used, 87.6% (106) schools were using computers in mathematics (Ibid, 1982).

In its report, the CCCS pointed to the educational need for computers to benefit all students. It mentioned that students needed to learn about and how to use computers. It asked for a comprehensive policy to cover curriculum development and teacher training, and to provide suitable and adequate resources (Ibid, 1982).

The report stated that there was a considerable commitment to computer education in New Zealand secondary schools, and a general willingness on the part of teachers to extend and develop this work further (Ibid, 1982).

Despite this early awareness and a developing trend of making sense of the importance of computers use in education, and in mathematics particularly, the official response did not come until 1990. The Minister of Education, Dr. Smith, accentuated this importance in his address to the Post Primary Teachers Association (PPTA) in Christchurch in 1990. He said: “As I have already noted, recent developments in New Zealand and overseas have highlighted important factors that must be addressed urgently by a national curriculum. These include the need ... to recognise the importance of new technologies and skills development” (Smith, 1991, p. 7).
1992-1998

In the 1990s educators, private and academic organisations, and the Ministry of Education released many reports, writings, and research. These were different visions, opinions and points of view on how, why, when New Zealand should integrate Information and Communication Technologies (ICT) in its schools. This period also, witnessed a curricular revolution that led to a new national curriculum. One of its elements was the recognition of the importance of new technologies, including computers, in education.

In 1992 the *Mathematics in the New Zealand Curriculum* (MiNZC) was released as an official statement to provide “the basis for mathematics programmes in schools from year 1 to year 13” (Ministry of Education, 1992, p. 5). This statement asserts the influence of technology on mathematics education. It stated,

“In an increasingly technological age, the need for innovation, and problem-solving and decision-making skills, has been stressed in many reports on the necessary outcomes for education in New Zealand. Mathematics education provides the opportunity for students to develop these skills, and encourage them to become innovative and flexible problem solvers” (Ibid, 1992, p. 7).

In 1993 the *New Zealand Curriculum Framework* (NZCF) was released to set out the official policy for teaching, learning and assessment in New Zealand schools. New technologies were identified as a reason for change and as a vehicle for developing New Zealand’s future. The Ministry of Education (1993, p. 1) argued,

“As we move towards the twenty-first century, with all the rapid technological change which is taking place, we need a work-force which is increasingly highly skilled and adaptable”
In the *Mathematics in New Zealand Curriculum: addendum to level 8*, (Ministry of Education, 1995) the Ministry of Education also suggested using computer software for different purposes such as exploring and investigating.

In 1996 the Ministry of Education released its report *Schooling for the Future*. Its focus was planning for education for the next 25 years. In this document applying technology, including computers and their impact, were identified as vital factors affecting future education in the next 25 years (Ministry of Education, 1996).

Regardless of several official pronouncements of the importance and desirability of integrating computers in New Zealand schools, there was no comprehensive national plan or vision on how or when this could be achieved. Rather, there were separate and scattered initiatives towards that end. The projects: ‘Schools Network’, the ‘Learning Enhancement with Information Technology’ and The ‘Technology Development Schools Programme’ are some examples. Hood claimed that there was “no cohesive strategy [in New Zealand] to develop technology products that will enhance the effectiveness and therefore the productivity of schooling” (1998, p. 123).

Generally, this stage framed the desires and ambitions, ‘goals’, of computer use in official documents and statements such as NZCF and MiNZC. However, success at implementing these broad ‘goals’ was poor, mainly due to the wide gap between ‘talking’ through many official documents and ‘working’ through real practical support to the field – workers (teachers) at school and classroom levels.

1998-2001

These years were the stage of practical contribution to a new era of the use of ICT in education. Six years after the curriculum reform, the Ministry of Education started its real support to schools by setting up a suitable infrastructure for integrating ICT. The help provided was supportive and practical. This happened as a result of serious efforts,
described below, from different sectors, groups and individuals of society, including schools and the Ministry of Education. One of the most obvious features of this stage was the co-operation and the partnership between the Ministry of Education and other parts of society.

In 1998 the Ministry of Education announced three initiatives to support schools and to improve their capability to integrate ICT. These were:

I. Information Technology Professional Development (ITPD). Through this initiative schools, or clusters of schools, were funded to organise and manage their own training and development (Ministry of Education, 1998a, p.13). The first 23 schools cluster was chosen in 1999.

II. Financial Assistance Scheme (FAS). Under this initiative government provide at least 50% of the costs of approved projects of cabling for local area networking (Ibid, p. 13)

III. NetDay. A national voluntary project that provided practical help for schools wanting to create local area network. (Ibid, p. 12)

In October 1998 the Ministry of Education launched the first “National Strategy” for integrating computer technology in schools. That is, Interactive Education: An Information and Communication Technologies Strategy for Schools. As the then Minister of Education said, “This National Strategy has been developed to support the use of information and communication technologies, to enhance teaching and learning and administration in schools” (Ibid, p. 4).

The National Strategy was developed “In consultation with a large number of stakeholders, including schools, sector groups, businesses, and government agencies” (Ibid, p.5). It was one of the consequences of the Information and Communication Technology Summit. In August 1998, about 40 people representing all the major school
sector groups, some tertiary education providers, interested groups and commercial organisations, and the Ministry of Education all participated in this summit, the purpose of which was to support the use of ICT in schools. The result was the document *Goals for 2001: Implementing ICT in Schools*, which led, two months later, to the first national strategy for integrating computer technology in schools.

In October 1998 the *Interactive Education: An Information and Communication Technologies Strategy for Schools* was released. It was the first national strategy. Included in objectives were:

- To improve student learning outcomes through the use of ICT in teaching and learning.

- To increase the effectiveness and efficiency of teachers and schools by helping them to:

  1. Enhance the delivery of the curriculum
  2. Reduce time spent in administration

(Ministry of Education, 1998a, p. 10)

The National Strategy announced what so-called “New Initiatives”. These were three new initiatives added to the three already in existence. They were:

1. On-Line Resource Centre: a central on-line centre to provide all schools with a mechanism for the delivery of multimedia resources, including curriculum and administration resources, using the Internet.

2. Professional Development for Planning and Implementation: a one-day course to be given to all principals to develop leadership skills in planning for the use of ICT in their schools.
3. ICT Professional Development Schools: under this initiative “Up to 23 schools, or groups of schools, throughout New Zealand that are successfully using ICT to enhance teaching and learning will be contracted for up to three years to provide professional development to other schools” (Ibid, p. 13).

1.4 The governmental goals for computer use

Ministry of Education recommends in MiNZC and NZCF using computers in mathematics teaching in different parts and several places of its contents. But it does not list the ultimate goals of computer use for teaching mathematics explicitly. They were mentioned as aims, ambitions, desires or recommendations. There are three issues have been highlighted in this regard:

First, MiNZC stated in its achievement aims list that:

“The mathematical curriculum intended by this statement will provide opportunities for students to: ... become confident and competent users of information technology in mathematical contexts” (Ministry of Education, 1992, p. 9).

This quotation indicates one of the government goals.

Second, Britt, Irwin, Ellis, and Ritchie (1993) found that MiNZC is designed in a student-centred way, and aligned in its nature with the constructivist learning theory. As a mathematics teacher myself I recognise the importance of this model, as a theoretical base of MiNZC, in their daily practice for implementation of the national curriculum, and how much it is important that the curriculum design and content both meet the notions implied in this learning theory. In a constructivist context students should be very active in constructing their own knowledge (Stromen and Lincoln, 1992; Kozma, 1991; Walter, 1991). The learning outcomes are higher order thinking skills such as
applying, reasoning, exploring, discovering and problem solving. These could be achieved through providing the learning activities of analysis, synthesis, evaluation, and processing of information. For powerful learning outcome gains, students should practice these activities in a collaborative work environment, where each student is considered as a resource rather a competitor for his peers (Roblyer, 2003; Rysavy and Sales, 1991). Within a constructivist model the teachers' role in implementing the curriculum is vital; it is the role of "fomenting questions, doubts, uncertainties, modelling strategies of inquiry, and criticising the quality of results" (Watkins, 1999, p. 18). The curriculum should help them to perform this role. It should help teachers to develop their students' ability of processing, organising, applying, criticising data in the daily life context.

It is stated in MiNZC:

"Students have a right to the opportunity to achieve to the maximum of their potential... as new experiences cause students to refine their existing knowledge and ideas, so they construct new knowledge" (Ministry of Education, 1992, p. 11)

Problem solving, reasoning, logical thinking are some of the skills that emphasized by MiNZC (ibid, p. 23). Also, analysing, investigating, evaluating, constructing, and simulating are some of the suggested learning experiences (ibid, p. 105, 179, 191, 199). Similarly, the environment of collaborative work is recommended in more than 15 places in MiNZC. For example it is stated:

"Students should be ... working co-operatively as part of a group by listening attentively, generating ideas, and participating in reflective discussion" (ibid, p. 29)

This points to the way in which computers should be used. It is to support a constructivist learning approach, if they will be used as a part of technological resources for curriculum implementation.
Thirdly, MiNZC suggests using the computer in teaching all strands within curriculum. For example, in number strand it is mentioned:

"Students could write a computer program or use a spreadsheet to generate tax tables" (ibid, p. 51).

In measurement strand it is mentioned:

"Students use a computer ... to find the area of an interval under a curve, and investigate factors which determine the perimeter and area of fractal" (ibid, p. 81).

In Geometry strand it is stated:

"Students should be ... using a calculator or computer to explore transformations of graphs of functions" (ibid, p. 117).

In algebra strand it is stated:

"Students should be ... investigating families of functions (using a graphics calculator or computer)" (ibid, p. 155).

In statistics strand it is stated:

"Students should be using technology, such as spreadsheets and graphing software, where appropriate, to investigate and display data" (ibid, p. 199).
With regard to mathematical processes strand, it is expected to use computers for serving this mathematical processes strand through all other strands.

It is stated that skills

"Are learned and assessed within the context of the more specific knowledge and skills of number, measurement, geometry, algebra, and statistics" (ibid, p. 23).

If this were linked to the MiNZC statement, "This curriculum statement assumes that ... computers will be available and used in the teaching and learning of mathematics at all levels" (ibid, p. 14), it becomes very clear that government’s goal is to use computers across the curriculum; through teaching all curriculum levels and strands.

Based on what is outlined above I have extracted three main governmental goals that are expressed through MiNZC and NZCF for the use of computers in the teaching-learning mathematics processes. These are that:

1. students will become confident and competent users of information technology in mathematical contexts;

2. students should use computers in a constructivist approach to enhance their learning; and

3. the use of computers is to be across the curriculum, integrated through all its strands and at all year levels.

To achieve such goals, computers should be well integrated into classroom teaching-learning processes. Reaching this status cannot happen unless at least three principal requirements are met. These are the hardware availability, accessibility, and the adequate professional training for teachers.
MiNZC states that:

"The curriculum statement assumes that both calculators and computers will be available and used in the teaching and learning of mathematics at all levels" (Ministry of Education, 1992, p. 14).

This quote indicates some assumptions on which the curriculum was based. The availability of computers and the actual use of them in teaching all levels are explicitly assumed. Subsequently, the accessibility of computers and the existence of suitable software are other implicit assumptions. The existence of trained teachers, who have professional knowledge of how, for what and when to use computers, was assumed as well. But the question is: to what extent are these assumptions based on the context?

1.5 The research purpose

Twenty years after these earlier reports (those mentioned in section 1.3), which found that computers were most likely being used for mathematics teaching, ten years after the new curriculum statement and three years after the National ICT Strategy release, this research set out to investigate how far the goals and ambitions of the Ministry of Education and the public have been achieved in practice.

The relationship between curriculum and the field of teaching is very important. A curriculum is more successful when built on the basis of interactive consultation with teachers - those responsible for implementing it in the field. Curriculum is not only a collection of plans and topics provided to teachers in a specific statement. Curriculum is also a practice and implementation as well as written statement. Cornbleth (1990) and others (Apple, 1990; Ramsay, Sneddon & Grenfell, 1983) argue that it is the context that shapes the curriculum. Separating the curriculum writing process and its construction
from the field of implementation is a sign of failure. It may end up with ‘intended’ curriculum, which is isolated from its context.

The mathematics curriculum statement recognises that integrating computers into classroom teaching-learning processes cannot be achieved by the written curriculum alone. Other salient factors are the actual availability and accessibility of computers, as well as adequate professional training for teachers. The existence of these factors in the field is taken for granted. This research aims to find out how far the curriculum assumptions match with the actual field of implementation.

Thomas in 1995 carried out a comprehensive nationwide study. Although the study covered most of the situation of the computer use at the time, it was aimed to “address the question of why the computer has not been more widely influential in the teaching of mathematics by discovering the pattern of use, and the factors influencing it, in New Zealand schools” (Thomas, 1996, p. 556). In this study Thomas concluded, “More funding for computers and for training seems necessary”. Thomas also observed that the beliefs, the attitudes, and the confidence of teachers are major elements in bringing change in the classroom use of computers.

Available research and reports, since then, tell us very little about current computer use for classroom mathematics teaching. This is a motivation for me as a researcher to fill this gap in the literature.

From what is outlined in the above sections, it is very clear that there is both a political and a public purpose for the use of computers in classroom teaching. There is a major concern also about the future of computer use. The National ICT Strategy and several other projects, documents and initiatives that were released in the last decade have been a product of this concern.

Beare argued, “The most reliable way to anticipate what the future will be like is to observe the trend lines in the present” (1998, p. 3). What distinguishes this research is
that it is not a general summary of what kinds of technology exist in schools. Rather, it is a detailed research trying to investigate the actual use of computers in the teaching and learning process, and other important related issues. It is designed to answer some questions for which we need answers, such as are the computers in schools available for all teachers' use evenly or do some subjects have a priority of use? For what purposes and for what proportion of each of the strand topics within the curriculum are computers used? Are computers installed in classrooms or in special laboratories? Do they need booking or not? What are the beliefs and attitudes of teachers in relation to the use of computers in their daily practice? This research hopes to provide teachers, educators, the government, the decision-makers and all concerned people with a background for further research and better planning.

Large amounts of money were allocated for implementation of different projects and initiatives directed to deal with the issues raised by Thomas and others in different studies and reports. For example, the government has allocated $14.5 million over three years, for the implementation of the National Strategy (Ministry of Education, 1998b). The government also launched, in 1998, the “Foresight Project” for the purpose of ensuring that money spent on science, research and technology serves a desirable future for New Zealand. (Mutch, 1999). Similarly, millions of dollars were spent to implement the different initiatives followed the National Strategy release. These factors indicate a need for more research to reveal what use mathematics and other teachers are actually making of computers and whether that usage is exemplary of 'best' or even 'good' practice? This thesis is an attempt to answer these important questions in relation to mathematics, and may as a result raise some issues in its conclusion about the second.

1.6 The research question

In the light of the purpose of this research, a main research question was developed. That is: "How and why do teachers use computer technology in secondary mathematics teaching in New Zealand".
This question was divided into three sub-questions. These are:

(1) To what extent have New Zealand high school mathematics teachers used computers in their daily teaching practice?

(2) For what purposes they have used computers in their day-to-day teaching?

(3) What are the views of New Zealand high school mathematics teachers about computer technology in the teaching process?

1.7 Glossary

Secondary level: the level of schooling from year 9 to year 13 according to the New Zealand system of education

Mathematics teacher: any full time or part time teacher who is teaching one or more of year 9-13 mathematics class in New Zealand schools in the scholastic year 2001

Secondary school: any New Zealand school that includes any level of year 9-13 in the year 2001, including composite and area schools.

Computer technology: any kind of technology that involves using computer hardware or software (computers, digital cameras, Internet, and e-mail).

Mathematics teaching: the teaching - learning activities that primarily aim at educational delivery of any part of New Zealand secondary mathematics curriculum
New Zealand mathematics curriculum: all statements or documents released by the New Zealand Government to direct the teaching-learning of mathematics in New Zealand schools.


Mathematics applied classes: all classes, which study an adapted applied mathematics version of *Mathematics in the New Zealand Curriculum* (MiNZC).
Chapter (2)

Methodology
The most important factor influencing the choice of an appropriate strategy for conducting social research is the purpose of the research (Brannen, 1994). This research aims to gather large-scale data for the purpose of generalisation to answer the question “How and why do teachers use computer technologies in secondary mathematics classroom teaching-learning process in New Zealand”.

2.1 Research strategy and instrument

A mail-survey strategy was used for this research, in order to get responses from all parts of New Zealand and to cover the national population of mathematics teachers in secondary schools.

The instrument used was a posted pre-designed questionnaire (Creswell, 1994). It is a relatively speedy way of collecting data for big sized samples. It can be given simultaneously to large number of people, who are widely distributed geographically, and it can be completed in the respondent’s own time (Herbert, 1997). In addition to that, it is appropriate for this group of respondents, secondary mathematics teachers, in terms of age, knowledge, and culture (Mertens, 1998).

The questionnaire was divided into five parts. The first part was a demographic part. It included some personal information about teachers, such as gender, age, and the number of years of experience they had as teachers. The second part covered the frequency of
teachers' use of computers for classroom teaching. The third part sought to discover the purposes for which computers were used. The fourth part elicited teachers' points of view and comments on the use of computers in classroom teaching. The last part was about the general barriers and benefits they perceived in relation to the effective use of computers in the teaching-learning process.

Three kinds of responses were used in completing the questionnaire. These were multiple-choice, open-ended questions, and scales. The multiple-choice section was to be completed by marking the square provided beside the suitable response. The open-ended section invited the respondent to write a few words or a sentence in the appropriate place. Circling or ticking the appropriate element on a scale or a table completed was the last.

A mixture of open and close questions was used in order to provide a better explanation of some issues. A copy of the questionnaire is attached as appendix (1).

2.2 Sampling

Different factors affect the selection of a research sample, the most important being the answers to the questions, 'what do you want to know?' and 'about whom do you want to know it?' (Bouma, 1993)

2.2.1 Population and sampling frame

Fraenkel and Wallen (1996) distinguish two kinds of sampling populations. The first is the "target population" which is the one that the results would be generalized to. The second is the "accessible population" that is the population which from the actual sample is drawn. The 'target population' and the 'accessible population' for this research are the same. All secondary mathematics teachers, who were teaching mathematics in 2001 for
year 9 to year 13 levels in all New Zealand schools, were members of both populations. Henceforth, the term ‘sample population’ is used to indicate both the ‘target’ and the ‘accessible’ population.

The problem with this population was its large size, and its wide geographical distribution. The first step to deal with the sample population was to find a way to identify all its members to get a “sampling frame” (Gall, Borg, Gall, 1996). The *Directory of New Zealand Schools and Tertiary Institutions* (Ministry of Education, 2000) contains a list of all secondary schools, which had any classes of year 9 to year 13 levels. Area and composite schools, which may have classes from year 1 to year 13 levels, were not included in this list. So, they were added to it to form the research “sampling frame”. There were 450 schools in total.

There were two problems attached to choosing a sampling frame, which could affect the decision of the sample size. The first was that the members of the accessible population were teachers whilst all the researcher had was a list of schools. The second was the absence of information on the number of mathematics teachers in each school.

To solve the second problem 12 schools of different types were contacted by phone asking for numbers of secondary mathematics teachers in each. The mean of these teacher numbers was calculated, and came to 6 teachers. So the estimated target population size of all (450) secondary schools in the country was 2700 teachers. To solve the first problem of not knowing the names of secondary mathematics teachers to draw the sample from, the researcher decided to get the head of mathematics department in every school to play a mediation role between the researcher and the teachers.

2.2.2 Sample size

Sample size is directly proportional with accuracy of results, and the degree of confidence in generalising results of the sample population. The sample size has an inverse relationship with population homogeneity. Also, each sample has a margin of
error due to the fact that no sample coincides absolutely with its population. To minimise this error and to increase the research validity, gaining a high degree of accuracy and confidence for generalising results, the researcher decided on a research sample totalling 50% of the sample population. That is 3 teachers from every school in the country. This was also expected to increase the possibility of a high number of responses and consequently provide a good representation for the sample population. The intended response rate was 35% of the sample size, which was 473 teachers.

2.2.3 Sampling technique

Two possible approaches for drawing the sample were considered. The first approach was to cluster teachers within schools, and then to choose a random sub-sample from each cluster. The second approach was to group all teachers working in schools and take a random sample from that group.

Selecting a representative sample was the main aim. So, the large sample size was the first factor to be taken into consideration. But to get a high degree of precision in generalising research results, large “sample size will not compensate for any bias that faulty sampling techniques may introduce. Representativeness must remain the prime goal in sample selection” (Ary, Jacobs, and Razavieh, 2002, p. 171).

Secondary schools in New Zealand vary in different respects. The school type, governmental, integrated or private, the location of the school (urban or country) and its size, are examples of these differences. This might lead to different budgets and opportunities for integrating computers in the classroom. So, in order to ensure that the sample was as representative as possible to the sample accessible population the first approach for sampling, to cluster teachers within schools, was chosen.

The problem with the ‘cluster’ approach lay in the lack of a database naming the mathematics teachers in each school. So, the head of mathematics department in each
school was chosen as the connecting person between the researcher and the teachers, and
to choose the sub sample on behalf of the researcher. However there remained the
possibility of bias in the process of drawing a sub-sample within each school. The
researcher’s concern was that questionnaires could be handed to good users of
computers. As the final focus of this research is not users but uses of computer
technology, the researcher addressed this concern by stressing the random distribution of
questionnaires in a special letter to the head of department (HOD), see appendix (2).

2.2.4 Questionnaire dissemination

When the sampling technique was decided, 1350 questionnaires were disseminated on
25 July 2001, three to each school in the country. A two weeks period was given as a
“wait time” (Mills, 2000).

The researcher attached a covering letter to each respondent with each questionnaire
inviting her/him to participate, clarifying the researcher’s belief of her/his importance,
and explaining the aim of the research. The letter also stated that the research was being
conducted under the supervision of the Christchurch College of Education, and that
collected data would be kept confidential and not be made public or published (see
appendix 3) except as aggregated totals and trends, or exemplary, anonymous
quotations.

A separate letter was sent to each HOD expressing the importance of this research to
them and their colleagues. It explained the research aims and asked for their cooperation
in presenting the questionnaire to their departments. It also set out the random sampling
process and explained the method of distributing the questionnaire in each department.

To minimise the number of non-respondents, a pre-paid mail envelope for returning the
completed questionnaire was attached to each questionnaire.
At the end of the ‘wait-time’ period, the response rate was 19% and 252 questionnaires were received back. That was a discouraging response, and well below the researcher’s expectations. A new letter was issued and sent to every head of department in every school around the country to extend the ‘wait time’ period for other two weeks and to encourage teachers who forgot to send their questionnaires, or had not yet completed them, to complete them and send them back. By the end of the second ‘wait time’ period another 52 questionnaires had been received. The total received questionnaires became 304, raising the overall response rate to 23%. Some Heads of departments sent apologies for being unable to participate in the study, and some teachers sent the questionnaires back incomplete with an attached notice of apology for being unwilling to participate.

2.3 Data organisation

Thirteen invalid questionnaires were discarded when reviewing all received questionnaires. This was for different reasons, such as answering questions by choosing more than one alternative where one choice was required, or where answering questions in a systematic way indicated unreliability, or because of obvious contradictions in the provided information.

At the end of the data entry process, a random sample of the questionnaires (10 questionnaires) was drawn for the purpose of checking the accuracy of data entry process. The result showed some mistakes in the data entry process of question 19 to 24. All data of these questions were re-entered again.

The Minitab statistics package was used to change entries for each variable into a tally table. Responses were organised and corrected accordingly, to meet statistical design requirements and to improve the internal validity of research results.
2.4 Validity and limitations

Although external and internal validity were important considerations for the researcher, the general validity of this research may be affected by some limitations.

2.4.1 External validity

Different procedures were adopted to increase the research’s external validity. First: the large size of the research sample (1350 teachers which is 50% of the sample population). This ensures that the response rate, even if low, would still generate a high enough number of respondents to be statistically useful. Second: selecting all schools in the country helped avoid the possibility of a biased sample in terms of several concerns such as the school type, location, and size. The relatively large number of responses (304) was a sign of good external validity. Third: addressing and asserting the importance of randomness while supplying the sampling technique to the heads of mathematics department was intended to improve the validity of research.

2.4.2 Internal validity

Internal validity was also an important consideration for the researcher. Data was processed by computer technology using statistics package enhanced accuracy.

The questionnaire was trialled with a pilot sample. The pilot sample comprised four heads of departments and four teachers of four chosen secondary schools in Christchurch. These schools were chosen on the basis of school differences such as single sex or mixed, private or state, and high or low deciles, to include a wide variety of teachers. The researcher prepared a sheet including convenience criteria for the questionnaire. It asked respondents to comment on the questionnaire’s aim, language, length, appearance, privacy considerations, and clarity of questions. It also asked if the available responses to questions were mutually exclusive, exhausted, balanced, and met
all possible answers? It asked as well about any question, which may be likely to lead a teacher to answer inappropriately. Each head was given two questionnaires, and two convenience sheets. The researcher asked the head and another teacher of her/his department to fill in the questionnaire, to comment on it according to the provided convenience criteria, and to address any other concern. In addition, the questionnaire was tried out with some of the researcher’s tutors and teacher friends. Many critiques, corrections and suggestions came out of this process. Accordingly, a number of changes were made to the questionnaire before it reached its final draft.

2.4.3 Description of the sample

A demographic analysis of the respondent sample showed that:

- Gender: there were 145 male and 144 female responses. Two were not identified. This shows gender equity in the research sample.

- Age: the sample comprised a wide range of age-groups of teachers

<table>
<thead>
<tr>
<th>Age</th>
<th>20 - 29</th>
<th>30 - 39</th>
<th>40 - 49</th>
<th>50 - 59</th>
<th>≥ 60</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of teachers</td>
<td>34</td>
<td>66</td>
<td>111</td>
<td>68</td>
<td>11</td>
</tr>
</tbody>
</table>

- Distribution of teachers over the Year level they teach:

<table>
<thead>
<tr>
<th>Level</th>
<th>Y9</th>
<th>Y10</th>
<th>Y11</th>
<th>Y12</th>
<th>Y13 S</th>
<th>Y13 C</th>
<th>Y11 M</th>
<th>Y12 M</th>
<th>Y13 M</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of teachers</td>
<td>187</td>
<td>207</td>
<td>191</td>
<td>156</td>
<td>96</td>
<td>60</td>
<td>48</td>
<td>35</td>
<td>10</td>
<td>16</td>
</tr>
</tbody>
</table>

28
• Job type: there were in the sample 258 full time teachers, 24 part time (≥ 0.5) teachers and 6 part time (< 0.5) teachers. This indicates that teaching is their sole occupation. The results will therefore give a clearer picture of actual teaching practice in New Zealand.

• Computer ownership:

<table>
<thead>
<tr>
<th>At school</th>
<th>Yes</th>
<th>No</th>
<th>Unknown</th>
</tr>
</thead>
<tbody>
<tr>
<td>At home</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>86</td>
<td>136</td>
<td>11</td>
</tr>
<tr>
<td>No</td>
<td>22</td>
<td>20</td>
<td>0</td>
</tr>
<tr>
<td>Unknown</td>
<td>7</td>
<td>2</td>
<td>0</td>
</tr>
</tbody>
</table>

Data on computer ownership shows that the sample is not limited to teachers who have opportunity to benefit from computer at their convenience.

• Responsibilities other than teaching: 175 (61.6%) teachers were free of any other management responsibilities and 109 (38.4%) teachers had other management responsibilities in addition to teaching. This combination of teachers helps in understanding some important factors of the environment work such as workload, and time that probably affect the use of computers in the classroom teaching.

• Qualifications in the general use of computers: 119 (41.2%) teachers either had a certificate or degree in computing or finished some computing papers, courses or trainings. At the time of the research 170 (59.9%) teachers had not studied computing at all. They described themselves as self-taught people. Also, 40 (13.8%) teachers described themselves as not knowledgeable users of computers. This indicates
that the sample comprises a range of teacher qualifications in computing skills.

- Degree of confidence in classroom use of computers: 56% (158) of teachers described themselves as very confident or confident in the use of computers for classroom teaching. However 42.2% (119) of them described themselves as not very confident or nervous. This again confirms a range of teacher confidence levels in using computers for classroom teaching among the sample group.

These demographic results show wide variability among respondent teachers regarding ownership of computers, and confidence levels as general users of computers. This supports confidence in the sample group.

2.4.4 Limitations

There is no perfect study, or absolute results. Uncontrolled variables are always a threat and can influence results. Although many steps were taken to raise this study’s validity, there are still limitations that may affect its results.

The rate of response is one of those limitations. The actual number of completed questionnaires received fell short of the desired level. The intended sample size was 35% (473 teachers) of the research accessible population, but the achieved size was about 23% (304 teachers).

Although the researcher addressed the importance of randomness in the sampling technique, emphasising that to the heads of departments, the randomness of the sample within each school was dependent on the trust placed in the heads of departments to achieve proper sampling. The research may therefore be limited by any (unknown)
failure of heads of departments to ensure a random selection within their schools 'clusters'. Many respondents also complained from stress, tiredness and overwork. This raises the possibility of completing some questionnaires without much reliability.

The number of respondents of mathematics-applied teachers was relatively small. In some questions it was very small; therefore it was not helpful to be studied in the same way as the normal mathematics classes. If the research were to be replicated, the sub-sample of these teachers should not be less than 25 to allow use of suitable statistical analysis and to raise the research validity (Gall et al., 1996).

While analysing data I realised that teachers are overloaded and that time is a sensitive issue to them. Several parts of some questions, which require details or some of thought before responding, were left empty. On reflection I felt that the questionnaire was long. It would be more useful if the questionnaire concentrated on factors directly related to the research question (Cohen & Manion, 1994) and dealt with fewer peripheral variables. That would make the questionnaire more manageable for teachers and offer deeper and wider insight into the research topic.

The questionnaire mainly was concerned with the use of computers in schools from a users' viewpoint. There were no questions directed to non-users. If I repeat the research I would take this point in consideration, and address some questions to non-users for further exploration of how they consider computers and their potential in the teaching process, and why they currently do not use them in this process.

Some parts of questions, specifically question (28), asked teachers to provide examples of what they mean. Response to these parts was generally low. If the research were to be replicated I would provide some alternative choices, based on pilot data to make it easy for respondents (Nueman, 2000) to tick what suits them.
However, many of the other open-ended questions produced useful data, both in their own sight and in terms of providing useful explanation and triangulation for other closed questions.
Chapter (3)

The extent of computer use in classroom teaching-learning processes
Chapter (3)

The Extent of Computer Use in
Mathematics Classroom Teaching

3.1 Introduction

The first key question of this research is: “To what extent have secondary mathematics teachers used computers in their daily teaching practice?”

The Mathematics in New Zealand Curriculum (MiNZC) statement set out an achievement aim for mathematics teaching as follows:

“[Students to] become confident and competent users of information technology in mathematical context” (Ministry of Education, 1992, p. 9).

Therefore the government assumes that computers are being used in the classroom to develop confident and competent users of information technologies, including computers, in a mathematical context.

In 1999 the government released the document The Learning Technologies Planning Guide for Schools: An Overview for School Management. One of its purposes was to
discuss the importance of learning technologies. It stated:

"With good teaching and learning as the primary goal, these learning technologies [including computers] can be used to make a distinct contribution, for example, as a routine tool for students to gather, analyse, and present information, or as a means to present dynamic visual images of key ideas" (Ministry of Education, 1999, p. 7).

So again, the government expects computer use would become a routine tool in the teaching-learning process.

With regard to the government goal stated above, this research studied the following specific issues:

(1) The proportion of computer users among mathematics teachers and the frequency of use of computers in classroom teaching.

(2) The proportion of taught topics in each strand of the mathematics curriculum in which computers were used.

(3) The types of software technologies that teachers use in classroom teaching.
3.2 The proportion of computer users, and the frequency of their use

3.2.1 Proportion of mathematics teachers who used computers with classes

Teachers were asked: how many periods on average they used computers in mathematics classroom teaching? Results show that three quarters of teachers are users of computers for classroom teaching, against one quarter of non-users. See Figure 3.1

**Figure (3.1)**

**Teachers’ general use of computers for classroom teaching (n=280)**

If this finding is compared with Thomas’ findings in 1995, it shows that the proportion of computer users among secondary mathematics teachers seems to be increasing. In his nation-wide survey, Thomas found that 32.8% of secondary mathematics teachers had
not used computers in their teaching at all (Thomas, 1996). In this study the figure was 25%.

In relation to gender, results show a non-substantial difference between male and female teachers regarding use of computers in classroom teaching.

See Figure 3.2

**Figure (3.2)**

*Gender differences in computer use for classroom teaching*

`(n: male=140, female=139)`

3.2.2 General frequency of use

When the frequency of use is considered results show relatively low use of computers in mathematics classroom teaching. A higher proportion (35%) of teachers use computers
for one or two periods a term. Only 3% of them used computers for four or more periods a week. See Figure 3.3

**Figure (3.3)**

*Frequency of computer use among teacher users (n=210)*

Again, these results show an increasing trend of computer use in mathematics teaching when compared with Thomas findings. In 1995 Thomas found that 5.9% of teachers used computers at least once a week (Thomas, 1996). In this study the percentage of the same category of users is 15%.

However, it should also be noted that when the actual number of periods in which computers were used is compared to the actual number of teaching periods available, the results indicate that the majority of teachers used computers for less than 1% of their actual teaching periods.
This low frequency of computer use in mathematics classroom teaching exists within both genders. The largest proportion of male (37%) and female (33%) teachers use computers in only one or two periods a term. Meanwhile teachers who use computers in four or more periods a week are 4% of male and 2% of female teacher users. The latter number is too small to detect significant difference. See Figure 3.4

**Figure (3.4)**

*Gender differences in teachers’ general frequency of computer use for classroom teaching (n, male = 140, female = 139)*

3.2.3 **The frequency of computer use over the first two terms**

Teachers were asked about how many periods per term in the last two terms (the first and the second terms of the year) they used computers in mathematics classroom teaching.
The results show that computers tended to be used more often in the second term than the first term. A possible reason could be that teachers are more settled in the second term than in the first term. See Table 3.1

**Table (3.1)**

**Frequency of computer use for teaching mathematics at all class levels (measured by number of classroom periods over terms 1 & 2, 2001)**

<table>
<thead>
<tr>
<th>Level Term</th>
<th>Y9</th>
<th>Y10</th>
<th>Y11</th>
<th>Y12</th>
<th>Y13S</th>
<th>Y13C</th>
<th>Y11 MA</th>
<th>Y12 MA</th>
<th>Y13 MA</th>
<th>Other Classes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st</td>
<td>300</td>
<td>179</td>
<td>128</td>
<td>176</td>
<td>251</td>
<td>67</td>
<td>43</td>
<td>33</td>
<td>30</td>
<td>35</td>
</tr>
<tr>
<td>2nd</td>
<td>220</td>
<td>181</td>
<td>166</td>
<td>230</td>
<td>276</td>
<td>60</td>
<td>79</td>
<td>43</td>
<td>51</td>
<td>37</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>520</td>
<td>360</td>
<td>294</td>
<td>406</td>
<td>527</td>
<td>127</td>
<td>122</td>
<td>76</td>
<td>81</td>
<td>72</td>
</tr>
<tr>
<td><strong>Average</strong></td>
<td>260</td>
<td>180</td>
<td>147</td>
<td>203</td>
<td>263.5</td>
<td>63.5</td>
<td>61</td>
<td>38</td>
<td>40.5</td>
<td>36</td>
</tr>
</tbody>
</table>

Table 3.1 shows that teachers used computers most often in year 13 statistics level.

The results also show that the number of periods in which computers are used tends to decrease as the year level rises, except at year 12 and year 13S at mainstream mathematics classes and at year 13MA in other classes. A likely reason for these exceptions to the general trend is that students are required to use computers in completing statistics assignments in these classes.
To clarify this trend, two Figures are drawn separately. Figure 3.5 is for mainstream classes and Figure 3.6 is for mathematics applied and other classes.

**Figure (3.5)**

Frequency of computer use in the first and second semesters of mainstream classes in 2001

![Graph showing frequency of computer use in mainstream classes in 2001](image)

**Figure (3.6)**

Frequency of computer use in the first and second semesters of mathematics applied classes in 2001

![Graph showing frequency of computer use in mathematics applied classes in 2001](image)
When frequency of computer use of computers was plotted for each teacher, covering both terms and all class levels, results show that a small percentage of teachers recorded the highest computer use. See Table 3.2

**Table (3.2)**

*Frequency of computer use in the first two terms of 2001*

<table>
<thead>
<tr>
<th>Number of periods a term</th>
<th>Number of teachers and percentage</th>
<th>Y9 n=210</th>
<th>Y10 n=208</th>
<th>Y11 n=204</th>
<th>Y12 n=173</th>
<th>Y13S n=83</th>
<th>Y13C n=60</th>
<th>Y11MA n=43</th>
<th>Y12MA n=37</th>
<th>Y13MA n=15</th>
<th>Others n=20</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>#</td>
<td>116</td>
<td>113</td>
<td>115</td>
<td>83</td>
<td>50</td>
<td>43</td>
<td>23</td>
<td>17</td>
<td>6</td>
<td>11</td>
</tr>
<tr>
<td></td>
<td>%</td>
<td>55</td>
<td>54</td>
<td>56</td>
<td>48</td>
<td>30</td>
<td>72</td>
<td>54</td>
<td>46</td>
<td>40</td>
<td>55</td>
</tr>
<tr>
<td>1</td>
<td>#</td>
<td>14</td>
<td>17</td>
<td>21</td>
<td>16</td>
<td>14</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>%</td>
<td>7</td>
<td>8</td>
<td>10</td>
<td>9</td>
<td>8</td>
<td>3</td>
<td>7</td>
<td>8</td>
<td>13</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>#</td>
<td>24</td>
<td>35</td>
<td>34</td>
<td>28</td>
<td>32</td>
<td>3</td>
<td>1</td>
<td>4</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>%</td>
<td>11</td>
<td>17</td>
<td>2</td>
<td>16</td>
<td>19</td>
<td>5</td>
<td>2</td>
<td>11</td>
<td>0</td>
<td>10</td>
</tr>
<tr>
<td>3</td>
<td>#</td>
<td>11</td>
<td>8</td>
<td>10</td>
<td>12</td>
<td>11</td>
<td>1</td>
<td>4</td>
<td>5</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>%</td>
<td>5</td>
<td>4</td>
<td>5</td>
<td>7</td>
<td>7</td>
<td>2</td>
<td>9</td>
<td>14</td>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td>4</td>
<td>#</td>
<td>5</td>
<td>7</td>
<td>10</td>
<td>8</td>
<td>19</td>
<td>4</td>
<td>1</td>
<td>3</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>%</td>
<td>2</td>
<td>3</td>
<td>5</td>
<td>5</td>
<td>12</td>
<td>7</td>
<td>2</td>
<td>8</td>
<td>7</td>
<td>0</td>
</tr>
<tr>
<td>5</td>
<td>#</td>
<td>11</td>
<td>10</td>
<td>9</td>
<td>9</td>
<td>6</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>%</td>
<td>5</td>
<td>5</td>
<td>4</td>
<td>5</td>
<td>4</td>
<td>0</td>
<td>2</td>
<td>5</td>
<td>20</td>
<td>5</td>
</tr>
<tr>
<td>6</td>
<td>#</td>
<td>11</td>
<td>9</td>
<td>0</td>
<td>5</td>
<td>7</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>%</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
Table 3.2 indicates several things. Firstly, it shows that a very high percentage of teachers did not use computers at all in the first and the second terms of the Year. For example, 55% of year 9 level teachers who responded to this question did not use computers in the first two terms at all. This table also supports the result which says that use of computers in year 13C is low compared with year 13S, and that the majority of
teacher use computers for only 1-2 periods a term. The table further shows that a small group of teachers recorded the largest proportion of periods' in which computers were used. For example, 2% of year 9 level teachers recorded 35% of the total periods in which a computer was used for the first and second terms. The same result applied to other levels also, except year 13S where the use of computers is not limited to a small number of teachers, and the percentage of non-users is the smallest.

Despite this discouraging finding, the results bode well. There are a group of teachers very committed to integrating computers into the teaching-learning process. Though they are a small minority, those who used computers in 20 or more periods a term are good examples of commitment, and show promise of driving the government's stated goal of computer use in the teaching-learning process.

When the data was examined in relation to gender, results show that the overall numbers of male and female users are not widely different at most levels. See Figure 3.7

**Figure (3.7)**

*Computers use over year levels of mainstream classes in relation to gender*

![Bar chart showing computer use by gender across different years.](image-url)
On the other hand, male teachers recorded most of the high frequencies of usage. If the frequencies greater than or equal to 8 periods a term and up are considered, the difference becomes very pronounced in favour of male teachers. See table 3.3

<table>
<thead>
<tr>
<th>Periods per term</th>
<th>Gender</th>
<th>Y9</th>
<th>Y10</th>
<th>Y11</th>
<th>Y12</th>
<th>Y13S</th>
<th>Y13C %</th>
</tr>
</thead>
<tbody>
<tr>
<td>≥2</td>
<td>Male</td>
<td>93</td>
<td>78</td>
<td>80</td>
<td>74</td>
<td>88</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>78</td>
<td>77</td>
<td>71</td>
<td>90</td>
<td>87</td>
<td>75</td>
</tr>
<tr>
<td>≥4</td>
<td>Male</td>
<td>51</td>
<td>35</td>
<td>27</td>
<td>40</td>
<td>54</td>
<td>89</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>45</td>
<td>26</td>
<td>26</td>
<td>35</td>
<td>47</td>
<td>38</td>
</tr>
<tr>
<td>≥6</td>
<td>Male</td>
<td>36</td>
<td>22</td>
<td>8</td>
<td>23</td>
<td>32</td>
<td>78</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>29</td>
<td>11</td>
<td>3</td>
<td>14</td>
<td>26</td>
<td>0</td>
</tr>
<tr>
<td>≥8</td>
<td>Male</td>
<td>20</td>
<td>12</td>
<td>8</td>
<td>14</td>
<td>29</td>
<td>56</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>8</td>
<td>6</td>
<td>3</td>
<td>12</td>
<td>13</td>
<td>0</td>
</tr>
<tr>
<td>≥10</td>
<td>Male</td>
<td>13</td>
<td>10</td>
<td>8</td>
<td>12</td>
<td>19</td>
<td>44</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>7</td>
<td>6</td>
<td>0</td>
<td>12</td>
<td>6</td>
<td>0</td>
</tr>
<tr>
<td>≥20</td>
<td>Male</td>
<td>9</td>
<td>2</td>
<td>4</td>
<td>5</td>
<td>3</td>
<td>44</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>4</td>
<td>0</td>
<td>0</td>
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<td>0</td>
</tr>
<tr>
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</tr>
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<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Generally speaking, then, the results show a low frequency use of computers in secondary mathematics classroom teaching. The overall amount of time spent in using computers does not seem sufficient to develop students who are using computers as a routine tool in their learning in a confident and competent way, especially in tasks like those mentioned in the mathematics curriculum such as reasoning, discovering, exploring, and analysing.
3.3 Using computers in teaching different strands of the curriculum

The amount of time spent using computers is not the only factor that gives an indication of the extent to which computers are being used. The range of topics involved, and the different curriculum strands for which computers are being used, are also important.

MiNZC (Ministry of Education, 1992, p. 14) states:

“Computer programmes provide excellent environments for mathematical experimentation and open-ended problem solving”.

It also states:

“The mathematical processes skills – problem solving, reasoning, and communicating mathematical ideas - are learned and assessed within the context of the more specific knowledge and skills of number, measurement, geometry, algebra, and statistics [mathematics curriculum strands]” (ibid, p. 23).

It also adds:

“This curriculum statement assumes that ... computers will be available and used in the teaching and learning of mathematics at all levels” (ibid, p. 14)

In its report, the Consultative Committee on Computers in Schools (CCCS) pointed to the educational goal for computers to benefit all students (Department of Education, 1982).

These quotations show a governmental emphasis on using computers for teaching
mathematical processes skills, within a mathematical knowledge context, in all strands of curriculum, and at all year levels.

This section is a description of two dimensions of computer use in teaching various curriculum strands. The first dimension is how widely computers are used among teachers in terms of year level and curriculum strands which computers can be used to serve. The second dimension is how widely computers are being used within each curriculum strand, in terms of the proportion of topics for which they are being used.

3.3.1 How widely is computer use spread among teachers?

Teachers were asked about their use of computers in teaching each strand of the mathematics curriculum at each year level. Results for mainstream mathematics classes, years 9, 10, 11, 12, 13S, and 13C were studied separately from mathematics applied classes for two reasons. First, is to simplify the process of studying the collected data. Second, is to avoid any misleading representations, which may result from the big difference in numbers of respondent teachers for both those categories.

(a) Results related to different levels of mainstream classes

*Curriculum strands

The results show a tendency for the statistics strand to be the area where computers were most utilised at all levels. The number strand comes second in computer use at the junior levels, while Algebra strand comes second to statistics strand at senior levels.
Measurement and mathematical processes strands are the areas with the lowest use of computer. See Table 3.4

**Table (3.4)**

**Computers use over the curriculum strands**  
_(n = number of teachers, p = percentage)_

<table>
<thead>
<tr>
<th>Strand</th>
<th>Number/Year</th>
<th>Number</th>
<th>P</th>
<th>Measurement</th>
<th>Number</th>
<th>P</th>
<th>Geometry</th>
<th>Number</th>
<th>P</th>
<th>Algebra</th>
<th>Number</th>
<th>P</th>
<th>Statistics</th>
<th>Number</th>
<th>P</th>
<th>Mathematical Processes</th>
<th>Number</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>9</td>
<td></td>
<td>65</td>
<td>68%</td>
<td>50</td>
<td>36%</td>
<td></td>
<td>58</td>
<td>48%</td>
<td></td>
<td>54</td>
<td>54%</td>
<td></td>
<td>70</td>
<td>74%</td>
<td></td>
<td>49</td>
<td>45%</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td></td>
<td>68</td>
<td>66%</td>
<td>57</td>
<td>42%</td>
<td></td>
<td>65</td>
<td>59%</td>
<td></td>
<td>62</td>
<td>61%</td>
<td></td>
<td>75</td>
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<tr>
<td>11</td>
<td></td>
<td>66</td>
<td>65%</td>
<td>52</td>
<td>44%</td>
<td></td>
<td>61</td>
<td>61%</td>
<td></td>
<td>64</td>
<td>64%</td>
<td></td>
<td>70</td>
<td>90%</td>
<td></td>
<td>49</td>
<td>55%</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td></td>
<td>40</td>
<td>43%</td>
<td>39</td>
<td>39%</td>
<td></td>
<td>46</td>
<td>46%</td>
<td></td>
<td>49</td>
<td>65%</td>
<td></td>
<td>62</td>
<td>82%</td>
<td></td>
<td>38</td>
<td>55%</td>
<td></td>
</tr>
<tr>
<td>13Stat</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td></td>
<td>---</td>
<td>---</td>
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<td></td>
<td>---</td>
<td>---</td>
<td></td>
<td>---</td>
<td>---</td>
<td></td>
</tr>
<tr>
<td>13Calc</td>
<td>14</td>
<td>14%</td>
<td></td>
<td>15</td>
<td>20%</td>
<td></td>
<td>18</td>
<td>33%</td>
<td></td>
<td>18</td>
<td>39%</td>
<td></td>
<td>---</td>
<td>---</td>
<td></td>
<td>12</td>
<td>25%</td>
<td></td>
</tr>
<tr>
<td><strong>Average</strong></td>
<td></td>
<td>51.2%</td>
<td></td>
<td>36.2%</td>
<td>49.4%</td>
<td></td>
<td>56.6%</td>
<td>84.2%</td>
<td></td>
<td>47%</td>
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<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

This table shows that the difference between the rate of computer use in statistics and other strands is noticeable. This is probably due to the fact that students are required to do statistics assignments and projects using computers, in which their results contribute towards their final grade. Although this issue needs more investigation, it raises the question about the relation between the use of computers and the assessment system.
The results also show a decreasing trend in the use of computers to teach number strand topics as the year level rises. The drop becomes clearer between year 12 and year 13C.

Figure 3.8

**Figure (3.8)**

Computers use for teaching topics of the number strand at different levels of mainstream mathematics classes
In relation to statistics and algebra strands, however, the case is the opposite. Here there is an increasing trend of computer use as the year level rises.

See Figure 3.9, and Figure 3.10

**Figure (3.9)**

Computer use for teaching topics of the statistics strand at different levels of mainstream mathematics classes

**Figure (3.10)**

Computers use for teaching topics of the algebra strand at different levels of mainstream mathematics classes
Results indicate that computers are used more often at junior (years 9, 10, and 11) than at senior level, except at the level of year 13S classes. Computers tended to be used most often at year 11, although this varies from strand to strand. See Figures 3.11 and 3.12

Figure (3.11)

Computers use for teaching number, measurement, and geometry strands at different levels of mainstream mathematics classes
Figure (3.12)

Computers use for teaching algebra, statistics, and mathematical processes strands at different levels of mainstream mathematics classes
(b) Results related to mathematics-applied classes

*Curriculum strands

The statistics strand is the area where computer use is highest, followed by the number strand. See Figure 3.13

**Figure (3.13)**

Computers use for teaching the curriculum strands at different levels of mathematics applied classes
* The year level

Generally, results indicate that the year 13MAP is the level where computers have the most use. See Figure 3.14

**Figure (3.14)**

*Computers use for teaching number, measurement, and geometry strands at different levels of mathematics applied classes*
The overall results indicate that the use of computers varies on the basis of two dimensions: the curriculum strand, and the year level. With respect to the first dimension the statistics strand was the area displaying the highest use at all year levels. In the second dimension year 11 was the level recording most use in mainstream mathematics classes, and year 13 MAP in mathematics applied classes.

3.3.2 How widely is computer use spread within each curriculum strand?

To get a better understanding of computer use within each strand, teachers were asked what proportion of each strand’s topics they use computers to teach. The results show that computers are used for teaching, only a small proportion or range of topics within all curriculum strands.
Irrespective of how often computers are used by teachers, Table 3.5 shows that computers are used for teaching ‘few’ or ‘very few’ topics within any given curriculum strand.

<table>
<thead>
<tr>
<th>Year</th>
<th>Strand</th>
<th>Number</th>
<th>Measurement</th>
<th>Geometry</th>
<th>Algebra</th>
<th>Statistics</th>
<th>Mathematical Processes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>n P1 P2</td>
<td>n P1 P2</td>
<td>n P1 P2</td>
<td>n P1 P2</td>
<td>n P1 P2</td>
<td>n P1 P2</td>
</tr>
<tr>
<td>9</td>
<td></td>
<td>65 5</td>
<td>42 30</td>
<td>20 58</td>
<td>4 32</td>
<td>26 45</td>
<td>32 70 43 67 49 37</td>
</tr>
<tr>
<td>10</td>
<td></td>
<td>68 3</td>
<td>34 57</td>
<td>21 65</td>
<td>5 26</td>
<td>23 62</td>
<td>34 75 83 33 55 2 31</td>
</tr>
<tr>
<td>11</td>
<td></td>
<td>66 3</td>
<td>35 52</td>
<td>2 61</td>
<td>5 23</td>
<td>3 64</td>
<td>3 70 7 33 49 0 31</td>
</tr>
<tr>
<td>12</td>
<td></td>
<td>40 3</td>
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<td>0 23</td>
<td>4 67</td>
<td>9 49</td>
<td>3 62 16 26 38 0 21</td>
</tr>
<tr>
<td>13S</td>
<td>Stat</td>
<td>- -</td>
<td>- -</td>
<td>- -</td>
<td>- -</td>
<td>- -</td>
<td>20 60 28</td>
</tr>
<tr>
<td>13C</td>
<td>Calc</td>
<td>- -</td>
<td>14 15</td>
<td>0 18</td>
<td>11 11</td>
<td>6 18</td>
<td>28 - - 12 0 8</td>
</tr>
<tr>
<td>11M</td>
<td>Map</td>
<td>12 13</td>
<td>15 13 15</td>
<td>15 13</td>
<td>15 15 15</td>
<td>13 15 15</td>
<td>17 18 47 11 9 27</td>
</tr>
<tr>
<td>12M</td>
<td>Map</td>
<td>10 0</td>
<td>30 8</td>
<td>0 25</td>
<td>4 6 0</td>
<td>17 12</td>
<td>33 8 0 0</td>
</tr>
<tr>
<td>13M</td>
<td>Map</td>
<td>2 0</td>
<td>0 2 50</td>
<td>0 2 50</td>
<td>0 2 50</td>
<td>4 50</td>
<td>0 3 0 0</td>
</tr>
</tbody>
</table>

**Key**  
- n: total number of users,  
- P1: users for ‘all’ or ‘most’ topics,  
- P2: users for ‘few’ or ‘very few’ topics

This table shows that even in the statistics strand, which is the area where computers were used the most, the proportion of topics that computers are used in is small. For example, at Year 13S level the percentage of teachers who use computers in teaching statistics in general is 95% of teachers who responded to the question. Only 20% of these use computers to teach ‘all’ or ‘most’ of the strand topics, and 28.3% of them use computers for teaching ‘few’ or ‘very few’ topics.

Figure 3.16 clarifies this result a little more. It displays the percentage of teachers who use computers for teaching any statistics topics (P1) or for teaching ‘few’ or ‘very few’ topics (P2) or for teaching ‘all’ or ‘most’ topics (P3) at different year levels of
mainstream mathematics classes. Mathematics applied and other classes are not included in the Figure because of the small numbers of teachers who responded to this question Table (3.5).

**Figure (3.16)**

**Frequency of computer use in teaching statistics strand at different levels of mainstream mathematics classes**

<table>
<thead>
<tr>
<th>Percentage</th>
<th>P1</th>
<th>P2</th>
<th>P3</th>
<th>Y9</th>
<th>Y10</th>
<th>Y11</th>
<th>Y12</th>
<th>Y13S</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>80</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>60</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>40</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Key: P1: total number of users, P1: users for “few” or “very few” topics, P2: users for “all” or “most” topics

The overall results show that computers were used in teaching ‘few’ or ‘very few’ topics in most curriculum strands. There was little computer use in Measurement, Geometry and Mathematical Processes strands. There was certainly insufficient use to ‘benefit all students’ at all levels was not even. The most frequent computer use was for junior and statistics classes.
3.4 Use of the Internet

Internet is described as information superhighways bringing together all world parts (as cited in Davis, 1997). It is not only a rich source of information but also an opportunity for more collaborative work between different groups of students from different parts of the world (Davis, 1997). Brown and Ryba (1996) argued that Internet could be used to support ‘good’ teaching practice.

The results of this research suggest that depending on the Internet, as a source of software applications that used in the classroom teaching-learning process seems to be secondary after applications provided by other sources. Results imply that only 45% of them depend on applications provided by Internet.

Although the Internet is the second most used source of software applications, commitment to its use is not very strong. It is used ‘very often’ or ‘often’ by just 18% of its users, while 44% of them use it ‘very little’ or ‘little’.
The most common use of Internet applications was at junior levels (years 9, 10, and 11). See Figure 3.17

**Figure (3.17)**

Teachers' use of the Internet at various class levels ($n = 47$)
Although, the Internet was mainly used to serve the statistics strand, it was used relatively evenly to serve other curriculum strands except mathematical processes strand where it was used much less. See Figure 3.18

**Figure (3.18)**

*Teachers’ use of the Internet to serve various curriculum strands (n = 37)*

Forty teachers reported use of various web sites for their daily teaching practice. The majority of them (68%) used “*maths on line*”. [www.glo.co.nz](http://www.glo.co.nz), and [www.nrich.maths.org](http://www.nrich.maths.org) were also included in the list of sites used.
3.5 Summary

Overall, computers have a small frequency of use (1% of the actual number of teaching periods). They are not being used to teach all curriculum strands. Users of computers in some strands, like geometry, mathematical processes, and measurement are a small group of teachers. Where computers are being used they are used to teach ‘few’ or ‘very few’ of the topics within a strand. Also they tend not to be used evenly across all year levels. Most teachers depend on schools to provide the software applications through the Network/Hard Drive. Using the Internet as a source of software applications is second in order, and there is only a little commitment to its use.
Chapter (4)

Purposes of computer use
Chapter (4)

Purposes of Computer Use

This chapter is an attempt to answer the second sub-question: For what curriculum purposes have teachers used computers in their day-to-day practice?

4.1 Introduction

To understand the actuality of computer use in classroom it is not sufficient to know the quantity or frequency of use. We must also discover the quality of that use; how computers are used, for what purposes, and with what level of proficiency.

Using computers for classroom teaching is mentioned directly in MiNZC more than 32 times in different places. In Geometry strand alone, LOGO program was recommended for use 9 times in several activities. Spreadsheets were recommended in 4 different places in Statistics strand. Specific purposes for usage are also mentioned.

MiNZC states:

“Computer programmes provide excellent environments for mathematical experimentation and open-ended problem solving”

“Computers are learning tools which students can use to discover and reinforce new ideas... computer software are tools which enable students to concentrate on mathematical ideas rather than on routine mechanical manipulation” (ibid, p. 14).

MiNZC also states:

“The mathematical processes skills - problem solving, reasoning, and communicating mathematical ideas - are learned and assessed within the context of the more specific knowledge and skills of number, measurement, geometry, algebra, and statistics [mathematics curriculum strands]” (p. 23).

Thus, using computers for specific purposes such as mathematical experimentation, open-ended problem solving, reasoning, communicating and concentrating on mathematical ideas, and discovering and reinforcing new ideas are all tasks emphasised in curriculum documents in terms of higher order mental processes.

Educators also point to the potential of computers in classroom teaching. Zbiek (1998) has suggested using computers to improve mathematical modelling. Others argued that they could increase construction of higher-level conceptualisation in geometry (Gentile et al, 1994). Some studies have also reported the computers’ potential to improve high-level reasoning and problem solving (Baker, Geerheart, and Herman, 1993; Sandholtz et al, 1997). Most of these purposes support constructivist-learning theory.

This chapter will try to paint a picture about what is happening in the classroom to help understanding how, and for what purposes, mathematics teachers are using computers.
4.2 Software types

4.2.1 Popular software

Teachers were asked about their use of Spreadsheets, Word Processing, and Logo software. Results were:

*Software ranked by user choice

Available figures show that the vast majority of mathematics teachers who use computers with classes use Spreadsheet software. There was a noticeable difference between the number of users of Spreadsheet software and the number of users of other software. Although the LOGO program was recommended many times in many places in MiNZC, its usage was restricted to a very small minority of teachers. See Figure 4.1

Figure (4.1)

Teachers’ use of some popular software

![Software usage chart]

Number of users

Spreadsheet  Word  LOGO

Software type
* Software choice ranked by year levels

Although the greatest use of Spreadsheet software was at year levels 11 and 9, there is a strong tendency for spreadsheets to be used at all year levels. The lowest use of Spreadsheet is at the year 13C level and mathematics applied classes.

Similarly, Word Processing software tends to be used at all levels, but especially in Junior, where greatest use is at year levels 10 and 9.

Teachers were inclined to use LOGO at the year levels 9, 10 only. For details see Table 4.1

Table (4.1)

<table>
<thead>
<tr>
<th>Software type</th>
<th>Number of users (n)</th>
<th>Y9</th>
<th>Y10</th>
<th>Y11</th>
<th>Y12</th>
<th>Y13S</th>
<th>Y13C</th>
<th>Mathematics Applied %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spreadsheet</td>
<td>153</td>
<td>46</td>
<td>44</td>
<td>48</td>
<td>31</td>
<td>39</td>
<td>4</td>
<td>19</td>
</tr>
<tr>
<td>Word</td>
<td>45</td>
<td>36</td>
<td>38</td>
<td>22</td>
<td>31</td>
<td>36</td>
<td>4</td>
<td>20</td>
</tr>
<tr>
<td>LOGO</td>
<td>15</td>
<td>53</td>
<td>67</td>
<td>7</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>7</td>
</tr>
</tbody>
</table>

* Software use in curriculum strands

The strand in which teachers recorded the highest use of Spreadsheet and Word Processing software was Statistics. Eighty percent of Spreadsheet users and seventy one percent of Word Processing users used them in the Statistics strand.
Although the number of the LOGO users is relatively small, all of them linked its use to the Geometry strand. See Table 4.2

Table (4.2)

Teachers’ use of some popular software to serve various curriculum strands

<table>
<thead>
<tr>
<th>Software type</th>
<th>Number of users (n)</th>
<th>Number</th>
<th>Measurement</th>
<th>Geometry</th>
<th>Algebra</th>
<th>Statistics</th>
<th>Mathematical processes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spreadsheet</td>
<td>145</td>
<td>48</td>
<td>12</td>
<td>13</td>
<td>36</td>
<td>80</td>
<td>15</td>
</tr>
<tr>
<td>Word</td>
<td>35</td>
<td>29</td>
<td>11</td>
<td>17</td>
<td>14</td>
<td>71</td>
<td>40</td>
</tr>
<tr>
<td>LOGO</td>
<td>13</td>
<td>0</td>
<td>0</td>
<td>100</td>
<td>0</td>
<td>0</td>
<td>8</td>
</tr>
</tbody>
</table>

4.2.2 Mathematics-topics software

Teachers were asked about their use of mathematical software packages relevant to algebra, geometry, graphing, and statistics topics. Results show the use of a wide range of software in each of these topic areas.

* Software ranked by user choice

Statistics and graphing packages seemed to be used by more teachers than algebra and geometry software. The number of users of statistics or graphing software is more than
double the number for users of algebra or geometry software. See Figure 4.2

Figure (4.2)

Teachers’ use of some mathematics-topics software

* Software choice ranked by year levels

Algebra software seemed to be used more at junior levels (years 9, 10, & 11) than at senior levels. Year 11 level had the highest usage of geometry and graphing software; while statistics software received the highest use at year 13S level the most
Although mathematics-topics software was used to some extent at all year levels, there is a clear tendency for usage to be less at year 13C compared with other levels. See Table 4.3

**Table (4.3)**

**Teachers' use of some mathematics-topics software**

at various class levels

<table>
<thead>
<tr>
<th>Software type</th>
<th>Number of users (n)</th>
<th>Y9</th>
<th>Y10</th>
<th>Y11</th>
<th>Y12</th>
<th>Y13S</th>
<th>Y13C</th>
<th>Mathematics Applied</th>
</tr>
</thead>
<tbody>
<tr>
<td>Algebra</td>
<td>23</td>
<td>35</td>
<td>39</td>
<td>39</td>
<td>26</td>
<td>17</td>
<td>4</td>
<td>9</td>
</tr>
<tr>
<td>Geometry</td>
<td>37</td>
<td>43</td>
<td>46</td>
<td>81</td>
<td>14</td>
<td>3</td>
<td>14</td>
<td>5</td>
</tr>
<tr>
<td>Graphing</td>
<td>68</td>
<td>18</td>
<td>26</td>
<td>57</td>
<td>47</td>
<td>26</td>
<td>16</td>
<td>7</td>
</tr>
<tr>
<td>Statistics</td>
<td>73</td>
<td>21</td>
<td>36</td>
<td>33</td>
<td>29</td>
<td>56</td>
<td>1</td>
<td>14</td>
</tr>
</tbody>
</table>

*Software use in curriculum strands*

Except in respect of graphing software, where it was mainly used to serve the algebra strand, the other software were mostly used to serve the relevant strand of that topic. Mathematics-topics software was used least in the measurement and mathematical processes strands. See Table 4.4
Table (4.4)

Teachers’ use of some mathematics-topics software
to serve various curriculum strands

<table>
<thead>
<tr>
<th>Software type</th>
<th>Number of users (n)</th>
<th>Number</th>
<th>Measurement</th>
<th>Geometry</th>
<th>Algebra</th>
<th>Statistics</th>
<th>Mathematical processes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Algebra</td>
<td>23</td>
<td>13</td>
<td>4</td>
<td>4</td>
<td>96</td>
<td>13</td>
<td>22</td>
</tr>
<tr>
<td>Geometry</td>
<td>33</td>
<td>6</td>
<td>3</td>
<td>97</td>
<td>9</td>
<td>9</td>
<td>6</td>
</tr>
<tr>
<td>Graphing</td>
<td>61</td>
<td>10</td>
<td>5</td>
<td>31</td>
<td>69</td>
<td>30</td>
<td>7</td>
</tr>
<tr>
<td>Statistics</td>
<td>72</td>
<td>3</td>
<td>1</td>
<td>3</td>
<td>4</td>
<td>100</td>
<td>7</td>
</tr>
</tbody>
</table>

The results revealed that a wide range of mathematics-topics software is available in schools and being used by teachers.

In algebra area the most widely used packages were “Anugraph” and “Green Globs”. For geometry, “Geometer” was the most popular package. Among a wide range of different Graphing software, the “Graphmatica”, “Anugraph” and “Green Globs” were the three most used by teachers.

A broad range of packages was used for Statistics, but “PC INFOS”, “Minitab”, “Statplot”, and “Statview” were at the top of the list.

4.2.3 Purposive software

Educational mathematics software may be categorised as taking these forms: drill and practice, tutorial, learning games, and simulations. Many of New Zealand secondary schools hold a range of all such packages. This section describes the responses of teachers to the use of these types of software.
Teachers tend to use these types of software in more or less equal proportions, except for tutorial software, which is used less than the others. See Figure 4.3

**Figure (4.3)**

*Teachers' use of some purposive software*

The greatest use of drill and practice software occurred at year levels 11, 10, and 9 respectively. The number of users at these levels is evidently greater than the number of users at other levels. This indicates that drill and practice software is used for junior rather than senior levels. See Table 4.5

Learning games software is more likely to be used solely for junior mainstream mathematics classes, with most use at the year 9 level. There was no use of this software type either at senior normal levels or in mathematics applied or other classes.

The greatest use of simulation software is in year 13S. The use of this software type is
small at other levels. Table 4.5 shows more details.

*Table (4.5)*

Teachers’ use of some purposive software
at various class levels

<table>
<thead>
<tr>
<th>Software type</th>
<th>Number of users (n)</th>
<th>Y9</th>
<th>Y10</th>
<th>Y11</th>
<th>Y12</th>
<th>Y13S</th>
<th>Y13C</th>
<th>Mathematics Applied %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drill &amp; Practice</td>
<td>24</td>
<td>42</td>
<td>50</td>
<td>50</td>
<td>8</td>
<td>4</td>
<td>0</td>
<td>17</td>
</tr>
<tr>
<td>Tutorial</td>
<td>19</td>
<td>32</td>
<td>32</td>
<td>47</td>
<td>37</td>
<td>37</td>
<td>21</td>
<td>5</td>
</tr>
<tr>
<td>Learning Games</td>
<td>26</td>
<td>69</td>
<td>22</td>
<td>23</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Simulation</td>
<td>29</td>
<td>17</td>
<td>10</td>
<td>21</td>
<td>28</td>
<td>66</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>

*Curriculum strands*

Drill and practice and learning games software were used most for number and algebra strands, while most use of simulations software was in the statistics strand. Tutorial software seems to be used more or less evenly for all curriculum strands. See Table 4.6

*Table (4.6)*

Teachers’ use of some purposive software
to serve various curriculum strands

<table>
<thead>
<tr>
<th>Software type</th>
<th>Number of users (n)</th>
<th>Number</th>
<th>Measurement</th>
<th>Geometry</th>
<th>Algebra</th>
<th>Statistics</th>
<th>Mathematical processes %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drill &amp; Practice</td>
<td>25</td>
<td>68</td>
<td>52</td>
<td>52</td>
<td>72</td>
<td>44</td>
<td>28</td>
</tr>
<tr>
<td>Tutorial</td>
<td>11</td>
<td>73</td>
<td>64</td>
<td>55</td>
<td>82</td>
<td>82</td>
<td>55</td>
</tr>
<tr>
<td>Learning Games</td>
<td>24</td>
<td>71</td>
<td>21</td>
<td>38</td>
<td>58</td>
<td>17</td>
<td>21</td>
</tr>
<tr>
<td>Simulation</td>
<td>26</td>
<td>15</td>
<td>8</td>
<td>8</td>
<td>12</td>
<td>96</td>
<td>19</td>
</tr>
</tbody>
</table>

70
4.3 Purpose

Research reported a strong relationship between the effectiveness of computer use for classroom teaching and the way in which they are being used. The Education Review Office (1997), in its report *The Use of Information Technology in Schools* emphasised *that* "the extent to which information technology can improve student achievement is strictly related to how it is used" (p. 4). Also, Ryba (1992) argued "not the features inherent in the computer but what people do with the technology that determines its effectiveness" (p. 86). Therefore, it is important for getting a clearer picture for the current situation of computer use to know the purposes for which mathematics teachers use them.

Teachers were asked about the purposes for which they use computers with classes. Results show that the most use of computers is for recording student results and test designing. See Figure 4.4

*Figure (4.4)*

**General purposes of computer use**

![Bar chart showing purposes of computer use](image-url)
To better understand the purposes for which teachers use computers, they were also asked how often they used them for each individual purpose.

About 85% of teachers used computers ‘very often’ or ‘often’ in test designing and for recording student results, while only 12% of teachers used computers to that extent for classroom teaching. About 68% of teachers used computers in ‘sometimes’ or ‘rarely’ rate for classroom teaching. See Table 4.7

<table>
<thead>
<tr>
<th>Purpose</th>
<th>Number of teachers (n)</th>
<th>Very often</th>
<th>Often</th>
<th>Sometimes</th>
<th>Rarely</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test designing</td>
<td>191</td>
<td>62</td>
<td>24</td>
<td>13</td>
<td>1</td>
</tr>
<tr>
<td>Lesson planning</td>
<td>136</td>
<td>23</td>
<td>18</td>
<td>36</td>
<td>23</td>
</tr>
<tr>
<td>Classroom teaching</td>
<td>165</td>
<td>4</td>
<td>8</td>
<td>43</td>
<td>45</td>
</tr>
<tr>
<td>Classroom management</td>
<td>79</td>
<td>20</td>
<td>18</td>
<td>28</td>
<td>34</td>
</tr>
<tr>
<td>Classroom materials</td>
<td>159</td>
<td>25</td>
<td>23</td>
<td>33</td>
<td>20</td>
</tr>
<tr>
<td>Student result recording</td>
<td>201</td>
<td>59</td>
<td>26</td>
<td>10</td>
<td>5</td>
</tr>
<tr>
<td>Communication with parents</td>
<td>154</td>
<td>32</td>
<td>33</td>
<td>21</td>
<td>14</td>
</tr>
</tbody>
</table>
Figure 4.5 offers a closer look at the purposes of teachers’ use of computers. It indicates that the commitment to computer use for administrative purposes is high. This situation is directly opposite to that of computer use for classroom teaching purposes.

**Figure (4.5)**

**Frequency of computer use for various general purposes**

These results suggest that the greatest use of computers is for doing job tasks other than actual classroom teaching.
4.4 The use of computers for different classroom teaching tasks

Teachers were asked for what teaching tasks they used computers. Results indicate that the most frequent use of computers was for extending pre-taught material, followed by practicing pre-taught material. See Figure 4.6

Figure (4.6)

Teachers’ use of computers for various classroom teaching-learning tasks

Using computers for mixed problem solving or explaining new material is relatively little.
Teachers were asked how often they used computers for these teaching tasks. Results indicate that although computers are used mostly for practicing and extending pre-taught material, the frequency of use is generally low. See Figure 4.7 and Table 4.8 for details.

**Figure (4.7)**

**Frequency of computer use for different classroom teaching tasks**

![Bar chart showing frequency of computer use for different tasks: Introducing new material, Explaining new material, Practicing pre-taught material, Extending pre-taught material, Solving mixed problems. The chart indicates that Very Often/Often tasks have the highest usage, followed by Sometimes/Rarely tasks.](image-url)
Table (4.8)
Frequency of computer use for different tasks of classroom teaching purpose

<table>
<thead>
<tr>
<th>Task</th>
<th>Number of users (n)</th>
<th>% of users</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Very often</td>
<td>Often</td>
</tr>
<tr>
<td>Introducing new material</td>
<td>117</td>
<td>3</td>
</tr>
<tr>
<td>Explaining new material</td>
<td>102</td>
<td>3</td>
</tr>
<tr>
<td>Practicing pre-taught material</td>
<td>125</td>
<td>4</td>
</tr>
<tr>
<td>Extending pre-taught material</td>
<td>132</td>
<td>5</td>
</tr>
<tr>
<td>Solving mixed problems</td>
<td>90</td>
<td>1</td>
</tr>
</tbody>
</table>

This table indicates little use of computers for problem solving or explaining new material. For example, 45% of users rarely use computers for introducing or explaining new material, and 53% of them rarely use computers for mixed problem solving. Therefore, results indicate that computers usage is more aimed at lower order reinforcement than at higher order conceptualisation, or reasoning or discovering new ideas.
Teachers also were asked to mention in which parts of a period they used computers. Results have shown that the majority of teachers used computers for a whole period. Use of computers for only a specific part of a period was little. See Figure 4.8

**Figure (4.8)**

Teachers’ use of computers in different parts of the teaching period

![Bar chart showing use of computers at different parts of the teaching period](chart.png)

This result can be understood in the light of when linked to the previous results. It is not surprising when it is remembered that computers were not used for conceptualisation or to explore on a concept, theory or a topic, which does not always need a time of a whole period. The majority of teachers used computers to teach statistics for “extending or practicing pre-taught material”. This might well require use of a computer for a whole period. In addition, the fact that many schools require computer laboratories to be booked for the whole period encourages such whole period use, and tasks that suit whole periods.
It could be argued that using computers for a 'whole period' to 'extend or practice a pre-taught material' reduces the possibility of using constructivist and discovery approaches, which are implicitly and explicitly recommended in the curriculum statement. This point needs further investigation, but it would seem from available results that computers are most likely being used either for statistics-simulation or drill and practice.

4.5 Summary

Overall, the results discussed in this chapter show that the majority of teachers use computers more for administrative purposes than for teaching and learning tasks. When the computer is used for teaching and learning it is used for extending or practicing a pre-taught topic in a whole period. Spreadsheet and Graphing software are the most frequently used types of software. Generally, the use of computers seems to be aimed at lower than higher order levels of thinking.

These results suggest a question for further research. That is: "Do our teachers adopt a constructivist approach in their teaching and learning practice, or is it something else?"

However, these results indicate that computers are relatively little used as learning tools which students can use for reasoning, communicating and concentrating on mathematical ideas, or for discovering and reinforcing new ideas in a way that satisfies the ambitions and the desires of the curriculum.
Chapter (5)

Teachers’ views on computers’ use in mathematics teaching
Chapter (5)

Teachers’ Views on Computers’ Use in Mathematics Teaching

5.1 Introduction

The third question guiding this research is: “what are the views of New Zealand high school mathematics teachers about computer technology in the teaching process?”

Many educators claim that teachers’ beliefs and attitudes to the technology are highly related to their classroom practices (Albion, 1998; Robinson, 1995). Therefore teachers’ beliefs are vital for their success at integrating computers into their daily practice.

This chapter aims to outline the views of mathematics teachers about using computers for teaching mathematics. These views will be examined from three different angles: First, their general conception of computer use in mathematics teaching. Second, their opinion in the light of their actual experience, and Third their vision for computers use in New Zealand high schools in the next 10 years.
5.2 Teachers’ general perception of using computers in mathematics teaching

The research provides clear evidence that teachers’ beliefs about the mathematics content knowledge and how it should be taught are very important in explaining how they teach their subject. A teacher’s belief is implicit in the way s/he teaches. In a qualitative study carried by Norton and his colleagues, they found that ‘there were a relationship between teachers’ use of computer technology, their beliefs about teaching and learning and their teaching practices’ (Norton, McRobbie & Cooper, 2000).

Results of this research show that the great majority of mathematics teachers clearly perceive a positive role for computers in teaching mathematics and developing mathematical processes skills. When teachers were asked about their level of agreement with some statements related to computer use in mathematics teaching, the results indicated that: 57% of them ‘disagreed’ or ‘strongly disagreed’ with the statement, “computers are helpful as a main instruction tool of mathematics”. A minority (20%) ‘agreed’ or ‘strongly agreed’. See Figure 5.1

**Figure (5.1)**

*Teachers’ response to the statement “Computers are helpful as a main instruction tool of mathematics” (n=270)*

---

<table>
<thead>
<tr>
<th>Percentage of teachers</th>
<th>Strongly agree</th>
<th>Agree</th>
<th>Not sure</th>
<th>Disagree</th>
<th>Strongly disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>Degree of agreement</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Strongly agree</td>
<td>5</td>
<td>10</td>
<td>5</td>
<td>15</td>
<td>20</td>
</tr>
<tr>
<td>Agree</td>
<td>15</td>
<td>20</td>
<td>10</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Not sure</td>
<td>20</td>
<td>25</td>
<td>15</td>
<td>10</td>
<td>5</td>
</tr>
<tr>
<td>Disagree</td>
<td>25</td>
<td>20</td>
<td>15</td>
<td>10</td>
<td>5</td>
</tr>
<tr>
<td>Strongly disagree</td>
<td>10</td>
<td>15</td>
<td>5</td>
<td>5</td>
<td>5</td>
</tr>
</tbody>
</table>

80
Also, 62% of teachers “agreed” or ‘strongly agreed’ with the statement, “Computers are helpful tools in solving problems”. See Figure 5.2

**Figure (5.2)**

*Teachers’ response to the statement “Computers are helpful tools in solving problems” (n=269)*
Regarding the statement, “Computers suit teaching other subjects more than mathematics”, 41% of teachers disagreed or strongly disagreed with it, whilst 25% of teachers ‘agreed’ or ‘strongly agreed’. So, many teachers suggest that computers are equally suitable for teaching mathematics and other subjects. See Figure 5.3

Figure (5.3)

Teachers’ responses to the statement “Computers suit teaching other subjects more than mathematics” (n=264)
In relation to the debate on the real value of the use of computers in mathematics teaching, 38% of teachers ‘disagree’ or ‘strongly disagree’ with the statement “Generally speaking, computers are given more value in mathematics education than they deserve”. However 36% of teachers are not sure whether this statement is correct or not. Overall, the big percentage of unsure teachers indicates that they have not had enough experience of computer use to judge this statement. See Figure 5.4

**Figure (5.4)**

Teachers’ opinion on the statement “computers are given more value in mathematics education than they deserve” (n=264)
In relation to the frequency of computer use, the majority of teachers believe they should not be used very frequently. Results indicate that 44% of teachers agreed or strongly agreed with the statement, “computers lose their novelty when being used very frequently”. While, 29% of teachers disagreed or strongly disagreed with that statement. See Figure 5.5

**Figure (5.5)**

**Teachers’ responses to the statement “computers lose their novelty when being used very frequently” (n=263)**

Teachers also were asked how useful they thought computers are for students of different abilities. Results indicate that the great majority of teachers believe that computers are useful for teaching students of all levels of abilities.
Ninety nine percent of teachers believe that computers are useful in teaching talented students, and all of these believe the same in the case of ‘above average’ and ‘average’ students. More than 96% of teachers believe in the usefulness of the computer in teaching students of “below average” and “low ability” levels.

The majority of teachers believe that computers are ‘very useful’ for teaching students of all ability levels but perhaps more for high ability than low ability. See Table 5.1

Table (5.1)

<table>
<thead>
<tr>
<th>Ability level</th>
<th>Number of teachers (n)</th>
<th>% of teachers</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Very useful</td>
<td>Useful</td>
<td>Not sure</td>
<td>Low useful</td>
<td>Not useful</td>
</tr>
<tr>
<td>Talented</td>
<td>267</td>
<td>34</td>
<td>49</td>
<td>13</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>Above average</td>
<td>264</td>
<td>22</td>
<td>60</td>
<td>14</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Average</td>
<td>264</td>
<td>16</td>
<td>61</td>
<td>21</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Below average</td>
<td>265</td>
<td>20</td>
<td>51</td>
<td>20</td>
<td>7</td>
<td>2</td>
</tr>
<tr>
<td>Low ability</td>
<td>267</td>
<td>27</td>
<td>38</td>
<td>24</td>
<td>8</td>
<td>3</td>
</tr>
</tbody>
</table>
Also, this table indicates that teachers see the usefulness of computers as increasing with higher student ability levels. See Figure 5.6

**Figure (5.6)**

*Teachers who think computers are ‘useful’ or ‘very useful’ for teaching students of different abilities*
Teachers expressed their perceptions of the three most useful benefits of the computer in daily teaching practice. Nine major benefits emerged:

- Keeping up with the Information Technology (IT) age
- Saving time
- Enhancing the teaching/learning environment
- Providing students with necessary and useful skills for future Education/Employment
- An effective aid for teaching different parts of mathematics syllabus
- Enhancing the quality of students work
- A new and rich source of information
- Extending the relevance of mathematics to real life circumstances
- Assisting in administrative tasks
Enhancing the teaching environment, teaching aid, and keeping up with the ICT age were respectively the three most important benefits in teachers' opinion. See Figure 5.7

**Figure (5.7)**

*Teachers' opinion on the most useful benefits of computers for classroom teaching*

This Figure suggests that teachers' perceptions were not closely aligned with their actual practice. Although using computers in the teaching mathematics process was regarded as beneficial, only a minority of teachers used them for this purpose. Also most teachers used computers for administrative purposes while this use was at the bottom of the list of computer benefits according to their responses. This indicates teacher awareness that computers are not always being used for purposes that give most benefit to students.

Results of this section indicate that the majority of New Zealand secondary mathematics teachers believe that computers suit teaching mathematics just as well as other subjects.
Also the great majority of them believe that computers are useful for teaching students of all different abilities.

Teachers hold a strong belief in using computers for problem solving, which indicates their inclination to use them in mathematics. Also they strongly believe in computers' benefit in enhancing the teaching and learning environment.

However teachers do not believe that computers are 'the' or even 'a' main instruction tool for teaching mathematics. If this opinion is placed alongside their belief that computers lose their novelty when used too frequently, the result could indicate a tendency for them to use computers as an 'aid' tool rather than a 'main' tool of mathematics instruction. This suggestion needs further research to develop a clearer perspective on this tendency.

5.3 Computer usefulness in mathematics teaching: the experience of teachers

5.3.1 Computers and mathematics material

Teachers were asked to respond, in the light of their personal experience, whether or not they found computer technology useful in teaching different parts of the mathematics material (concepts, skills, theorems, mathematical processes, problem solving). Generally teachers found computers of 'little' use in teaching different parts of the syllabus, except where related to problem solving.
For example, 181 teachers found computers useful in teaching mathematical concepts, but only 14% of them said that was the case in ‘all’ or ‘most cases’. Whereas 86% of them mentioned that they were useful in ‘few’ or ‘some’ cases. See Table 5.2

Table (5.2)

**Teachers’ actual experience of the usefulness of computers in teaching different parts of mathematics syllabus**

<table>
<thead>
<tr>
<th>Part of the syllabus</th>
<th>Number of teachers (n)</th>
<th>% of teachers</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>All cases</td>
<td>Most cases</td>
</tr>
<tr>
<td>Concepts</td>
<td>181</td>
<td>1</td>
</tr>
<tr>
<td>Skills</td>
<td>171</td>
<td>1</td>
</tr>
<tr>
<td>Theorems</td>
<td>137</td>
<td>1</td>
</tr>
<tr>
<td>Processes</td>
<td>160</td>
<td>0</td>
</tr>
<tr>
<td>Solving problems</td>
<td>171</td>
<td>1</td>
</tr>
</tbody>
</table>
Figure 5.8 indicates that teachers singled out problem solving as the only part of the mathematics syllabus where computers were used in ‘most’ or ‘some cases’ in their experience. Conversely, the syllabus areas of theorems and processes were areas where a large majority of teachers found computers were not useful or have little usefulness.

**Figure (5.8)**

**Teachers actual experience of the usefulness of computers in teaching different parts of mathematics syllabus**

5.3.2 Computers and the teaching - learning environment

The majority of teachers found computers useful in some aspects of the teaching environment. The greatest usefulness of computers they found was for motivating students and making mathematics more interesting.
Interestingly a substantial number of teachers (149) felt that using computers in the classroom teaching process wastes too much class time. However closer analysis shows that most of these teachers felt this was so in only a few cases.

Figure 5.9 shows the details

**Figure (5.9)**

**Teachers’ opinion on computer impact on the teaching environment**

![Bar chart showing teachers' opinions on computer impact on teaching environment](chart.png)
Table 5.3 provides a closer look to this issue.

### Table (5.3)

**Teachers’ actual experience of computer usefulness in relation to the teaching environment**

<table>
<thead>
<tr>
<th>Aspect of teaching environment</th>
<th>Number of teachers (n)</th>
<th>% of teachers</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>All cases</td>
<td>Most cases</td>
</tr>
<tr>
<td>Motivate students</td>
<td>192</td>
<td>7</td>
</tr>
<tr>
<td>Enhance the social interaction</td>
<td>163</td>
<td>1</td>
</tr>
<tr>
<td>Enhance the collaborative work</td>
<td>169</td>
<td>2</td>
</tr>
<tr>
<td>Make mathematics more interesting</td>
<td>189</td>
<td>6</td>
</tr>
<tr>
<td>Waste too much of classroom time</td>
<td>147</td>
<td>1</td>
</tr>
</tbody>
</table>

This table shows that 52% of teachers felt that the use of computers made mathematics more interesting for students in ‘all’ or ‘most’ cases. Also 44% of teachers found computers motivated students in either ‘all’ or ‘most’ cases.

Fourteen percent of teachers found computers wasted too much of students’ classroom time in ‘all’ or ‘most’ cases, and 86% of them found that was the case in ‘few’ or ‘no’ cases.

A closer look at these results indicates that computers deliver a positive benefit in some cases, but not in others. The majority of teachers found computer use served as a ‘catalyst’ for learning, by motivating students and making mathematics more interesting.
By contrast, the majority of teachers found very little benefit from computer use in achieving enhanced social interaction, or improved collaborative work. These two opposing tendencies, and the pronounced differences between them, comprise an area worthy of further research. See Figure 5.10

**Figure (5.10)**

*Frequency of actual teachers’ experience of usefulness of computers in different aspects of the teaching environment*

<table>
<thead>
<tr>
<th>Percentage of teachers</th>
</tr>
</thead>
<tbody>
<tr>
<td>All/Most cases</td>
</tr>
<tr>
<td>Some/No cases</td>
</tr>
</tbody>
</table>

**Aspect of teaching environment**

- Motivate students
- Enhance the social interaction
- Enhance the collaborative work
- Make mathematics more interesting
- Waste too much of classroom time
5.3.3 Computers and teachers’ pedagogy

Educators perceive computer technologies as an influential agent for changing teaching pedagogies towards more interactive, collaborative, and higher order of thinking skills learning (Ryba, 1992; Heid and Baylor, 1993, Lai, 1992; Robinson, 1995)

The results of this research indicate that teachers felt that using computers had not affected or changed the way they taught mathematics. Results show that the majority (71%) of teachers felt such effect in “some” or “few” cases of their experience. See Figure 5.11

**Figure (5.11)**

*Teachers’ experience of the impact of computers on the way that mathematics is taught (n = 182)*

![Diagram showing teachers' experience of the impact of computers on the way that mathematics is taught](image-url)
Teachers found ‘little’ consistency between using computers and their own teaching model. Thirty eight percent of teachers found computers met their teaching methodology in “few” or “no” cases. See Figure 5.12

**Figure (5.12)**

*Teachers’ response to the statement “computers meet my teaching model” (n = 176)*

These results indicate that the way teachers teach mathematics is not much influenced by the use of computers.

This result could explain in part why the ‘work’ level of students was lower than levels of their ‘motivation and interest’ (Figure 5.10). Computers motivate students and make learning mathematics more interesting, but because there is little consistency between the existing and the required techniques and strategies for using computers in teaching, teachers were unable to integrate using computers into the process to create a “collaborative” learning environment.

However this inconsistency between the impacts of computer use on different aspects of the teaching environment may have other reasons. This area warrants further investigation.
When these two results are viewed alongside the fact that the majority of teachers found computers of a little advantage in teaching different parts of mathematics syllabus, except for problem solving, we cannot escape the question: why are computers not being used effectively? This clearly needs more investigation, especially when we know that teachers endorse the suitability of computers for teaching mathematics.

5.3.4 Computers and the mathematics syllabus

Many educators claim that the use of computers will affect what may be taught in mathematics (National Council of Teachers of Mathematics, 2000; Heid & Baylor, 1993)

Results indicate that 77% of teachers also responded to the related question, felt that computers affect what can be taught in mathematics. However the majority of these teachers (83%) felt so in just a small proportion (‘some’ or ‘few cases’) of their experience. See Figure 5.13

Figure (5.13)

Teachers’ response to the statement “Computers affect what has to be taught in mathematics” (n = 136)
5.3.5 Computers and teaching-learning products

On the basis of their experience teachers found that computers had the potential to enhance the teaching products, such as enabling more students to succeed, or to make better use of what they learnt in their daily life, thus enhancing achievement of the curriculum outcomes.

The vast majority (96%) of teachers had experienced the usefulness of computers in mathematics applications. The same proportion (96%) of teachers experienced the potential of computers to enhance teaching outcomes. A solid 91% of teachers also reported that computers enabled more students to succeed. See Table 5.4

Table (5.4)

<table>
<thead>
<tr>
<th>Teaching product aspects</th>
<th>Number of teachers (n)</th>
<th>% of teachers</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>All cases</td>
<td>Most cases</td>
</tr>
<tr>
<td>Are useful in mathematics applications</td>
<td>184</td>
<td>3%</td>
</tr>
<tr>
<td>Enhance teaching outcomes</td>
<td>181</td>
<td>2%</td>
</tr>
<tr>
<td>Enable more students to succeed</td>
<td>182</td>
<td>2%</td>
</tr>
</tbody>
</table>

98
Teachers perceive computers as being more useful in mathematics applications than in enhancing teaching outcomes, or enabling more students to succeed. See Figure 5.14

**Figure (5.14)**

**Teachers’ views on computer impact on teaching products**

This Figure shows difference between teachers’ views regarding the role of computers in ‘usefulness in mathematics applications’ on the one hand, and “enhancing teaching outcomes” and “enabling more students to succeed” on the other. This suggests that teachers believe that computer-based lessons self motivate students, but do not in themselves lead to better achievement.

5.3.6 Teachers’ self-satisfaction

In the light of their experience teachers have a high commitment to increase use of computers in classroom teaching, but the greater proportion of them feel dissatisfied with their current use of computers. They are not completely satisfied with their
knowledge on how to use computers to teach mathematics, and they are not satisfied with their knowledge on how students may use computers for learning mathematics.

Forty five percent of teachers felt ‘high’ or ‘very high’ satisfaction with their commitment to make more use of computers in the teaching process. Conversely, satisfaction with the current use of computers is rated as ‘low’ or ‘very low’ for 59% of them.

Also, 41% percent of teachers felt a ‘low’ or ‘very low’ degree of satisfaction with their knowledge on how to use computers in teaching mathematics, and 44% them felt the same low degree of satisfaction with their knowledge on how students could use computers to learn mathematics. See Table 5.5

| Experience aspect                                      | Number of teachers (n) | % of teachers | |
|--------------------------------------------------------|------------------------|---------------|
|                                                        |                        | Very high     | High  | Average | Low | Very low |
| Commitment to more use                                 | 274                    | 14            | 31    | 33      | 18  | 4        |
| Current use                                            | 273                    | 2             | 6     | 33      | 35  | 24       |
| Knowledge on how to use computers to teach Maths.      | 274                    | 7             | 14    | 38      | 23  | 18       |
| Knowledge on how students could use computers to learn Maths. | 273                    | 3             | 13    | 40      | 33  | 11       |
5.4 The future use of computers in NZ mathematics teaching

5.4.1 Teachers' vision

There was no common vision about the future use of computers in mathematics teaching expressed by teachers. Teachers fell into 3 categories: majority of advocates, many negatives, and minority of critics.

A few teachers tabled negative responses to the questionnaire and expressed frustration with their teaching conditions that related to computer use. As one teacher said, “difficult to say when the school does not have many computers”. Another teacher said, “there is not much of a vision because the same problem pops up all the time; there is no money, all teachers are overbooked and stretched out”. A third said, “I want enough books, rulers and calculators first!!! before I need computers”. And another said, “at the moment the syllabus is geared towards passing School Cert. So the time spent in using computers is luxury”.

The advocates of computer use had two visions. The first was calling for more effective integration of computers into the teaching process. They wanted to have enough computers in each class, with easy access to the network and Internet, to be used wisely as an aid or tool when needed. They were a bit cautious about relying on or over rating them. One teacher said, “...That is used as an aid to benefit student’s learning, but should not be seen as a substitute for using their brains”. Another said, “... computers are in the classroom but do not dominate the program”. A third saw computers as, “...teacher aids on central topics but will not replace teachers’ teaching or students having to do work”. Another teacher said: “just a tool, not the centre of focus”. The second vision of the advocates was very strong support for computers to be integrated into classrooms without reservation. These teachers were looking for some changes in the curriculum, changes in the physical situation of classrooms, in the teacher’s roles, and in the assessment system. Some of them called for a full computer based mode of
instruction, and others for compulsory use of computers. The following are some quotes indicating such visions: "full PowerPoint teaching", "wide ranging use at tutors in mathematics curriculum with teacher as facilitator. No need for current class/school structure, learning at own speed on any appropriate level. True I.E.P's school’s as resource controls, teachers/students on-line", "every pupil with a laptop, so it is just as accessible as pen and paper", "computer use should be compulsory in all strands and becomes part of the curriculum", "each student has his/her laptop! All notes/lessons/exercises/individual lesson plans + levels of work, so students can work at their own pace/ability", "most of mathematics learning could and should take place on computers", "curriculum written to take advantage of computers", and "...to be an integral part of NCEA assessment."

The critics, the minority of teachers, were either not optimistic about the future of computer use, or they openly called for giving up using them. They are still not convinced about computers' potential to enhance the teaching process. One of these said, "I do not think they are the magic cure for mathematics that people originally thought". Another teacher said, "not really important in Maths". A third teacher argued, "not essential, other resources of good benefit to student are less expensive", and "more [computer use] than at present but not excessively so".
However, when teachers, even the critics, were asked about their degree of agreement with the statement: “computers will be used more efficiently in mathematics teaching in New Zealand in the next 10 years”, the majority of teachers (53%) agreed with this expectation. This hints to an optimistic vision for the future of computer use. Figure 5.15 provides details of their degree of agreement on this issue.

**Figure (5.15)**

**Teachers’ expectation of more effective use of computers in**

**New Zealand schools in the next ten years (n=267)**

Overall, vision of future use of computers in mathematics teaching in New Zealand is: to use the computer effectively as an ‘aid tool’ when appropriate, to be available in sufficient numbers (1 computer for each 3 students in every classroom), to have Network, and Intranet access for every student at any time during the school time, to be used by competent students and well trained teachers, to be maintained regularly by a skilled technician, and to have software and curriculum designed in harmony for interchangeable use.
5.4.2 Teachers’ recommendations to the New Zealand Ministry of Education

Teachers backed their vision up by a set of recommendations to the Ministry of Education. The great majority of them believe the Ministry of education has a vital role to play for better incorporation of computers into future classroom teaching. This role, as teachers expressed it involves:

- To provide schools with enough funding to have adequate and sufficient numbers of standard type computers in every classroom.

- To provide free training on specific programmes that directly relate to different curriculum areas.

- To subsidise the cost of recommended licensed software, Internet access, and Networking computers for every school.

- To provide all schools with necessary resources which are available to teachers as required, for classroom teaching of different of curriculum areas.

- To develop a New Zealand computer-based curriculum, and an attendant user-friendly software and teachers’ tutorial that can be used as a textbook while implementing the curriculum.

Many teachers feel that all schools should have the same opportunities to use computer technology but this is not currently the case. They argue that it is the Ministry of Education’s responsibility to maintain equity between schools in this regard.
Teachers point for example to what they see as waste of money, time, and effort when the Ministry of Education leaves every school to shop around, purchasing its own suitable hardware and software. As one teacher said, “Do not get every one to re-invent the wheel.”

A great proportion of teachers also feel they lack information on available software. Many teachers complain of not having a list or booklet listing software in the field. As one teacher said, “Available programmes must be presented to teachers. We should not have to go searching for useful stuff (too time wasting).”
Chapter (6)

Barriers to Computer Use in Mathematics Teaching
Chapter (6)

Barriers to Computer Use in Teaching
Secondary Mathematics

6.1 Introduction

A great deal of literature pointed to different barriers to integration of computers into classroom teaching – learning processes. In New Zealand, like other western countries, teachers confront many barriers to computer use in classroom teaching; availability and accessibility of hardware, professional training, school funds, software availability and suitability, and educational system (the curriculum, teachers’ work – load, assessment system) are of most difficult obstacles (Thomas, 1996; Hodson, 1990; Gilmore, 1993, Atmore, 1995; McKinnon, 1995, Education Review Office, 1997)

Results of this research reveal that the current situation is almost the same as it was six years age. Teachers often use computers for administrative purposes rather than classroom teaching. The proportion of teachers using the computer for classroom teaching is quite small. Moreover, computer use is infrequent, limited to one or two year levels, covers few or very few topics in one or two curriculum strands, and most common use for either practising or extending a pre-taught material. However teachers hold firm views in favour of computer use in mathematics teaching. So, what do they perceive as the main current hindrances to the use of computers?
6.2 Obstacles to using computers in classroom teaching

When teachers were asked to write down the three main barriers to their use of computers, they identified 'hardware availability', 'lack of professional training' and 'lack of time' respectively.

In another section in the questionnaire, among 14 reasons provided for not using computers to the level they believe desirable, teachers singled out 8 of them as barriers to computer use in daily practice. At the top of the list was 'lack of time', 'software suitability' for what is being taught, and 'hardware accessibility'. More than 91% of respondents mentioned confronting each of those obstacles except the 'professional training' which was mentioned only by 85% of teachers. See Figure 6.1 for details.

Figure (6.1)
The obstacles experienced by teachers to computer use in classroom teaching

![Bar chart showing percentage of teachers facing various obstacles](image-url)
Teachers were not only asked to mention obstacles experienced in gaining access to computers, but also to rate the relative frequency of these obstacles. When ‘very often’ and ‘often’ responses were used as a measure of the prevalence of the obstacle, ‘hardware accessibility’, ‘lack of time’, and ‘hardware availability’ took the first three places, respectively, at the top of the obstacles list. The order of these obstacles, as measured by teachers’ responses is shown in Figure 6.2

Figure (6.2)

**Obstacles to computer use measured by teachers responses.**

‘very often’ or ‘often’

<table>
<thead>
<tr>
<th>Obstacle</th>
<th>Teachers’ percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lack of time</td>
<td>80</td>
</tr>
<tr>
<td>Hardware accessibility</td>
<td>75</td>
</tr>
<tr>
<td>School finance</td>
<td>70</td>
</tr>
<tr>
<td>Software availability</td>
<td>65</td>
</tr>
<tr>
<td>Professional training</td>
<td>60</td>
</tr>
<tr>
<td>Software suitability to what be taught</td>
<td>55</td>
</tr>
<tr>
<td>Hardware accessibility</td>
<td>65</td>
</tr>
<tr>
<td>School finance</td>
<td>70</td>
</tr>
<tr>
<td>Software availability</td>
<td>80</td>
</tr>
<tr>
<td>Hardware availability</td>
<td>75</td>
</tr>
</tbody>
</table>

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To understand the availability and accessibility of hardware in the field, teachers were asked to respond to a question about the number of computers either always available, or by pre-arrangement, for their mathematics classroom teaching, according to their location.

The great majority of computers in schools were installed in special laboratories. In connection to the classroom, results show that 51% of teachers who responded had no computers in their classroom, 35% had 1 computer, 9% had 2 computers, and 3% had 4 computers. These results are shown in full in Figure 6.3

**Figure (6.3)**

**Computers available in teachers’ classrooms**

Teachers were asked to make their comments on this issue. When these comments were studied, some related themes emerged:

- As most computers are installed in special laboratories which are shared by different departments, the frustration was not the fact that
pre-booking was required. It was the length of time in advance these laboratories need to be booked. As one teacher said, “use of rooms depends on advance booking, up to a term ahead”. Another teacher comment was, “1 bookable lab for 1200 students - nearly impossible to sequence classes in lab”.

- Many schools devoted the use of available computers to specific subjects rather than mathematics. The following are some teacher comments in this regard: “is difficult to get into since lab is primarily for use by computer students”, “we have one computer lab at school which we have not used for maths”, “the school has two computer labs, but they are exclusively for IT use. hardly available for me in maths dept”, “due to the number of computing classes - unable to get access to the computer rooms”, “it varies from day to day TIM, CAT, CPT and 3rd form keyboarding have preference”, “part of computer suite, heavily used by tech / computing / english departments”, “4 classrooms are used mainly for - text information management - computer studies - 1 term technology modules”, “2 computer rooms, one has 16, one about 30, but large room is almost permanently booked for computer classes”, “due to the number of computing classes - unable to get access to the computer rooms”, “it is very difficult to book time into the computer rooms for other subjects, since the rooms already have full timetable for subjects like TIM and Year 7 & 8”, “computer suite appears fully used and not really used to any advantage in maths.”

- There are big differences among schools regarding provision of computers. Some schools are very well equipped and have no problems, while others are struggling and in some cases have no computers for teaching available at all. One teacher described the case of his school saying: “none! (some coming ~5)”. Another teacher said:
"not available for classes", "1 room serves school of 1200 students", "the school lacks of computers", "only 1 mobile computer available for use".

On the other hand some teachers described the situations as: "our school is very well equipped with computers. I find that laptops and a wireless network makes classroom use a joy", "computer access is no problem in this school", "each Y10 and Y11 pupil has a computer notebook", "all maths staff have laptops and the ability to access the school network, internet, etc. in the classroom; as well as large screen and projector", "my previous school had far better access, current school struggling to get access for maths up and running".

- Differences among teachers regarding their commitment to the use of computers. There are teachers who are very committed to the use of computers in teaching. Also, there is one who does not care and does not even know what is going on in his school. For example, a teacher said: "never used them, don't know", another said: "not really up and running from my understanding". On the other hand, one teacher said: "I think that maths dept. has to have one computer per classroom". Another teacher said: "I have recently purchased my own laptop to use in the classroom (with the data show)".

- Some schools impose a compulsory levy on their students for some aspects of computers use. This was a hindrance for classroom teaching, as students were not always able to inject money into their accounts.
6.3 Teachers' training needs

There was a strong desire among teachers to learn more about the use of computers in classroom teaching. This desire is understandable in the light of their being 170 teachers (59.9%) who had not studied computing at all. They described themselves as self-taught people. Gawith (1994) distinguishes two areas of literacy related to technology use. These are: 'technological literacy' which relates to the operational side of technologies use and 'information literacy' which relates to the use of technology for processing data. The results of this research show that teachers need training in both areas.

Many teachers when asked what there training needs were wrote comments like: “any thing”, “any ideas go”, and “ideas on how to use computers in teaching”.

Seventeen percent of teachers were not in need for any training on computer use. While, 83% of teachers mentioned their need for training on computer use, these needs vary from being urgent on any thing, which could help them to integrate computers into classroom teaching, to training on computer use for teaching specific areas of the curriculum. When teachers were asked to identify those curriculum areas where they needed training, most teachers mentioned a training need in all curriculum areas. The rest asked for training in algebra, and geometry. Another group of teachers mentioned a need for training on graphics software.
A different group mentioned a need for ‘new ideas and guidance on what they can use computers for’. Also, 31% of teachers mentioned their need for training on ‘specific areas in the technical use of computers’, and 11% of them recorded a need for urgent training, mostly on the ‘general use of computers in classrooms’. Details are shown in Figure 6.4

Figure (6.4)

Computers available in teachers’ classrooms

Teachers' percentage

(A) None  (B) On specific areas of the curriculum  (C) On the technical use of computers  (D) Urgent  (B) + (C)  (B) + (C) + (D)  (B) + (D)
Chapter (7)

Discussion and Conclusion
Chapter (7)
Discussion and Conclusion

7.1 Discussion

The central question of this research has been to investigate the extent to which and manner in which computer technology is being used in New Zealand secondary mathematics classes, and the degree of coherence between this usage and Ministry goals stated in MiNZC and statements on Information and Communication Technologies (ICT) in teaching and learning.

The previous chapters answer the three research sub-questions. Results, generally, suggest that computers are being used in the classroom teaching by 75% of teachers only infrequency to serve mostly the Statistics strand for extending or practicing pre-taught material using drill and practice software at junior level and tutorial and simulations software at senior level specifically for statistics classes. Teachers maintain a strong belief in the positive role of computer use in the teaching learning process and they express a clear desire for professional training in this regard.

This chapter is a discussion of the degree of coherence between Ministry goals and the actuality of current practice in the field of teaching in the light of the three previous chapters’ results, as reported by respondents to the questionnaire of the research.
7.1.1 Does the current situation regarding computer use provide opportunities for students to become confident and competent users of computers?

In 1999 the government released *The Learning Technologies Planning Guide for Schools: An Overview for School Management* document. One of its purposes was to discuss the importance of learning technologies. It stated:

"With good teaching and learning as the primary goal, these learning technologies [including computers] can be used to make a distinct contribution, for example, as a routine tool for students to gather, analyse, and present information, or as a means to present dynamic visual images of key ideas" (Ministry of Education, 1999, p. 7).

It is clear that the government is expressing an expectation of computer use as a routine tool in students’ learning.

In developing confident and competent student - users of computer as a routine tool in their learning, the time given to them to experience these tools is an important factor. Goldenberg (1988), for example, argued that students are not naturally able to interpret computer-generated graphs; so some misleading conclusions can arise from using certain computer programs. When students work with these programs over a long period of time, these misconceptions do not seem to dominate their work (Goldenberg, 1988, Heid, Sheets, Matras & Menasian, 1988; Schoenfeld, 1988), and students become more confident and competent in using these programs.

Results of this research indicate that 75% of New Zealand secondary mathematics teachers use computers with classes at least once or twice a year. The biggest proportion of these teachers (35%) use computers for one or two periods a term. If we assume that
the average full-time teacher load is 20 periods a week and the term length is 10 weeks, this means that the time given to computer use is less than 1% of the actual teaching time. The second largest proportion of teachers using computers (32%) use them in 1-3 periods a month, which means that for them the average time of computer use is 2.5% of the actual teaching time.

These results confirm that most mathematics teachers are not regular users of computers in their classrooms. It is correct that there is no definite period of time to achieve the goal of developing confident and competent student-users of the computer as a routine tool for their learning. However, it is unlikely that this goal could be reached by using the computer in one or two periods a month or a term.

7.1.2 For what curriculum purposes are computers used?

MiNZC’s suggestions (Ministry of Education, 1992, p. 23, 105) regarding the purposes for which computers could be used is consistent with those of many educators. Hood (1998) for example, claims that: “Information technology can allow students to learn best in their own ways, and to explore and develop their individual areas of interest” (p. 122). Other educators see the computer as providing students with the tools to explore their own understanding and to test out their developing ideas (Hodson, 1997, Ryba & Anderson, 1987, Nolan & Ryba, 1987). Similarly, Cornu (1995) argues that with the computer-assisted learner “little by little, [students] with the help of their companions or the teacher ... they are going to build themselves new knowledge. There still exist a few of these tools, which allow the exploration and discovery of a particular subject” (p. 20).

The findings of this research imply that most mathematics teachers use computers for administrative purposes rather than classroom teaching. For example 201 teachers reported their use of computers for recording student results, while 165 teachers reported computer use for classroom teaching purposes. The majority (132) of those teachers
used computers for extending pre-taught material, while 125 of them used computers for practicing pre-taught material. In the meanwhile, 102 teachers reported they used computers for explaining new material, and 90 teachers mentioned their use of computers for solving mixed problems.

Also, results indicate infrequent use of computers for tasks such as exploration and discovery. For example, 10% of teachers who use computers for the purpose of explaining new material use them ‘very often’ or ‘often’, while 11% of teachers who use computers for solving mixed problems, and 8% of teachers who use computers for introducing new material use them at the same rate.

If these results are linked to those which indicate that computers are mostly being used to serve the statistics topics and for a whole period, then these findings imply that purposes such as mathematical exploration and experimentation, open-ended problem solving, investigating geometric concepts and number patterns, and discovering new mathematical ideas receive less emphasis in most curriculum strands. Generally, the use of computers is aimed more at lower order reinforcement than higher order conceptualisation or reasoning and discovering new ideas.

Therefore, in contrast to what the curriculum recommends, most computer usage in mathematics teaching tends to focus on lower rather than higher levels of thinking.

These results do not provide enough evidence to claim that computers have being used in a supportive way for the constructivism learning theory. More than that they pose a question for further research on whether mathematics teachers instruct in a way which is consistent with the constructivism, or some other learning theory.
7.1.3 Are computers being used across the curriculum?

The curriculum emphasises the use of computers in teaching all strands at all levels (Ministry of Education, 1992). Many educators, also, documented in their research the usefulness of multiple uses of computers for teaching different mathematics topics. Heid and Baylor (1993) for example, contend that computers offer an opportunity for students to have an efficient graph tool and symbolic manipulator in Algebra and an efficient geometric construction tool in Geometry. Similarly, it is claimed that computers are useful tools for teaching and learning the skills of the Mathematical Processes such as modelling (Fey, 1991), reasoning (Yerushalmi, Chazan, and Gordon, 1987), and problem solving (Liao and Bright, 1989).

In relation to the mainstream mathematics classes, these research results imply that computers are being used mostly to serve the statistics strand. Other strands such as measurement, geometry, and mathematical processes are unlikely to be targeted by the use of computers in the teaching learning process. More than 84% of user teachers use computers for statistics teaching. By contrast 47% of user teachers use computers to serve the mathematical processes strand, and less than 35% of them use computers to teach the measurement strand. Even when computers are being used to teach these strands, the proportion of topics in which computers are used is small. In relation to statistics strand, for example, where computers are used by the highest percentage of teachers, 11% of them use computers to teach ‘all’ or ‘most’ topics within the strand, while 32% of them use computers to teach ‘few’ or ‘very few’ topics. The same results apply to mathematics-applied classes.

With regard to the curriculum year levels, MiNZC emphasises the use of computers at all levels in many places (Ministry of Education, 1992).

Findings of this research indicate that computer use is greater at junior level than at senior level, except at the y13S level. The highest percentages of user teachers are year 11 (63.2%) and year 10 (60.4%) teachers. The year 13C level records the lowest
percentage (25.5%) of user teachers. Related to mathematics applied classes, results show that computers are used mostly at year 13 level, while year 12 MA has the lowest percentage of user teachers.

These results demonstrate that the use of computers for classroom secondary mathematics teaching and learning processes does not, completely, comply with curriculum goals as stated in MiNZC.

7.1.4 Do the assumptions, relating to computer use that the curriculum was built on exist in practice?

Availability

Results of this research indicate that availability is still an obstacle, which prevents the appropriate use of computers in classroom teaching. The majority of teachers (79%) identified the availability of computers as a barrier to their use of computers for classroom teaching. Some of them described their schools’ situations as being very serious.

Although 20% (57) of teachers have computers available in their classrooms, for the teaching process, the number of available computers is small. More than 68% of teachers with computers in their classrooms have only one computer, and less than 9% of them have more than 4 computers in each classroom.

Availability of computers does not refer to the hardware availability only. Software availability is another aspect of this problem. The ratio of teachers who identified software availability as a barrier to their use of computers was greater than the ratio that pointed to a hardware availability problem. Even when software is available teachers mentioned its suitability as a third factor contributing to the availability problem. Two
hundred and thirty teachers (78%) confirmed that they experience the problem of the software suitability.

Accessibility

Accessibility was the second greatest obstacle to computer use confronting teachers in their daily classroom teaching practice.

A majority of teachers, 79% (230), reported the existence of computers at their schools, located in special laboratories. Many teachers identified other factors, as detailed in chapter 6, which compound the problem of computer accessibility. These are: the booking system for computers laboratories, the allocation of computer laboratories for Information and Text Management classes, and the lack of technicians. All these factors work collectively to make the problem of computers accessibility a real hindrance confronting teachers.

Training of teachers

The vast majority of teachers have a strong desire to have more training on integrating computers into the classroom teaching - learning processes. Results of this research indicate that 59% of teachers have never studied computing, and 42% of teachers described themselves as nervous users of computers. The results, also, show that 78% of teachers (226) mentioned a lack of professional training as an obstacle to their classroom use of computers. Fifty percent of those teachers experienced their lack of professional training as a problem in their daily teaching practice ‘often’ or ‘very often’.

In terms of satisfaction, a large proportion of teachers are unsatisfied with their own professional training. About 41% of teachers expressed ‘low’ or ‘very low’ satisfaction with their professional knowledge on how to use computers in teaching mathematics, and 44% expressed the same degree of satisfaction with their professional knowledge on
how students could use computers to learn mathematics. Accordingly, 78% (226) of teachers expressed a need for training on either the technical use of computers or on teaching specific areas of mathematics curriculum using computers. These figures provide no evidence on the claim that teachers are, generally, well trained professionally on how, when, and for what to use computers in their daily practice.

From the results outlined above it is clear that assumptions intrinsic to the curriculum, related to computer use in teaching secondary mathematics, have not yet been fulfilled.

7.2 Conclusion

This research presents the findings of a nation-wide survey about the current use of computer technology in secondary mathematics teaching in the light of government’s goals expressed in MiNZC and other curriculum documents. Overall, it provides evidence that the level of computer use in secondary mathematics teaching is still below the desired level, and far short of government expectations.

Despite the fact that computers started penetrating New Zealand secondary mathematics classrooms 30 years ago (Department of Education, 1982), this research indicates that the use of computers in classroom teaching is still an issue of concern for teachers and policy makers. It also demonstrates that 10 years after the release of MiNZC, and 3 years after the release of the national information technology strategy, the assumptions and goals relating to the use of computers, upon which the curriculum was built, are still not fully realised.

The majority of teachers do not yet integrate computers in daily practice. Teachers who use computers frequently in their classroom teaching activities are the exception rather than the norm. For only a minority of teachers do the frequency of computers use, the
range of topics taught, the number of curriculum strands being served, and the purposes computers are used for, match the desired teaching outcomes as expressed in the mathematics curriculum statement or found in relative literature.

This research uncovers two contradictions that teachers experience. The first contradiction is between teachers' perceptions, and actual practice related to computer use. The vast majority of teachers believe in the usefulness of computers for classroom teaching, but achieve only infrequent use of them. The second contradiction is between teachers' level of satisfaction and their attitudes towards computer use. Most teachers have very positive attitudes towards using computers for classroom teaching, but they are dissatisfied with the current level of use. The majority of teachers tend to use computers as a teaching 'aid', but there is confusion and ambivalence among them about how to incorporate them efficiently for this purpose.

Teachers are aware of the potential impact of computers on the future of teaching and learning processes, and they are looking for a new flexible education system, new curriculum, suitable software and adequate professional training.

Teachers face many obstacles preventing them from using computers to their potential. These obstacles are often out of their control, such as teachers' load, availability of hardware, suitability of software, and the professional training.

The research also gives some insight into the methodology of teaching and learning applied by teachers in the classroom when using computers. Although further research is needed to explore this point, results imply that the current use of computers is not aligned with the constructivist approach.

Assuming it is better, I believe in “proact rather than react” action (Ornstein and Hunkins, 1998, p. 384). So, I have utilised these research results to pose several questions for further research; questions which may be of interest to the government and
concerned parties, and lead to better understanding of present needs, and more focused future planning. Among these, for example: What is the role which the assessment system playing to improve the actual use of computer? Do we need a revolution in our curriculum to fit the use of computer technology? Or do we need a revolution in computer technology to fit our teaching needs? With regard to the ambivalence between teachers' perceptions and attitudes on one hand and their actual computer use for classroom teaching on the other hand – how did this come to be? Do our teachers fear the use of computer technology or do they hold some misconceptions about it, or they have a clear educational vision, which they stick to? How did the difference between our schools regarding provision of computer technology equipment become so wide? How can we change this reality for the benefit of all our children and the society in large? Do we intend to use computers in our schools as a ‘tool’ for teacher’s use in the teaching process (instructional tool), or for students’ use in the learning process (learning tool), or for both? This research does not answer such questions but provide a description of usage that raise them for further research.

A national policy ensures a minimum limit for computer technology requirements in schools that could help in confronting the inequality of opportunities issue, a challenge that schools face at present resulting from their wide disparity in computer facilities.

It is necessary but not enough to ensure the availability and the accessibility of computers in schools. Teachers need knowledge of available software and computer technology developments. They need also to have adequate professional training and enough knowledge on how, why, for what, and when to use computers. This can diminish the gap between teachers' perceptions and actual practice related to the use of computers.

I see the issue of integrating computer technology into classroom teaching as similar to a multi-variable algebraic equation. When the value of any variable is changed, all other variables' values are likely to be affected and should be modified to maintain the equality of both sides to maintain the 'balance of the equation'.

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A solution of the equation is unlikely to be reached by random trials. We may need to have a holistic look to all ‘variables’ at once. To plan what possible changes can be made to each ‘variable’ and how other ‘variables’ should be modified accordingly. We should understand that ‘values’ of all ‘variables’ are not ‘numbers’ that can be evaluated individually and arranged in an increasing or decreasing order. Rather they are net-related variables, and not any one of them has a ‘real’ value unless they have been evaluated collectively.

Variables of the equation are many. Educators, students, teachers, decision-makers, parents and caregivers, school administrators, curriculum, educational system, educational environment, the progress and developments happening in any of societal sectors, and many other variables. Therefore when any one of these factors changes we have to modify all others to maintain the balance of the equation. Problem in integrating new information technology may be hidden behind underestimating one of these variables, the teacher.

Broader research on classrooms indicates that teacher is the key issue in any solution, but not solely the only one. Begg (1998), McGee (1997) and others have identified the dangers of leaving teachers only as the “eventual recipients” of any decision related to their profession.

Few doubt that computers can be an effective means for viewing, creating, and shaping our future. But the big questions which remain unanswered are: do we have a clear vision of our educational future in the light of rapid computer technology development? Is there a serious and comprehensive plan for achieving this vision? Whether the answers are yes or no, this research provides a contribution to ongoing debates about integrating the computer use into the secondary mathematics curriculum implementation. It indicates that attention needs to be given to issues of: teachers’
professional development, school equipping, adequate curriculum, helpful educational system, and suitable software for New Zealand setting.

I am confident that a clear understanding of the current status and predicaments, coupled with more research, debate, determination, and collaborative effort will contribute to mapping the path towards fulfilling a 'preferable' future.
References


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Appendix
(1)
Secondary Mathematics Teachers’ Questionnaire

Please remember that all questions are concerned with secondary mathematics teaching in New Zealand schools. Please return the completed questionnaire by FRIDAY 10th August 01

Part (A): Demographics
In questions 1 to 6, please tick (✓) the category that describes your situation:

(01) Age group is: □20-29 □30-39 □40-49 □50-59 □≥60
(02) Gender is: □male □female
(03) Job type is: □full time □part time ≥0.5 □part time <0.5
(04) Years of teaching experience: □≤5 □6-10 □11-15 □16-20 □21-25 □26-30 □31-35 □≥36
(05) Number of mathematics periods taught/week: □≤10 □11-15 □16-20 □21-25 □≥25
(06) Do you have your own computer? □yes □no At home: □yes □no
(07) How many mathematics classes are you teaching? [Key: Y=year, MAP=mathematics applied]
Please write down the number of classes that you teach of each year level.

|----|-----|-----|-----|-----|----------|----------|--------|--------|--------|-------|-------|

(08) Please list any formal training you have had on the use of computers in maths classroom teaching.
[Key: A= all, S=Statistics, C=Calculus, N=number, G=geometry, M=measurement, A/= algebra, MP=mathematical process, MAP=mathematics applied].
Fill in the following table as in the provided two examples:

<table>
<thead>
<tr>
<th>Year of Training</th>
<th>Topic of Training</th>
<th>Length of Training</th>
<th>Strand of Curriculum to be served</th>
<th>Levels (years)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1998</td>
<td>Using “StatView” package</td>
<td>2 hours</td>
<td>S</td>
<td>12, 13S</td>
</tr>
<tr>
<td>2000</td>
<td>Using Excel</td>
<td>1 day</td>
<td>N</td>
<td>9, 11,12</td>
</tr>
</tbody>
</table>

*In questions 9, 10, 11 please tick (✓) as many categories as you need to describe yourself:
(09) My role in the Maths Dept is: [Key: MU=management unit]
□ Teacher □HOD □MU1 □MU2 □MU3

(10) Regarding the general use of computers, I
□ have got a full certificate or degree majoring in computing. Title?___________________________
□ have finished some computing papers/courses/training
□ am a self-taught person
□ am not a knowledgeable user

(11) Regarding the use of computers in mathematics classroom teaching, I
□ have a full certificate or degree majoring in educational computing. Title?_____________________
□ have finished some papers/courses
□ have done some professional training
□ am self-trained
□ am not well-trained.
*In questions 12 & 13 please circle the category that best describes your level of confidence.
[Key: VC = very confident, C = confident, NVC = not very confident, N = nervous]*

(12) How confident are you as a computer user? VC C NVC N
(13) How confident are you in using computers in mathematics classroom teaching? VC C NVC N
(14) How many computers are available for you to use in mathematics classroom teaching?

In the following table, please enter the number of computers available (always or by pre-arrangement) for you to use in mathematics classroom teaching:

<table>
<thead>
<tr>
<th>Number of computers fixed in my classroom</th>
<th>Number of computers fixed in special labs.</th>
<th>Number of computers fixed in other classrooms</th>
<th>Number of computers in mobile pods</th>
<th>Number of computers fixed in other resource rooms</th>
</tr>
</thead>
</table>

Comments:

**Part (B): Frequency of use**

(15) How many periods on average, do you use computers in mathematics classroom teaching? Please count all mathematics classes you teach:
☐ ≥ 4/week  ☐ 1-3/week  ☐ 1-3/month  ☐ 1-2/term  ☐ 1-2/year  ☐ not at all
(If your answer is "not at all", please go directly to question 24).

(16) How often do you use the following kinds of software technology in mathematics classroom teaching?
[Key: VO = very often, O = often, ST = sometimes, L = little, VL = very little, N = never]
Please circle the appropriate category:

Floppy disk/CD ——— VO  O  ST  L  VL  N
Hard drive/Network ——— VO  O  ST  L  VL  N
Internet ——— VO  O  ST  L  VL  N
Other ——— VO  O  ST  L  VL  N (please state what?)

Comments:

(17) For what proportion of topics in each strand of the mathematics curriculum do you use computers in classroom teaching?
[Key: A = all topics, M = most topics, S = some topics, F = few topics, VF = very few topics, N = none]
For each year level you teach, please write down the appropriate category:

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<td>Number</td>
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<td>Measurement</td>
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<td>Geometry</td>
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<td>Algebra</td>
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<tr>
<td>Statistics</td>
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<td></td>
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<tr>
<td>M. Processes</td>
<td></td>
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</tbody>
</table>

(18) Over the last two terms, how many periods per term did you use computers in mathematics classroom teaching?

<table>
<thead>
<tr>
<th>Level Term</th>
<th>Y9</th>
<th>Y10</th>
<th>Y11</th>
<th>Y12</th>
<th>Y13 Stat.</th>
<th>Y13 Cal.</th>
<th>Y11 MAP</th>
<th>Y12 MAP</th>
<th>Y13 MAP</th>
<th>Other</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st Term</td>
<td></td>
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<td></td>
<td></td>
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<tr>
<td>2nd Term</td>
<td></td>
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</table>

Page 2/6
(19) In this question you are given several software types or topics. As in the given example, for each software type/topic you do use, please 
underline{circle} the classes you use it for, write the name of the main software being used and 
underline{tick} (√) the strands of curriculum being served.

[Key: S=Statistics, C=Calculus, N=number, G=geometry, M=measurement, A=algebra, 
MP=mathematical processes]

Example:

<table>
<thead>
<tr>
<th>Software Type Or topic</th>
<th>Year/s</th>
<th>Name of main software used</th>
<th>Strand/s used in</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>N</td>
</tr>
<tr>
<td>Spread Sheet</td>
<td>9, 10, 11, 12, 13S, 13C, MAP, Other</td>
<td>Excel</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Software Type Or topic</th>
<th>Year/s</th>
<th>Name of main software used or www address</th>
<th>Strand/s used in</th>
</tr>
</thead>
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<tr>
<td></td>
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<td></td>
<td>N</td>
</tr>
<tr>
<td>Drill &amp; practice</td>
<td>9, 10, 11, 12, 13S, 13C, MAP, Other</td>
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<tr>
<td>Tutorial</td>
<td>9, 10, 11, 12, 13S, 13C, MAP, Other</td>
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<td></td>
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<tr>
<td>Learning Games</td>
<td>9, 10, 11, 12, 13S, 13C, MAP, Other</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Simulation</td>
<td>9, 10, 11, 12, 13S, 13C, MAP, Other</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Internet WWW</td>
<td>9, 10, 11, 12, 13S, 13C, MAP, Other</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spreadsheet</td>
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<td></td>
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<tr>
<td>Word processing</td>
<td>9, 10, 11, 12, 13S, 13C, MAP, Other</td>
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<tr>
<td>LOGO</td>
<td>9, 10, 11, 12, 13S, 13C, MAP, Other</td>
<td></td>
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<tr>
<td>Algebra</td>
<td>9, 10, 11, 12, 13S, 13C, MAP, Other</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Geometry</td>
<td>9, 10, 11, 12, 13S, 13C, MAP, Other</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Graphing</td>
<td>9, 10, 11, 12, 13S, 13C, MAP, Other</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Statistics</td>
<td>9, 10, 11, 12, 13S, 13C, MAP, Other</td>
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<td>Other</td>
<td>9, 10, 11, 12, 13S, 13C, MAP, Other</td>
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<tr>
<td>Other</td>
<td>9, 10, 11, 12, 13S, 13C, MAP, Other</td>
<td></td>
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<tr>
<td>Other</td>
<td>9, 10, 11, 12, 13S, 13C, MAP, Other</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Comments:


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Part (C): Purposes of use
In questions 20, 21, 22 please circle the category that best describes the frequency of your use of computers in mathematics classroom teaching.
[ VO= very often O= often ST= sometimes R= rarely N= never]

(20) How often do you use computers in each of the following period parts?
   At the beginning only—— VO O ST R N
   In the middle only—— VO O ST R N
   At the end only—— VO O ST R N
   The whole period—— VO O ST R N

(21) How often do you use computers for the following purposes as a mathematics teacher?
   Test designing ..................................... VO O ST R N
   Lesson planning .................................... VO O ST R N
   Mathematics classroom teaching ............... VO O ST R N
   Classroom management (seating, grouping,...) .. VO O ST R N
   Classroom materials (labels, instructions,...) ... VO O ST R N
   Recording students’ results........................ VO O ST R N
   Communication with parents......................... VO O ST R N

(22) How often do you use computers in mathematics classroom teaching for?
   Introducing new material (concept, skill, theorem,...)—— VO O ST R N
   Explaining new material ................................ VO O ST R N
   Practicing pre-taught material....................... VO O ST R N
   Extending pre-taught material...................... VO O ST R N
   Solving mixed problems............................ VO O ST R N
   Other, please state what?............................ VO O ST R N

Part (D): Views and Opinions

(23) To what proportion of your experience in the use of computers in mathematics classroom teaching, do you find each of the following statements apply?
   [ AC= all cases MC= most cases SC= some cases FC= few cases N= no cases]
   Please circle the appropriate category:

I find that computers:

Are useful in teaching mathematical concepts—— AC MC SC FC N
Are useful in teaching mathematical skills—— AC MC SC FC N
Are useful in teaching mathematical theorems—— AC MC SC FC N
Are useful in teaching mathematical processes—— AC MC SC FC N
Motivate students—— AC MC SC FC N
Are useful in mathematical applications—— AC MC SC FC N
Are useful in solving problems—— AC MC SC FC N
Enhance the social interaction among students—— AC MC SC FC N
Enhance the collaborative work among students—— AC MC SC FC N
Enhance teaching outcomes—— AC MC SC FC N
Make mathematics more interesting for students—— AC MC SC FC N
Enable more students to succeed—— AC MC SC FC N
Affect what has to be taught in mathematics—— AC MC SC FC N
Affect the way that mathematics is taught—— AC MC SC FC N
Meet my teaching model—— AC MC SC FC N
Waste too much of students’ classroom time—— AC MC SC FC N
(24) How useful do you think computers are for students of different abilities?
[VU= very useful  U= useful  NS= not sure  LU= little useful  NU= not useful]
Please circle the appropriate category:

<table>
<thead>
<tr>
<th>Talented</th>
<th>VU</th>
<th>U</th>
<th>NS</th>
<th>LU</th>
<th>NU</th>
</tr>
</thead>
<tbody>
<tr>
<td>Above average</td>
<td>VU</td>
<td>U</td>
<td>NS</td>
<td>LU</td>
<td>NU</td>
</tr>
<tr>
<td>Average</td>
<td>VU</td>
<td>U</td>
<td>NS</td>
<td>LU</td>
<td>NU</td>
</tr>
<tr>
<td>Below average</td>
<td>VU</td>
<td>U</td>
<td>NS</td>
<td>LU</td>
<td>NU</td>
</tr>
<tr>
<td>Low ability</td>
<td>VU</td>
<td>U</td>
<td>NS</td>
<td>LU</td>
<td>NU</td>
</tr>
</tbody>
</table>

(25) What is your level of agreement with each of the following opinions, in relation to the use of computers in mathematics classroom teaching?
[SA= strongly agree, A= agree, NS= not sure, D= disagree, SD= strongly disagree]
Please circle the appropriate category:

Generally speaking, computers:
- Are helpful as a main instruction tool for mathematics
- Are helpful tools in solving problems
- Suit teaching other subjects more than mathematics
- Are given more value (in mathematics education) than they deserve
- Lose their novelty when being used very frequently
- Are not being used to the degree that was expected two decades ago
- Will be used more efficiently in mathematics teaching in NZ in the next ten years

Part (E): Barriers and Benefits

(26) How often each of the following acts as an obstacle to your use of computers in mathematics classroom teaching? [VO= very often, O= often, ST= sometimes, R= rarely, N= never]
Please circle the appropriate category:

<table>
<thead>
<tr>
<th>Availability of hardware</th>
<th>VO</th>
<th>O</th>
<th>ST</th>
<th>R</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability of software</td>
<td>VO</td>
<td>O</td>
<td>ST</td>
<td>R</td>
<td>N</td>
</tr>
<tr>
<td>Accessibility to hardware</td>
<td>VO</td>
<td>O</td>
<td>ST</td>
<td>R</td>
<td>N</td>
</tr>
<tr>
<td>Accessibility to software</td>
<td>VO</td>
<td>O</td>
<td>ST</td>
<td>R</td>
<td>N</td>
</tr>
<tr>
<td>Suitability of available software to what I teach</td>
<td>VO</td>
<td>O</td>
<td>ST</td>
<td>R</td>
<td>N</td>
</tr>
<tr>
<td>Suitability of available software to how I teach</td>
<td>VO</td>
<td>O</td>
<td>ST</td>
<td>R</td>
<td>N</td>
</tr>
<tr>
<td>Lack of time</td>
<td>VO</td>
<td>O</td>
<td>ST</td>
<td>R</td>
<td>N</td>
</tr>
<tr>
<td>School finance</td>
<td>VO</td>
<td>O</td>
<td>ST</td>
<td>R</td>
<td>N</td>
</tr>
<tr>
<td>School's computer policy</td>
<td>VO</td>
<td>O</td>
<td>ST</td>
<td>R</td>
<td>N</td>
</tr>
<tr>
<td>Curriculum statements</td>
<td>VO</td>
<td>O</td>
<td>ST</td>
<td>R</td>
<td>N</td>
</tr>
<tr>
<td>Lack of co-operation among teachers</td>
<td>VO</td>
<td>O</td>
<td>ST</td>
<td>R</td>
<td>N</td>
</tr>
<tr>
<td>Lack of professional training</td>
<td>VO</td>
<td>O</td>
<td>ST</td>
<td>R</td>
<td>N</td>
</tr>
<tr>
<td>Students' attitude towards using computers</td>
<td>VO</td>
<td>O</td>
<td>ST</td>
<td>R</td>
<td>N</td>
</tr>
<tr>
<td>Nature of mathematics</td>
<td>VO</td>
<td>O</td>
<td>ST</td>
<td>R</td>
<td>N</td>
</tr>
</tbody>
</table>

(27) What is your current level of satisfaction regarding your use of computers in mathematics classroom teaching? [VH= very high  H= high  A= average  L= low  VL= very low]
Please circle the appropriate category:

- My commitment to more use is
- My satisfaction with current use is
- My satisfaction with my knowledge on how to use computers to teach mathematics is
- My satisfaction with my knowledge on how students could use computers to learn mathematics is

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(28) What are your training needs on how to use computers in mathematics classroom teaching?
   Please tick (\ ) the appropriate box/es:
   □ I do not need any training
   □ I need some training on using computers in specific areas of the mathematics curriculum.
   Please list examples
   □ I need some training on specific areas of the technical use of computers.
   Please state on what?
   □ I need urgent training. Please state on what?

(29) What recommendations you would like to send to the Ministry of Education and secondary schools to get the most benefit of the use of computers in mathematics teaching in New Zealand?

(30) What is your vision or ideal for the use of computers in secondary mathematics teaching in New Zealand schools in future?

(31) In your opinion, what are the three most significant barriers to the use of computers in teaching secondary mathematics in New Zealand schools?

(32) In your opinion, what are the three most significant benefits of using computers in teaching secondary mathematics in New Zealand high schools?

End

Thank you for your time and help

Note: After you complete this questionnaire, please use the provided pre-paid envelope to send it back by FRIDAY 10th August 2001 to:

Hasan Toubat
C/o Dr. Vince Ham
Christchurch College of Education
P O Box 31-065
Christchurch

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Appendix
(2)
Hasan Toubat  
C/o Dr. Vince Ham  
Christchurch College of Education  
P.O.Box 31-065  
Christchurch  
Tel (03) 357-9919  
E-mail toubath@student.cce.ac.nz

25/July/01

Dear Head of Maths Department;

You and your department teachers are invited to participate in some research on the use of computer technology in secondary mathematics teaching in New Zealand schools. The research is being conducted under Christchurch College of Education supervision as a part of a Masters Degree thesis.

There is a great deal of literature on the topic of this research. We almost daily hear or read about educators’ opinions on using computer technology in mathematics teaching learning process. The aim of this research is to investigate teachers’ opinions, and to provide us as “field experts” with the opportunity to talk about our experiences in relation to the use of computers in secondary mathematics classroom teaching.

I would greatly appreciate your willingness to reply this invitation for the benefit of all of us. In this case, your participation will be in disseminating the three enclosed “Mathematics teacher” questionnaires to three secondary mathematics teachers in your department. If there are more than three secondary teachers, including you, please disseminate the questionnaires randomly. Selected teachers may include you or may not. They may be computer users or may not; the research is concerned with both. The most important issue is the randomness of the selection process.

I would like to assure you of confidentiality in conducting this research. Your identity, as well as your school’s, and your department’s teachers, will not be revealed under any circumstances. The collected information and the questionnaires will not be accessible to the public or any other party except the researcher and the advisory committee. The results will be published only as aggregated results, and used for further research or for sending some recommendations to the Ministry of Education.

If you have any concerns regarding the research, please do not hesitate to contact me or my research supervisor Dr. Vince Ham at Tel (03-3437780 Ext 8158) or e-mail vince.ham@cce.ac.nz I/He will be very happy to discuss them with you. I am also happy to provide you with a results’ summary on request.

Thank you for your time and help.

Yours sincerely

Hasan Toubat
Appendix
(3)
Hasan Toubat  
C/o Dr. Vince Ham  
Christchurch College of Education  
P.O.Box 31-065  
Christchurch  
Tel (03) 357-9919  
E-mail toubah@student.cce.ac.nz

25 July, 01

Dear Secondary Maths Teacher,

You are invited to participate in some research on the use of computers in mathematics teaching. The research is being conducted under Christchurch College of Education supervision as a part of a Masters Degree thesis.

We almost daily hear or read educators’ opinions about the use of computer technology in mathematics classroom teaching. The aim of this research is to investigate teachers’ opinions and to provide us, as field experts, with the opportunity to talk about our experiences regarding the use of this technology in secondary mathematics curriculum delivery in New Zealand schools. Your opinion about this issue, your positive and negative experiences, and the real possibilities for using these technologies in daily practice are most important in this research.

Your participation will be in the form of filling in the attached questionnaire and sending it back in the pre-paid envelope to the researcher.

I would like to assure you that your identity and your school’s will not be revealed in any results. The responses will be confidential and will not be accessible to the public or any other party other than the supervisory committee. The aggregated results of this research could be published. It could be also the foundation for further research or for specific recommendations sent to the Ministry of Education. I am very happy to provide you with a results summary on request.

Teachers are at the heart of the teaching and learning process. We are the locus of any educational development. I do believe that your participation in this research is vital.

If you have any concerns regarding the research, please do not hesitate to contact me, or my research supervisor Dr. Vince Ham at Tel (03-3437780 Ext 8158) or e-mail vince.ham@cce.ac.nz. I/He will be very happy to discuss them with you.

I look forward to receiving your completed questionnaire. Please send it back by FRIDAY 10th August, 2001.

Thank you for your time and help.

Yours sincerely

Hasan Toubat
EXTENDED
ABSTRACT
Ideals versus Practices

A survey of
New Zealand secondary mathematics teachers’
classroom use of computers

Extended Abstract of a thesis
submitted in partial fulfilment of the requirements of the degree
of Master of Teaching and Learning

Hasan Mohammad Toubat

Christchurch College of Education
Christchurch
New Zealand

September 2003
Ideals versus Practices
A survey of New Zealand secondary mathematics teachers’ classroom use of computers

Hasan Toubat
Christchurch College of Education
Christchurch - New Zealand

Abstract

Several pieces of research and reports in the mid 1990s and beyond indicate a low level of using computers technologies in mathematics teaching and learning processes in New Zealand schools.

This article discusses computer use in New Zealand secondary mathematics teaching, as it existed in 2001. It attempts to answer the questions: to what extent and for which purposes are computers being used? What are teachers’ views about integrating computers into day-to-day practice? The article is based on the results of a nationwide survey of teachers.

It would seem that little coherence exists between daily reality and governmental objectives for computer use, which are expressed, either explicitly or implicitly, in the Mathematics in New Zealand Curriculum (MiNZC). This article discusses the reasons that lead to this lack of harmony between the ‘official talk’ and the ‘field of work’.
The paper concludes by raising questions and offering suggestions for consideration in order to move forward towards more effective use of computer technologies in New Zealand schools.

Introduction

The 1990’s witnessed a curricular revolution that led to a new national curriculum. One of its elements was the recognition of the importance of new technologies, including computers, in education.

In 1992 the *Mathematics in the New Zealand Curriculum* (MiNZC) was released as an official statement to provide “the basis for mathematics programmes in schools from year 1 to year 13” (Ministry of Education, 1992, p. 5). This statement asserts the influence of technology on mathematics education. It stated,

“In an increasingly technological age, the need for innovation, and problem-solving and decision-making skills, has been stressed in many reports on the necessary outcomes for education in New Zealand. Mathematics education provides the opportunity for students to develop these skills, and encourage them to become innovative and flexible problem solvers” (Ibid, p. 7).

In 1993 the *New Zealand Curriculum Framework* (NZCF) was released to set out the official policy for teaching, learning and assessment in New Zealand schools. In 1996 the Ministry of Education released its report *Schooling for the Future*. Its focus was planning for education for the next 25 years. In this document applying technology, including computers and their impact, were identified as vital factors affecting future education in the next 25 years (Ministry of Education, 1996).

Large amounts of money were allocated for implementing different projects and initiatives directed to integration of computers in schools. So, there is a need for research to reveal what use mathematics and other teachers are actually making of computers and whether that usage is exemplary of ‘best’ or even ‘good’ practice?

Thomas in 1995 carried out a comprehensive nation-wide study. Although the study covered most of the situation of computer use at the time, it was aimed to “address the question of why the computer has not been more widely influential in the teaching of mathematics by discovering the pattern of use, and the factors influencing it, in New Zealand schools” (Thomas, 1996, p. 556). In this study Thomas concluded, “More funding for computers and for training seems necessary” (ibid, p. 561). Thomas also observed that the beliefs, the attitudes, and the confidence of teachers are major elements in bringing change in the classroom use of computers.

Available research and reports since then tell us very little about current computer use for classroom secondary mathematics teaching.

**Method**

For the sample in the survey, teachers were clustered within schools (450) around New Zealand. The head of mathematics department randomly drew a sub-sample of 3
teachers from each school. Accordingly the research sample was 1350 teachers. Each of them received a pre-prepared questionnaire, through the head of mathematics department, to be completed and sent back to the researcher in a pre-paid provided envelope. At the end of an extended ‘wait-time’ period, 304 questionnaires were received back, being a response rate of about 23%.

Results

The extent of computer use

Results of this research show that three quarters of secondary mathematics teachers are users of computers for classroom teaching. When the frequency of use is considered results show relatively low use of computers in mathematics classroom teaching. A higher proportion (35%) of teachers use computers for one or two periods a term. Only 3% of them used computers for four or more periods a week. See Figure 1

Figure (1)

Frequency of computer use among teacher users (n=210)
Teachers were asked how many periods per term in the last two terms they had used computers in mathematics classroom teaching. The results show that computers tended to be used more often in the second term than the first term. A possible reason could be that teachers are more settled in the second term than in the first term. See Table 1

Table (1)

Number of periods that computer used in for teaching mathematics at all class levels in 2001

<table>
<thead>
<tr>
<th>Level Term</th>
<th>Y9</th>
<th>Y10</th>
<th>Y11</th>
<th>Y12</th>
<th>Y13S</th>
<th>Y13C</th>
<th>Y11 MA</th>
<th>Y12 MA</th>
<th>Y13 MA</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st</td>
<td>300</td>
<td>179</td>
<td>128</td>
<td>176</td>
<td>251</td>
<td>67</td>
<td>43</td>
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<td>2nd</td>
<td>220</td>
<td>181</td>
<td>166</td>
<td>230</td>
<td>276</td>
<td>60</td>
<td>79</td>
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<td>51</td>
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<td>Total</td>
<td>520</td>
<td>360</td>
<td>294</td>
<td>406</td>
<td>527</td>
<td>127</td>
<td>122</td>
<td>76</td>
<td>81</td>
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<tr>
<td>Average</td>
<td>260</td>
<td>180</td>
<td>147</td>
<td>203</td>
<td>263.5</td>
<td>63.5</td>
<td>61</td>
<td>38</td>
<td>40.5</td>
</tr>
</tbody>
</table>

Table (1) shows that teachers used computers most often in year 13 statistics level. The results also show that the number of periods in which computers are used tends to decrease as the year level rises, except year 13S year 13C.

When frequency of computer use was plotted for each teacher, covering both terms and all class levels, results show that a small percentage of teachers recorded the highest computer use. For example 2% of year 9 level teachers recorded 35% of the total periods in which a computer was used.

Despite this finding there are a group of teachers very committed to integrating computers into the teaching learning process. Though they are a small minority, those who used computers in 20 or more periods a term is good example of such
commitment, and show promise of driving the government's stated goal of computer use in the teaching-learning process.

The amount of time spent using computers is not the only factor that gives an indication of the extent to which computers are being used. The range of topics involved, and the different curriculum strands for which computers are being used, are also important.

Teachers were asked about their use of computers in teaching each strand of the mathematics curriculum at each year level. The results show a tendency for the statistics strand to be the area where computers were most utilised at all levels. This is probably due to the fact that students are required to do statistics assignments and projects using computers, in which their results contribute towards their final grade. Although this issue needs more investigation, it raises the question about the relation between the use of computers and the assessment system. The number strand comes second in computer use at the junior levels, while algebra strand comes second to statistics strand at senior levels. Measurement and mathematical processes strands are the areas with the lowest use of computer. See Table 2

**Table (2)**

*Computers use over the curriculum strands*

(n = number of teachers, p = percentage)

<table>
<thead>
<tr>
<th>Strand</th>
<th>Number</th>
<th>Measurement</th>
<th>Geometry</th>
<th>Algebra</th>
<th>Statistics</th>
<th>Mathematical Processes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>P</td>
<td>n</td>
<td>P</td>
<td>n</td>
<td>P</td>
</tr>
<tr>
<td>9</td>
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<td>68%</td>
<td>50</td>
<td>36%</td>
<td>58</td>
<td>48%</td>
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<td>10</td>
<td>68</td>
<td>66%</td>
<td>57</td>
<td>42%</td>
<td>65</td>
<td>59%</td>
</tr>
<tr>
<td>11</td>
<td>66</td>
<td>65%</td>
<td>52</td>
<td>44%</td>
<td>61</td>
<td>61%</td>
</tr>
<tr>
<td>12</td>
<td>40</td>
<td>43%</td>
<td>39</td>
<td>39%</td>
<td>46</td>
<td>46%</td>
</tr>
<tr>
<td>13Stat</td>
<td>---</td>
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<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>13Calc</td>
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<td>14%</td>
<td>15</td>
<td>20%</td>
<td>18</td>
<td>33%</td>
</tr>
<tr>
<td>Average</td>
<td>51.2%</td>
<td>36.2%</td>
<td>49.4%</td>
<td>56.6%</td>
<td>84.2%</td>
<td>47%</td>
</tr>
</tbody>
</table>

6
To get a better understanding of computer use within each strand, teachers were asked what proportion of each strand’s topics they use computers to teach. The results tend to show that computers are used for teaching, only a small proportion or range of topics within all curriculum strands.

Irrespective of how often computers are used by teachers, Table (3) shows that computers are used for teaching ‘few’ or ‘very few’ topics within any given curriculum strand.

**Table (3)**

<table>
<thead>
<tr>
<th>Strand</th>
<th>Number</th>
<th>Measurement</th>
<th>Geometry</th>
<th>Algebra</th>
<th>Statistics</th>
<th>Mathematical Processes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Year</td>
<td>n</td>
<td>P1</td>
<td>P2</td>
<td>n</td>
<td>P1</td>
<td>P2</td>
</tr>
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<td>9</td>
<td>65</td>
<td>5</td>
<td>42</td>
<td>50</td>
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</tr>
<tr>
<td>10</td>
<td>68</td>
<td>3</td>
<td>34</td>
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<td>11</td>
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<td>35</td>
<td>52</td>
<td>2</td>
<td>27</td>
</tr>
<tr>
<td>12</td>
<td>40</td>
<td>3</td>
<td>23</td>
<td>39</td>
<td>0</td>
<td>23</td>
</tr>
<tr>
<td>13Stat</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>13Calc</td>
<td>14</td>
<td>0</td>
<td>14</td>
<td>15</td>
<td>0</td>
<td>20</td>
</tr>
<tr>
<td>11Map</td>
<td>13</td>
<td>15</td>
<td>15</td>
<td>13</td>
<td>15</td>
<td>15</td>
</tr>
<tr>
<td>12Map</td>
<td>10</td>
<td>0</td>
<td>30</td>
<td>8</td>
<td>0</td>
<td>25</td>
</tr>
<tr>
<td>13Map</td>
<td>2</td>
<td>0</td>
<td>2</td>
<td>50</td>
<td>0</td>
<td>2</td>
</tr>
</tbody>
</table>

**Key**
- $n$: total number of users
- $P1$: users for “all” or “most” topics
- $P2$: users for “few” or “very few” topics

This table shows that even in the statistics strand, which is the area where computers were used the most, the proportion of topics that computers are used in is small. For example, at year 13S level the percentage of teachers who use computers in teaching statistics in general is 95% of teachers who responded to the question. Only 20% of these use computers to teach ‘all’ or ‘most’ of the strand topics, and 28.3% of them use computers for teaching ‘few’ or ‘very few’ topics.
Although the Internet is the second most used source of software applications, commitment to its use is not very strong. It is used ‘very often’ or ‘often’ by just 18% of its users, while 44% of them use it ‘very little’ or ‘little’.

**Purposes of computer use**

Teachers were asked about their use of some popular software as Spreadsheets, Word Processing, and Logo software. Available figures show that the vast majority of mathematics teachers who use computers with classes use Spreadsheet software. There was a noticeable difference between the number of users of Spreadsheet software and the number of users of other software. Although the LOGO program was recommended many times in many places in MiNZC, its usage was restricted to a very small minority of teachers. See Figure 2

![Figure 2](chart.png)

In relation to mathematics content software, teachers were asked about their use of mathematical software packages relevant to algebra, geometry, graphing, and statistics topics. Results show that statistics and graphing packages seem to be used by more teachers than algebra and geometry software.
Algebra software seemed to be used more at junior levels (years 9, 10, & 11) than at senior levels. Year 11 level had the highest usage of geometry and graphing software; while statistics software received the highest use at year 13S level. See Table (4)

**Table (4)**

**Teachers’ use of some mathematics-topics software at various class levels**

<table>
<thead>
<tr>
<th>Software type</th>
<th>Number of users (n)</th>
<th>Y9</th>
<th>Y10</th>
<th>Y11</th>
<th>Y12</th>
<th>Y13S</th>
<th>Y13C</th>
<th>Mathematics Applied Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Algebra</td>
<td>23</td>
<td>35</td>
<td>39</td>
<td>39</td>
<td>26</td>
<td>17</td>
<td>4</td>
<td>9</td>
</tr>
<tr>
<td>Geometry</td>
<td>37</td>
<td>43</td>
<td>46</td>
<td>81</td>
<td>14</td>
<td>3</td>
<td>14</td>
<td>5</td>
</tr>
<tr>
<td>Graphing</td>
<td>68</td>
<td>18</td>
<td>26</td>
<td>57</td>
<td>47</td>
<td>26</td>
<td>16</td>
<td>7</td>
</tr>
<tr>
<td>Statistics</td>
<td>73</td>
<td>21</td>
<td>36</td>
<td>33</td>
<td>29</td>
<td>56</td>
<td>1</td>
<td>14</td>
</tr>
</tbody>
</table>

Mathematics-topics software was used least in the measurement and mathematical processes strands. See Table (5)

**Table (5)**

**Teachers’ use of some mathematics-topics software to serve various curriculum strands**

<table>
<thead>
<tr>
<th>Software type</th>
<th>Number of users (n)</th>
<th>Number</th>
<th>Measurement</th>
<th>Geometry</th>
<th>Algebra</th>
<th>Statistics</th>
<th>Mathematical processes Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Algebra</td>
<td>23</td>
<td>13</td>
<td>4</td>
<td>4</td>
<td>96</td>
<td>13</td>
<td>22</td>
</tr>
<tr>
<td>Geometry</td>
<td>33</td>
<td>6</td>
<td>3</td>
<td>97</td>
<td>9</td>
<td>9</td>
<td>6</td>
</tr>
<tr>
<td>Graphing</td>
<td>61</td>
<td>10</td>
<td>5</td>
<td>31</td>
<td>69</td>
<td>30</td>
<td>7</td>
</tr>
<tr>
<td>Statistics</td>
<td>72</td>
<td>3</td>
<td>1</td>
<td>3</td>
<td>4</td>
<td>100</td>
<td>7</td>
</tr>
</tbody>
</table>
Teachers also were asked about the use of some purposive software such as drill and practice, tutorial, learning games, and simulations. Results imply that teachers tend to use these types of software in more or less equal proportions, except for tutorial software, which is used less than the others.

Results also indicate that drill and practice software is used at junior rather than senior levels. Learning games software is more likely to be used solely for junior mainstream mathematics classes, with most use at the year 9 level. The greatest use of simulation software is in year 13S.

Teachers were asked about the purposes for which they use computers with classes. Results show that the greatest use of computers is for recording student results and test designing.

Results show that about 85% of teachers used computers ‘very often’ or ‘often’ for test designing and for recording student results, while only 12% of teachers used computers to that extent for classroom teaching. About 68% of teachers used computers ‘sometimes’ or ‘rarely’ for classroom teaching. See Table (6)

**Table (6)**

<table>
<thead>
<tr>
<th>Purpose</th>
<th>Number of teachers (n)</th>
<th>Very often</th>
<th>Often</th>
<th>Sometimes</th>
<th>Rarely</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test designing</td>
<td>191</td>
<td>62</td>
<td>24</td>
<td>13</td>
<td>1</td>
</tr>
<tr>
<td>Lesson planning</td>
<td>136</td>
<td>23</td>
<td>18</td>
<td>36</td>
<td>23</td>
</tr>
<tr>
<td>Classroom teaching</td>
<td>165</td>
<td>4</td>
<td>8</td>
<td>43</td>
<td>45</td>
</tr>
<tr>
<td>Classroom management</td>
<td>79</td>
<td>20</td>
<td>18</td>
<td>28</td>
<td>34</td>
</tr>
<tr>
<td>Classroom materials</td>
<td>159</td>
<td>25</td>
<td>23</td>
<td>33</td>
<td>20</td>
</tr>
<tr>
<td>Student result recording</td>
<td>201</td>
<td>59</td>
<td>26</td>
<td>10</td>
<td>5</td>
</tr>
<tr>
<td>Communication with parents</td>
<td>154</td>
<td>32</td>
<td>33</td>
<td>21</td>
<td>14</td>
</tr>
</tbody>
</table>
A closer look at this table, suggest that the commitment to computer use for administrative purposes is higher than for teaching and learning.

Teachers were asked for what teaching tasks they used computers. Results indicate that the most frequent use of computers was for extending pre-taught material, followed by practicing pre-taught material. Although computers are used mostly for practicing and extending pre-taught material, the frequency is generally low.

See Table (7)

<table>
<thead>
<tr>
<th>Task</th>
<th>Number of users (n)</th>
<th>% of users</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Very often</td>
</tr>
<tr>
<td>Introducing new material</td>
<td>117</td>
<td>3</td>
</tr>
<tr>
<td>Explaining new material</td>
<td>102</td>
<td>3</td>
</tr>
<tr>
<td>Practicing pre-taught material</td>
<td>125</td>
<td>4</td>
</tr>
<tr>
<td>Extending pre-taught material</td>
<td>132</td>
<td>5</td>
</tr>
<tr>
<td>Solving mixed problems</td>
<td>90</td>
<td>1</td>
</tr>
</tbody>
</table>

Therefore, results indicate that computers usage is more aimed at lower order reinforcement than at higher order conceptualisation, or reasoning or discovering new ideas.
**Teachers’ perception of the use of computers**

Results of this research show that the great majority of mathematics teachers clearly perceive a positive role for computers in teaching mathematics and developing mathematical processes skills. When teachers were asked about their level of agreement with some statements related to computer use in mathematics teaching, the results indicate that the majority of teachers believe that computers are equally suitable for teaching mathematics and other subjects. 41% of them ‘disagreed’ or ‘strongly disagreed’ with the statement, “Computers suit teaching other subjects more than mathematics”, whilst 25% of teachers ‘agreed’ or ‘strongly agreed’ with it. Also 62% of teachers ‘agreed’ or ‘strongly agreed’ with the statement, “Computers are helpful tools in solving problems”. Results also show that more than 96% of teachers believe that computers are useful for teaching students of all levels of abilities.

Although teachers believe in a positive role for computers in the teaching-learning process, 57% of them ‘disagreed’ or ‘strongly disagreed’ with the statement, “computers are helpful as a *main* instruction tool of mathematics”. A minority (20%) ‘agreed’ or ‘strongly agreed’. When teachers were asked about their opinion on the most useful benefits of computers for classroom teaching, enhancing the teaching environment, teaching aid, and keeping up with the ICT age were respectively the three most important benefits in teachers’ opinion. See Figure (3)
Figure (3)
Teachers' opinion on the most useful benefits of computers for classroom teaching

<table>
<thead>
<tr>
<th>Benefit</th>
<th>Number of teachers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Keeping up with IT age</td>
<td>40</td>
</tr>
<tr>
<td>Saving time</td>
<td>60</td>
</tr>
<tr>
<td>Enhancing the teaching environment</td>
<td>80</td>
</tr>
<tr>
<td>For future needs</td>
<td>100</td>
</tr>
<tr>
<td>A teaching aid</td>
<td>120</td>
</tr>
<tr>
<td>Enhancing the quality of students' work</td>
<td>140</td>
</tr>
<tr>
<td>A new-rich source of information</td>
<td>160</td>
</tr>
<tr>
<td>Relating mathematics to the real life</td>
<td>180</td>
</tr>
<tr>
<td>Assisting in administrative tasks</td>
<td>200</td>
</tr>
</tbody>
</table>

This figure suggests that teachers' perceptions were not closely aligned with their actual practice. Although using computers in teaching mathematics was regarded as beneficial, only a minority of teachers actually used them for this purpose. Also, teachers used computers most for administrative purposes while this use was at the bottom of the list of computer benefits according to their responses.

In the light of teachers' experiences the majority of them found computer use served as a 'catalyst' for learning, by motivating students and making mathematics more interesting. By contrast, the majority of teachers found very little benefit from computer use in achieving enhanced social interaction, or improved collaborative...
work. These two opposing tendencies, and the pronounced differences between them, comprise an area worthy of further research. See Figure 4

**Figure (4)**

**Frequency of actual teachers’ experience of usefulness of computers in different aspects of the teaching environment**

![Bar chart showing the percentage of teachers' experience of usefulness of computers in different aspects of the teaching environment.](chart)
Teachers found that using computers had not affected or changed the way they taught mathematics. Results show that the majority (71%) of teachers felt such effect in "some" or "few" cases in their experience. See Figure (5)

Figure (5)
Teachers' experience of the impact of computers on the way that mathematics is taught (n = 182)

These results indicate that the way teachers teach mathematics is not much influenced by the use of computers.

This result could explain in part why the 'work' level of students was lower than levels of their 'motivation and interest' (Figure 4). Computers motivate students and make learning mathematics more interesting, but because there is little consistency between the existing and the required techniques and strategies for using computers in teaching, teachers were unable to integrate using computers into the process to create a "collaborative" learning environment.
However, this inconsistency between the impacts of computer use on different aspects of the teaching environment may have other reasons. This area also warrants further investigation.

**Barriers to computer use**

Although results show that teachers hold firm views in favour of computer use in mathematics teaching, they still seem to confront strong barriers preventing them from effectively integrating computers into curriculum implementation.

Among 14 reasons provided for not using computers to the level they believe desirable, teachers singled out 8 of them as barriers to computer use in daily practice. More than 85% of respondents mentioned confronting each of those obstacles. When how often teachers experienced those obstacles is taken in consideration, ‘hardware accessibility’, ‘lack of time’, and ‘hardware availability’ were at the top of the list. See Figure (6)

**Figure (6)**

*Obstacles to computer use measured by teachers responses, ‘very often’ or ‘often’*
Discussion

The three main goals of MiNZC seem to be:

1. students will become confident and competent users of information technology in mathematical contexts;

2. students should use computers in a constructivist approach to enhance their higher levels of learning skills such as, exploration, investigation, and open-ended problems solving; and

3. the use of computers is to be across the curriculum, integrated through all its strands and at all year levels.

With regard to developing confident and competent student - users of computer as a routine tool in their learning, the time given to them to experience these tools is an important factor. Results of this research indicate that the biggest proportion of teachers (35%) use computers for one or two periods a term. If we assume that the average full-time teacher load is 20 periods a week and the term length is 10 weeks, this means that the time given to computer use is less than 1% of the actual teaching time. Therefore, it is unlikely that the curriculum goal could be reached by using the computer in one or two periods a month or a term.

In relation to the purposes of computer use, the findings of this research imply that most mathematics teachers use computers for administrative purposes more than classroom teaching.

Also, results indicate infrequent use of computers for tasks such as exploration and discovery. If these results are linked to those which indicate that computers are mostly being used to serve the statistics topics and for a whole period, then these findings imply that purposes such as mathematical exploration and experimentation, open-ended problem solving, investigating geometric concepts and number patterns,
and discovering new mathematical ideas receive less emphasis in most curriculum strands. Generally, in contrast to what the curriculum recommends, the use of computers is aimed more at lower order reinforcement than higher order conceptualisation or reasoning and discovering new ideas.

In relation to the curriculum strands, results imply that computers are being used mostly to serve statistics strand. Other strands such as measurement, geometry, and mathematical processes are unlikely to be targeted by the use of computers in the teaching learning process. Even when computers are being used to teach these strands, the proportion of topics in which computers are used is small.

With regard to the curriculum year levels, Findings of this research indicate that computer use is greater at junior level than at senior level, except at the y13S level.

These results demonstrate that the use of computers for classroom secondary mathematics teaching and learning processes does not completely comply with curriculum goals as stated in MiNZC.

**Conclusion**

This research presents the findings of a nation-wide survey about the current use of computer technology in secondary mathematics teaching in the light of government’s goals expressed in MiNZC and other curriculum documents. Overall, it provides evidence that the level of computer use in secondary mathematics teaching is still below the desired level, and short of government expectations.

The research uncovers two contradictions the teachers’ experience. The first contradiction is between teachers’ perceptions and their actual practice related to computer use. The vast majority of teachers believe in the usefulness of computers for classroom teaching, but achieve only infrequent use of them. The second contradiction is between teachers’ level of satisfaction and their attitudes towards
computer use. Most teachers have very positive attitudes towards using computers for classroom teaching, but they are dissatisfied with their current level of use.

Teachers face many obstacles preventing them from using computers to their potential. These obstacles are often out of their control, such as teachers’ load, availability of hardware, suitability of software, and the professional training.

The research also gives some insight into the methodology of teaching and learning applied by teachers in the classroom when using computers. Although further research is needed to explore this point, results imply that the current use of computers is not highly aligned with the constructivist approach.

In this regard the results pose several questions for further research; questions which may be of interest to the government and concerned parties, and lead to better understanding of present needs, and more focused future planning. Among these, for example would be: What is the role which the assessment system playing to improve the actual use of computers? Do we need a revolution in our curriculum to fit the use of computer technology? Or do we need a revolution in computer technology to fit our teaching needs? With regard to the ambivalence between teachers’ perceptions and attitudes on one hand and their actual computer use for classroom teaching on the other hand – how did this come to be? Do our teachers fear the use of computers technology or do they hold some misconceptions about it, or do they have a clear educational vision, which they stick to? How did the difference between our schools regarding provision of computer technology equipment become so wide? How can we change this reality for the benefit of all our children and the society in large? Do we intend to use computers in our schools as a ‘tool’ for teacher’s use in the teaching process (instructional tool), or for student’s use in the learning process (learning tool), or for both? This research does not answer such questions but provides a description of usage that raises them for further research, and indicates that teachers’ opinions should be considered when answering these questions.
References


END