**An Assessment of factors affecting Technology Adoption by Teachers:
The case of Caribbean Secondary Schools**

by

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B.Sc Computer and Management Studies (Hons)

A thesis submitted to
the Faculty of Graduate Studies and Research
in partial fulfillment of
the requirements for the degree of

Master of Business Administration

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The Faculty of Graduate Studies and Research
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Thesis Supervisor
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This thesis is dedicated to the memory of my dearly beloved mother and father

You were my greatest source of strength and support

Thank you for teaching me to work hard and persevere

Abstract

This research aims at identifying the factors that influence teachers' intentions to use and integrate computer technology in their lessons. The research model goes beyond most technology adoption studies and combines two existing bodies of research - education technology and information systems – in an attempt to find the best mix of explanatory factors. The factors have been categorized into two main groups: institutional level factors (strategic direction and policies, time, lack of adequate/appropriate hardware and software, access to technology, integration into curriculum, training, technical and institutional support) and individual level factors (perceived usefulness of computers, attitude towards computers, and peer and superior influence). Data collection involved a combination of surveys and interviews involving secondary schools in eight Caribbean islands namely: Anguilla, Antigua, Dominica, Grenada, Monsterrat, St.Kitts, St.Lucia and St.Vincent. Results showed the most significant factors were attitude to computers, perceived usefulness, and availability of hardware. Appropriate recommendations have been made to promote technology adoption.

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1 Introduction

“Information and communications technologies (ICT) are a diverse set of technological tools and resources used to communicate, and to create, disseminate, store, and manage information” (New directions of ICT use in education, UNESCO’s world Communication and Information Report, p. 1 <http://www.unesco.org/education/educprog/lwf/dl/edict.pdf>. accessed 28.01.2002). The incorporation of ICTs into the formal education system is being heralded as one of the most important aspects of education in today’s society as it has the potential to provide students with critical skills that are essential for success in today’s technology driven society (Trattner, Wang, Carter, 2000).

In recent years education authorities in many countries have acknowledged the importance of ICTs in education and have sought to invest heavily in the provision of technology to schools under their jurisdiction. However the question remains – is the mere provision of computers and related technology to schools sufficient to guarantee its use? Thus according to Moore (2001), despite the fact that billions of dollars are being invested in technology in the United States every year, the reality is that many schools are still grappling with issues such as: ensuring that technology is being used in the classroom, ensuring that it is being used with effective instructional practices, and determining which technology skills are most needed and desired for teachers.

The issue of non-adoption or underutilization of computer technology in schools has caught the attention of researchers and school administrators alike. Several research studies have been conducted at various levels of the education system in countries across the globe, in an effort to determine which factors affect the acceptance or rejection of computer technology in schools. (For example in the UK- Simpson, Payne, Munro and Lynch (1998), Lawson and Comber (1999); USA - Hoffman (1996); Belgium - Braak (1999); Malaysia - bin Bakar and Mohamed (1998); the Netherlands - Mooij and Smeets (2000)). Many of these studies have focussed their attention on teachers, as they are seen as key to student learning and achievement (Moore, 2001), and could thus provide valuable insight into present (and future) practices in the classroom.

However, the problem of non-adoption of computer technology is not limited to schools. For years management of business organisations have grappled with the problem of rejection of computer systems by employees in their organisations. There is an extensive body of information systems research which includes the work of researchers such as Davis, Bagozzi and Warshaw (1989); Davis (1989, 1993); Compeau and Higgins (1995); Compeau, Higgins and Huff (1999); Vankatesh and Davis(2000) devoted to explaining and predicting computer usage behaviour in the organisation.

Contrasting opinions exist on the issue of computer use in schools. While some (such as Leidner and Jarvenpaa, 1993; Murphy and Greenwood, 1998; Braak, 2001) highlight the merits and benefits of technology integration in the classroom, others (such as Oppenheimer, 1997; Healy, 1998; Sherman, 1998) express skepticism and believe that

those benefits are being oversold. It is not the aim of this research to prove (or disprove) the claims of either side, but merely to highlight concerns about technology integration as expressed by education authorities in the Caribbean (and other countries), given that the initial investments in technology have already been made.

Thus the focus of this thesis is to identify which factors influence the non-adoption of computer technology by teachers in Caribbean Secondary Schools, given that the computers are already present in those schools. The factors examined will be drawn from previous research conducted in schools and will uniquely combine those with factors from information systems research. Based on the results of the study, an attempt will be made to suggest measures that can be instituted by education administrators and policy makers to address the problem of non-adoption by teachers.

The scope of this project is limited to secondary schools (as opposed to primary schools), since in most Caribbean islands this is the only level of the education system currently equipped with computers and related equipment.

1.1 Significance of Study

Most studies done on technology adoption in schools have been focussed on developed rather than developing countries. The effect is that the results may not necessarily be generalizable to developing countries, and the Caribbean in particular. This study provides a unique and specific perspective on technology adoption in individual islands in the english speaking Caribbean. The results of this study may be generalizable to the Eastern Caribbean region as many of the islands are similar in terms of education system, culture and resources.

The research model goes beyond most technology adoption studies and combines two existing bodies of research - education technology and information systems – in an attempt to find the “best mix” of explanatory factors. It is hoped that the results will add to both existing bodies of knowledge in trying to pinpoint the main determinants of information technology adoption in schools.

The results of this study will no doubt provide a better understanding of the determinants of acceptance or rejection of computer technology by teachers in the Caribbean. This would be of use to education administrators, as it would allow them to implement measures to circumvent the negative factors, and to emphasise the positive in the day-to-day administration of the school. Education policy makers and planners would be in a better position to design policies to enhance and promote technology acceptance and adoption in schools.

The rest of this paper is organized as follows: The next chapter describes a review of the relevant literature and presents definitions, impact and applications of computer technology in schools. It also presents an overview of existing theories on technology acceptance. Based on the literature reviewed, Chapter 3 presents the research model and hypotheses. Chapter 4 gives details of the proposed empirical study and development of research instrument. Results are tabulated and presented in Chapter 5 and discussed in Chapter 6 along with limitations and implications of this study. The final chapters present recommendations and conclusions.

2 Literature Review

This chapter lays the theoretical foundation for the research. It outlines results of an extensive search of existing literature on technology adoption in business organizations and schools. First, definitions of the various terms are put forward in an effort to provide clarification and direction for the remainder of this study. Next, the impact of computer technology on education is examined through its effect on teaching practices and the role of the teacher. This is followed by a presentation of the various studies on technology adoption conducted in educational settings. The chapter ends with a review of various adoption theories from information systems literature.

2.1 Definitions

A myriad of terms are currently being used to refer to various forms of computer technology existing today. In the following sections an attempt will be made at clarification for our purposes.

2.1.1 ICT/IT

The term information and communications technology (ICT) refers to:

a diverse set of technological tools and resources used to communicate, and to create, disseminate, store, and manage information... Thus the new digital ICTs are not single technologies but combinations of hardware, software, media, and delivery systems. Today, ICT in education encompasses a great range of rapidly evolving technologies such as desktop, notebook, and handheld computers; digital cameras; local area networking; the Internet and the World Wide Web; CD-ROMs and DVDs; and applications such as word processors, spreadsheets, tutorials, simulations, electronic mail (email), digital libraries, computer-mediated conferencing, videoconferencing, and virtual reality.

(New directions of ICT use in education, UNESCO's World Communication and Information Report, p. 1 <http://www.unesco.org/education/educprog/lwf/dl/edict.pdf>. accessed 28.01.2002.)

This is not very different from the definition of information technology (IT) as given by the Information Technology Association of America indicating that in many cases the terms are loosely interchangeable. IT is defined as:

the collection of products and services that turn data into useful, meaningful, accessible information. The information technology industry has several major facets: computer hardware, software and services. Often, telecommunications hardware, software and services are also included in the definition. Given the convergence of this technology, including the Internet, hand held devices, intelligent machines and other equipment, clear distinctions between information technology and telecommunications are exceedingly difficult.

www.itaa.org/news/itinddesc.pdf accessed 28.01.2002

2.1.2 Educational Technology/ Instructional Technology

Broadly speaking, educational technology may be referred to as an approach to achieving the objectives of education (Ely, 2000). The scope of educational technology can be broadened to include the use of research, learning theory, emergent technologies, and child and adult psychology directed towards solving instructional and performance problems (University of San Francisco website: available at <http://www.students.itec.sfsu.edu/itec865/text.v1/prospects/definition.html> accessed 12-03-2001). One of the frequently used definitions of educational technology recognized by the Association of Communications and Technology (ACET) has defined the term as instructional technology, which refers to the theory and practice of design, development, utilization, management and evaluation of processes and resources for learning (Ely, 2000).

Although the terms educational technology and instructional technology are used interchangeably, there exists a difference in focus. Instructional technology focuses on instructional problem solving using a scientific and systems approach, while the emphasis in educational technology is the art of using technology to support learning (Cutshall, 2000).

For the purposes of this research project we are interested in the use of computers and related technologies for purposes of classroom instruction. Since many schools in the Caribbean are yet to fully incorporate communication technologies, the scope of this project is limited to the use of computers in the classroom for instructional purposes. For

the remainder of this paper, the term computer technology is used interchangeably with information technology (IT).

2.2 Impact of Computer Technology on Education

2.2.1 Teaching Practices

The past decade has produced a dramatic increase in the development of technology-based teaching and learning (Alavi and Leidner, 2001). However, the mere existence and rapid improvements in computer instructional technology is not sufficient to produce improvements in instruction (Hannafin and Rieber, 1989). Information technology in education is at risk of what Perkins (1985) calls the fingertip effect: the situation where a technology may change people's method of doing certain things without having any effect on basic aspirations, endeavors and thinking habits of a population.

An examination of instructional theory by Reigeluth (1996) points to the need for a change in the paradigm for education and learning from one focused on sorting students, to one which is more focused on student learning. He believes that the current model of classroom instruction places too much emphasis on standardization and advancement of the fittest, which in turn leads to passive learning by students. Thus, the emphasis should be placed more on meeting the needs of learners; this can be achieved by encouraging more active learning through customizing to fit individual needs, and thus ensuring the advancement of all.

One way of meeting individual learning needs is to allow learners to control lesson pace, sequence, options and activities. It is believed that the learner is best suited to make these choices based on a perceived or verified need (Hannafin and Rieber, 1989). In order for this process of learner-centered and learner-controlled learning to be even remotely successful, it must be guided effectively by instructional theories and technologies. With the shift away from the teacher being the centre of instruction to being an agent of learning, flexible guidelines must be given for the design of suitable learning environments and choosing among the various approaches to instruction and the design of these various approaches (Reigeluth, 1996).

2.2.2 Role of the Teacher

Traditional classroom teaching is on the verge on transformation. Use of the emerging electronic technologies creates enormous challenges to teachers since it demands significant changes in their pre-existing knowledge, attitudes and behaviours (Norton and Sprague, 1996). Davis (1995) believes that new technologies in the classroom are forcibly changing teachers' pedagogical roles from traditional instructor to facilitator and skills developer, where the teacher is now expected to guide students towards understanding the application and most importantly, to teach students how to evaluate the information presented by new technologies such as the Internet.

While some teachers are excited about the new prospects presented by the emerging technologies, others feel threatened by their perceived diminishing importance in a classroom enhanced by computers and related technologies. Some teachers view their role as changing from the central authority figure in the classroom to facilitators of learning (Costa and Matthews, 2000). Muffoletto (1996) believes that computer delivered instruction have the power to completely transform the classroom, the school, and the role of the teacher.

It is important to remember that the role of teachers is pivotal to any real change in the education system, as teachers have control over what happens to themselves, their classrooms, and their schools (Rudduck, 1991). Of primary concern to this research is how teachers react to the new roles that the current transformations in the education sector have thrust upon them. More specifically, what factors determine how teachers will respond to their new calling as technology enabler in the classroom?

2.2.3 Benefits and outcomes

IT can be used across the curriculum to enhance student learning (Murphy and Greenwood, 1998). “One of the principal advantages of the use of IT in teaching and learning is that it enables schools and colleges to cater for the needs of the individual rather than to the average needs of the class (Murphy and Greenwood, 1998, pp 414). Use of IT in the classroom serves to motivate learners and provide flexibility to cater to individual needs in various ways: information can be presented in new and innovative

ways to enable students to understand more readily, provides students with power to take risks by trying different ideas, and better caters to students with special learning needs. Overall, the use of IT allows learners to gain confidence and challenge themselves more (Murphy and Greenwood, 1998).

From a pedagogical point of view, the use of IT seems to offer greater educational benefits than other more traditional teaching methods. Some of these benefits include the ability to: facilitate wide access to information, act as a stimulant for collaborative learning, allow flexibility in teaching and learning, and help eliminate the bounds of time and space from instructional processes (Braak, 2001). The Idaho State Technology Initiative states that its primary goal is “to improve the quality and effectiveness of classroom instruction and learning”, and also identifies the “mastery of basic academic skills” as the most important learning priority (Buck Institute for Education, p 2.1).

Leidner and Jarvenpaa (1993) suggest that the potential exists for use of computer-based teaching methods to improve classroom learning. They concluded from their case studies of electronic classrooms that the computer-based teaching methods that required hands-on use by students seemed to provide an advantage over traditional teaching methods and other computer-based methods that did not require hands-on student use. Methods of instruction such as computer-assisted instruction (CAI) and interactive learning systems (ILS) are based on pedagogical assumptions such as: “learners learn more effectively and efficiently when they are able to control the pace, feedback is a critical part of effective

learning, and active involvement leads to more effective learning than passive involvement” (Leidner and Jarvenpaa, 1995, p 274).

Thus if the computer technology is appropriately applied it has the ability to take students further than just assimilation of content and superficial levels of understanding - as offered by traditional methods of instruction - to facilitating synthesis, analysis, and evaluation (Robertson, 2000).

2.2.4 Application

Teachers may use computer technology for non-instructional purposes as a productivity tool, or in the classroom for instructional purposes. As a productivity tool computer technology may be incorporated into many aspects of education delivery such as building curriculum, lesson plans, instructional units and presentations, using tools which facilitate integration of computer technology and classroom content (Robertson, 2000). The use of information technology as a research-gathering tool has made a significant impact on present day education (Trattner et al., 2000). More specifically, use can be made of the Internet to research a wide array of topics (which may be used to enhance lessons or compile reports, etc.) (Robertson, 2000).

A 2000 statewide survey in Idaho asked teachers to report on the most common uses of computers both in and out of the classroom. The most common uses identified for non-instructional purposes were:

- To record/calculate grades
- To email teachers, students or parents
- To write lesson plans, notes or handouts
- To make slides or multimedia presentations
- To access Internet resources or lesson plans

(An Analysis of computer use by Idaho Students and Teachers, prepared for Governor's Office, State of Idaho, pp. 3.2)

The most common student uses of computers in the classroom as identified by Idaho middle and high school teachers are presented below: *(pp. 2.7 to 2.8)*

- To improve basic academic skills (73%)
- To write essays and other assignments (65%)
- To motivate interest in a subject (64%)
- To access the Internet for research (57%)
- To challenge the brightest students (52%)
- To remediate slower learners (52%)
- To communicate with others by email (43%)
- To complete simulations (34%)
- To take a test or quiz (33%)
- As a reward for completing other work (32%)
- To play "learning games" (24%)
- To prepare multimedia presentations (22%)
- To make or contribute to a website (14%)

The focus of this research project is to examine computer use by teachers in the classroom for instructional purposes as identified above. This is not to imply that other uses are totally irrelevant, for example the Idaho State report (*cited above*) described a low, but statistically significant correlation between teachers' computer use for instructional and non-instructional purposes. The report suggests "once teachers understand how technology can benefit their non-instructional teacher tasks, they may begin to use computers more frequently for instructional ends" (pp 3.8). It may be safe to assume also that once teachers become acquainted with using the technology on their own time and at their own pace, they are likely to gain competence and confidence and are then more likely to transfer these skills to classroom use.

2.3 Education Research on IT Use in Schools

To date researchers have conducted a myriad of analytic and empirical assessments on the situation of Information and Communications Technology use in schools in an effort to explain, and possibly improve the situation. The results are as varied as the studies themselves, and suggest a variety of factors from the macro level to the micro level that are believed to significantly influence the decisions of teachers to use or not to use technology in the classroom. Below is a synopsis of some pertinent factors arising from the research.

Braak (2001) in a study conducted in secondary schools in Brussels identified the following as the main barriers to technology use by teachers: demographic factors, computer experience, computer attitudes, innovativeness, medium characteristics and

organizational constraints. Watson, Blakeley and Abbott (1997) found the most significant barriers to be: lack of resources and technical resource persons, and also lack of training for teachers. Hoffman (1996) presented what he called eight success factors for schools in their endeavours to help teachers adopt technology in the classroom. These factors were: Administrative Support, Staff Development and Technical Support, Availability of Technology, Technology Use Plan, Technology Coordinator, Facilities and Maintenance, Assessment and Broad participation.

Ely (1999), identified eight conditions which were thought to be critical to ICT implementation in schools: dissatisfaction with the status quo, existence of knowledge and skills, availability of resources, availability of time, existence of rewards or incentives, participation, commitment, and leadership. According to Lawson and Comber (1999), the successful introduction of information technology into schools and colleges, has been identified as a product of both personnel factors such as teachers and IT coordinators, and technical factors such as the availability of hardware.

Easdown (1995) examined the results of earlier researchers such as Plomp, Pelgrum & Steerneman, 1990; Veen, 1993; Williams and Moss, 1993, who all sought to classify the long list of factors into two distinct groups for easier study. The classifications were:

1. Institutional Level Factors
2. Individual Level factors

According to Easdown (1995), evidence from the work of other researchers (including Veen, 1993; and Easdown, 1994) suggest that individual level factors are more important in explaining teachers' use of computers, than institutional factors.

2.3.1 Institutional Level Factors

These factors relate to the institutional context that the teachers operate in; the most prominent of these factors identified by Easdown (1995) were found to be the school's ability to provide the following: clear institutional policies to direct and guide the school's plans for information technology; adequate (and appropriate) hardware, software and curricular materials; adequate time to allow teachers to become familiar with the technology; clear procedures for teachers to gain easy access to the technology; technical assistance to teachers to help in preparation and delivery of lessons involving the technology; and positive attitude from the Head Teacher or Principal towards the innovation. These factors will be examined in further detail in the next chapter, with the research model and hypothesis presentation.

2.3.2 Individual Level factors

These factors relate to teachers beliefs and preconceptions about the use of computers, and how these relate to teaching and learning in their subject disciplines. It also includes factors relating to curriculum content, and how it should be taught.

2.3.2.1 Teacher Beliefs and Perceptions

IT presents tremendous opportunities for improving teaching and learning in the classroom. In order to fully capitalize on the true potential of this technology, teachers have to be encouraged to experiment and find ways to fully integrate the technology into their classroom practice (Easdown, 1995). The question should be asked - to what extent is technology adoption related to a personal decision by the teacher?

The nature of the teaching profession is very isolating and demanding (Rudduck, (1991); thus any new implementation requires much extra effort on the part of the individual teacher. Traditionally secondary school teachers are left to decide on their own whether or not to use certain didactic methods in the classroom (Mooij and Smeets, 2001). Regarding IT use in the classroom, it follows that teachers get to decide whether (or not) to use it, and also how exactly they should incorporate ICTs into their lessons. Teachers are unlikely to embrace any ideas or solutions handed down by management and which seem unnecessary, unnecessarily hard to implement, or requires them to put in several extra hours, unless they feel that the prospective change has a good purpose (Rudduck, (1991).

So how can education authorities promote information technology adoption in the classroom? Mooij and Smeets (2001) advocate that teachers must see the advantages and must be convinced, in order to be motivated to incorporate IT into their teaching. Rudduck (1991) holds the view that real change must first take place in the teacher and this can only be possible if the teachers are consulted, and are allowed to give input into

what types of changes take place in teaching methods and classroom practices. Lawson and Comber (1999) believe that attitudes can be changed if the appropriate training and support is provided to teachers.

There seems to be a lack of consensus in the literature over the varied number of personal and behavioural factors that influence teachers' use of technology. In many cases teachers themselves are being targeted as the main limitations for IT adoption in the classroom. Lawson and Comber (1999) indicate that some of the main barriers are teachers' lack of skill, fear of the computer, or lack of understanding the various ways in which IT can be used to enhance teaching and learning in the classroom. It is also believed that teachers find IT adoption problematic, as it demands various changes at the same time: in attitudes, knowledge, and classroom practice.

2.4 Information Systems Research

2.4.1 Pedagogical Issues

One branch of information systems research based on studies conducted in higher education (more specifically in graduate business schools) draws a parallel between the use of computer technology in education and the more established uses in business organizations. According to Leidner and Jarvenpaa (1993, p. 24) "The potential uses of information technology in education share the very characteristics of information technology which businesses have used to gain competitive advantage and make productivity improvements: the interactiveness of computers, the distribution of

information, the provision of analytical tools, the elimination of distance barriers, and to a lesser extent the replacement of repetitive tasks". The success of information technology use in education is believed to depend on the degree to which the technology is integrated with the instructional objectives in much the same way the success of an information system is linked to how well it matches the organizational strategy (Leidner and Jarvenpaa, 1993).

The effectiveness of information technology in improving learning will depend on the degree to which the technology supports a particular learning model and how relevant it is to a particular learning situation (Leidner and Jarvenpaa, 1995). Thus information technology use within an educational environment will be reflective of some model of learning whether planned or inadvertently (Leidner and Jarvenpaa, 1995). In support of this argument they present an examination of some of the most widely accepted learning models: objectivism, constructivism, collaborativism, cognitive information processing, and socioculturalism. (*See Table 1*)

Table 1: Summary of Learning Models

Model	Basic Premise	Goals	Major Assumptions	Implications for Instruction
Objectivism	Learning is the uncritical absorption of objective knowledge	Transfer of knowledge from instructor to student Recall of knowledge	Instructor houses all necessary knowledge Students learn best in isolated and intensive subject matter	Instructor is in control of material and pace Instructor provides stimulus
Constructivism	Learning is a process of constructing knowledge by an individual	Formation of abstract concepts to represent reality Assigning meaning to events and information	Individuals learn better when they discover things themselves and when they control the pace of learning	Learner-centred active learning Instructor for support rather than direction
Collaborativism	Learning emerges through shared understandings of more than one learner	Promote group skills-communication, listening, participation Promote socialization	Involvement is critical to learning Learners have some prior knowledge	Communication-oriented Instructor as questioner and discussion leader
Cognitive Information Processing	Learning is the processing and transfer of new knowledge into long-term memory	Improve cognitive processing abilities of learners Improve recall and retention	Limited selective attention Prior knowledge affects level of instructional support needed	Aspects of stimulus can affect attention Instructors need feedback on student learning
Socioculturism	Learning is subjective and individualistic	Empowerment Emancipatory learning Action-oriented, socially conscious learners with a view to change rather than accept or understand society	Anglos have distorted knowledge and framed information in their own terms Learning occurs best in environments where personally well known	Instruction is always culturally value laden Instruction is embedded in a person's everyday cultural/social context

Source: Leidner and Jarvenpaa (1995) page 270

Of the learning models presented, the constructivist model best supports the concept of learner-centred instruction that assumes that persons are able to learn better if they discover for themselves rather than if they are simply told or instructed. In this situation the teacher would become a creative intermediary of the process of learning. The classroom environment would most often reflect a project-oriented session in which case the teacher would provide tools to help the learners construct their own views of reality (Leidner and Jarvenpaa, 1995). However, it should be noted that although computer-assisted instruction (CAI) and interactive learning systems (ILS) are based on constructivist theory, they have so far mainly supplied drill and practice tutorials which present material in a highly structured linear fashion. Thus although they claim to customize instruction to fit individual learning styles by allowing learners to construct their own knowledge, they have mainly succeeded in providing consistent delivery of course material which is all pre-determined knowledge (Leidner and Jarvenpaa, 1995).

Leidner and Jarvenpaa (1995) advocate that in order to fully understand the use of information technology as a tool in improving learning processes, it is important to first understand the pedagogical assumptions underlying the design of this technology. They present different visions of electronic classrooms, each of which represents the potential impact of IT on learning. The visions presented were drawn from organizational research and adapted to the educational setting by Leidner and Jarvenpaa (1995). These visions are informing up, informing down, and transforming. A brief synopsis of the IT visions is presented below.

Automating refers to the mere replacement of some aspect of human labour with IT usually in the performance of structured routine tasks. Many aspects of teaching and learning are not considered structured tasks and are not conducive to automation as described here. However, certain aspects of instruction are more likely to be automated particularly delivery of content.

Informing Up refers to the use of IT to keep managers informed of detailed aspects of their organization's performance. The classroom application of this vision involves the provision of timely feedback to the instructor on students' understanding of class material taught. In this manner, the instructor would be able to clear up misunderstandings and clarify matters as soon as possible.

Informing Down refers to the use of technology to provide information to persons in the lower levels of the organization. The classroom application involves giving students access to information so that they can analyze it critically and discuss pressing issues among themselves.

Transforming: Using IT as the basis of transforming an organization involves information distribution and sharing at all levels thus allowing power and authority to shift away from position and status and move toward knowledge and information. The classroom application would involve the use of IT in the following ways: (1) to redefine physical boundaries of the classroom, (2) enable more teamwork, (3) facilitate learning as a continuous, time-independent process (4) facilitate multi-level, multi-speed knowledge creation.

From their analysis of early attempts to introduce IT into management education, Leidner and Jarvenpaa (1995) conclude that the process has followed the classic path of automation rather than transformation, where the primary use has been to simply automate information delivery in classrooms. If no fundamental changes are made to the actual process of teaching and learning, it may produce the undesirable result of simply speeding up what may already be ineffective teaching methods. Instead, Leidner and Jarvenpaa (1995) believe that schools should try to informate up and down, with the ultimate goal of transforming the educational environment and processes. As a possible solution they present groups of technologies in which schools should invest en route to achieving the IT visions (*See Table 1*).

Table 2: Electronic Classroom Types, Assumptions, and Related Models of Learning

ELECTRONIC CLASSROOM TYPE	PRINCIPAL PEDAGOGICAL ASSUMPTION
The Vision to Automate	
Instructor Console	Instructor the centre of classroom activity Presentation technologies can make the delivery of information more memorable and interesting
Instructor Console and Stand-alone Student Computers	Students learn better if they can emulate what the instructor is doing on the computer Learning is more effective when it is interactive
Computer Assisted Learning	Students benefit when they control the pace of learning Feedback should be frequent
Distance Learning	Weakness in education is the lack of availability of good courses and faculty Accessibility in remote locations or smaller schools can be efficiently provided via telecommunications
The Vision to Informate Up	
Key Response Pads	The instructor needs feedback The ability to elicit responses via technology is superior to hand-raising
Instructor-Student Email	Feedback, even delayed, is better than no feedback Limited access to instructors limits communication
The Vision to Informate Down	
Learning Networks	Delivery of information is not a pressing problem, but rather the lack of current information from realistic contexts Students create knowledge through information exploration
Hypermedia/Internet	Students need to create their own knowledge structures
Simulation/Virtual Reality	The more real the context, the more effective the learning Students should be provided the means to experience the phenomenon during class
Synchronous Communication Classrooms	Participation is critical to the learning process Anonymity encourages participation
Groupware-Supported Synchronous Communication Classrooms	Structure imposed on communication is effective in helping students learn Communication is more efficient when structured
The Vision to Transform: Virtual Continuous Learning Spaces	
Asynchronous Communication Across Distances	Learning is an ongoing process Time should be flexible Learning need not be geographically dependent
Groupware-Supported Asynchronous Communication Across Distances	Ad hoc communication is more effective when supported with a structure

Source: Leidner and Jarvenpaa (1995) page 281

2.4.2 Technology Adoption Literature

Since the mid 1970s, understanding which factors influence an individual's use of information technology has been a focal point of Information Systems research. It was recognized then that adoption of new technology was not living up to expectations (Campeau and Higgins, 1995). They highlighted that the mere presence of computers could not improve organizational performance if they weren't used. Unfortunately at that time there was widespread resistance to end-user systems by managers and professionals (Davis, 1989). Researchers and practitioners in the field sought to gain a full understanding of why people resisted using computers, in an attempt to devise methods for evaluating information systems and thus predict users' response to such systems. There was the ultimate aim of positively altering user behaviour through improvements in the nature of the systems and the implementation methods (Davis, Bagozzi, Warshaw, 1989). This understanding is crucial in order to ensure that performance is not affected by user rejection, as user acceptance is often the critical factor influencing the success or failure of an information system project (Davis, 1993).

Significant strides have been made over the past decades in finding theoretical and empirical support in an attempt to fully explain and predict user acceptance of information technology in the workplace (Vankatesh and Davis, 2000). However, this by no means suggests that the problem has been solved. Gaining understanding of, and creating the environment that would allow information systems to be fully accepted by employees still remains a high priority research issue today (Vankatesh and Davis, 2000).

2.4.2.1 Behavioural Theories

Early researchers in search of theoretical foundations for explaining determinants of computer user behaviour searched for explanations from existing social psychology theory, which led to the inclusion of intention models (Davis, et. al., 1989). Intention models used behavioural intention to predict usage, and focused primarily on finding the factors that influenced intention (Taylor and Todd, 1995). The more prominent models taken from the literature includes: Theory of Reasoned Action (TRA), Technology Acceptance Model (TAM), and Theory of Planned Behaviour (TPB). These theories are examined below.

2.4.2.2 Theory of Reasoned Action (TRA)

The Theory of Reasoned Action (TRA) presented by Ajzen and Fishbein (1980) was one of the first intention models to gain widespread acceptance as a possible means of predicting and explaining user acceptance of computer systems. Essentially, this theory suggested that individuals would use computers if they were able to see directly the positive benefits of using them (Campeau and Higgins, 1995). More specifically according to the TRA, an individual's decision to perform a specific behaviour is determined by that person's behavioural intention (BI) to perform that behaviour; while BI is further determined by the individual's attitude (positive or negative feelings about performing the target behaviour¹) and subjective norm (the person's perception that most people who are important to him think he should or should not perform the behaviour in

¹ as defined by Fishbein and Ajzen, 1975

question²) concerning that behaviour (Davis, Bagozzi, Warshaw , 1989). The TRA is a widely researched model and has been extensively tested in predicting and explaining behaviour in a variety of domains; however for that same reason TRA was found to be too general (Davis, et. al., 1989).

Figure 1: Theory of Reasoned Action (TRA)

Source Davis et al,1989

2.4.2.3 Technology Acceptance Model (TAM)

In an attempt to be more specific Davis (1989) developed the Technology Acceptance Model (TAM) - an adaptation of the TRA - to explain computer usage behaviour. TAM incorporated findings of several years of IS research based on TRA, and sought to explain an individual's intention to use a computer system in terms of two fundamental beliefs of the individual with regards to the system: the individual's Perceived Usefulness, and Perceived Ease of Use. Davis believed that any other factor that may affect an individual's use of a system would do so through those two main determinants, and should therefore be classed as external variables (Taylor and Todd, 1995).

² as defined by Fishbein and Ajzen, 1975

TAM has proved to be a very powerful yet simple model in explaining and predicting computer users' intention to use and their actual usage behaviour; and continues to be the foundation for many studies on computer usage behaviours. Results of numerous empirical studies indicate that there is substantial theoretical and empirical support in favour of TAM (Davis 1989, Davis et al. 1989). TAM has consistently been capable of explaining a substantial portion (about 40%) of variance in usage intentions and behaviour, and has also compared favourably against other theoretical models (Vankatesh and Davis 2000). TAM has been validated by many researchers who have used this model (or variations of it) to explain user behaviour in a number of applications such as email, voicemail, word-processing (Lederer, Maupin, Sena, Zhuang, 2000). Recent applications of TAM to explain user acceptance and adoption of computer technology include the World Wide Web (Lederer et al. 2000) and telemedicine (Croteau and Vieru, 2001), among others.

Figure 2: Technology Acceptance Model (TAM)

Source Davis et al, 1989

Since its development (Davis, 1989) TAM has gone through various modifications, adaptations and extensions by many researchers (including Davis himself) in an effort to further refine and extend its explanatory and predictive powers. One major modification by Davis (1993) included attitude as a mediator, and proposed that system design features influenced a person's beliefs about the system (perceived usefulness and perceived ease of use). Those beliefs further influenced attitudes (the degree of favourableness or unfavourableness an individual associates with using a particular system (Taylor and Todd, 1995)), which allowed the individual to form intentions to use or not use the system. Davis' findings supported the hypothesis that attitude did have a significant effect on usage, and also confirmed earlier findings of the significance of perceived usefulness as a primary determinant.

2.4.2.4 Theory of Planned Behaviour (TPB)

Theory of Planned Behaviour (also based on TRA) sought to address the problem of user rejection of technology. The main difference between the Theory of Planned Behaviour and previous models was the addition of perceived behavioural control, meant to account for situations where individuals do not have complete control over their behaviour (Taylor and Todd, 1995). The Theory of Planned Behaviour posited that behaviour was influenced by intention and perceived behavioural control; intention in turn, was influenced by attitude, subjective norm, and perceived behavioural control, each of which was determined by a set of underlying beliefs.

Figure 3: Theory of Planned Behaviour (TPB)

Source: Taylor and Todd, 1995

Perceived Behavioural Control (PBC) describes an individual's perceptions of what he/she believes are internal and external constraints that may impede his/her behaviour. Results of various studies have indicated that PBC does have a significant effect on behavioural intention, though the explanatory power may be limited. One major limitation of TPB is that the underlying beliefs for each determinant of usage have not been decomposed to a consistent and generalizable set of variables, which makes it difficult to operationalize TPB. This limitation has been addressed by presenting an alternative version: The Decomposed Theory of Planned Behaviour (Taylor and Todd, 1995).

2.4.2.5 The Decomposed Theory of Planned Behaviour

In this case, the underlying beliefs of the determinants: attitude, subjective norm, and perceived behavioural control have been broken down into multi-dimensional constructs (Taylor and Todd, 1995). This modification is deemed beneficial in identifying a clear and consistent set of beliefs that would be applicable across a variety of settings, thus making operationalization of the model more straightforward.

The approach used to decompose attitudinal belief structures was adopted from perceived characteristics of an innovation theory, which identified three major characteristics of an innovation believed to influence acceptance: relative advantage, complexity and compatibility. The constructs perceived ease of use and perceived usefulness (used in TAM), were also categorized as underlying determinants of attitude (Taylor and Todd, 1995). Subjective norm refers to the influence of significant referent groups in an organization on an individual's usage behaviour. These significant groups have been identified as superiors, peers and subordinates (Taylor and Todd, 1995). Perceived Behavioural Control was decomposed into a personal dimension (self-efficacy), and to external resource constraints. Self-efficacy refers to an individual's belief in his/her ability to perform a particular behaviour. Facilitating conditions were found to be twofold: resource facilitating conditions (the availability of resources such as time, money and other specialized resources) and technology facilitating conditions (such as the availability and compatibility of the supporting technology) (Taylor and Todd, 1995).

Results of a study conducted by Taylor and Todd (1995) support the hypotheses that the main determinants of the decomposed TPB (attitude, subjective norm, and perceived behavioural control) all have significant effects on behavioural intention, and significant indirect effects on actual behaviour. Most of the underlying beliefs proved to have a significant effect on the determinants of intention, with the exception of ease of use and compatibility.

This chapter has provided the theoretical background for determining which factors should be given further consideration. The next chapter presents the research model along with the various hypotheses to be tested.

3 Theoretical Framework

The previous chapter examined various theories in technology adoption as a means of giving direction and theoretical grounding for this study. In this chapter, the research model is presented along with the appropriate hypotheses. Justification from the literature is also provided for the variables selected as part of the model.

3.1 Model Justification and Hypotheses

The Research Model presented below seeks to examine the effect of certain factors on teachers' intention to use or not to use computer technology in the classroom. The proposed model is based on the literature review presented in the previous chapter. Factors for the model have been categorized into two main groups: Institutional Level Factors and Individual level factors, based on the work of Easdown (1995) and other researchers. For the most part the institutional factors have been drawn from education literature and studies, while the individual factors have been drawn from the information systems literature. However, this distinction is not absolutely clear-cut, as there are overlaps in the theories and factors presented.

3.1.1 Research Model

Figure 4: Research Model

3.1.2 Hypotheses – Individual Level Factors

3.1.2.1 Perceived Usefulness

Perceived usefulness is defined as the degree to which a person believes that using a particular system would enhance his or her job performance (Davis, 1989). A technology that is used and therefore ranks high in perceived usefulness is one where the user believes there is a positive relationship between use of that technology and job performance. Previous extensive research around the Technology Acceptance Model (TAM) has theorized and presented empirical support about the importance of perceived usefulness as a fundamental determinant of computer use in an organization. In an early study conducted by Davis (1989), perceived usefulness was found to be highly correlated with self-reported current usage ($r = 0.63$) and self-reported future usage ($r = 0.85$). In that same study Davis (1989) also found a significant but much smaller correlation between perceived ease of use and self reported current ($r = 0.45$) and future ($r = 0.59$) usage. This led him to suggest that perceived ease of use may not be a direct determinant of usage, but rather may be a causal antecedent to perceived usefulness. Subsequent studies have used TAM as a theoretical base and have continued to theorise about the importance of fundamental determinants Perceived Usefulness and Perceived Ease of Use. Davis (1991) again found perceived usefulness to have a powerful effect on usage which was 50% over and above the effect of perceived ease of use on usage; which suggested that users were likely to use a system if they thought it would improve their job performance, even if it was difficult to use. Results of a recent longitudinal study by Vankatesh and Davis (2000) were consistent with earlier findings that while perceived usefulness is a strong and direct determinant of usage intentions, perceived ease of use is

a secondary determinant and acts primarily through perceived usefulness. This relationship has been tested and supported by many studies (e.g. Davis 1989, 1991; Davis et. al 1989; Vankatesh and Davis 2000) and is not in dispute here; thus the inclusion of perceived usefulness and the exclusion of perceived ease of use in the research model. Education researchers see teachers' workload as being already overburdened, and suggest that teachers will only engage in using technology in the classrooms if they see it as directly related to improving their job performance. We therefore theorize that teachers are likely to use computers in their jobs only if they are convinced of the benefits.

Hypothesis 1: The higher the level of perceived usefulness of computers in job performance, the greater will be teachers' intentions to use computers in the classroom.

3.1.2.2 Attitude

Attitude, as defined by Fishbein and Ajzen (1975) is a measure of the degree to which a person likes or dislikes an entity. The significance of belief and attitudinal constructs has received much recognition in the belief - attitude - intention theories, which generally seek to explain IT usage behaviour by individuals. These theories are based on Fishbein and Ajzen (1975) Theory of Reasoned Action, which posits that an individual's beliefs about an object leads to the formation of an attitude about that object; while that attitude leads to behavioural intentions, which ultimately affect the actual behaviour of the individual to the object (p. 6). Both TAM and TPB have included attitude as a direct determinant of behavioural intention and/or usage behaviour (Taylor and Todd, 1995), and previous research has found significant links between attitude and usage (Davis et al., 1989).

Attitude of teachers towards IT is a critical success factor for integration into classroom instruction (Lawson and Comber, 1999); since attitude invariably influences the decision to use (or not to use) the technology. Not only is technology adoption influenced by current attitudes, but also by pre-existing notions that have been formed prior to its implementation. These attitudes are influenced by the individual's personal interest and prior experience with IT (Somekh, 1996). Computer attitude among teachers has been the focus of several research studies to date, resulting in a number of measures being developed to measure attitude among both in-service and pre-service teachers. The Computer Attitude Scale developed by Gressard and Loyd (1986) has emerged as one of the most popular and reliable measures. This scale measures attitude by means of three sub-scales: computer anxiety, computer liking, and computer confidence (Braak, 2001; Francis, Katz, Jones, 2000). Computer liking (affect) and computer anxiety measure directly opposite feelings: liking represents positive feelings of the pleasure a person receives from using computers, while anxiety represents the negative feelings of uneasiness or anxiety a person experiences while using computers (Campeau, Higgins and Huff, 1999). Thus in an attempt to gain a more complete understanding of teachers' feelings toward computers and how it affects their intention to use, we decompose attitude into its three components: liking, anxiety and confidence.

Hypothesis 2: A positive attitude to computers will positively influence teachers' intentions to use computers in the classroom.

3.1.2.3 Subjective Norm

Subjective norm (SN) as defined by Fishbein and Ajzen (1975), refers to a person's perception of what most people who are important to him/her think about his/her performance (or non performance) of the behaviour in question. SN has been modeled in both TRA and TPB as a direct determinant of usage intentions, and as a determinant of perceived usefulness in TAM2 (Vankatesh and Davis, 2000). It has been posited in these theories that an individual is prone to execute a particular behaviour if they believe one or more important referents think they should, and they are sufficiently motivated to conform to the referents' wishes (Vankatesh and Davis, 2000). Results obtained about the effect of subjective norm are inconclusive, and leave room for further examination of this variable. For example Mathieson (1991) found that SN had no significant effect on intentions, while Taylor and Todd (1995) found that it did have an effect (Vankatesh and Davis, 2000). In the decomposed Theory of Planned Behaviour, subjective norm was decomposed into three important referent groups which were believed to have an influence on an individual's behaviour in the workplace: peers, superiors and subordinates (Taylor and Todd, 1995). Subordinate groups in the teaching profession are not clearly distinguished and may be irrelevant to behavioural decisions. Thus for the purposes of this study, we are primarily interested in the importance of peer and superior influence in supporting and initiating teachers' use of computers, and its effect on intention behaviour.

Veen (1993) reported that the Principals played an important role in influencing teachers' decisions to use computers by giving moral support, and showing commitment and interest in their efforts.

Therefore we hypothesize the following:

Hypothesis 3a: The stronger the support from the principal, the greater will be teachers' intentions to use computers.

Hypothesis 3b: The stronger the support from peers, the greater will be teachers' intentions to use computers.

3.1.3 Hypotheses - Institutional Level Factors

The education literature clearly points to factors existing at the administration level that greatly impact teacher behaviour, and over which teachers have little or no influence. (e.g. Easdown 1995; Hoffman, 1996; Simpson et al, 1998; Murphy and Greenwood, 1998). From the information systems literature, the Theory of Planned Behaviour included as a determinant perceived behavioural control (PBC) – which took into account situations where individuals did not have complete control over their actions. PBC was further decomposed to model its underlying constructs, which included resource facilitating conditions (such as time and money) and technology facilitating conditions (which includes technology compatibility issues). Essentially, the decomposed TPB posited that the lack of these facilitating conditions would have a negative effect on usage intentions and behaviour (Taylor and Todd, 1995). Thus the

factors presented below are hypothesized as major determinants of teachers' intentions to use technology in schools.

3.1.3.1 Strategic Direction and Policies

The introduction of computers involves some organizational change, and leadership is considered an important factor in successful organizational change (Hoffman, 1996). Experiences in US schools confirm the majority of research literature which states that leadership is "the single most important factor affecting the successful integration of technology. This is true at the state level and at the school level" ("Factors That Affect The Effective Use Of Technology For Teaching And Learning; Lessons From The SEIR*TEC Intensive Site Schools", <http://www.seirtec.org/publications/lessondoc.html> ##9 accessed 29.07.2001). The document cites evidence that the most successful technology programs are usually adopted in states that have visionary leaders, legislators, and education administrators. It also highlights that the most successful schools are the ones with the strongest leaders, and Principals who are committed to facilitating effective technology use by their teachers and students. Watson, Blakely and Abbot (1998) found in their study that a certain level of institutional and managerial commitment was crucial for the success of technology projects in schools. In its absence the project success is totally dependent on the level of personal satisfaction and motivation of individuals. Lawson and Comber (1999) also found in their study that support from senior management given in a public way was instrumental in encouraging the classroom teacher to get involved in the process of integration and devote the time and energy to the its development, despite all other pressures that they faced. In addition, school principals

can play the role of motivator by highlighting the attempts of teachers who seek to use technology to improve teaching and learning in the classroom (Factors That Affect The Effective Use Of Technology For Teaching And Learning; Lessons From The SEIR*TEC Intensive Site Schools, <http://www.seirtec.org/publications/lessondoc.html> ##9 accessed 07/29/2001).

IT implementation and adoption in schools has been plagued with a lack of what many term as strategic goals and enabling policies at the school, district and national levels. According to Easdown (1995) many institutions lack clear policies and goals to effectively guide technology adoption. O'Neil (2001) in a review of Office of Technology Assessment (OTA) Report on US Schools comments that there is a "lack of vision and clarity of goals" concerning the future of technology in schools, and implies also that with constant changes in the thrust of technology education, school policies have not been able to keep pace. As a result, "teachers have become confused, and administrators frustrated, with many educators unclear where they should be headed in technology use" (Teachers and Technology: Potential and Pitfalls; A study of schools in United States <http://www.eklavya.org/computers.htm> accessed 29.07.2001).

Therefore it is proposed that the existence of proper policies and clearly defined strategic goals is necessary to encourage schools and consequently teachers to embrace the new technologies.

Hypothesis 4: Lack of strategic direction and relevant policies will negatively influence teachers' intentions to use computers

3.1.3.2 Time

Lack of sufficient time was found to be one of the biggest barriers to technology implementation in classrooms in the US. This includes time for technology training, time to try out the technology in the classroom, and even time for teachers to talk to other teachers concerning technology issues (“Teachers and Technology: Potential and Pitfalls; A study of schools in United States” <http://www.eklavya.org/computers.htm> accessed 29.07.2001). In a survey of US Public schools, Dorman (2001) reports that among barriers to computer use identified by teachers, the highest reported barriers were lack of release time to learn how to use computers (82%) and lack of time in the class schedule for students to use computers (80%). The survey also revealed that those teachers who felt there was insufficient time allocated for integration were less likely to incorporate computers into their instruction. Research conducted in UK schools by Lawson and Comber (1999) also found that time was a crucial factor. They reported that even teachers who were initially very excited by the new technology and its potential uses complained consistently that there was insufficient time for further exploration, or even to evaluate the impact of technology use on students. Watson, Blakely and Abbot (1997) also alluded to the problem of time constraints after reporting that an experiment on technology use in teacher training colleges in the UK was severely hampered by the fact that the staff had no extra time to spend on exploring and using the new technology, and although they expressed willingness to participate, it was near impossible to fit time into an already overcrowded agenda. They speculate that had the activity been timetabled into the daily schedules of teachers, a greater level of use may have reported. Similarly, computers have been purchased and placed in some secondary schools in the Caribbean

with no corresponding changes in teachers' time schedule to allow for extra time for experimentation and familiarization.

Hypothesis 5: Lack of adequate time to experiment with computers will negatively influence teachers' intentions to use computers

3.1.3.3 Lack of Adequate and Appropriate Hardware and Software

Williams and Moss (1993) in their research involving UK Secondary Schools state that successful implementation of information technology in the National Curriculum must be preceded by the provision of appropriate hardware and software resources. It is very difficult for schools and individual teachers to focus on effectively integrating technology as a tool for teaching and learning in the classroom when they face challenges such as lack of basic technological equipment and facilities. Lack of sufficient hardware is seen as a definite obstacle faced by teachers ("Factors That Affect The Effective Use Of Technology For Teaching And Learning; Lessons From The SEIR*TEC Intensive Site Schools", <http://www.seirtec.org/publications/lessondoc.html##9> accessed 29.07.2001).

It can be a frustrating experience for teachers who are required to teach classes where less than one half of the students have access to computers at the same time. This situation often requires teachers to find innovative ways of keeping the other half of the students meaningfully occupied, and later are required to repeat the same lesson involving computers for the remainder of the students. This situation adds to the teachers' workload, (and also compromises the quality and quantity of time spent on the lesson.) ("Problems Integrating Computers Into The Classroom, Possible Solutions" <http://www.mdln.hws.edu/~skrabut/stan/school/paper661.html> accessed 29.07.2001). In

some cases, the hardware existing in schools is too antiquated to run current software; further, the process of acquiring new hardware for schools usually involves a long and drawn out process, thus rendering it almost impossible for schools to receive equipment on time to benefit from current software developments (“Problems Integrating Computers Into The Classroom, Possible Solutions” <http://www.mdln.hws.edu/~skrabut/stan/school/paper661.html> accessed 29.07.2001). The availability of appropriate educational software is fundamental to curriculum integration. However, many schools and teachers are plagued with the lack of sufficient and appropriate software. It is believed that software developers are reluctant to produce educational software because educators are not purchasing it; and educators are not purchasing educational software because vendors are not producing it; resulting in a perpetual cycle (“Problems Integrating Computers Into The Classroom, Possible Solutions” <http://www.mdln.hws.edu/~skrabut/stan/school/paper661.html> accessed 29.07.2001).

Hypothesis 6a: Lack of adequate and appropriate hardware in schools will negatively influence teachers’ intentions to use computers in the classroom.

Hypothesis 6b: Lack of adequate and appropriate software in schools will negatively influence teachers’ intentions to use computers in the classroom.

3.1.3.4 Access to Computer Technology

There is generally a lack of clear procedures in educational institutions to guarantee easy access to computer technology to all who need to use it (Easdown, 1995). Quite apart from the existence of hardware and software in schools, providing easy access to teachers

is a major consideration that involves the issue of location in the classroom versus computer labs. In many cases computers are located in computer labs where teachers don't have adequate and consistent access to them that would encourage their use as an everyday tool. Also while the majority of schools in the US reported to have Internet access, the proportion of classrooms with Internet access was considerably less ("Teachers and Technology: Potential and Pitfalls; A study of schools in United States" <http://www.eklavya.org/computers.htm> accessed 07/29/2001). Dorman (2001) in a survey of US Public schools confirmed these findings. His results indicated that teachers who had a larger number of computers in their classrooms reported a higher level of technology use than those who had only one or two computers in their classrooms, and that teachers were more likely to use the computers when they were located in their classrooms than when they were located in other parts of the school. Dawes (1999) found a crucial link between training and access to computers in his study of teachers in UK schools. Teachers who received computer training reported that they felt the training was wasted as they had no access to computers for practice either at school or at home, and therefore were liable to forget the new skills learned.

Hypothesis 7: Lack of adequate access to computers will negatively influence teachers' intentions to use computers in the classroom

3.1.3.5 Integration into Curriculum

Approximately 70 percent of school principals and 45 percent of teachers reported that the major barrier to effective use of technology was insufficient teacher understanding of ways to integrate technology into the curriculum. They also reported the lack of software integrated with curriculum (68 percent of principals and 60 percent of teachers) (*U.S. Department of Education -- September 2000* http://www.ed.gov/offices/OUS/PES/edtech_SERFF.html accessed 02.08.2001). Watson, Blakeley and Abbott (1997) observed that even in the few cases where teachers use ICTs, it is usually for personal work, and that there was very little change in the pedagogy of their classrooms. It is very difficult for teachers to apply their technology skills in the classroom if they cannot make a direct connection between teaching strategies, improvements in achievement, and most of all – the curriculum (*Factors That Affect The Effective Use Of Technology For Teaching And Learning; Lessons From The SEIR*TEC Intensive Site Schools*, <http://www.seirtec.org/publications/lessondoc.html##9> accessed 29.07.2001). In a survey of student teachers in the UK, the teachers complained that while they were taught to use specific software, they had no idea how it should be integrated into their actual classroom teaching (and the curriculum) (Simpson, Payne, Munro, Lynch, 1998).

Hypothesis 8: Lack of adequate knowledge and ability to integrate computer technology into the school curriculum will negatively influence teachers' intentions to use computers.

3.1.3.6 Lack of Appropriate Training

It was reported that overall, graduates of teacher education programs in the United States were not sufficiently trained to use technology as a teaching tool. Even in cases where training had been received, the type of training usually focused on teaching how to operate computers rather than teaching ways to integrate computers into particular subject areas. Further, the practice of giving lessons on computer use in individual subject disciplines may not even be sufficient to guarantee its use in the classroom. The report proposes that the best approach to achieving ICT integration into normal classroom lessons is to foster and adopt integration of computers and other new technologies into all aspects of the pre-service teacher education curriculum: from the first freshman course to student teaching and beyond. This would help inculcate into the minds of teachers that computers are as valuable a tool as the traditional chalk and board. (“Teachers and Technology: Potential and Pitfalls; A study of schools in United States” <http://www.eklavya.org/computers.htm> accessed 29.07.2001).

The training issue should be regarded cautiously however, as many institutional administrators believe that the mere provision of training courses is sufficient, without regard to whether the training is ever put into practice. Thus the provision of technology training to teachers without first ensuring that they have the resources, support and opportunity needed to apply their new knowledge and skills is a waste of time and resources as teachers will soon forget skills learnt if not put into practice immediately, (and will most likely lose any existing enthusiasm and motivation). (“Factors That Affect The Effective Use Of Technology For Teaching And Learning; Lessons From The

SEIR*TEC Intensive Site Schools”, <http://www.seirtec.org/publications/lessondoc.html> ##9 accessed 29.07.2001).

Hypothesis 9: Lack of appropriate training in computer technology will negatively influence teachers' intentions to use computers in the classroom

3.1.3.7 Lack of Technical and Institutional Support

Institutional support may include financial support given to teachers to purchase software and other essential equipment, allocation and provision of technical assistance, planning and implementation support through a school IT committee (or IT co-ordinator), and overall policy and moral support (Veen, 1993). Additionally, support from management is also essential in ensuring the provision of other facilitating conditions such as provision of training, adequate release time for training and practice on computers, and incentives to promote computer use in the classroom.

In his study involving Dutch Secondary schools, Veen (1993) alluded to the importance of both technical and institutional support for teachers. He reported that teachers viewed the support of a technical assistant as essential in facilitating their use of computers in the classroom. They relied on technical assistance to support a wide range of tasks from making copies of software, to the more significant task of collaboration and practical assistance during lessons in the computer lab. The results of Veen's (1993) case study revealed that responsibility for implementing new technology in schools should not be shouldered by individual teachers; but rather should involve a more broad-based initiative

from school management and administrators. Lawson and Comber (1999) concluded from their study of UK secondary schools that teachers were more motivated and committed to innovative practices using computer technology in the environments where technology initiatives received strong support from senior management.

Hypothesis 10 a: Lack of proper institutional support will negatively influence teachers' intentions to use computers

Hypothesis 10 b: Lack of proper technical support will negatively influence teachers' intentions to use computers

3.1.3.8 Behavioural Intention (BI)

The dependent variable in this model is Behavioural Intention, defined by Fishbein and Ajzen, (1975) as a measure of the strength of an individual's intention to perform a specific behaviour. BI has been a significant inclusion in well-researched and empirically tested models of usage behaviour such as TRA, TAM and TPB; and research results have revealed that the employment of intention in these models has increased the predictive powers of those models, as compared with some models which do not include intention (Fishbein and Ajzen, 1975). Intention to carry out a behaviour is seen as an essential antecedent to performing that behaviour (Taylor and Todd, 1995); and the sole direct determinant of behaviour (Davis, et. al. 1989). Behavioural Intention was found to be an accurate predictor of actual usage behaviour, as all other factors that influence user behaviour were found to act indirectly by influencing BI (Davis, et. al. 1989).

Regarding the situation in Caribbean schools, only a small percentage of schools have computer technology available; an even smaller number of teachers have actually started using computers. Thus any attempt at measuring actual usage behaviour would be meaningless. It is most appropriate in this situation (as supported by empirical data) to use intention as an indicator of future usage behaviour.

The research model to be tested with accompanying hypotheses was developed in this chapter. The next chapter gives details of the research design, which includes sample, methodology and data analysis

4 Research Design

This chapter gives details of the research study conducted. It starts with a description of the sample, and details of the research methodology. The next section looks at questionnaire development and pre-testing, along with methods of questionnaire distribution and collection. The chapter ends by giving details of interviews and data analysis.

4.1 Sample

The sample population included secondary school teachers from the English speaking Caribbean islands of St.Lucia, Grenada, Dominica, St.Vincent, Antigua, St.Kitts, Monsterrat and Anguilla. Though these islands are similar in culture, population make-up, language, and education system, the use/introduction of computer technology in their education systems are at diverse stages of development. Therefore, individual investigations were required of these islands in order to make the results generalizable to the region as a whole.

In each of these islands, only secondary schools equipped with functioning computer technology were chosen for the survey, since the primary interest was in investigating what factors act as barriers to the use of the technology, given that it is already present in schools. The sample included teachers of all subjects in the secondary school curriculum and of all grade levels.

According to Hair, Anderson, Tatham and Black (1987, pg. 166) the desired ratio of observations to independent variables should fall between 15 to 20 observations for each independent variable. At this ratio, the results will be generalizable, if the selected sample is truly representative of the population. Thus the ideal sample size should fall in the region of 180 to 240 responses, to correspond with the 12 independent variables in our model. However, due to the phenomenal low and unpredictable response rate for mail surveys, a total of 860 questionnaires were distributed to the sample population to ensure that the desired number of responses was obtained.

4.2 Method

Data collection consisted of a combination of interviews and questionnaires, in order to facilitate both qualitative and quantitative analysis. Quantitative analysis involves structured survey questioning, and is typically used for large samples. Results are numerically and statistically analyzed (Davis, 2000 pg. 293). Qualitative research is often combined with quantitative investigations. This may potentially result in a very powerful combination if the two research methodologies are made to be complementary. For example, “in-depth interviews can be used after an extensive survey to dig into the why of the results obtained” (Davis, 2000, p. 313). Interviews facilitate a longer and more flexible relationship between respondent and interviewer, resulting in data with more depth and richness of context. This creates a greater potential for new insights and perspectives into the problem (Aaker and Day, 1980, p 111).

At least one contact person was identified from within the education system of each participating territory. These persons were either senior Information Technology teachers, or Ministry of Education curriculum/planning officers with responsibility for IT. Contact persons facilitated the process of data collection by distributing and collecting questionnaires, and also through participation in interviews.

4.3 Questionnaires

4.3.1 Pre-testing

Questionnaires were sent out to about 40 teachers in two schools in St.Lucia for pre-testing. The main focus of the pre-test was to ensure that respondents easily understood all questions, and that all possible answer choices were included for each question. Comments were taken into consideration, and any final changes or corrections were made before sending out the final questionnaire.

One additional question was added at the end the questionnaire used for the pre-test in order to solicit comments from participants. The question read: “We would appreciate any suggestions you may have for making this questionnaire clearer or easier to answer. For instance, were any of the questions confusing? Why?” Aaker and Day (1983 pg. 171)

4.3.2 Distribution and Collection

Questionnaires with the attached cover letters and consent forms were sent via express mail to the contact person in each island for distribution to schools on their island with functioning computer technology installed. An envelope bearing the return address of the local contact person accompanied each questionnaire. In order to ensure confidentiality of responses, participants were instructed in the cover letter to return completed questionnaires in sealed envelopes to their local contact for further delivery to the researcher.

An adaptation of the Total Design Method (TDM) for Mail and telephone surveys (Dillman, 1978, p. 183) was used to send out reminders in an effort to increase response rate. Approximately one week after initial dispatch, the first reminder was sent to each contact person via email. This person was in turn instructed to send a brief reminder to the general staff at each participating school, thanking those who had responded and giving a courteous reminder to those who had not.

A second reminder was sent to the contact person via email approximately three weeks later. He/she was instructed to send another reminder to each school, along with some replacement questionnaires for those that may have been misplaced. This reminder served to appeal to those who had not responded and to emphasize its importance to the research results.

The final reminder similar to the second was sent approximately seven weeks later.

4.3.3 Measure

The measures used for this survey were drawn primarily from existing literature and adapted for the purpose of this study; while some were constructed for the purpose of this survey. Responses were rated on a five point Likert scale represented by 1 = strongly disagree, 2 = disagree, 3 = not certain, 4 = agree and 5 = strongly agree.

The Likert scale is a widely accepted and adopted technique (Davis, 2000, p. 203). It is a summated scale with a series of items to which the respondent is asked to indicate his level of agreement or disagreement with each item on the scale (Miller, 1970, p. 92). This scale has become very popular due to its relative ease of construction and administration (Aaker and Day, 1980, p. 217). “It is highly reliable when it comes to a rough ordering of people with regard to a particular attitude or attitude complex. The score includes a measure of intensity as expressed on each statement” (Miller, 1970, p. 92). The five-point Likert scale allows for a neutral position (as opposed to 4 or 6 point) and is the “most generally and widely used response form in Likert scaling” (Francis, Katz, Jones, 2000, p. 152).

The instrument consisted of three sections (See Appendix A).

Section A asked some general questions about current and previous computer use, and personal attitude towards computers in general and its use in the classroom, and subjective norm. The measure for computer attitude was taken from Francis, Katz, Jones (2000) who used a 30-item Computer Attitude Scale developed by Loyd and Gressard (1986). This Computer Attitude Scale has been one of the most frequently used

instruments to measure computer attitudes among pre-service and in-service teachers (Francis et al, 2000). The scale consists of 3 10-item sub-scales measuring computer anxiety, liking and confidence. For use in this study and to facilitate construct brevity, each subscale was reduced to 5 items with the highest factor loadings, thus explaining the highest amount of variance for that sub-scale. The result was a 15-item scale to measure attitude.

The measure for perceived usefulness uses a 4-item scale taken from Davis et al (1989), and also used by Chau (2001), Vankatesh and Davis (2000) and several other researchers. The items were modified slightly to reflect the use of computers instead of a software package. For example: "I would find WriteOne useful in the MBA program" was changed to "I would find computers useful in the classroom". Superior and Peer influence were each measured using 2 items. The first item was adapted from Campeau, Marcolin and Kelley (2001) measure of subjective norm "Those people who are important to me strongly support my using the web for school-related information gathering" was changed to "My Principal (peers) strongly supports my use of computers in the classroom". The second item "The support of my Principal (peers) regarding computer use is important to me" was developed for the purposes of this research.

Section B asked questions related to institutional factors presented in the research model. Some questions from this section were taken from measures used by Campeau et al., (2001) for facilitating conditions, and adapted for the purpose of this study. These questions were: "If I need someone's help in ...I could get it easily"; "I am able to find

the time I need to ...". The measures for specific factors such as: Time, Access, Training, Hardware and Software, Support, Curriculum integration, and Policies and Strategies, were developed specifically for this survey, and sought to measure different components of each factor based on the literature. For example, access was measured using 6 items to measure various components such as access during scheduled lessons, during school hours, after school hours, Internet access, and policies for access. The questions followed as closely as possible to general format used by Campeau et. al (2001) in their measure for facilitating conditions. Behavioural Intention to adopt was measured using a 2-item scale adapted from Taylor and Todd (1995). For example "I intend to use CRC to print projects...this term" was changed to "I intend to intend to incorporate them in my lessons as a teaching and learning tool". In order to increase clarity of items, each of the 2 statements were preceded by the phrase "Assuming I have access to computers,..." used by Vankatesh and Davis (2000) in a different measure for Behavioural Intention.

Section C contained questions on demographic information such as age, gender, education attainment, and teaching experience. This information was necessary as an aid in analysis and interpretation of results.

4.4 Interviews

Interviews were conducted with country representatives of each of the participating territories who served as contact persons for this research. Face to face interviews were made possible during a meeting/training session of the ICT Committee of the OERU (Organization of Eastern Caribbean States Education Reform Unit) held in St.Lucia in March 2002.

The purpose of interviews was to get an in depth understanding of any of the underlying issues which may not be reflected in the questionnaire responses, and to provide support for the findings of the questionnaire responses. Nine persons from the participating territories were interviewed.

Interviews lasted about 45 minutes during which open-ended questions were asked on policies and procedures governing computer use and technology access at the school level. Most interviews were recorded with the permission of the respondents in order to facilitate data analysis.

4.5 Data Analysis

This stage involved initial editing and coding of questionnaire responses. This was followed with data entry in SPSS statistical package. Negatively worded items were reverse coded, in order to have all scales in the same direction. Then items that formed composite scales were combined, and Alpha coefficients were calculated to ensure scale reliability.

Descriptive and summary statistics were calculated for each item in order to get an initial understanding of the data. The research model was tested using correlation and regression analyses following Davis (1989,1991) Vankatesh and Davis (2000).

The single open-ended question, and responses to interview questions were also examined for the primary purpose of getting a deeper understanding of the quantitative analysis.

This chapter gave a detailed description of the research design and methodology. The following chapter presents detailed results which include item responses and statistical tests.

5 Results

The previous chapter gave an account of the research methodology used along with details of the design such as sample, data collection and analysis. This chapter gives the results of data analysis and statistical tests performed. First a demographic description of respondents is presented according to country, along with summaries of their computer experience. This is followed by a detailed breakdown of item responses obtained from questionnaires. Results of correlation and regression analyses are then presented to examine relationships between independent variables and intention to use.

5.1 Demographics

A total of 860 questionnaires were distributed in 9 Caribbean islands: namely Anguilla, Antigua, British Virgin Islands (BVI), Dominica, Grenada, Monsterrat, St.Kitts, St.Lucia, and St.Vincent. A total of 192 valid responses were received from 8 of the islands, with the largest percentage coming from St.Lucia (23.4%) and Dominica (21.9%); none were received from BVI. (Table 3). This number clearly met with the recommended target for this survey of between 180 and 240 responses.

Table 3: Number of responses by Country

COUNTRY	Frequency	Percent
Anguilla	18	9.4
Antigua	17	8.9
Dominica	42	21.9
Grenada	19	9.9
Monsterrat	17	8.9
St.Kitts	20	10.4
St.Lucia	45	23.4
St.Vincent	14	7.3
Total	192	100.0

Figure 5: Distribution by Country

The following statistics are presented in table 5; numbers are rounded off for clarity

Of the 192 respondents the majority were female (65 %). This trend was observed in all of the islands with the exception of Antigua, which had more male respondents (53%).

Over half of the overall population (53%) were under 30 years. Most individual populations revealed that trend, but it was emphasised in Dominica with an overwhelming 73% below the age of 30, while Monsterrat was the opposite with 80% of its population over the age of 30. Fifty four (54%) of respondents had been teaching for 10 years and under, though St. Vincent contrasted with the trend having 43% of respondents with over 20 years teaching experience.

In terms of education attainment, varying distributions were recorded across the islands. Of the total population, 97% had received some form of post-secondary education, with 44% having received an undergraduate degree or higher.

There was a representation of teachers from all subject areas, with the highest representation from Science (23%) and Social Sciences (16%). Information Technology teachers represented 7% of the respondents.

5.2 Computer Use

The following statistics are presented in table 8; numbers are rounded off for clarity

A substantial majority (89%) of the respondents reported that they were current computer users, with 59% of these persons reporting to be regular users (use often and very often). Of the computer users, the majority (56%) had been using for 5 years and under, while a significant percentage (44%) were more experienced users (over 5 years).

Concerning use, 31% reported regular use as an administrative tool (Table 4), whereas 11% reported that they currently use computers in the classroom as a teaching tool. It should be noted, however, that out of the total population, just over 10% use computers as a teaching tool (only half of those use for subjects other than Information Technology).

Table 4: Use computers as a teaching tool

Subject	Already Use	
	Count	% of total population
English Language/Literature		
Languages		
Science	2	1.1
Mathematics	1	.5
Business	2	1.1
Technical/Vocational	1	.5
Information Technology	10	5.3
Social Sciences	2	1.1
Other	2	1.1
Total	20	10.7

Table 5: Demographics of respondents by country

	Anguilla	Antigua	Dominica	Grenada	Monterrat	St. Kitts	St. Lucia	St. Vincent	Total Population
AGE									
20 and under			12.2%	26.3%			15.6%	7.1%	9.6%
21-30	50.0%	31.3%	61.0%	26.3%	20.0%	52.6%	40.0%	35.7%	42.8%
31-40	33.3%	31.3%	17.1%	15.8%	66.7%	15.8%	26.7%	28.6%	26.7%
41-50	16.7%	37.5%	9.8%	31.6%	13.3%	21.1%	15.6%	28.6%	19.3%
51-60						10.5%	2.2%		1.6%
GENDER									
Male	33.3%	52.9%	41.5%	26.3%	18.8%	47.4%	26.7%	30.8%	34.6%
Female	66.7%	47.1%	58.5%	73.7%	81.3%	52.6%	73.3%	69.2%	65.4%
Teaching Experience									
Less than 1 year	5.6%		11.9%	5.3%		10.5%	15.6%	21.4%	10.3%
1-10 yrs	55.6%	38.5%	59.5%	47.4%	20.0%	36.8%	44.4%	21.4%	44.3%
11-20 yrs	27.8%	38.5%	16.7%	10.5%	73.3%	21.1%	26.7%	14.3%	25.9%
21-30 yrs	5.6%	23.1%	11.9%	36.8%	6.7%	26.3%	13.3%	42.9%	18.4%
31-40 yrs	5.6%					5.3%			1.1%
Education Attainment									
High/Secondary School		5.9%	7.5%			5.3%	2.2%		3.2%
'A' Level Certificate	5.6%		42.5%	36.8%		15.8%	17.8%	15.4%	20.4%
Teachers' College Certificate		35.3%	10.0%	10.5%	20.0%	31.6%	15.6%	15.4%	12.9%
College Diploma/Assoc Deg	5.6%	35.3%	32.5%	15.8%	20.0%	15.8%	11.1%	38.5%	19.3%
Undergraduate Degree	72.2%	35.3%	2.5%	36.8%	26.7%	31.6%	51.1%	35.7%	34.9%
Postgraduate Certificate		11.8%	2.5%		13.3%		2.2%		3.2%
Graduate Degree	16.7%	11.8%	2.5%		20.0%			15.4%	5.9%
Teaching subject									
English Lang/Literature	11.1%	5.9%	7.3%	26.3%	6.3%	21.1%	15.6%	7.1%	12.7%
Foreign Languages	5.6%		12.2%	5.3%		5.3%	15.6%	35.7%	10.6
Science	33.3%	23.5%	31.7%	21.1%	12.5%	15.8%	22.2%	7.1%	22.8%
Mathematics	11.1%	11.8%	14.6%	5.3%	6.3%		4.4%	7.1%	7.9%
Business	11.1%	17.6%	7.3%	10.5%	12.5%	5.3%		7.1%	7.4%
Technical/Vocational	11.1%	11.8%	2.4%	5.3%	12.5%	15.8%	11.1%	7.1%	9.0%
Information Technology	15.6%	23.5%	2.4%	10.5%	6.3%	10.5%	2.2%	7.1%	6.9%
Social Sciences	11.1%	5.9%	17.1%	15.8%	43.8%	21.1%	26.7%	14.3%	16.4%
Other			4.9%			5.3%	2.2%	7.1%	6.3%

There was overwhelming level of interest (82%) expressed in using computers as a teaching tool whether now or sometime in the future, while less than 2% indicated outright that they had no interest (Table 8).

In the majority of cases (72%) computers were located in a single computer lab (Table 6) and most had between 11 and 30 computers for instructional purposes (Table 7).

Table 6: Location of computers

Location	Valid Percent
One computer lab	72.1
More than 1 comp lab	16.4
One computer in each class	1.1
Library/Staff room	8.2
Specialist room	1.6
Other	.5
Total	100.0

Table 7: Number of computers for instructional use

Number of computers	Valid Percent
1-10	31.2
11-20	33.1
21-30	22.3
More than 30	13.4
Total	100.0

Table 8: Computer Use by country

	Anguilla	Antigua	Dominica	Grenada	Monsterrat	St.Kitts	St.Lucia	St.Vincent	Total Population
Currently use computers									
Yes	83.3%	100.0%	88.1%	78.9%	94.1%	95.0%	88.9%	85.7%	89.1%
No	16.7%		11.9%	21.1%	5.9%	5.0%	11.1%	14.3%	10.9%
Frequency of Computer Use									
Very often	40.0%	29.4%	37.8%	26.7%	37.5%	36.8%	20.0%	38.5%	32.0%
Often	40.0%	35.3%	27.0%	13.3%	31.3%	26.3%	30.0%		26.7%
Sometimes	6.7%	23.5%	29.7%	53.3%	31.3%	26.3%	35.0%	30.8%	30.2%
Seldom	13.3%	11.8%	5.4%	6.7%		10.5%	15.0%	30.8%	11.0%
Period of Computer Use									
Less than 1 year		5.9%	2.7%	6.7%		10.5%	15.0%	23.1%	8.1%
1-5 years	40.0%	17.6%	48.6%	73.3%	37.5%	57.9%	52.5%	53.8%	48.3%
6-10 years	26.7%	41.2%	37.8%	20.0%	56.3%	31.6%	25.0%	7.7%	31.4%
More than 10 years	33.3%	35.3%	10.8%		6.3%		7.5%	15.4%	12.2%
Use as an administrative tool									
Very often	20.0%	11.8%	10.8%	6.7%	20.0%	15.8%	7.5%	23.1%	12.9%
Often	13.3%	35.3%	18.9%	13.3%	26.7%	15.8%	10.0%	15.4%	17.5%
Sometimes	46.7%	35.3%	40.5%	33.3%	20.0%	5.3%	20.0%	7.7%	26.9%
Seldom	13.3%	17.6%	13.5%	20.0%	26.7%	31.6%	30.0%	30.8%	22.8%
Never	6.7%		16.2%	26.7%	6.7%	31.6%	32.5%	23.1%	19.9%
Interest in current or future use as a teaching tool									
Already Use	11.1%	20.0%	4.9%	10.5%	23.5%	10.0%	8.9%	7.1%	10.6%
Interested	77.8%	53.3%	90.2%	73.7%	70.6%	85.0%	86.7%	92.9%	81.5%
Interested only if mandatory		26.7%	4.9%	10.5%	5.9%	5.0%			5.3%
Not Interested	11.1%						2.2%		1.6%
Other				5.3%			2.2%		1.1%

5.3 Item responses

Responses have been tabulated for individual items used to measure variables from the research model. Percentage of responses along with item means and standard deviations are presented. In many cases in the interest of brevity, items have been slightly modified, but still convey the same measure. (See Appendix A for questions in their entirety).

Scale reliabilities were calculated for items that were measured with scales (perceived usefulness, attitude, time, policies and intention) and are presented within relevant sections below. All scales recorded an alpha co-efficient higher than 0.80, indicating that measures were adequate. In other cases only one item was used to measure a construct (superior influence, peer influence, hardware, software, training, access, curriculum, administrative and technical support) and these items are also indicated in their relevant section below.

5.3.1 Perceived Usefulness

The measure for this variable was based on a 4-item scale originally used by Davis et al (1989) and later by Vankatesh and Davis (2000), Chau (2001). The original scale recorded high reliability with Cronbach Alpha value of 0.97. Items were modified slightly for the purposes of this research and the modified scale also recorded high reliability with Cronbach Alpha measuring 0.88

Scale mean was 3.99 where 1 represents low perceived usefulness and 5 represents a high level of perceived usefulness of computers. Mean value suggests that the majority of respondents viewed computers to be useful as a teaching tool. (Table 9)

Table 9: Perceived Usefulness

Qu. No.	Item	Mean	Std. Deviation
8	Usefulness 1	4.17	.902
9	Usefulness 2	3.94	.933
10	Usefulness 3	3.65	.957
11	Usefulness 4	4.19	.814

Scale mean = 3.99

5.3.2 Attitude to Computers

The measure for this variable was based on a 30-item computer attitude scale developed by Loyd and Gressard (1986) and used by Francis, Katz, Jones (2000) with original of Cronbach Alpha value equal to 0.95. Scale was reduced to 15 items for the purposes of this research and recorded Cronbach Alpha value of 0.87.

Scale mean was 4.17, where 1 represents a negative attitude and 5, a positive attitude to computers. Mean value suggests an overall positive attitude to computers among the sample population.(Table 10)

Table 10: Attitude to Computers

Qu. No.	Item	Mean	Std. Deviation
12	anxiety 1	4.29	.901
13	anxiety 2	4.13	.785
14	anxiety 3	4.33	.895
15	anxiety 4	4.12	.969
16	anxiety 5	4.33	.936
17	liking 1	4.37	.738
18	liking 2	4.05	.870
19	liking 3	4.29	.790
20	liking 4	3.78	.992
21	liking 5	4.13	.901
22	confidence 1	4.27	.758
23	confidence 2	4.25	.803
24	confidence 3	4.37	.786
25	confidence 4	4.05	.882
26	confidence 5	3.84	.969

Scale mean: 4.17

5.3.3 Subjective Norm

Majority of respondents were not certain of the support of their principal (54%) or peers (51%), although it was deemed important. Sixty nine (69%) felt the support of the Principal was important (agree and strongly agree) whereas a lesser but sizable number (55%) felt the support of peers to be important. (Table 11)

Table 11: Superior and Peer Influence

Qu No.	Item	1 Strongly Disagree %	2 Disagree %	3 Not Certain %	4 Agree %	5 Strongly Agree %	Mean	Std. Dev
27	My principal Strongly supports my using computers in the classroom	4.9	6.5	53.5	22.2	13.0	3.3	.95
28	Support of principal is important to me	1.1	6.5	23.2	42.7	26.5	3.9	.92
29	My peers strongly support my using computers in the classroom	2.7	3.8	51.1	29.1	13.2	3.5	.87
30	Support of peers is important to me	3.4	16.2	25.1	38.0	17.3	3.5	1.06

5.3.4 Time

Time was measured using a 2-item scale constructed for the purpose of this research. The scale comprised a combination of items measured in questions 31 and 32 (Table 12), and had a Cronbach Alpha value of 0.97. Scale mean was 3.6.

For individual items, the majority (64%) felt that they would have adequate time to learn or practice using computers, and similarly 60% felt that they would have adequate time to do research and other preparation tasks involving computer use. However they were not as certain whether there would be enough time during lessons for students to use computers. In this case 31% thought there would be enough time during lessons, while 34% were not certain.

Table 12: Time

Qu No.	Item	1 Strongly Disagree %	2 Disagree %	3 Not Certain %	4 Agree %	5 Strongly Agree %	Mean	Std. Dev
With my current workload I would have adequate time								
31	...to learn/practice how to use computers	4.7	15.1	16.7	40.6	22.9	3.6	1.13
32	...to do research and preparation tasks	4.8	17.6	18.1	37.8	21.8	3.5	1.15
33	...for students to use during lessons	3.7	20.0	34.2	30.5	11.6	3.3	1.03

Scale mean: 3.6

5.3.5 Training

Less than half (40%) of respondents had received any form of computer training from education authorities. Of those who received training only 30% felt that the training was adequate to enable them to integrate computers into their lessons. (Table 13)

Table 13: Training 1

Qu No.		Yes	No
34	Received computer training from school authorities	40.3	59.7
35	Was training adequate to enable integration in lessons?	30.4	69.6

Overall, 71% felt that they needed training in introduction to computers and common software programs, while an even greater percentage (87%) felt that they needed training in how to incorporate computers in their lessons. The biggest indicator of the need for training was that 89% (with 53% strongly agree) indicated if they received (further) training they would be willing to attempt integration in their lessons. Q38 was used as the measure for this construct during statistical analysis. (Table 14)

Table 14: Training 2

Qu No.	Item	1 Strongly Disagree %	2 Disagree %	3 Not Certain %	4 Agree %	5 Strongly Agree %	Mean	Std. Dev
36	I need (further) trainingin common software programs	5.3	18.5	4.8	38.1	33.3	3.8	1.24
37	...on how to incorporate into my lessons	1.6	5.2	6.3	45.5	41.4	4.2	.89
38	If I received (further) training I would be willing use	1.1	5.3	4.2	36.3	53.2	4.4	.87

5.3.6 Availability of Hardware and Software

There seemed to be consensus (77%) that the number of computers available was insufficient (51% strongly disagree and 27% disagree). There was not much consensus on conditions of computers, however with 36% not certain whether they were in good working condition (probably because many teachers do not use them regularly). A near equal 35% agreed that computers at their school were in good working condition, while 33% disagreed. The responses left no doubt as to the relationship between adequate hardware and intentions to use. A great majority of 90% (51% agree and 39% strongly agree) reported that if adequate and appropriate hardware were installed, they would be willing to use computers in their lessons. Q41 was used as the measure for this construct during statistical analysis. (Table 15)

Concerning software, the majority of teachers seemed unaware of the existing situation. 50% were not certain whether it was/would be easy to get the necessary software for teaching their lessons, while 36% thought that getting software is/would be a problem. (Table 15)

Table 15: Hardware and Software

Qu No.	Item	1 Strongly Disagree %	2 Disagree %	3 Not Certain %	4 Agree %	5 Strongly Agree %	Mean	Std. Dev
39	Sufficient number of computers	50.8	26.2	8.9	9.4	4.7	1.9	1.18
40	Computers in good working condition	17.7	15.1	36.0	25.3	5.9	2.9	1.16
41	If adequate/appropriate hardware were installed, I would be willing to use ..	.5	3.2	6.4	50.8	39.0	4.2	.76
42	No problem in getting software	17.0	19.1	49.5	8.0	6.4	2.7	1.05

5.3.7 Access

A significant majority of respondents (71%) reported that it was not easy to get access to computers for use during scheduled lessons (30% disagree and 41% strongly disagree). Access during non-teaching periods was not so clear-cut since 41% of teachers felt it was difficult, with a close 39% agreeing that it was easy. While it appears somewhat difficult to get access for use during school, it appears a bit easier to get access at other times outside normal school hours according to 60% of respondents. In most cases, there seemed to be an absence of clear policies to allow access to teachers, as reported by 44%, while another 31% seemed unaware, or not certain about any policies to enable access. Internet access did not appear to be readily available as indicated by 50% of responses. Q43 was used as the measure for this construct during statistical analysis. (Table 16)

Table 16: Access

Qu No.	Item	1 Strongly Disagree %	2 Disagree %	3 Not Certain %	4 Agree %	5 Strongly Agree %	Mean	Std. Dev
43	It is very easy for me to get access... ..during my scheduled lessons	40.8	30.4	13.6	7.3	7.9	2.1	1.24
44	...outside my scheduled class time	16.4	24.9	20.1	27.5	11.1	2.9	1.28
45	...outside normal school hours	9.5	21.7	9.0	37.0	22.8	3.4	1.31
46	Clear policies /guidelines exist to allow me access to computers when I need them	16.8	27.2	31.0	16.8	8.2	2.7	1.17
47	Easy access to the Internet from my school	26.7	23.0	15.7	27.7	6.8	2.6	1.32

5.3.8 Curriculum

A small number of teachers (30%) claimed to have knowledge of how to incorporate computers in their lessons, while only 24% agreed that there was appropriate software available for teaching in their subject area. The majority (55%) was not certain of the availability of software for teaching in their subject area, while a very small minority (9%) claimed to have the ability to develop their own software for integration into their teaching. Concerning changes in the curriculum to accommodate computer use, 59% of respondents thought that it was necessary. Q51 was used as the measure for this construct during statistical analysis. (Table 17)

Table 17:Curriculum

Qu No.	Item	1 Strongly Disagree %	2 Disagree %	3 Not Certain %	4 Agree %	5 Strongly Agree %	Mean	Std. Dev
48	I have knowledge of how to incorporate computers into my teaching	15.3	36.3	17.9	22.1	8.4	2.7	1.21
49	There is lack of appropriate software available for teaching in my subject area *	4.9	16.8	54.6	14.1	9.7	3.1	.94
50	I am able to develop my own software application for incorporation into my lessons	32.6	33.7	25.1	5.3	3.2	2.1	1.03
51	My subject(s) curriculum must be changed to allow for incorporation of computers	3.3	12.1	25.7	38.8	20.2	3.6	1.04

* negative item reverse coded for analysis

5.3.9 Technical and Administrative Support

While 45% reported that they could easily get help in using the computer if necessary, only 28% felt that there was adequate technical support, with a significant 36% being uncertain. Only a very small minority (4%) agreed that adequate funding was available for maintenance and computer supplies, while only 28% agreed that there was adequate management support to promote computer use. Q52 was used as the measure for technical support while Q54 was used as the measure for administrative support during statistical analysis. (Table 18)

Table 18:Support

Qu No.	Item	1 Strongly Disagree %	2 Disagree %	3 Not Certain %	4 Agree %	5 Strongly Agree %	Mean	Std. Dev
52	Can easily get help in using the computer	8.9	12.0	34.4	36.5	8.3	3.2	1.06
53	Adequate technical support	16.5	19.1	35.6	25.0	3.7	2.8	1.1
54	Adequate funding and institutional support	33.9	27.6	33.9	3.6	1.0	2.1	.95
55	Overall adequate management support	20.4	23.7	27.4	23.1	5.4	2.7	1.19

5.3.10 Policies

This construct was measured using a 2-item scale constructed for the purpose of this research. The scale comprised questions 56 and 57, and had a Cronbach Alpha value of 0.83. The majority of respondents seemed unaware of any school (46%) or Ministry of Education (51%) policies in support of computer use in the classroom. Of those who had an opinion, 24% believed that their school, and 30% believed that their Ministry had clear policies to promote use.

Table 19: Policies

Qu No.	Item	1 Strongly Disagree %	2 Disagree %	3 Not Certain %	4 Agree %	5 Strongly Agree %	Mean	Std. Dev
56	School has clear policies to promote use in schools	12.2	17.5	46.0	20.6	3.7	2.9	1.00
57	Ministry of Education has clear policies to promote use in schools	10.4	9.3	50.8	22.4	7.1	3.1	1.00

Scale mean = 3.0

5.3.11 Intention to Use

The measure for this variable was based on a 2-item scale originally used by Taylor and Todd (1995). The original scale recorded high reliability with Cronbach Alpha value of 0.91. Items were modified slightly for the purposes of this research and the modified Intentions to use computers were overwhelmingly positive. 89% (46% agree and 43% strongly agree) indicated intentions to incorporate computers in their lessons, while 87% (46% agree and 43% strongly agree) indicated intentions to use frequently. Scale mean was 4.3 indicating high intention levels. (Table 20)

Table 20: Perceived Usefulness

Qu.58		Mean	Std. Deviation
58	intention 1	4.3	.73
59	intention 2	4.3	.73

Scale mean = 4.3

5.3.12 Benefits of Computers

There was one open-ended question at the end of the instrument, which asked “What (potential) benefits do you see from using computers in your classroom teaching?”. The responses were categorized and tabulated in descending frequency. (Table 21)

Table 21: Benefits of Computer Use in the classroom

Benefits	Frequency	Rank (based on frequency)
Enhances learning increases student interest; motivation	64	1
Facilitates Internet research for both students and teachers provides up to date information, and teaching/learning materials	37	2
Provides Visual stimuli helps increase understanding of abstract concepts	32	3
Prepares students for job market and real world - via exposure, awareness	28	4
Enhances Teaching; makes lessons interesting; flexible	25	5
Develops student skills and abilities – research, creativity, computer and problem solving skills	16	6
Saves time for both students and teachers: reduces writing tasks, production of teaching materials	13	7
Higher standard and presentation of work	7	8
Helpful in Foreign language Teaching Listening and writing drills; research language cultures	7	9
Essential/Necessary tool	7	10
Facilitates Remedial work- students can work at their own pace	6	11
Administrative classroom tasks Testing, grading, record keeping	5	12

Benefits were ranked in order starting at highest to lowest frequency, suggesting that higher ranked items were deemed most important by respondents.

5.4 Statistical Analysis

Statistical tests involved a combination of correlation and regression analyses. Results are presented below.

5.4.1 Correlation Analysis

Correlation Analysis was used to examine the strength and direction of relationships between variables, and more specifically, between independent variables and intention to use (Table 22). Hardware ($r = .420$), usefulness ($r = .419$) and attitude ($r = .391$) had the highest correlations with the dependent variable indicating significant association between these variables and intention to use. Other variables with lower, but significant correlations with intention to use were time ($r = .267$) and training ($r = .236$) indicating somewhat weaker relationships.

The weakest correlations with intentions to use were software, policy, and administrative support, indicating no significant association between these variables and intention to use (discussed further in next chapter). Intercorrelations among independent variables were relatively weak in most cases, except between superior and peer influence which had a moderate correlation ($r = .512$). However, this did not suggest a problem, as the exclusion of either one of these variables in turn had no significant effect on regression results (next section).

Table 22: Correlations

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1 Superior influence 1	1													
2 Peer influence 1	.512**	1												
3 TIME	.156*	.362**	1											
4 Training 3	-.007	.065	.118	1										
5 Hardware 3	.087	.098	.098	.313**	1									
6 Software	.037	.087	.161*	.044	-.080	1								
7 Access 1	.327**	.132	.133	-.059	-.008	.172*	1							
8 Curriculum 4	.055	.030	-.011	.121	-.100	.026	-.037	1						
9 Technical Support 1	.093	.227	.177	-.108	.011	.173	.324	-.070	1					
10 Administrative Support1	.147*	.196**	.145*	-.114	-.128	.280**	.194**	-.075	.172*	1				
11 POLICY	.299**	.288**	.148*	-.024	-.062	.349**	.272**	-.055	.171*	.393**	1			
12 USEFULNESS	.208**	.315**	.273**	.174*	.238**	-.012	.128	-.029	.149	-.058	-.089	1		
13 ATTITUDE	.089	.215**	.328**	.132	.306**	.001	.088	-.009	.056	.058	-.101	.321**	1	
14 INTENTION TO USE	.141	.133	.267**	.236**	.420**	.011	.104	-.071	.133	.028	.036	.419**	.391**	1

** Correlation is significant at the 0.01 level (2-tailed).

* Correlation is significant at the 0.05 level (2-tailed).

5.4.2 Regression Analysis

Multivariate regression allows an examination of the impact of multiple variables acting in conjunction with each other on the dependent variable (Sweet, 1999). Following Davis (1989, 1991) and Vankatesh and Davis (2000), regression analysis was used to analyze the research model.

An examination of the regression results (coefficients table) reveals 3 significant predictors namely: Perceived Usefulness (sig. = .000), Attitude to computers (sig. = .000), and availability of Hardware.

Table 23: Regression Coefficients

Coefficients ^a					
Model		Unstandardized Coefficients		Standardized Coefficients	Sig.
		B	Std. Error	Beta	
1	(Constant)	5.524	.486		.000
	Usefulness	.191	.030	.419	.000
2	(Constant)	3.392	.607		.000
	Usefulness	.155	.029	.340	.000
	Hardware 3	.637	.120	.336	.000
3	(Constant)	1.793	.769		.021
	Usefulness	.129	.029	.284	.000
	Hardware 3	.540	.121	.284	.000
	ATTITUDE	3.871E-02	.012	.214	.001

a. Dependent Variable: Intention to Use

The value of R square for the final model (.321) indicates that 32% of the variance in intention to use can be explained by the combination of the 3 selected predictors, namely usefulness, hardware and attitude.

Table 24: Model Summary**Model Summary^d**

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.419 ^a	.176	.172	1.29033
2	.531 ^b	.282	.275	1.20721
3	.566 ^c	.321	.310	1.17755

a. Predictors: (Constant), Usefulness

b. Predictors: (Constant), Usefulness, Hardware 3

c. Predictors: (Constant), Usefulness, Hardware 3, ATTITUDE

d. Dependent Variable: Intention to Use

Table 25: ANOVA**ANOVA^d**

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	67.520	1	67.520	40.554	.000 ^a
	Residual	316.343	190	1.665		
	Total	383.863	191			
2	Regression	108.422	2	54.211	37.198	.000 ^b
	Residual	275.440	189	1.457		
	Total	383.863	191			
3	Regression	123.179	3	41.060	29.611	.000 ^c
	Residual	260.684	188	1.387		
	Total	383.863	191			

a. Predictors: (Constant), Usefulness

b. Predictors: (Constant), Usefulness, Hardware 3

c. Predictors: (Constant), Usefulness, Hardware 3, ATTITUDE

d. Dependent Variable: Intention to Use

5.5 Interviews

Interview responses have been summarized and tabulated according to country (Appendix C). While a content analysis is not presented separately, interview responses are used to gain a better understanding of the results of quantitative analysis (Davis, 2000, p. 313) and also to create a greater potential for new insights and perspectives into the research question (Aaker and Day, 1980, p 111). Thus, interview responses will be presented as part of the discussion in the next chapter.

5.6 Results Summary

This chapter examined survey responses in detail to get a general understanding of the existing perceptions and conditions at schools represented. Then statistical tests were used to test the research model. Three of the hypotheses were supported (Table 26):

Table 26: Results Summary

Hypotheses		Supported
1	Perceived usefulness of computers in job performance will positively influence teachers' intentions to use computers in the classroom.	yes
2	A positive attitude to computers will positively influence teachers' intentions to use computers in the classroom.	yes
3a	The stronger the support from the principal, the greater will be teachers' intentions to use computers.	no
3b	The stronger the support from peers, the greater will be teachers' intentions to use computers.	no
4	Lack of strategic direction and relevant policies will negatively influence teachers' intentions to use computers	no
5	Lack of adequate time to experiment with computers will negatively influence teachers' intentions to use computers	no
6a	Lack of adequate and appropriate hardware in schools will negatively influence teachers' intentions to use computers in the classroom.	yes
6b	Lack of adequate and appropriate software in schools will negatively influence teachers' intentions to use computers in the classroom.	no
7	Lack of adequate access to computers will negatively influence teachers' intentions to use computers in the classroom	no
8	Lack of adequate knowledge and ability to integrate computer technology into the school curriculum will negatively influence teachers' intentions to use computers.	no
9	Lack of appropriate training in computer technology will negatively influence teachers' intentions to use computers in the classroom	no
10 a	Lack of proper institutional support will negatively influence teachers' intentions to use computers	no
10 b	Lack of proper technical support will negatively influence teachers' intentions to use computers	no

Interpretations and implications of these results will be discussed in the next chapter.

6 Discussion

Based on the results presented in the previous chapter, this chapter will contain a discussion of the most significant predictors of teachers' intentions. Following this discussion the other factors deemed less significant will be examined.

6.1 Most Significant Factors

Statistical analysis revealed that the three most significant predictors of teachers' intentions to use computers are: perceived usefulness, attitude to computers, and the availability of hardware. These results were supported by both regression and simple correlations. While it is no surprise that these variables were selected as part of the final model, it is a bit surprising is that so few factors (3) qualified as major predictors of teacher intentions to use computers in Caribbean secondary schools.

6.1.1 Perceived Usefulness

Perceived Usefulness (along with ease of use) appeared in the original Technology Acceptance Model (TAM) advanced by Davis (1989), as one of the primary predictors of user acceptance of computer systems. Simply stated it means that a user's intention (or decision) to use a particular computer system will depend heavily on whether they perceive the system to be useful to the performance of their jobs. This variable has stood the test of time, and still remains a major predictor of intentions to use when applied to the context of the use of computers in the classroom. Thus, results of this study are also consistent with those of Davis (1991) and Vakatesh and Davis (2000) among others.

This reiterates the argument put forward by Rudduck, (1991) that teachers are unlikely to embrace ideas or solutions handed down by management, unless they feel the prospective change has a good pedagogical purpose. In the Caribbean today, computer use in the classroom is not mandatory and is not a part of the curriculum, therefore it is left up to the judgment of the individual teacher where conditions permit, to decide whether or not to use computers in their classes. It follows that teachers are not likely to go through the added task of learning and researching different software for use in the classroom if they do not foresee the benefits either to their students or to themselves.

So the question is “In what ways do teachers perceive the computer to be a useful tool in the classroom?” Some indication of the answer is presented in table 21 (page 77), which tabulates teachers’ perceived benefits of computer use. Worthy of note is that the majority of benefits named by teachers were student, rather than teacher oriented. For example, the highest ranked benefit was their assumption that it enhances learning for students by increasing interest or motivation. Teacher-cantered benefits such as ‘reduces writing time’ and ‘classroom administrative tasks’ were ranked 7 and 12 respectively. This may suggest that generally teachers were more interested in the benefits for their students rather than for themselves.

6.1.2 Attitude to Computers

Attitude to computers is another predictor that dates back to early studies of adoption and was used in 3 major theories: Theory of Reasoned Action (Ajzen and Fishbein, 1980), Technology Acceptance Model (Davis, 1989) and Theory of Planned Behaviour (Taylor and Todd, 1995). It was also found to be a factor in education research by Lawson and Comber (1999), Somekh (1996), Braak (2001) among others.

The significance of attitude as a predictor highlights the notion stated earlier that since computer use is voluntary, teachers who have negative attitudes are unlikely to use computers, while those with positive attitudes more likely to use. More specifically, in this case attitude was decomposed into three items: anxiety, liking and confidence. It follows that those teachers with strong intentions not only have a liking for computers, but also feel comfortable and confident when using them.

Interview responses from all the islands indicated a prevalence of positive attitudes among teachers and that the few resistant cases were being tackled by different methods. For example, in one island awareness building sessions are being conducted in schools to “sell” the benefits of computer use to teachers and in another, compulsory national computer training for teachers has caused drastic changes from skepticism to enthusiasm.

6.1.3 Availability of Hardware

Of the selected model, availability of hardware is probably the greatest predictor of intentions. An overwhelming majority (90%) stated that if adequate and appropriate hardware were installed they would be willing to use computers. This is with the assumption that hardware comes equipped with productivity software, which is the common standard.

Based on interview responses it is apparent that there are various problems associated with hardware. Not only is it inadequate in numbers, in some cases it is outdated or has limited capabilities; rendering it incapable of supporting latest software versions. Added to that, in some islands technical support is extremely inefficient when computers break down, and in others the process of purchasing new hardware is extremely bureaucratic and extensive thus compounding the problem of insufficient hardware.

Interviewees from every single island acknowledged that insufficient numbers posed a problem and in most cases it was deemed as the biggest barrier to computer use. Further, insufficient hardware inadvertently affects access for both students and teachers. In most islands there is one computer lab per school, which means that priority has to be given to Information Technology classes. However, the demands of the CXC (Caribbean Examinations Council) syllabus means that computer labs are occupied about 80% of the time with classes preparing for external exams in IT. This leaves little time for teachers of other subjects to use the computer labs for research or preparation, let alone conducting classes there. It was emphasized in many of the interviews that the

underlying cause of insufficient hardware is limited financial resources; undeniably one of the biggest problems faced by developing countries.

6.2 Other Factors

While the factors discussed above were deemed the most significant, it must be recognized that these factors do not work in isolation and invariably affect and are affected by other factors. Following is a discussion on some other factors attributed with some significance by interviewees.

6.2.1 Time

It is surprising that time was not selected in the final model as a major barrier since it headed the list of many researchers such as Dorman (2001), Lawson and Comber (1999), Watson, Blakely and Abbot (1997). What was also surprising was that even though many of the interviewees alluded to the notion that teachers were already overburdened, the majority (over 60%) of survey respondents agreed that they would have sufficient time to learn, practice or do preparation tasks using the computer.

Several possible explanations may be advanced to explicate these findings. For example, it may be due to high levels of perceived usefulness of computers and that teachers are driven by the possible benefits, which include saving time. It could also be due to strong positive attitudes towards computers which means that teachers are very eager and willing to use them in their classes, and do not view time as a major barrier in light of the seemingly insurmountable problem of insufficient hardware. Another possible

explanation is that teachers have accepted the fact they will remain overburdened and therefore have chosen to ignore time as an issue. Other possible explanations may be that teachers are drawn to the novelty of computers, or that they see potential benefits for personal and professional growth and are therefore willing to make sacrifices on their personal time.

6.2.2 Training

While training on its own did not prove to be a significant predictor of intentions it is nonetheless deemed important by 89% of respondents who replied that if the appropriate training were provided they would be willing to use computers in the classroom. This may suggest that though training would act as a significant bonus or incentive, it may not necessarily be a top decision making factor in teachers' intentions. Another explanation might be that training is acting through another factor such as attitude. Interviewees in 2 of the islands indicted a noticeable change in attitude among teachers and principals (from negative to positive) after receiving training. It is suggested that the effect of training on attitude may be examined in future research.

It is difficult to establish any consensus across the islands as their training programs are at diverse stages of development; while some islands have done little or no training, others have completed training teachers at all levels of the school system in productivity tools, and one island has even trained in integration software for various subjects in the curriculum. Out of the islands that have done training so far, only one island has trained in software for integration into other subjects at the secondary school level. It is reported that teachers who did receive training in specialized software have all been using

computers in their lessons, suggesting a relationship between training and use. However, it has not been established whether this relationship pertains to training in general, or more specifically to specialized training (which may prove to be a more significant predictor of intentions).

One problem associated with training and is currently being faced by the island more advanced in training, is the rapid turnover of teachers who have been trained in computer use and/or basic maintenance. This particular Ministry of Education has spent large sums of money bringing in overseas based trainers for training and certification of teachers. Those teachers after being certified have used that as a springboard for moving unto more lucrative careers leaving their successors to grapple on their own with where their predecessors left off, not having benefited from the training themselves.

It should be noted nonetheless that the problem of retaining staff with computer skills is not unique to schools, but also plagues private sector entities. Education authorities should consider implementing strategies such as retention incentives, and knowledge transfer incentives to dissuade teachers with computer skills from leaving.

6.2.3 Technical Support

This variable also was not selected as a major predictor of computer use, although it was recognized in some interviews as a major barrier with far reaching effects on the schools. It is possible that there was a cancelling effect between the islands, since in some islands technical support was largely inadequate contrasted to some others with efficient systems. In most cases, the technical staff of the Ministry of Education was responsible for providing support to schools, however that proved difficult if not impossible with understaffed units in some islands, (such as one technician to service about 15 schools), while it seemed to work in cases where there was the right balance. In some other cases technical support was outsourced to private firms – a more efficient, but relatively expensive alternative. A sort of middle ground approach was used in some islands where one teacher from each school was trained in basic computer maintenance to allow him/her to handle minor problems at the school level, and only major problems would be reported to the Ministry of Education or to external service provider.

6.2.4 Access

Though not selected in the final model, access seemed to be of some importance as indicated in all interviews as a possible problem. Also 71% of survey respondents indicated that access during school hours was difficult, thus making it virtually impossible to use in their classes. As stated earlier and confirmed by interviewees, priority had to be given to Information Technology classes, which meant virtually no time for other subjects. In some cases, access outside school hours was also difficult mainly because computer labs were considered to be strictly the domain of the IT teacher,

and access was restricted to other teachers or given only through permission from the IT teacher(s). The reason forwarded for that view was in some cases hardware and technical support were so hard to come by, that computers had to be treated as a precious commodity and preserved from overuse and abuse.

A possible explanation why access did not appear as a factor in the final model is that it acts indirectly through other factors such as availability of hardware, policies and administrative support.

6.2.5 Subjective Norm

Superior and Peer Influence did not appear to have a major influence on teachers' intentions to use computers. In most instances survey responses revealed that teachers had no idea where their principals or peers stood on the issue of computer use. This may lead one to conclude that many principals either do not have the issue of computer integration on their list of priorities, or even worse may be silently resistant to the idea. A few interviewees admitted to some amount of resistance or reluctance on the part of principals and some senior teachers whom they believe are satisfied with the status quo, and therefore unwilling (or afraid) to make changes that they feel might cause them to lose control. The apparent weak association between superior and peer influence and intentions should not result in totally discounting those factors, as respondents clearly indicated that the support from their Principal (69%) and peers (55%) on matters of computer use was important to them. Though not relevant currently education

administrators may tap into the potential of having selected Principals and peers act as advocates of computer use with the aim of influencing others to do the same.

6.3 Non-Significant Factors

Factors such as policies, administrative support, curriculum, and availability of software ranked very low in survey results. In many cases, teachers were uncertain or unconcerned (based on high number of “not certain” responses). This may not necessarily mean that these factors are unimportant but may suggest that they do not play a significant role in teachers’ intentions to use computers at the present time. It may be that teachers are more concerned with issues that affect their day-to-day use of computers and leave the planning or long-term issues to education planners and curriculum officers. For example, while lack of appropriate software and funding to acquire necessary software was identified as a definite barrier by many interviewees, this was not the case with survey respondents. (Software in this case refers to specialized software for teaching in specific content areas, as there is a common standard that all hardware is supplied with common productivity software).

A model policy has been developed by the OECS Education Reform Unit (OERU) and has been distributed to the various islands for adapting to their particular situation. All islands so far have been working from this model policy and are currently at various stages of development. It has been pointed out that development of the policy has proved to be a slow and bureaucratic process, as in many cases education officials and political

administrators are not fully conversant with the issues of technology integration, and are therefore reluctant to approve (or promote) something that they do not understand.

The next chapter gives recommendations and proposed solutions for the main barriers discussed in this chapter, and suggests methods of tackling technology integration in schools.

7 Recommendations

This chapter proposes remedies to counteract the main barriers identified and discussed in chapters 5 and 6. In addition, it highlights the importance of leadership and planning in the whole process of technology integration. The chapter ends with a synopsis of the main recommendations in the form of critical success factors.

Understanding the many barriers to computer integration faced by teachers in Caribbean Secondary schools is only the first step to resolving the situation. This understanding should provide a springboard for planning and action targeted at eliminating, or minimizing the effects of these barriers. Given that computers are already present in many schools, recommendations have been presented as a way of maximizing the use of the technology. Education planners, administrators and teachers can use these recommendations as a guide in addressing issues faced in the various islands.

Many of the recommendations presented below have been drawn from previous research done by the author on ICT planning and policy issues facing education authorities in developing countries. This research was done in conjunction with the thesis supervisor, and included in the document “Guidelines for Sectoral ICT Policy and Planning: A consultation document” and published by the Commonwealth Network of IT for Development (COMNET – IT) and the Commonwealth Secretariat available at: <http://www.comnet.mt/CRIIS2001/Documents/ICT2001-W.pdf>. Some of the issues singled out in the document are similar to those discussed here and for this reason, some of the same recommendations are applicable.

7.1 Addressing Teacher Attitudes and Perceptions about Computers

The apparent importance of teachers' attitudes and perceptions about computers on their intentions to use the technology should be taken very seriously. It may be an indication to education authorities of the need to ensure that teachers are not only comfortable with using the technology, but that they also appreciate and believe in its potential benefits. Teachers must be convinced (not just told) of the potential benefits to themselves and their students through demonstrations, practical examples and testimonials from other schools - or even other islands – if they are to fully embrace the technology.

Efforts should be made at addressing concerns of all teachers, while paying special attention to principals and senior teachers who have the ability to influence others. Along with the general training and awareness building sessions already being deployed in a few islands, education administrators in all islands should employ creative strategies to encourage teacher involvement and support for technology initiatives. Some suggestions follow.

7.1.1 Motivating Teachers to Use technology

- The use of productivity tools for personal and administrative tasks should be encouraged, as this would help teachers become familiar and thus more comfortable and confident with computers, making them more likely to use them in the classroom.

- Teachers should be supported in all attempts at technology integration by all levels of the education system from policy makers and administrators to their principals and peers. It is important that this support be demonstrated both verbally and in tangible form.
- Professional development sessions and support groups may be used for sharing experiences and collaboration on methods and techniques to be used in the classroom. These sessions should be facilitated or supported by principals and other school authorities.
- It is important that teachers, or their representatives be involved in all stages of planning and implementation in order to gain their acceptance and support for new initiatives in which they are expected to participate.
- Special recognition and incentives may be given to teachers who use innovative methods of introducing ICTs into the classroom to enhance education delivery and learning. This could also encourage teachers to keep updated on the latest technology and methods available.
- Incentives in the form of subsidies, tax exemptions or special loan arrangements, should be provided to encourage teachers to purchase computers for personal use. This would foster familiarity and confidence with the technology, thus breeding positive attitudes. Scholarships and bursaries to further education may also be provided as incentives.

If strategies are to be successful, they should be part of the much larger process of innovation and change in education (Easdown, 1995). Thus encouraging teacher use of technology should not be tackled in isolation. It should be combined with innovation and change at the general school level, as well as factors related specifically to teachers' training and development.

- Technology Training should be fully integrated into the curriculum of teacher training colleges, while in-service training should be continued for teachers already in the system.
- Training should go beyond computer literacy and productivity tools, and focus on coaching subject teachers on various methods of introducing computers into their particular content areas. Training should not only introduce teachers to specialized software in their areas, but also provide them with the capacity to use software productivity tools to design and develop their own software applications for use in teaching their subjects.
- Targeted training should be directed at administrators and planners in technology use and benefits, so they can successfully initiate and support efforts of ICT introduction in schools. Special attention should be placed on training principals and senior teachers so they can act as advocates of technology use within the schools and be empowered to lead by example.
- Subject specialists should be made available in each content area (*at the school, district or national level*) to provide guidance and direction for integrating technology into that particular subject by initiating experimentation and recommending appropriate courseware.

7.2 Addressing (non) Availability of Hardware

The issue of availability of hardware is directly associated with the availability of financial resources, as procuring equipment involves significant expenses and sometimes lengthy processes. It is also important that the performance and longevity of hardware be preserved with efficient technical support and maintenance. To maximize the full potential of the hardware obtained, immediate steps should be taken to ensure that all teachers can benefit from using it, by addressing the issue of access for all. As indicated before, many of these recommendations were originally published in “Guidelines for Sectoral ICT Policy and Planning: A consultation document” (cited above).

7.2.1 Procuring Equipment

This is a very high investment, and while efforts must be taken to minimize costs, it is necessary to ensure that cost cutting does not compromise performance and longevity of equipment. Various procurement options should be considered; some of which are presented below:

- Education ministries should seek to establish direct partnership with overseas manufacturers in order to benefit from reduced costs by eliminating the middleman, and getting discounts from bulk purchase
- Generic computers should be purchased as they are usually cheaper than brand-name computers, and comparable in performance

- Avoid purchasing the latest model equipment as it is usually more expensive, but shows no measurable difference in performance or longevity than previous models
- Establishment of local computer assembling plant may result in reduced costs to schools and education administrators
- Seek donations of used and refurbished equipment from, private sector organizations, NGOs, friendly governments and schools and universities in more developed countries. It is important to have minimum acceptable standards and inspection of donated equipment, to guard against schools becoming “dumping grounds” for non-functioning equipment.
- Although it is the overall responsibility of education authorities, schools should be encouraged to initiate action towards establishing and maintaining their own computer labs, under the general guidance of the education authority.

7.2.2 Maintaining Equipment

- Budgetary allocations should be made for occasional upgrading and general maintenance of equipment. Additionally, computers may be made available to members of the community for a fee, which could be used to cover or contribute to maintenance costs.
- Strict security measures should be enforced in all schools to protect equipment from vandalism, theft or damage caused by improper use.

- Establishment of government funded technical institutions to train young school leavers in computer maintenance. Through partnership with schools in the community, trainees may get practical experience by repairing broken equipment from schools thus benefiting both institutions. Alternatively individual schools with the capability may wish to set up their own technical programs, where students learn computer maintenance by working on actual broken equipment.
- Technical support should also be provided to teachers by recruiting a computer lab technician in each school. His/her responsibility would involve provision of technical support to teachers, as well as the general upkeep and maintenance for computer labs. Alternatively this role could be performed by one or more teachers, who may be compensated with fewer teaching periods, or paid overtime.

7.2.3 Providing access to Technology

- Computer labs should be located in all educational institutions. In cases where finances do not readily permit, schools in close proximity may share facilities or employ the use of a mobile computer lab.
- Unrestricted access to the technology should also be provided to teachers both during and outside of school hours, to encourage and facilitate research and experimentation on new teaching methods. Computers for teacher use should be placed in a convenient location such as the staff room or school library.

- Internet connectivity should be easily accessible to be used as an aid in instruction and as a research tool.

7.3 Leadership and Planning

Effective leadership and planning are absolute essentials to implementing any change successfully and seamlessly. In a report presented on US schools, leadership at both the state and school levels was cited as the key factor affecting successful integration of technology. There was evidence that the most successful technology programs were usually adopted in states that had visionary leaders, legislators, and education administrators. The report also stated that in terms of technology integration the most successful schools were the ones with the strongest leaders, and principals who were committed to supporting technology use by their teachers and students (“Factors That Affect The Effective Use Of Technology For Teaching And Learning; Lessons From The SEIR*TEC Intensive Site Schools”, <http://www.seirtec.org/publications/lessondoc.html> ##9 accessed 29.07.2001). Watson, Blakely and Abbot (1998) also found in their study that a certain level of institutional and managerial commitment was crucial for the success of technology projects in schools. In its absence the project success is totally dependent on the level of personal satisfaction and motivation of individuals.

Thus the SEIR*TEC report (cited above) recommends that comprehensive technology plans to be drawn up at the national, district and school levels. The plans should seek to involve all stakeholders in order to achieve community support and involvement. Implementation should be attempted by working together in groups to devise new patterns for staffing and organizational changes. Additionally, there should be specific measures for evaluating success and progress of the plan, so that necessary alterations may be made in time.

In addition policies and legislation should be instituted as a means of setting national standards, as well as to ensure continuity even after changes in administrators. According to the World Education Forum, the onus lies on governments to critically assess IT experiences and options and then establish clear policies and guidelines with regard to technology integration. Policies should encompass resource allocations in relation to the provision of basic education, and emphasize choices that bridge the digital divide, increase access and quality, and reduce inequity (Education For All, 2000 available at <http://unesdoc.unesco.org/images/0012/001202/120240e.pdf> accessed 28.01.2002, p. 27).

7.4 Critical Success Factors

From the recommendations given above, some are deemed the most critical in helping to achieve technology integration into the classrooms.

- Any attempts at change and innovation should be initiated and promoted from the top levels of administration and supported by appropriate policies and legislation.
- Attention should be addressed to ‘selling’ the potential benefits of technology to teachers in order to increase their interest and motivation for using. Teachers should receive verbal as well as tangible support from all levels of administration.
- Teachers should receive appropriate training in methods of integration accompanied by opportunities for experimentation and collaboration with peers.
- Immediate efforts should be made to provide teachers with the necessary tools i.e. adequate and appropriate hardware and software. In addition technical support should be made readily available to avoid frustrating efforts of teachers.

The final chapter summarises main ideas of the study and presents limitations and implications of the research. Suggestions for further research are also presented along with the conclusion.

8 Summary and Conclusion

8.1 Summary

The aim of this study was to identify which factors influence intentions of teachers in Caribbean secondary schools, to use and integrate computer technology in their lessons. The factors selected for the study were drawn from technology adoption studies in business organisations as well as educational institutions, and were categorized into two main groups: institutional level factors and individual level factors. The institutional factors tested were: strategic direction and policies, time, lack of adequate/appropriate hardware and software, access to technology, integration into curriculum, training, technical and institutional support; while the individual level factors were: perceived usefulness of computers, attitude to computers, and subjective norm.

Data collection involved a combination of questionnaires and interviews involving eight Caribbean islands namely: Anguilla, Antigua, Dominica, Grenada, Monsterrat, St.Kitts, St.Lucia and St.Vincent. A total of one hundred and ninety two (192) usable surveys were received from secondary school teachers in the islands concerned. Interviews with planning/curriculum specialists and senior IT teachers from these islands were used to gain an in-depth perspective on survey results.

Correlation and regression analyses were performed on survey data. Results indicated that the most significant factors were attitude to computers, perceived usefulness, and availability of hardware. Results were followed by appropriate discussions and recommendations on improving future technology initiatives in schools.

8.2 Implications of study

The results of this study should help education administrators and policy makers from the Caribbean region; more particularly countries of the OECS (Organisation of Eastern Caribbean States) understand more clearly some of the issues facing integration of computers in classrooms. It should highlight current problems experienced by teachers in schools with severe shortages and shortcomings in hardware. Even more importantly the results should highlight the importance of teacher factors such as attitudes and perceptions about computers.

The above realization can be used as a planning guide, to indicate to administrators that even the purchase of enormous amounts of hardware for schools will not guarantee computer use. It must be preceded and accompanied by awareness building and a general drive to inform and educate teachers of the benefits to be derived from computer use.

A further implication is the realization that factors do not usually act in isolation and therefore planning personnel should adopt a more holistic approach to the introduction of computers in schools.

8.3 Limitations of study

The random selection method for questionnaire distribution within the islands was a limitation of this study. Due to the large population size it was impossible to address individual surveys or to keep track of early, late or non-responders. This makes any assessment of non-response bias impossible.

One obvious but unavoidable limitation related to the fact that respondents were asked to imagine the effect of various factors on their future intentions to use computers. While it may have been more effective to study the effect of these factors against actual use instead of a hypothetical scenario, it was not possible under present circumstances since the majority of islands are not yet at the stage of integration making it impossible to measure actual use. Further, many studies of human behaviour have found intentions to be an accurate predictor of actual use (Fishbein and Ajzen, 1975; Davis, et. al.1989; Taylor and Todd, 1995).

One other limitation concerns the application of theoretical models developed in the North American context to the Caribbean environment. In this study no allowances were made to account for the differences in culture and social environment, and the potential impact of these on survey results. Thus the issue of social context should be addressed in future studies.

8.4 Suggestions for further research

This study examined the direct effects of several variables on teachers' intentions to use computers. Some factors such as access and training deemed of some importance from survey and interview responses were not significant factors in the final model. It would be interesting to examine the effect of these factors acting through others in a future study. For example, the effect of training can be measured with attitude acting as an intervening variable, and hardware can be measured with access and technical support as intervening variables.

Further research could also focus on individual countries in an effort to isolate factors peculiar to those countries.

8.5 Conclusion

Unfortunately in many cases, legislators and administrators often demand to see direct improvements in test results based on the amount of money spent on technological innovations in schools without considering teacher attitude and behaviour – very important variables (“Factors That Affect The Effective Use Of Technology For Teaching And Learning; Lessons From The SEIR*TEC Intensive Site Schools”, <http://www.seirtec.org/publications/lessondoc.html##9> accessed 29.07.2001). It must be noted however that the process to achieve technology integration into the education system of a country does not begin and end with putting computers in schools. As

Hoffman (1996) so correctly put it: dropping and dipping cannot work (dropping hardware into a classroom and dipping teachers into a little training). In order to achieve complete technology acceptance and integration in the classroom, the many barriers facing teachers today must be addressed and remedied. Maximum use and benefits can only be derived through corresponding changes in teacher attitudes and perceptions through awareness building and training; ensuring availability and access to hardware and necessary resources, and directed by proper leadership and planning. Overall, the support from all levels of the education sector is essential, while that of teachers is critical.

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Appendix A – Questionnaire with cover letter and consent form

Date:

Dear Respondent

Education authorities throughout the Caribbean are concerned that the true potential of computer technology is not being fully realised in the education system. It is believed that computers should not be limited to the teaching of Information Technology, but would be beneficial in teaching of all subjects in the secondary school curriculum. It is important to get a clear understanding of how teachers feel about computers in general, and what facilitating conditions encourage or hinder the use of computers in the classroom.

You are being asked to participate in a research project that aims at collecting and presenting the views of teachers around the Caribbean on the issue of computer use in schools. Thus it is important to hear the views of as many of you as possible, in order to get a true representation of your opinions and concerns. Participation in this study will involve the completion of the attached questionnaire (approximately 15 minutes). Your completed questionnaire should be placed in the accompanying envelope, sealed, and returned to the address indicated on the accompanying envelope. Please indicate your willingness to participate by signing and returning the attached consent form to the same address in a separate envelope which has also been provided.

The questionnaire is totally anonymous, and you are assured of complete confidentiality of your responses. Participation in this study is completely voluntary, and you may withdraw at any time without penalty. You are free to leave unanswered any question you find objectionable, **but it is important to this research that questionnaires are answered as completely as possible.**

The results of this research will be made available to Education Ministries in all participating countries. A summary of results will also be made available to you upon request. For any questions about this study, or requests for results please send email to the researcher at clouis@chat.carleton.ca, or research supervisor Dr. Gerald Grant: gerald_grant@carleton.ca, or by writing to Claudia Louis or Dr. Grant at the above address.

Thank you for your help.

Sincerely,

Claudia Louis
Researcher

Dr. Gerald Grant
Research Supervisor

Informed Consent Form

Please indicate your willingness to participate in this study by signing below.

In order for questionnaires to remain anonymous, consent forms must be returned in separate envelopes that have been provided.

Please be assured that your responses will remain completely confidential. All data will be stored securely at the Sprott School of Business, Carleton University and will be made available only to the researchers. Results will only be released in a summarised form.

Questions or concerns about the ethical conduct of the study should be addressed to the Chair of the Ethics Committee Professor Klaus Pohle: klaus_pohle@carleton.ca, or phone: 613-520-2600 ext 7434.

I have read the above description of the study and understand the conditions of my participation. My signature indicates that I agree to participate in the research.

Name (Please print) _____

Signature _____

Date _____

Section A

The following questions ask about your experience (if any) with computers. Please choose only one response per question, and indicate your choice by placing a check (✓) in the corresponding box.

1. Do you currently use computers at school or elsewhere?
☐ YES ☐ NO (If no, skip to question 5)
2. How often do you currently use computers ?
☐ VERY OFTEN ☐ OFTEN ☐ SOMETIMES ☐ SELDOM ☐ NEVER
3. For how long have you been using computers?
☐ LESS THAN 1 YEAR ☐ 1-5 YEARS
☐ 6 - 10 YEARS ☐ MORE THAN 10 YEARS
4. How often do you currently use computers at school for administrative purposes (eg. typing exams, calculating grades, preparing lesson notes, handouts, etc. ?
☐ VERY OFTEN ☐ OFTEN ☐ SOMETIMES ☐ SELDOM ☐ NEVER

The following questions refer specifically to computer use for instructional support (ie. as an aid in teaching lessons) whether in the classroom or computer lab.

5. Are you interested in incorporating computers in your lessons, whether now or sometime in the future?
☐ I ALREADY DO ☐ YES ☐ YES, ONLY IF IT IS MANDATORY ☐ NO
☐ OTHER (please specify) _____
6. What is the *approximate* number of computers in your school designated for instructional use/support?
☐ 0 ☐ 11 - 20 ☐ MORE THAN 30
☐ 1 - 10 ☐ 21 - 30 ☐ I HAVE NO IDEA
7. What is the main arrangement of computers in your school that are designated for instructional use/support? (Select all that apply)
☐ ONE COMPUTER LAB ☐ LIBRARY/ STAFF ROOM
☐ MORE THAN ONE COMPUTER LABS ☐ SPECIALIST TEACHERS/ SPECIALIST ROOMS
☐ A FEW COMPUTERS IN EACH CLASSROOM
☐ OTHER (please specify) _____

Please **CIRCLE** the appropriate response.

		STRONGLY DISAGREE		NOT CERTAIN		STRONGLY AGREE
8.	Using computers in my lessons will help enhance learning for my students	1	2	3	4	5
9.	Using computers in my lessons will help enhance my effectiveness as a teacher	1	2	3	4	5
10.	Using computers in my lessons will help improve the grades of my students	1	2	3	4	5
11.	Overall, I find/would find computers a very useful tool to aid in lesson delivery	1	2	3	4	5
	Computers make me feel very uncomfortable *	1	2	3	4	5
12.	I feel/would feel at ease in a computer class	1	2	3	4	5
13.	I get a sinking feeling when I think of trying to use a computer *	1	2	3	4	5
14.	I feel/would feel comfortable working with a computer	1	2	3	4	5
15.	Computers make me feel uneasy and confused *	1	2	3	4	5
16.	I like/would like working with computers	1	2	3	4	5
17.	The challenge of solving problems with computers does not appeal to me *	1	2	3	4	5
18.	I think working with computers is/would be enjoyable and stimulating	1	2	3	4	5
19.	Figuring out computer problems does not appeal to me*	1	2	3	4	5
20.	I will do as little work with computers as possible *	1	2	3	4	5
21.	I am sure I could do work with computers	1	2	3	4	5
22.	I'm not the type to do well with computers *	1	2	3	4	5
23.	I think using a computer would be very hard for me *	1	2	3	4	5
24.	I could get good grades in computer courses	1	2	3	4	5
25.	I have a lot of self-confidence when it comes to working with computers	1	2	3	4	5

* negative items reverse coded for analysis

		STRONGLY DISAGREE		NOT CERTAIN		STRONGLY AGREE
26	My Principal strongly supports my using computers in the classroom	1	2	3	4	5
27	The support of my Principal regarding computer use is important to me	1	2	3	4	5
28	My peers strongly support my using computers in the classroom	1	2	3	4	5
29	The support of my peers regarding computer use is important to me	1	2	3	4	5
	<i>Assuming I have access to computers, with my current workload....</i>					
30	... I have/would have adequate time <u>outside my scheduled class time</u> to learn/practice how to use computers	1	2	3	4	5
31	... I have/would have adequate time <u>outside my scheduled class time</u> for other tasks such as Internet research and experimentation in preparation for computer use during lessons	1	2	3	4	5
32	... I have/would have adequate time <u>during my scheduled lessons</u> to allow students to use computers	1	2	3	4	5

Comments(if any) _____

Section B

This section asks questions about the administration and management of computers in your school, and its impact on your decision to use computers for instructional support in the classroom now or in the future. Please answer each question to the best of your knowledge by **CIRCLING** the appropriate response.

33. Have you received any form of computer training supported or funded by school authorities?

1. YES

2. NO

If yes...do you think it was adequate/ appropriate to enable you to incorporate use of computers in your lessons?

34. computers in your lessons?

1. YES

2. NO

	Training	STRONGLY DISAGREE	DISAGREE	NOT CERTAIN	AGREE	STRONGLY AGREE
35	I need (further) training on how to incorporate computers in my lessons	1	2	3	4	5
36	I need (further) training on basic introduction to computers and common software programs	1	2	3	4	5
37	If I received (further) computer training from school authorities, I would be willing to try using computers in my lessons	1	2	3	4	5
	Hardware and Software					
38	The number of computers available is sufficient to allow all students to participate during my scheduled classes	1	2	3	4	5
39	The majority of computers at my school are in good working condition	1	2	3	4	5
40	If adequate/appropriate hardware were installed, I would be willing to use computers in my classes	1	2	3	4	5
41	Getting the software I need for use in my lessons is/would be no problem	1	2	3	4	5
	Access					
42	It is very easy for me to get access to computers for use <u>during my scheduled lessons</u>	1	2	3	4	5
43	It is very easy for me to get access to computers <u>outside my scheduled class time</u>	1	2	3	4	5
44	It is very easy for me to get access to computers <u>outside normal school hours</u>	1	2	3	4	5
45	There are clear policies/guidelines at my school to allow me access to computers when I need them	1	2	3	4	5
46	It is very easy for me to get access to the Internet from my school	1	2	3	4	5

Comments(if any) _____

Curriculum	STRONGLY DISAGREE		NOT CERTAIN		STRONGLY AGREE
47 I have knowledge of how to incorporate computers into teaching my subject area	1	2	3	4	5
48 There is a lack of appropriate software available for teaching in my subject area *	1	2	3	4	5
49 I am able to develop my own software application for incorporation into my lessons	1	2	3	4	5
50 My subject(s) curriculum must be changed to allow for incorporation of computers in my lessons	1	2	3	4	5
Support					
51 If I need someone's help in using the computer during or outside scheduled lessons I can get it easily	1	2	3	4	5
52 There is adequate technical support available for fixing computer problems when they arise	1	2	3	4	5
53 There is adequate funding available at my school to facilitate computer use in the classroom (e.g. for maintenance, computer supplies, etc.)	1	2	3	4	5
Policies					
54 My school has clear policies to promote computer use in schools	1	2	3	4	5
55 The Ministry of Education has clear policies to promote computer use in schools	1	2	3	4	5

	STRONGLY DISAGREE		NOT CERTAIN		STRONGLY AGREE
All things considered					
56 Assuming I have access to computers, I intend to incorporate them in my lessons as a teaching and learning tool	1	2	3	4	5
57 Assuming I have access to computers, I intend to use them <i>frequently</i>	1	2	3	4	5

Comments(if any) _____

SECTION C

The following questions ask some information about yourself; this information will be used to categorize your answers. Please choose only one response per question, and indicate your choice by placing a check (✓) in the corresponding box. Please be assured that your responses will be held in the strictest confidence

58. My age group is:

☐ 20 YEARS AND UNDER	☐ 31-40 YEARS	☐ 51-60 YEARS
☐ 21-30 YEARS	☐ 41-50 YEARS	☐ 61 YEARS OR OLDER

59. My gender is: ☐ MALE ☐ FEMALE

60. I have spent a total of ____ years in the teaching profession

☐ LESS THAN 1 YEAR	☐ 11-20 YEARS	☐ 31-40 YEARS
☐ 1-10 YEARS	☐ 21-30 YEARS	☐ MORE THAN 40 YEARS

61. My main teaching subject area is: *(please tick only one)*

☐ ENGLISH A/B	☐ MATHEMATICS	☐ INFORMATION TECHNOLOGY
☐ MODERN LANGUAGES	☐ BUSINESS	☐ SOCIAL SCIENCES
☐ SCIENCE	☐ TECHNICAL/VOCATIONAL _____	
☐ OTHER <i>(please specify)</i> _____		

62. My highest level of educational attainment is ... *(please tick only one)*

☐ HIGH /SECONDARY SCHOOL	☐ COLLEGE DIPLOMA/ASSOC. DEGREE
☐ 'A' LEVELS	☐ UNDERGRADUATE DEGREE (Bachelors)
☐ TECH/VOC CERTIFICATE
(e.g. comm. college)	☐ POSTGRADUATE CERTIFICATE
☐ TEACHER'S COLLEGE CERT.	☐ GRADUATE DEGREE (Masters, Ph.D.)

63. Country _____

64. School: ☐ PUBLIC ☐ PRIVATE ☐ OTHER

65. School Name (optional) _____

66. What (potential) benefits do you see from using computers in your classroom teaching?

*** THANK YOU VERY MUCH FOR YOUR ASSISTANCE!! ***

Appendix B - Interview questions with cover letter and consent form

Date:

Dear Interviewee

It is believed that computers would be beneficial in the teaching of **all subjects in the secondary school curriculum**, and therefore it is important to hear the views of senior teachers and principals, in order to get a true understanding of some of the underlying issues concerning computer use in the classroom. You are being asked to participate in a research project that aims at collecting and presenting the views of teachers around the Caribbean on the issue of computer use in schools. This research is being undertaken in partial fulfillment of a master's thesis.

Your participation in this study will involve one interview, which is estimated to last about one hour. It may be necessary to record the interview as an aid in our analysis. Please be assured that your responses will remain completely confidential, and all responses will be coded such that your name is not associated with the data. All data will be securely stored at the Sprott School of Business, and coded data will be made available only to the principal researcher (myself) and thesis supervisor, Dr Gerald Grant.

Participation in this study is completely voluntary, and you may withdraw at any time without penalty. There is no known or foreseen risk associated with participation in this study.

A summary of results will also be made available to you upon request. For any questions about this study, or requests for results please send email to the researcher at clouis@chat.carleton.ca, or research supervisor Dr. Gerald Grant: gerald_grant@carleton.ca, or by writing to Claudia Louis or Dr. Grant at the above address. Questions or concerns about the ethical conduct of the study should be addressed to the Chair of the Ethics Committee Professor Klaus Pohle: klaus_pohle@carleton.ca, or phone: 613-520-2600 ext 7434.

If you are willing to participate in this study, please sign below.

I have read the above description of the study and understand the conditions of my participation. My signature indicates that I agree to participate in the research.

Name (Please print) _____

Signature _____

Date _____

Country Name:

- 1) What is your level of involvement with IT in the education system in your country?
- 2) At what stage is your country in introducing computers in secondary schools?(eg. early implementation or do the majority of secondary schools have computers?)
- 3) From your Ministry's perspective is the current level of computer use in the classroom satisfactory? (Please explain)
- 4) Are computers being used as a tool in classroom instruction for other subjects ?
- 5) **The following have been identified as possible barriers to computer use by teachers . For each one below, briefly describe the current problems faced in your country, and suggest what measures you think would be necessary to encourage teachers to use computers in their lessons.**
 - i) General attitude of teachers to computers (positive, negative...do attitudes affect computer use?)
 - ii) Adequate hardware/software (eg. are there sufficient computers in the schools, efficient methods of acquiring hardware/software)
 - iii) Access to computers (eg. are computers available after school so teachers can practice, are computer labs available to all teachers?)
 - iv) Time (eg. Do teachers have adequate time for training, planning lessons, experimenting on the computer, given the current workload?)
 - v) Training (eg. have teachers received adequate/appropriate training, what type of training is needed)
 - vi) Technical support (eg. are there problems in maintaining computers)
 - vii) Institutional support (eg. funding in schools for materials, equipment, etc.)
 - viii) Curriculum (eg. does current curriculum allow for use of computers, are changes needed?)
 - ix) Policies (eg. are appropriate policies being implemented to support computer use, what are the attitudes of policy makers?)
- 6) What do you see as the biggest challenge(s) faced by your country concerning integration of computers?

Appendix C - Interview Responses

	Country 1	Country 2	Country 3	Country 4
Stage of implementation	<ul style="list-style-type: none"> - Labs installed at sole secondary school on island 	<ul style="list-style-type: none"> - All secondary schools have been equipped with computer labs 	<ul style="list-style-type: none"> - Majority of schools have computers 	<ul style="list-style-type: none"> - Completed implementation in all secondary schools
Current use	<ul style="list-style-type: none"> - Used primarily for preparing students for external exams (CXC) in Information Technology - used to a very limited extent in other subject areas 	<ul style="list-style-type: none"> - Used primarily for preparing students for external exams (CXC) in Information Technology 	<ul style="list-style-type: none"> - Used primarily for preparing students for external exams (CXC) in Information Technology - Also used in teaching of Math, English, French, Spanish, Biology and Physics 	<ul style="list-style-type: none"> - Used primarily for preparing students for external exams (CXC) in Information Technology - Also used in teaching of Math, English, French, Spanish, Biology and Physics
Teacher Attitude	<ul style="list-style-type: none"> - Very receptive 	<ul style="list-style-type: none"> - Very receptive 	<ul style="list-style-type: none"> - Generally very receptive - Resistance from a few 	<ul style="list-style-type: none"> - Generally very receptive - Resistance from a few
Time	<ul style="list-style-type: none"> - No major complaints - Use is optional, so people find their own time 	<ul style="list-style-type: none"> - Majority of teachers are already overburdened and a solution must be found 	<ul style="list-style-type: none"> - Teachers are generally overburdened - Awareness building sessions help convince teachers that they can reduce time spent on tedious tasks by automating administrative tasks 	<ul style="list-style-type: none"> - Majority of teachers are already overburdened - No immediate solution in sight as numbers of teachers at a school is based on overall student/teacher ratio regardless of subject taught
Training	<ul style="list-style-type: none"> - Use of productivity tools currently being taught at the teacher training institution - No such training for teachers already in the system(puts them at a disadvantage) 	<ul style="list-style-type: none"> - IT training is made compulsory in teacher Training - Some teachers take their own initiative for training - Training sessions have been organized by IT Teachers Assn 	<ul style="list-style-type: none"> - Some awareness building sessions at the teacher training college - Training concentrates on productivity tools 	<ul style="list-style-type: none"> - National computer training was compulsory for all teachers - Training was very effective in breeding positive attitudes - software specific training also provided in integration into subjects such as Math, French and Spanish

	Country 1	Country 2	Country 3	Country 4
Hardware	<ul style="list-style-type: none"> - Numbers inadequate to allow exposure to all students 	<ul style="list-style-type: none"> - Numbers inadequate to allow exposure to all students - Problem in purchasing due to long drawn out process 	<ul style="list-style-type: none"> - Inadequate numbers due to lack of funding 	<ul style="list-style-type: none"> - Numbers inadequate to allow exposure to all students and teachers
Software	<ul style="list-style-type: none"> - Software licences very expensive and is a barrier 	<ul style="list-style-type: none"> - no current problems in acquiring software as supplied by a private entity 	<ul style="list-style-type: none"> - Lack of software for already limited hardware only compounds the problem 	
Access	<ul style="list-style-type: none"> - Computer labs accessible to non-IT teachers when not in use for IT - Computers available in staff room 	<ul style="list-style-type: none"> - Computer labs generally accessible only to IT teachers - Labs only open during school hours 	<ul style="list-style-type: none"> - Computer labs generally accessible only to IT teachers 	<ul style="list-style-type: none"> - Computer labs accessible to non-IT teachers when not in use for IT - Available after school hours
Curriculum	<ul style="list-style-type: none"> - Computers can be used with current curriculum 	<ul style="list-style-type: none"> - IT teachers feel overwhelmed with the curriculum - One possible solution: Have workshops for subject teachers, to be organized by curriculum officers 	<ul style="list-style-type: none"> - Some revision may be necessary to promote use of computers 	<ul style="list-style-type: none"> - Some subjects lend themselves more to the use of ICT than others
Technical Support	<ul style="list-style-type: none"> - Provided by government IT department - Response time sometimes slow 	<ul style="list-style-type: none"> - Provided by National Computer Centre and private entity - Ministry staff being trained to provide technical support 	<ul style="list-style-type: none"> - Currently training 1 teacher per school in basic computer maintenance - Backup support provided by MOE staff or outsourced - Shortage of technical staff at MOE means administrator must do technical work 	<ul style="list-style-type: none"> - Provided by MOE, however insufficient number of technical support staff - Some teachers have been trained from each school to handle minor problems - Problem of attrition of trained staff - Proposed solution: outsource support maintenance

	Country 1	Country 2	Country 3	Country 4
Admin support	<ul style="list-style-type: none"> - Funding is allocated by MOE, though not always sufficient 	<ul style="list-style-type: none"> - Funding provided by education levy fund - Therefore no problems 		<ul style="list-style-type: none"> - Funding sourced from computer lab fee charged to students - Therefore no problems
Policies	<ul style="list-style-type: none"> - Some policies exist 	<ul style="list-style-type: none"> - Currently trying to adapt OERU model policy - May need to sensitize policy makers to technical issues in ICT 	<ul style="list-style-type: none"> - Policy currently in draft awaiting next stage - May need to sensitize policy makers to technical issues in ICT 	<ul style="list-style-type: none"> - Existence of National ICT policy - Currently embarking on an education policy...starting with the OERU model and following guides from the national policy
Biggest problem	<ul style="list-style-type: none"> - Scheduling to maximize availability of the labs for all - Acquisition of funding to acquire software for teaching in different subject areas 	<ul style="list-style-type: none"> - Computer labs dominated mainly by IT teachers, therefore limited or no access to non IT teachers 	<ul style="list-style-type: none"> - Funding for acquiring the necessary hardware and software - Getting people to understand and accept the change process 	<ul style="list-style-type: none"> - High turnover rates among teachers who have received ICT training form MOE - Difficulty in finding persons qualified in ICT to teach - Providing technical support to all schools efficiently with limited staff

	Country 5	Country 6	Country 7	Country 8
Stage of implementation	<ul style="list-style-type: none"> - Labs installed at sole secondary school on island 	<ul style="list-style-type: none"> - All government secondary schools and primary schools have computers 	<ul style="list-style-type: none"> - Majority of schools have computer labs (17 out of 20) 	<ul style="list-style-type: none"> - Currently at second phase of school computerization project - At the end of the project most (about 85%) of the 21 secondary schools will have computer labs
Current use	<ul style="list-style-type: none"> - All students are currently being exposed to computers - Integration on a very small scale in Science, Art, Technical Drawing 	<ul style="list-style-type: none"> - Used primarily for preparing students for external exams (CXC) in Information Technology 	<ul style="list-style-type: none"> - Used primarily for preparing students for external exams (CXC) in Information Technology 	<ul style="list-style-type: none"> - Currently being used mainly for routine administrative work - Current initiative to extend the use of computers for instructional purposes
Teacher Attitude	<ul style="list-style-type: none"> - Many currently use computers for administrative tasks - Most teachers have demonstrated great interest in ICT integration in their classes 	<ul style="list-style-type: none"> - Many seem intimidated by computers and the prospect of change - Computer awareness sessions being delivered in all schools to help heighten interest - Planned awareness building among education planners also to allow them to plan with computers in mind 	<ul style="list-style-type: none"> - Generally most teachers seem very receptive to the use of computers - Some are not computer literate however - A few are sceptical due to limitations (barriers such as access, time, etc.) 	<ul style="list-style-type: none"> - Most teachers have a positive attitude to computers - However main emphasis so far has been on the use as an administrative tool rather than a teaching tool

	Country 5	Country 6	Country 7	Country 8
Time	<ul style="list-style-type: none"> - Most teachers would be able to find time during their non-teaching periods - Some teachers feel overwhelmed with the demands of teaching 3 courses with School Bases Assessments (SBA) - Workload may be lessened by scheduling a maximum of 2 SBA subjects per teacher 	<ul style="list-style-type: none"> - Seen as a definite barrier by many 	<ul style="list-style-type: none"> - CXC syllabus with SBA (School Based Assessments) make heavy demands on teachers' time - Many teachers already overburdened and find it difficult to fit in any extra time for practicing and learning to use computers 	<ul style="list-style-type: none"> - No special allocation of time for experimenting with computers - Teachers must find their own time if interested
Training	<ul style="list-style-type: none"> - Sessions on introduction to computers and general productivity software organized by MOE - Working in collaboration with teachers union to train all teachers at all levels of the school system 	<ul style="list-style-type: none"> - Formal training and syllabus workshops at the ministry level for IT teachers - Possible training for general teacher population currently being discussed - MOE encouraging all schools to start in-house staff development sessions on computer use (has already begun in some) 	<ul style="list-style-type: none"> - Computer literacy training and productivity tools have been started in the secondary schools from Summer 1999. Also did some basic computer maintenance training for 1 teacher from each school - Have not done training in integration - Training for all Principals on the island in computer literacy also provided 	<ul style="list-style-type: none"> - Teachers generally have not received sufficient training (especially in the use of computers for instructional purposes)
Hardware	<ul style="list-style-type: none"> - Numbers not quite adequate, however still better off than some other islands as there is 1:2 ratio for most classes 	<ul style="list-style-type: none"> - Hardware is pretty inadequate - Labs age around 8-10 years average, so there is need for upgrading and maintenance 	<ul style="list-style-type: none"> - Problems both in numbers and capability - Limits number of students who are exposed to ICTs - Hardware acquisition usually involves long process - Donated equipment not always up to standard 	<ul style="list-style-type: none"> - Numbers currently insufficient

	Country 5	Country 6	Country 7	Country 8
Software		<ul style="list-style-type: none"> - Problem with software as most of it is not 'region friendly' 	<ul style="list-style-type: none"> - Mainly productivity software available - Hardware capability limits software that can be used 	<ul style="list-style-type: none"> - Instructional software insufficient
Access	<ul style="list-style-type: none"> - Access to labs when not in use for IT - Access to computer in office and staffroom - Access available after school hours 	<ul style="list-style-type: none"> - Big problem as labs are used about 80% of the time for CXC and SBAs - Only accessible to IT teachers because CXC takes up all the time 	<ul style="list-style-type: none"> - Big problem as labs are used majority of the time for CXC and SBAs - Access is usually through IT teachers or Principal 	<ul style="list-style-type: none"> - Generally not available as they ought to be
Curriculum	<ul style="list-style-type: none"> - Generally seems workable - In terms of scheduling more subjects should be timetabled in blocks instead of single periods to facilitate computer use 	<ul style="list-style-type: none"> - Greater emphasis on CXC in high schools, so that limits integration somewhat - Already integrated in primary schools 	<ul style="list-style-type: none"> - May need a curriculum reform to incorporate IT. - Good planning will ensure that it fits into time allotted for curriculum - Necessary to work in conjunction with CXC 	<ul style="list-style-type: none"> - Need for the alignment of learning outcomes in all the curricula areas with ICT learning outcomes.
Technical support	<ul style="list-style-type: none"> - Provided by lab technician attached to the MOE - (Efficient due to small numbers) 	<ul style="list-style-type: none"> - Island wide support provided by IT team (4 technicians from MOE) - Has been efficient in terms of response times - Cost efficient 	<ul style="list-style-type: none"> - Currently provided by MOE, however grossly inadequate due to insufficient staff - One teacher from each school trained to take care of basic maintenance - Need for ICT co-ordinator in each school to be responsible for maintenance - Maintenance can be decentralised to the district level, which leaves MOE free to play a co-ordinating role 	<ul style="list-style-type: none"> - Outsourced to private sector - Recognised need for MOE to develop its own internal capacity for maintenance purposes

	Country 5	Country 6	Country 7	Country 8
Administrative support	<ul style="list-style-type: none"> - Funds provided by MOE on an annual basis - School provides materials 	<ul style="list-style-type: none"> - Funds provided by MOE - Funds sometime inadequate so some schools engage in fund-raising 	<ul style="list-style-type: none"> - Ministry is currently responsible for providing these funds - Not always sufficient so some schools raise their own funds 	<ul style="list-style-type: none"> - Funding generally provided by the Government and other grants from friendly governments
Policies	<ul style="list-style-type: none"> - Currently in the making (trying to adapt OERU model) - Policy is very necessary to get the reluctant teachers on board, as some are still sceptical 	<ul style="list-style-type: none"> - Currently looking at OERU model, along with other drafts in an attempt to create our own 	<ul style="list-style-type: none"> - The need for a policy is recognised and supported by all stakeholders - Policies are currently in the making by adapting OERU model - Some people are a bit sceptical and have some queries, but no resistance 	<ul style="list-style-type: none"> - Recognised need for a comprehensive ICT policy - Work will start shortly on drafting of an ICT policy based on the OERU model
Biggest problem	<ul style="list-style-type: none"> - Inadequate hardware to allow access for all - Lack of software for individual subjects 	<ul style="list-style-type: none"> - Inadequate amount of hardware to allow access to all (caused by limited resources) 	<ul style="list-style-type: none"> - Inadequate amount of hardware to allow access to all (caused by limited resources) Each school needs at least 2 computer labs - CXC seems to be dominating the things that happen at the secondary schools and we need to move away from that. - need to liaise a lot more with CXC in terms of some of the plans we have for integration - need some proper maintenance planning 	

Appendix D – List of Contact Persons and Interviewees

Worrel Brooks	Anguilla
Leo Cato	Grenada
Abraham Durand	Dominica
Doristeen Etinoff	Antigua
Cheril Fevriette	St.Lucia
Cathy Gill	St.Lucia
Chester James	St.Vincent
Bernadine Louis	British Virgin Islands
Quinton Morton	St.Kitts
Tyrone Smith	British Virgin Islands
Cheverlyn Williams	Monsterrat