Brunel
UNIVERSITY
WEST LONDON

Evaluating ICT in Mathematics Teaching

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By

Ebtisam Aqeel

Department of Information Systems & Computing

Brunel University

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Abstract

The challenge for educators is to prepare students for life in a technological advanced society that will continue to change exponentially. Work requirements have changed and computer skills have become a basic requirement for a majority of jobs. As computers have become more prevalent in everyday life and in the work place, their use has gained in importance around the world. Kuwait, like other countries, has recognised the need to increase the technological background of its students to compete better in world markets.

This research recognises the importance of ICT in Education and realises the difficulties involved in its effective adoption. For that reason, it presents an empirical study of the ICT adoption process by examining perceived innovation attributes, and the relationship of individual characteristics in this process. The theory that supports the research effort is Rogers' theory of Diffusion of Innovation, which was used as the theoretical framework to hypothesise a model of ICT adoption. This model is called the ICT ARABIA Model (ICT Adoption using Rogers' model, and Bringing In Addition), and was designed to elicit the relative importance of the perceived innovation attributes in influencing ICT adoption in Mathematics education.

The empirical context of the research is 259 participants in mathematics departments, which are analysed using quantitative and qualitative research approaches. Results indicated that the ICT ARABIA Model was most useful in explaining ICT adoption by mathematics departments. The relative importance of each factor of the ICT ARABIA Model was determined by rank ordering the mean importance scores for each factor. However, an additional factor emerged, and this was leadership. Also, demographic characteristics were found non- significant predictors of ICT adoption. These findings highlighted many issues for further study. The main concern was regarding the importance of the perceptions of innovation attributes in influencing the ICT adoption in mathematics education; however, leadership was also an influential factor, which resulted from interviews. Those interested in programme innovation and change in educational departments may need to focus on finding a strong leader to help in the process.

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Chapter 1: Introduction

1.1 Background

We are living in a world that is increasingly interconnected, a world that relies on computers and networked communities, a world that is shaped by larger economic and social trends such as globalisation, demographic change, and development towards a knowledge-based society (Reding, 2002). Technology has changed our lives in significant ways. The power of computers and networked information and communication technologies (ICT) has transformed our homes, our workplaces, and our societies (McCain and Jukes, 2001). Computers govern our home appliances, our cars, access to our money in banks, and our communication networks. It is difficult to think of an aspect of our personal lives that is not influenced by computers (ECDL, 2001).

The last decade saw the proliferation of the World Wide Web with its international connections, instant access to information on myriad topics, e-mail, and increasingly, e-commerce (Hofstetter, 1998). People of all ages are using the web on a daily basis and many have numerous e-mail boxes. Young children, even those still in preschool, play games on the web, and students are increasingly assigned research projects involving finding information on the web. Investors retrieve the latest stock quotes and manage their portfolios over the web. Collectors are buying and selling over the web, and recently, on-line auctions have come into vogue. Airline tickets, hotel reservations, real estate, bank loans, groceries, health information, books, information about schools and colleges, and many other services are all available over the web (Hofstetter, 1998).

Living successfully in this Information Age necessitates skills like computer and Internet competence, which provide a technologically supportive environment (Brand, 1998). Education is a crucial factor in preparing the citizens of this world to succeed in it and benefit from its opportunities. According to Reding (2002), schools have the responsibility of preparing their students to be successful. Today's workplace and communities have tougher requirements than ever before. They need citizens who can think critically and strategically to solve problems. These individuals must learn in a rapidly changing environment, and build knowledge taken

from numerous sources and different perspectives. They must understand systems in diverse contexts, and collaborate locally and around the globe (Jones et al., 1995). Thus, to meet the demands of the world in which they will live, students will need to adapt to changing conditions and learn independently. They will need to be well equipped with essential mathematical knowledge and skills, with skills of reasoning, problem solving and communication, and with the ability and the incentive to continue learning on their own. They will require the ability to use technology effectively and the skills for processing large amounts of quantitative information (NCTM, 2000).

One of the main goals of education has always been to provide students with skills that will help them become lifelong learners. In order to prepare students for the challenges that face them in the workforce, many educators (Means, 1994; Tenbusch, 1998; Honey et al., 1999; Al-Subah, 2002) believe that technology should be an integral part of education. Becker and Ravitz (1999) consider that technology can be a catalyst for educational reform. Using technology in classrooms will, to a certain extent, shift the roles of students and teachers. Teachers will act as facilitators helping students to access information, process it, and communicate that information, working to encourage students to think and research information and to become active participants in their own learning process, which is a trend towards active motivation of the learners to communicate and collaborate inside as well as outside the classroom (Bagley and Hunter, 1992). Students gain confidence and self-esteem when using technology, which helps modify instruction and connects students' learning to the real world. Thus, students gain access to information that was never available before, and are provided with unlimited learning opportunities and resources (Becker, 1994; Charp, 1998). Researchers (Berenfeld, 1996; Charp, 1996; Molnar, 1997) show the use of technology enables learners to reach outside the classrooms, allows for more efficient use of time, motivates students, helps teachers individualise instruction, and provides access to unlimited information. They suggest that focusing on solving real-world problems through using technology will develop higher-order thinking skills. This allows students to see how what they are learning fits into their future, and helps them become productive citizens. It also allows them to explore and discover things that have before been beyond their reach. Moreover,

studies (Kulik, 1994) showed that computers increase test scores, as well as time spent on tasks, decrease learning time, create more positive attitudes, and build self-esteem in students.

Over and above, computers are widely used as a medium of teaching and learning due to a number of attributes, such as their ability to process data, their repetitive capability, their capacity to evaluate responses, their immediate feedback, etc., and due to their motivational effect on learners (Jones and Fortescue, 1987; Brutchin et al., 1994). Perhaps the most frequently reported advantage is that computers are potentially interactive, and that as a result of this interactivity, they can promote more active learning amongst students of all ages and all abilities (O'Shea and Self, 1984). Besides, there are many arguments in favour of the use of the computers in the classroom, in the light of arguments for diversifying teaching methods in key subjects, such as mathematics (Cockcroft, 1982). The Cockcroft Report strongly recommended changes in teaching and learning styles, with more attention given to discussion, investigation and problem solving. The computer has been seen as a catalyst for change in mathematics education, and is capable of economically handling many routine, tedious and time-consuming traditional activities, and in creating settings for learning and providing well-designed and attractive software for problem solving and investigation (Brenner et al., 1997; Huntley et al., 2000).

Researchers in the field of mathematics (Cockcroft, 1982; Obied, 1990) have suggested that mathematics should be studied in order to develop powers of logical thinking, accuracy, and spatial awareness. According to Galindo (1998), especially in geometry, the curriculum should require students to explain and justify their answers, gradually leading them to understand the limitations of visual and empirical justifications, so that they come to see proofs as a logical necessity. The importance of computers in the classroom was emphasised by the NCTM (1980) when it recommended numerous curriculum changes based upon the changing needs in an increasingly technological society. The NCTM suggested that the mathematics curriculum should take full advantage of the power of calculators and computers at all class levels.

Mathematics is a subject with great potential to exploit technology in creative and innovative ways in both content delivery and functionality. It is a subject area with a

recognised hierarchy of topics, which can be introduced with varying degrees of depth to a wide range of users. Additionally, much of mathematics relies on computation to arrive at answers and visualisation of results for dramatic impact, with functionality provided by computing platforms (Kellar et al., 2003).

1.2 Research Problem

Academic, community, business and government leaders are calling upon schools, colleges and universities to create a different kind of student from a generation ago. This is in response to the challenges posed by the new global economy, where the knowledge and skills of a nation's workers are the key to its competitive success. Among the skills called for in students are critical thinking, problem solving, written communication, and ability to work collaboratively (Uchida, 1996). To meet the demands of our global economy and a dramatically different society, there must be corresponding adaptations in our educational environments to develop 21st century skills. Educational technology provides educators with valuable tools to teach, develop and reinforce skills by dramatically altering the options for inquiry, analysis and expression (CEO, 2001). Consequently, the current policies of educational reform call for an emphasis on the integration of technology into the instructional process (Glennan and Melmed, 1996; Honey et al., 1999).

Although the current trend in educational reform is towards more technology integration, and beside the overwhelming evidence cited for the benefits of ICT, the literature (Butzin, 1992; Cafolla and Knee, 1995; OET, 1995; Dias, 1999; Clark, 2000) indicates that the process has not yet been implemented effectively. Integrating technology into the curriculum is not a new field for teachers and administrators, and much research has previously been done. However, technology integration has not been successfully implemented and accepted by teachers and administrators in schools, because adoption is not an easy task, and integrating technology into teaching and learning is a slow and time-consuming process that requires substantial levels of support and encouragement for educators.

Although availability of computers is a necessary condition for computer use, this is not sufficient (Glennan and Melmed, 1996). Therefore, it is imperative to examine conditions which will help to integrate technology and instruction for effective

implementation. The main condition for technology integration to be thoroughly and effectively implemented is that it is the teachers who must master the process. Teachers are the key to successful integration of technology in curriculum and instruction. Wiburg (1997) points out that teachers are the main implementers of technology in the classroom, stand in the front line of experimentation with any kind of instructional technology or products, and are the first to suffer from any inappropriate technology planning. When the school system utilises technology, teachers' opinions and actual needs should be valued. They are actual practitioners of technology integration, and they directly experience and recognise how technology integration influences teaching and learning. They can therefore provide helpful information for future technology planning in schools (Wiburg, 1997; OET, 1999).

Since teachers are the critical factors in successful technology implementation, and the key to integrating educational technology into the curriculum, teacher perception regarding technology, in general, and its integration into instruction, and ascertaining which factors promote teacher participation and which cause teachers to resist or hesitate, are the focus of this study. There are many variables and dimensions to consider.

ICT has been considered an ultimate means for delivering solutions to the Kuwaiti educational deficits, on the basis of the information so far available, and due to a great sense of urgency among education specialists and administrators about the necessity of a radical change in the school curricula (Al Sabah, 2002). To face the great challenges of the new century, including globalisation of the economy, drastic changes in the world of work and employment, and acceleration in the pace of scientific and technological progress, it merits further study.

This research will look at using ICT as a medium for instruction in mathematics classrooms in the State of Kuwait, where the notion of using computers and the Internet in a classroom is fairly new. In the past years, more and more schools have started to introduce computers labs to their premises. However, in comparison to other countries in the world, Kuwait lags behind in terms of the use and number of computers in its educational system (Goodman et al., 1998). In addition, the implementation of ICT in developing countries tends to suffer from the assumption that models used for developed countries are appropriate, without recognising the

idiosyncrasies of the organisation. Also, there is insufficient identification of factors that need to be considered in adopting and managing it in developing countries, especially to avoid the pitfalls which have been encountered in some of the developed countries.

As governments are debating policies, strategies and avenues of educational reforms, a variety of organisations are starting to study possible ways of using ICT in schools. However, so far, no specific guidelines and instructions on using ICT in classes have been devised. It seems as if, at this stage of reform, most institutions are concerned with political issues and overall strategies, without taking into consideration teachers' willingness to adopt technology in their classrooms. The National Report for the Gulf States (2001) stated that it all depends on the teachers. The report goes on to describe what the new teachers' roles would be, and what skills they have to demonstrate. Consistent with the Report, researchers (Sarason, 1995; OET, 1997; Wilburg, 1997) point out that the teachers are the actors for change, the ones to help ICT use in education to emerge, apply ICT in education, and help integrate ICT in the current educational system, consequently transforming education. However, not much consideration seems to be given to how current teachers are affected by the proposed changes, and what type of support they might need in order to be able to understand and deal with the change.

If teachers are the designated actors of change, but do not receive much or any support in preparing for and accepting it, nothing besides nice looking and well-intended strategies and polices will actually occur to reform the Kuwaiti education system. This study will not consider the policy and government-related issues in the change of the Kuwaiti education system; instead, it will focus on the teachers, the actual subjects working and using the computers and the Internet in their classrooms. It will identify and examine the factors that affect teachers' perception regarding the adoption of ICT as an educational medium, and hence might impact on their acceptance of the ICT, and subsequent use. These factors might provide some insights into what educational authorities need to keep in mind when devising and implementing reform strategies, and what is necessary to encourage teachers to support the change strategies proposed.

1.3 Approach to problem

Change is a normal part of life, and as much a feature of the educational landscape as any other area of society (Haddad and Draxler, 2002). Research on educational change strongly supports the notion that innovations will not be implemented in schools simply because they make sense and meet specified needs (Fullan, 2001). The response of individuals to change depends upon many factors, some of the most important being the perceived effect of the change, their degree of control over the change, and attitudes formed concerning its nature. Extensive research literature and practical evidence are available, describing the innovation diffusion process in a wide range of fields (Clarke, 2001).

Educational technology is a field of innovation and change. Many of the most important products and practices developed by educational technologies require dramatic shifts in the way we think about, deliver, administer, and assess instruction and training. Studying the adoption, diffusion, implementation, and institutionalisation of innovations is essential to the field of educational technology, because the field has suffered from a lack of widespread acceptance of technology (Burkman, 1987). ICT can be considered an educational innovation. Rogers (2003) defines diffusion of innovation as the process by which an innovation is communicated through certain channels over time, among members of a social system. An innovation is an idea, practice, or object that is perceived as new by the individual, group, or organisation. After receiving information about an innovation, the potential adopter makes a decision to either adopt or reject the innovation. Using diffusion of innovation theory as a conceptual guide provides an increased understanding of how and why this innovation has spread into education.

Several theories have been developed to explain individual adoption and acceptance of ICT. Among these are the Diffusion of Innovation (DOI) Theory (Rogers, 1983, 1995, 2003), the Theory of Reasoned Action (Ajzen and Fishbein, 1980), the Technology Acceptance Model (TAM) (Davis, 1989, 1993), and Social Cognitive Theory (Compeau and Higgins, 1995).

The two that have received a great deal of attention in literature are the Rogers (2003) DOI theory, and the Davis (1989, 1993) TAM. DOI identified five perceived attributes of an innovation to influence adoption behaviour: relative advantage,

complexity, compatibility, trialability, and observability, whereas the TAM posits that ICT adoption has two perceived attributes that influence adoption: usefulness and ease of use. Due to many similarities between these models, and also owing to the fact that many researchers have combined elements of both models in their studies on technology adoptions (Thompson et al., 1991; Agarwal and Prasad, 1997), they were selected as the foundation upon which modified models were built for this study. These two theories have a well-grounded Moore and Benbasat (1991) instrument to measure an individual's perceptions concerning the attributes of an ICT innovation, which identifies the perceived attributes of an innovation as key predictors that explain adoption. Its dependent variable is users' perceptions to adopt technology. The model applies most readily to situations where the individual user can voluntarily choose whether to adopt the innovation or not, and provide reasons for adoption. This was however adapted to focus on the objectives of the study.

One major reason for this lack of utilisation is that the educational technologies have concentrated their efforts on developing instructionally sound and technically superior products, while giving less consideration to other issues. Technical superiority, while important, is not the only factor that determines whether or not an innovation is widely adopted (Pool, 1997). A complex web of social, economic, technical, organisational, and individual factors interact to influence which technologies are adopted, and to alter the effect of a technology after it has been adopted (Segal, 1994). In order to fully understand the field, practitioners have to understand more than just hardware, software, design models, and learning theory. Understanding why people use educational technology and, perhaps more importantly, why they do not, is at the core of the process. That is where adoption, diffusion, implementation, and institutionalisation come in.

1.4 Research Objectives

A deliberate decision has been taken to base this research on Rogers' theorem. Studying the adoption, diffusion, implementation, and institutionalisation of innovations is essential to the field of educational technology. Several decades of research have shown that people respond to change in different areas to acceptance of technological innovations. Rogers' DOI model can help us recognise effective

approaches to initiating effective change as we adapt to the demands of the new century. There is no application for which this research approach is optimal in any sense, merely that there is an expectation that a contribution to knowledge will be made.

One of the main issues dealing with successful integration of technology in schools is the polices and procedures that lead to a school's staff adoption of technology. For example, teachers play a critical role when integrating technology into the curriculum. They cannot be forced by the ministry of education, principals and policy makers to integrate technology into their lessons. They are individuals with different potential and varying degrees of openness to technological innovations. For this reason, it is very important to understand when and how teachers and the entire school staff adopt or reject educational innovations.

The purpose of this study is four-fold. First, to gain understanding of the issues inhibiting the adoption and successful utilisation of ICT by reviewing the relative literature pertaining to the following: 1) key issues in the adoption of ICT, 2) problems and prospects for ICT in education, and 3) importance of ICT in education.

Second, to review the various research models and theories that are associated with the diffusion of innovation literature, such as Diffusion of Innovation (DOI) theory (Rogers, 2003), Theory of Reasoned Action (TRA) (Davis, 1989), and the Moore and Benbasat model (1991), in order to gain an understanding of the issues related to the topic, and at the same time, extract the theoretical background for factors that are perceived to be important to the adoption and utilisation phenomena in Kuwait.

Third, based on Rogers' theorem, to address the gap in the diffusion literature and global information systems research by developing a model which examines factors that are perceived to be important to the individual adoption and use of ICT within the educational setting in the State of Kuwait.

Finally, to develop a model which looks beyond possible solutions, and focuses on the basic underlying problem contributing to the failure of ICT use in classrooms. This model is to be based on the Rogers' (2003) DOI theory, Davis (1989) TAM, and the Moore and Benbasat model (1991), to examine factors affecting the adoption and utilisation of ICT by mathematics teachers for purposes of teaching and learning. There are many possible factors affecting a teacher's perception of the usefulness of

the computer as a medium for educating, her or his acceptance of the medium, and subsequent continuous use.

This study also attempts to make an assessment of the attitudes of teachers and educators in mathematics education towards the adoption of ICT and subsequent use. These factors could be broadly groupe as:

1. Innovation attributes (relative advantage, compatibility, image, ease of use, result demonstrability, visibility, trialability).
2. Demographic characteristics (age, gender, rank, experience, educational level, skill level).

1.5 Research Methodology

The main aim of this field study in Kuwait is to identify the perceptions, views and attitudes of mathematics teachers, mathematics head teachers, mathematics student teachers, and principals towards the introduction and use of computers for mathematics teaching. The study will also examine their views towards facilitating the introduction and use of computers in mathematics classrooms.

The study will employ both quantitative and qualitative approaches, and will use the following methods in data collection:

- Questionnaires (primary source)
- Interviews

The methodological approach of this study will, however, be based on questionnaires as a primary source for gathering information.

To generalise these perceptions, views and attitudes to Kuwait as a whole will require a large sample of principals, mathematics teachers, mathematics head teachers, and as many mathematics student teachers as possible. It was decided, therefore, to measure these samples' attitudes by using a questionnaire survey. A questionnaire survey seems to meet the purpose of this study, since:

1. A large number of questions can be included.
2. Most of the questions require only closed-ended answers.
3. A large number of respondents can be covered.

A survey conducted with the samples in Kuwait intermediate schools gives insight into the relative importance of the identified factors as they influence the formation of the participants' perceptions regarding ICT.

On the other hand, interviews are suitable to seek information from specific individuals, because most of the questions which need to be asked are about their opinions, current procedures, and future plans, which can be better explained during the interview. Furthermore, the number of personnel who need to be interviewed will be small.

1.6 Dissertation Outline

This dissertation is structured in seven chapters, each one providing an understanding in carrying out this research. A brief outline of the chapters is now presented.

Chapter 1 begins by introducing the main issues that the research will address. These focus on the general background to ICT and their importance in education. Therefore, the main objectives of the research are stated. The chapter ends with a summary outline of the dissertation, along with brief overviews of each chapter explained.

Chapter 2: ICT in Education

This chapter includes an up-to-date review of the available literature in this field, and introduces different perspectives on the relevance of Information and Communication Technology (ICT). It will also look into the impact of ICT on the educational system and its importance, and the main barriers that the introduction of computer technology into subject-teaching might encounter.

Chapter 3: Proposed Model for ICT Adoption

As reported in Chapter 2, ICT adoption in education is a problematic issue. Chapter 3 therefore attempts to overcome this problem by reviewing the diffusion theories and evaluating them by proposing a conceptual framework. Thereafter, an attempt is made to produce a conceptual model for the adoption of ICT in mathematics teaching in Intermediate education in the State of Kuwait, which is developed and analysed.

Chapter 4: Research Design and Methodology

This chapter presents the methodology of the study. The research instruments, selection of samples, and procedures for conducting the field study and collecting

data are described. Also, the reasoning behind the research methods is stated within the Chapter 4. The research strategies are also described and discussed.

Chapter 5: Data Analysis and Findings

This chapter provides a description of the sample for this research. In this context, 259 participants are studied and their perceptions towards the adoption of ICT are reported. The main factors that influence the rate of ICT adoption are described and analysed.

Chapter 6: Application of the ICT Adoption Model

Based on the research findings, Chapter 6 revises the conceptual model proposed in Chapter 3. The revised model supports the adoption of ICT, and is influenced by factors including : (1) relative advantage, (2) compatibility, (3) image, (4) result demonstrability, (5) ease of use, (6) visibility, (7) trialability, and (8) leadership.

Chapter 7: Conclusion and Further Research

In drawing the discussion to a close, this chapter summarises the research presented in this dissertation. The research contribution is also identified in this chapter. Also, it provides the major conclusions reached about the possible limitations of the research, and potential areas of further research are also discussed.

Chapter 2: ICT in Education

2.1 Introduction

As Information and Communication Technology (ICT) becomes more widely used in classrooms and schools, attention is being focused on how it can make teaching and learning more effective. This chapter begins with an overview of the definition and evolution of ICT. Then the influence which ICT has on society and education will be covered. The chapter will proceed with a discussion of ICT capabilities which teachers need to develop in order to harness its potentials in the teaching and learning process. Barriers which inhibit teachers from using ICT in their classrooms will be discussed.

The ability of ICT to improve the delivery of education has received widespread attention in recent years. Throughout the world, education institutions, businesses and governments are working in different ways to realise the potential of ICT to provide better educational opportunities.

2.2 What is ICT ?

In order to arrive at a working definition of ICT, it seemed easiest to make an assessment of the existing definitions, in what way they agree, and just where the big differences are.

' Convergence' is the word to understand the very notion of ICT. According to Herrmann et al. (2000), ICT is considered a convergence between computing and communications, forming information and communication technologies

In the view of the Commonwealth Department of Education, Training and Youth Affairs (DETYA) (2001), ICT generally relates to those technologies that are used for accessing, gathering, manipulating, and presenting or communicating information. These technologies could include hardware (e.g. computers and other devices), software applications, and connectivity (e.g. access to the Internet, local networking infrastructure, videoconferencing).

The European Commission (2001), in their report, state that ICT refers to a range of services (such as telephony, fax, and Internet), applications (such as distance

education and management information systems), and technologies (ranging from 'old technologies' such as television, to 'new technologies' such as cellular phones), which often run over telecommunications networks using various equipment and software.

A definition of the term has also been provided by the Concise Dictionary of Computing such as:

"The science of Information handling and processing made possible by the convergence of the Technologies of Computing, Microelectronics and Telecommunications".

The convergence of the three aspects of technology highlighted in the definitions above has given information a new dimension and scope. Besides printed materials, the usual form taken by information before the invention of these technologies, new information now exists in electronic forms, and instead of limiting the transfer of information within a given office or department, information can now travel all around the globe within a matter of seconds. Telecommunications is a key factor here. It widens the scope of this tool. Unlike the traditional view of telecommunications which meant 'communication across distance', telecommunications is now understood to mean 'electronic and digital communication across distance', with an ultimate goal being to create individual networks which allow information to flow widely and with little resistance from individual to individual (Barone et al., 1996). The latter identify two levels of telecommunications : basic and advanced. At the basic level, telecommunications involves "(1) a computer, (2) a modem, (3) a phone line, and (4) networks. Advanced telecommunications incorporates (1) television, (2) cable television with interactive multimedia software, (3) narrowcasting, (4) videotape, (5) compact and laser disc, and (6) fiber optics".

One early example of ICT convergence is the crossing of photocopy machine and telephone, leading to the creation of fax. But the most spectacular achievement in this area is convergence of computer and telephone that resulted in the upsurge of the Internet (Aufrant and Nivlet, 2001).

The association of telecommunications and information technology has led some educational organisations or authorities, as in the British Programme on Information

and Communication Technologies (PICT) (Mansell, 1994), to use ICT instead of IT, in order to capture the features and services which technology can provide nowadays. For the purpose of this study, ICT is defined in terms of the common technological base of the equipment used in information transformation processes. This definition is adopted from the PICT. In this definition, both information and communication technologies are widely referred to as IT. The term refers both to emerging communication and information technologies covering computing, software, communication and networking, and media.

2.3 ICT and Society

As technology keeps developing, its tools become cheaper, smaller in size, and consume less power. Due to the size of the computer and its related technologies, it gains portability, so that it can fit into all kinds of different environments. As information grows in terms of amount and type, it becomes more readily available for people now than in the past. Consequently, people become more exposed to information, as technology becomes affordable, enabling us to do more and more tasks faster and better (Jinkerson, 1994).

As well as hardware and software becoming more powerful and affordable (OTA, 1995), ICT has become an integral part of almost all walks of life. With its varying forms, namely computers, video, television, telephones, radio, and telecommunications network, ICT exerts a limitless influence on how we live, work, and play. As a result of this influence, today's society has become so technology-oriented that acquiring ICT skills and knowledge is almost imperative for successful adulthood (Eisele and Eisele, 1990). According to OTA (1995), technologies are considered as fundamental tools for carrying out business, and are quickly becoming the principal means for people to acquire information. Moreover, ICT not only provides information to people but also has an impact on the work available to them, and the way in which this work is carried out. It has put some people out of their jobs by replacing their skills, but at the same time has created new jobs. Clarke (1986) also anticipated that there would be no jobs in the factories in 2019, except for a limited number of technicians, because these factories would be automatically operated by computers and robots. Nowadays, on-line communities exist where work

is carried on in remote locations, thereby replacing community with communication. This has made it almost unnecessary to go to the workplace, because many people can now perform the tasks required through computer communications and networks.

2.4 ICT and Education

Due to the impact of ICT on almost all aspects of life, and the rapid changes to the economic, social and political transformation that requires new skills (Barnett, 2000), it would be surprising if education remained isolated from technologies that already have a fundamental impact upon business and home (McKinsey and Company, 1997).

Along with this, technology makes the process of handling, processing and communicating information more effective, and since education is primarily an information-handling profession, then there must be marriage and mutual relationship between the two. On the one hand, the most commonly cited reasons for using ICT in education have been to better prepare the current generation of students for the workplace (NCREL, 1999). On the other hand, there has been a groundswell of interest in how ICT can best be harnessed to improve the efficiency and effectiveness of education (Tinio, 2002) .

According to Johnson et al. (1994), technology makes education more effective by introducing more than merely new ways of managing and conducting the learning and teaching process; it also brings new ways of thinking about education. These views about the role of ICT in education are reflected in the rationales which educational authorities adopt in introducing ICT into their education systems.

2.4.1 Rationales for Adoption of ICT in Education

Various claims which have been made to justify the use of computers in schools have been conveniently summarised by Hawkridge (1990). He identified and described four popular rationales for the use of computers in schools. These are the social, vocational, pedagogic, and catalytic.

The social rationale suggests that all children should be aware and unafraid of how computers work. Because computers play an increasingly important part in modern

life, and because schools are supposed to prepare children for adult life, it follows that schools should provide some measure of computer awareness.

The vocational rationale suggests that children should learn to operate computers because learning to programme gives children confidence in their ability to control computers. Learning how to use applications programs (word processors, spreadsheets) provides skills that will be needed later in life. Computer literacy and computer science should therefore be offered at school.

The pedagogic rationale is based on the belief that computers are able to teach. Computer-aided learning and computer-aided instruction offer certain advantages over traditional methods.

The catalytic rationale, the belief here, is that computers are able to change education for the better. Managerial, administrative and teaching efficiency can be improved The use of computers enables teachers to place more emphasis on important problem-solving approaches rather that tedious rote learning and calculation. Computers give both children and teachers more independence. Collaborative learning, rather than competitive learning, can be stressed.

While one might question these rationales, the idea of improving teaching and learning has gripped the imagination of educators world wide. With the idea of enriching the curriculum, it is generally acknowledged that computer networks have the potential to support teachers by facilitating collaboration and improving access to information about effective teaching and other resources (Harasim et al., 1995). Extending traditional methods of presenting information and offering new opportunities through the techniques that computers make possible is very exciting. The catalytic rationale clearly has the most potential and supporters. Papert (1980) argues that the main justification for the use of computers in teaching is that they can provide rich learning experiences which are otherwise unobtainable. Specially, they can be used to generate new ways of thinking in students by encouraging them to control their environments through the exploration of non-structured problems, rather than react to their environments by encountering structured problems set by the teacher. Hence, they are to move from dependence towards independence in learning. This rationale sees computers providing children with the opportunity to move away from rigid curricula, rote learning and teacher-centred lessons by giving

more control to children to do their own learning. The call of catalytic rationalists is a Papertian call for the child to control the computer rather than the computer control the child (Papert, 1980)

2.4.2 Using ICT in Schools

After the rationales discussed above, the actual use of ICT in schools can be classified into four areas, as shown in Figure 2.1 below.

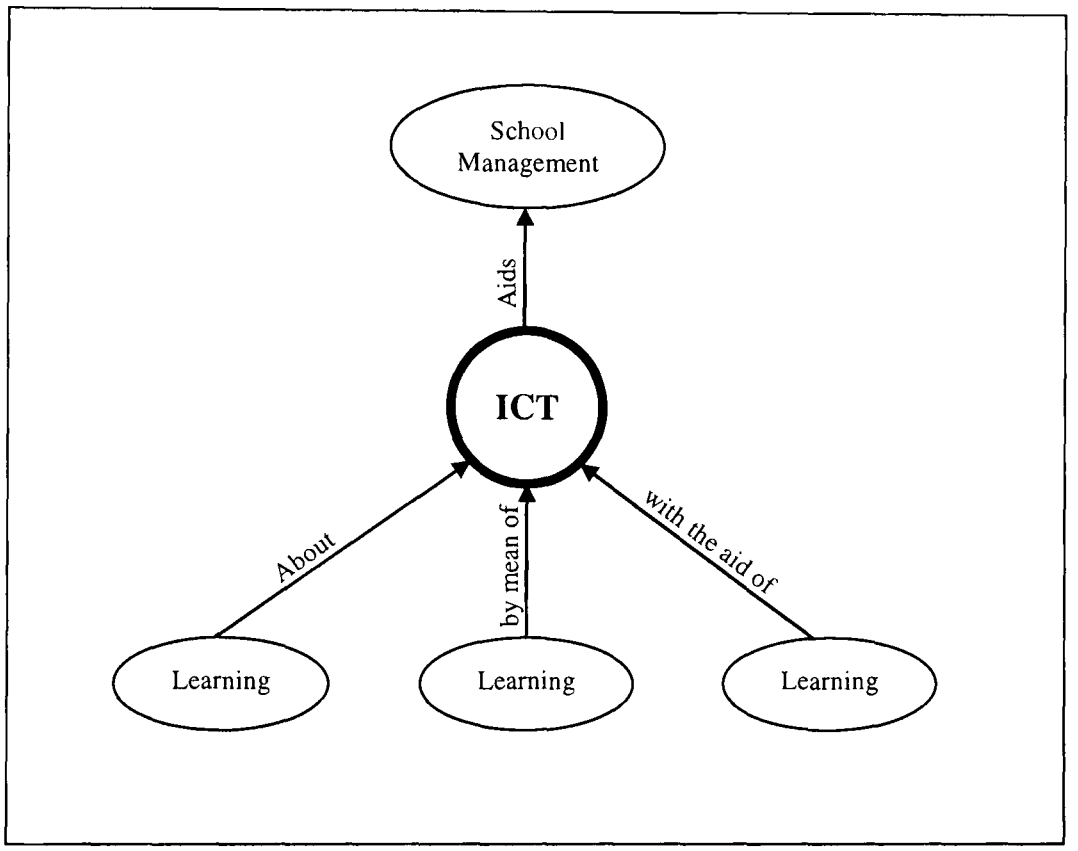

Figure 2-1: Interrelation among four areas of ICT - Source: Weert (1986)

The figure indicates that learning about ICT could be regarded as a separate subject. Students must learn knowledge about ICT, which contains the awareness of the principles of programming and systems design; operation of software and machinery; using and applying generic software, such as Database and Internet; and learning about the social impact of ICT.

Learning with the aid of ICT refers to ICT as a tool in the learning process. For example, pupils use electronic equipment, such as a CD-ROM encyclopaedia, to help

their learning. In this respect, ICT is an instrument to achieve understanding. The computer is either a support or a resource tool, but not necessarily providing a teaching modality.

As for learning by means of ICT, this may for example be an Integrated Learning System, and this means using ICT to support students' learning progress directly in other subjects. Teaching ICT entirely across the curriculum is used to stimulate student motivation.

Finally, ICT is regarded as an aid to school management, and is used to tackle administrational and managerial work, even though this area is considered essential in education itself.

2.4.3 ICT & Teaching and Learning

The main purpose of introducing ICT in education is to improve teaching and learning. Watson's (1993) research pointed out that the integration of appropriate content with a suitable approach can provide a stimulating learning environment. Therefore, suitable facilities and stimulation to combine one's educational thinking with an agreed body of knowledge can produce a powerful environment for learning, and as demonstrated in Figure 2.2, courses on appropriate operation and application of ICT have the greatest effect on students' achievement.

In Figure 2.2, Watson (1993) shows that ICT is an aid in educational activity. It can be seen that ICT can support teaching, and become a useful tool in assisting teachers in teaching, or students in learning, effectively and efficiently.

Apart from this, because of abundant resources and technical advances, it is clearly found that speed and automatic functions of ICT allow teachers to store, transform, and display the information aspects of their teaching (Loveless,2001), and to add a new dimension to the students' learning (Becta, 2001). For example, using the Internet to learn has lots of benefits, as it could remove distraction in learning, and enable teachers and students to gain access to historical, recent, immediate or interactive information. In addition, accessing information on CD-ROM or the Internet exploits the provisional nature of information stored, processed and presented using ICT, as work can be changed easily by using a word processor to edit and refine writing.

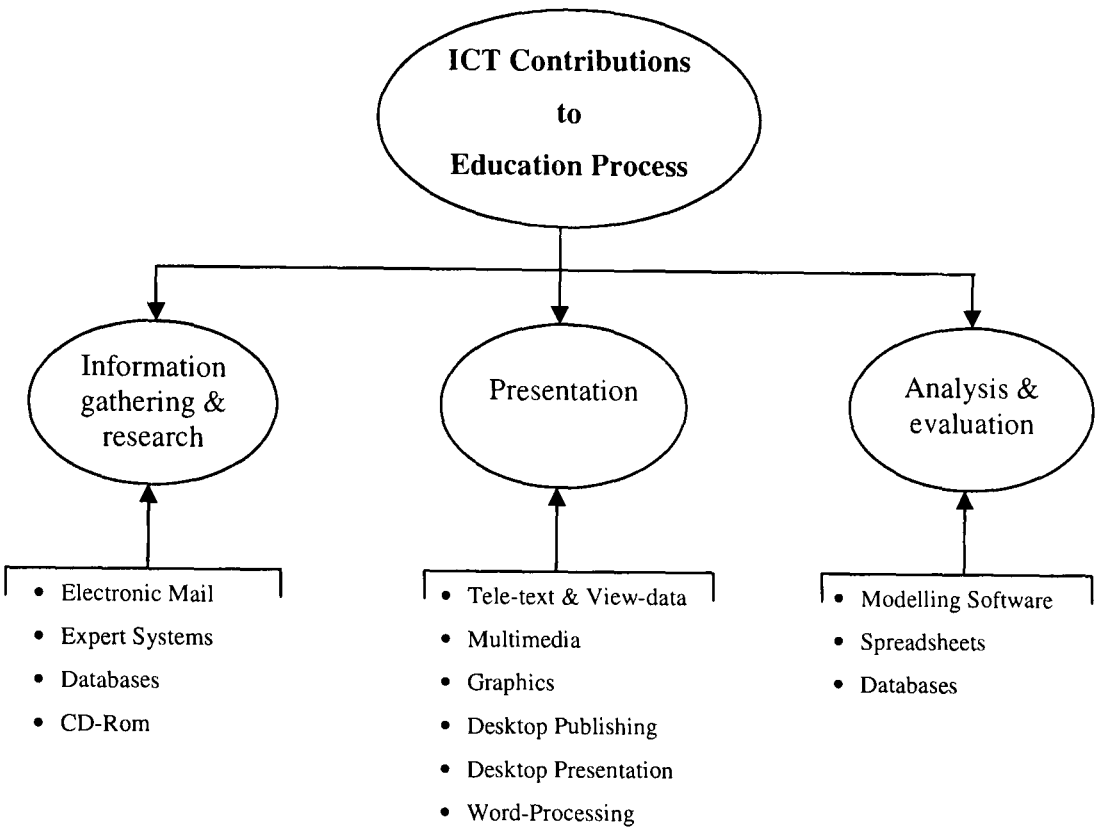

Figure 2-2: Contribution of ICT to Education Process - Source: Watson (1993)

As a result of ICT supporting teaching and learning, the use of ICT for whole class teaching offers the opportunity to create a dynamic learning environment that can integrate CD-ROM, Internet, Software applications, and pre-prepared notes or frameworks. Research by Kennewell et al. (2000) explicitly demonstrates that the components of ICT capability consist of :

Routines: ICT operations without conscious thought, where students are allowed to communicate ideas and refine ideas and experiment, and communicate with a wider audience, for example through e-mail.

Techniques: Through information handling, students are able to store, retrieve, alter and present information. They can establish relationships between elements of information, and apply knowledge to tasks and problems.

Processes: Students can know a sequence of techniques for achieving a specified goal. They are encouraged to explore and experiment through simulation.

Concepts: Students build up measurement that enables appropriate processes to be selected and carried out effectively. They absolutely understand the concept of feedback and its use.

Higher order skills: The most important abilities are identifying opportunities, planning, hypothesising, monitoring, decision-making, evaluating, and reflecting on learning. Students can apply ICT appropriately.

2.5 Benefits of ICT

In the light of the above discussion regarding aims and purposes of introducing computers in schools, ICT has worthy benefits for students and teachers from a number of attributes. High speed and reliability, extremely large storage, provisional nature, and the interactive way in which information is stored, processed, and presented are major features to account for the potential of ICT in education (Ager, 1998; Mumtaz, 2000).

Studies that demonstrate the effectiveness of technology are plentiful (Kulik, 1994; Apple Computer Inc., 2001; U.S Department of Education, 1996; Sivin-Kachala, 1998; Bransford et al., 1999). According to such studies, technology benefits students in two major ways: cognitively and affectively. Cognitive benefits include higher levels of achievement, higher levels of critical thinking, more creative thinking, and better communication skills. On the other hand, affective benefits include more positive attitudes about school, better self-esteem, opportunities for teamwork, and more social awareness.

A study conducted by the U.S Department of Education (1996) demonstrates that there is an impact of using ICT on increased student achievement. Researchers studied nine technology-rich schools, and concluded that the use of technology resulted in educational gains for all students. Kulik (1994) also contributed to this area of research. He aggregated the findings of 500 studies, and found that students who used computers scored higher than non-users, and that they learned more in less time. Wenglinsky (1998), also, assessed the effects of simulation and higher order thinking skills on a national sample of over 6000 students, and found that those who used technology gained high level scores in maths. Moreover, Sivin-Kachala (1998) reviewed 219 studies about technology use, and found that technology showed

positive effects on achievement in all major subject areas. Furthermore, Cooper et al. (2000) noted that educational gains may be greater by achieving higher scores for students who are visual learners, average, disabled, shy about classroom participation, or second language learners.

Studies demonstrate that other cognitive benefits abound as well. Bransford et al. (1999) showed that technology can support learning in five major ways: create more exciting curricula, provide tools for scaffolding, provide opportunities for feedback, reflection, and revision, expand opportunities for teacher learning, and provide for local and global communication. Research done by the Apple Computer Company and other researchers (Apple Computers, Inc., 2001; Roblyer and Edwards, 2000) concluded that while students in technology-rich learning environments continued to perform well on standardised tests, they also developed a variety of other competencies, which included the ability to explore and represent information dynamically and in many forms, improved communication skills, and self-initiated learning.

Studies that attest to the affective benefits of ICT include Kulik's (1994), who demonstrated that students had more positive attitude towards school when technology was used. Sivin-Kachala (1998) also showed that students' attitudes towards instruction, as well as their self-concept, were improved as a result of using technology in instruction. The Apple study found that students experienced improved social awareness when they used technology regularly in their instruction (Apple Computers, Inc., 2001).

Technology has many other potential benefits. It can generate motivation, foster creativity, facilitate self-analysis, and allow for multiple intelligences (Roblyer and Edwards, 2000). These possibilities have significant implications. Motivating students has become more important as correlations are shown between dropping out and undesirable outcomes (Roblyer and Edwards, 2000). The visual and interactive features of many technological resources help focus students' attention and keep them interested in the learning task (Pask-McCartney, 1989; Summers, 1990-1991). Additionally, when researching a topic on the Internet, students can make spontaneous discoveries of related information drawn from more than one subject (Cooper et al., 2000).

There are various ways in which computers benefit students, through visual and auditory elements. Research (Mayer, 1999) has found that there was better understanding of explanation when students received words and corresponding pictures, rather than just words alone. Mayer (1999) coined the phrase 'multimedia principle', to indicate that learners are better able to make connection between texts accompanying visuals, and are less able to make connection when just text is presented. Further to this principle is the 'contiguity principle' (Mayer and Anderson, 1992) which means that the effectiveness of multimedia instruction increases when words and pictures are presented in the same time and space, rather than at different times or in different parts of the programme. According to Lim (1999), students are given more control of learning with regard to their own pace, and review material more readily. To many students, technology is motivational and non-judgemental. It gives them prompt feedback, individualises their learning, and tailors the instructional sequence. Technology can meet specific student needs, increase their autonomy, allow for more responsibility, promote equal opportunities in an early non-sexist environment, encourage student cooperation with peers, and encourage them to make decisions (Burgess and Trinidad, 1997). Furthermore, multimedia can demonstrate complex and dynamic processes that cannot usually be explained easily with conventional methods such as microscopic nuclei of living cells, or events that happen too quickly, such as the movement of sound waves, or too slowly, like the action of glaciers over centuries. In the area of science, as stated by Garcia (1998), the capacity of animation to recreate, and make observable what in nature is unobservable, makes it possible to see demonstration of various scientific concepts.

Multimedia can benefit the learner in understanding concepts in many subject areas. Regarding second language development, animations give students a 'non-verbal' period, where they can conceptualise natural phenomena without the stress of learning the new language. They can draw, manipulate and involve themselves in learning scientific concepts without having an advanced English language to take part in the learning process (Garcia, 1998).

Miller and Hamilton (1992) indicated that, through computer simulation, students were able to conduct experiments in a more safe, practical and inexpensive environment. Simulation can supplement actual lab work when things go wrong.

Furthermore, in simulation preparation and supervision, time is reduced, so the teacher can use his/her time to concentrate more on other demanding aspects of the curriculum. Simulation is a cost-effective solution, as no animals, reagents and drugs are needed for a practical curriculum, and reuse is possible year after year.

Another advantage of technology is the opportunity it provides for individualisation. As students have a variety of learning styles, the computer has the potential to allow individuals to use the learning styles they wish, and to proceed through programmed learning at their own pace, with instant correction, explanation and reinforcement (Dewhurst et al., 2000). The computer is superbly adapted to this concept, in that it can provide sound, colour, graphics, animation, and video. In addition, this is layered onto text, where students can receive comprehensive, individualised instruction in all the skills, which are listening, speaking, reading and writing (Fosnot, 1996).

Learning styles can vary among individuals. For example, some people learn better alone, while others learn better in groups (Stepich, 1996). Many different types of learning styles exist, and most individuals learn using a combination of different styles. The use of technologies such as multimedia and the web can help address learning styles which are typically neglected by traditional teaching methods (Schacter, 1999). Moreover, it can provide students with customised learning experiences based on their background, individual talents, age level, cognitive style, and interpersonal preferences (Tapscott, 1998). Using computers can also incorporate scaffolding, so that weaker students are provided with assistance to achieve high results (Krajcik et al., 1998).

Another effect of technology cited by teachers is increased inclination on the part of students to work cooperatively (Bramble and Mason, 1990). There are many sound educational reasons for group work, from cognitive and social development of the children to the flexibility in organisation for the teacher. Working in groups trains students to work with each other (Friesen, 1999). According to Gooden (1996), computers can make task-based learning an exciting event. Presentation of software allows students to learn quickly to create a professional look to any subject. The topics are developed as a group, with teacher guidance, and so they entail high personal commitment to their completion. CD-Rom encyclopaedias, Internet searches, and materials brought from home can also provide sounds, photos, video

clips and text-based information that students can incorporate into their own multimedia show (Jason, 1998). Furthermore, publication of the project on the World Wide Web, or an oral presentation with a projector device, makes sharing the project far easier than with paper, and gives students great personal satisfaction in their achievement (Wellburn, 1996).

Technology provides opportunities for acquiring problem-solving skills, either through instructional software, or through skills when one is trying to use computer tools to accomplish a task (Hutchins, 1996). According to Collins et al. (1997), teachers who have adopted technology use in their classrooms believe that computer-based technologies could provide support for thinking processes. Ethical, altruistic and long-range thinking are of crucial importance to society. Analysing, synthesising, creating, evaluating, planning and decision-making are all now required in home, community and workplace (Nuthal, 1999). For example, today, many workers in industrial plants need to read and interpret complicated manuals and make important decisions on-line. This kind of complex problem which every individual and organisation must deal with today necessitates the development of higher order thinking processes and of intelligent behaviour (Barnett, 2000).

2.6 ICT and Learning Mathematics

Computers and mathematics have shared an intimate connection for many decades. According to Solomon (1996), the most popular use of computers in education has been in the mathematics classroom. Computers, with their visual displays, can often help students visualise geometric figures and represent mathematical ideas (Wiest, 2001). Computers are rich resources of meaningful problems, with many strategies for solving them (Clements, 2000). Computers may also increase the emphasis on conceptual thinking and planning in mathematics (Fey, 1989). They provide students with tools that allow them to become constructive and investigatory in their problem-solving approach (Abidin and Hartley, 1998).

Successful multimedia environments can enable students to experience mathematical success, increase their motivation, and improve student-teacher relationships (O'Connor and Brie, 1994). Additional research (Wohlhuter et al., 2000) showed an improvement in students' problem-solving abilities, while maintaining their

computational skills. Computers, as stated by Clements (2000), have made significant contributions to the field of mathematics; they provide an environment to test ideas and feedback; encourage autonomy of mathematics and link the general rule to the specific case; link the symbolic to the visual word and thus catalyse mathematical language; emphasise concepts and facilitate problem solving; and also encourage positive and social interaction.

Technology improves the learning of problem-solving skills by providing an environment that encourages inquiry and extension. It allows students to make mathematical connections (Abramovich and Brown, 1996), and shifts to a more process-related learning that will allow students to develop problem-solving skills (Cardelle-Elawer and Wetzel, 1995). Computers can make problem-solving more interesting, more realistic, and more useful to students (Kelman et al., 1983). Computers can store and retrieve data, simulate real life problems, present material in a fun and exciting manner, and they can be tailored to meet students' needs and learning styles (Wiest, 2001). According to NCTM (2000), technology infusion into mathematics should focus on real life problems and allow students to experiment with maths concepts. One of the important criteria for good problem-solving mathematics software is to promote effective mathematical discourse and reasoning, as recognised by NCTM (Willson and Wolodko, 2000).

Mathematics concepts such as fractions, distance and speed are often challenging topics for students to grasp, and computers can definitely aid in these areas. By starting with a simple word problem and working on various strategies to solve it, one can discover many ways in which technology can be further used to implement these ideas (Abramovich and Nabors, 1998). Since there are many paths, techniques and tools for exploring problems, as well as different ways of identifying patterns and finding solutions, students can test out their own strategies on the computer. They can also receive immediate feedback, and then tailor their next attempt at the problem with the new information. The National Assessment of Education Progress (NAEP) in country drew some interesting conclusions about the connection of mathematics and technology (Wenglinksky, 1998). The research revealed that when computers are properly used, they improve student proficiency in mathematics, as well as the overall learning environment of the school.

With computers, educators can create problem-solving environments that promote behaviours important to real-life problem solving, and yet are rarely seen in the classroom (Irvine and Prejean, 1999). Many researches indicated that when real world objects were presented and the students could use a variety of their senses, interactive multimedia products could be beneficial. For example, computer-generated graphics can also assist young children in developing symbolic representations that are important in childhood development (Escobedo and Bhargava, 1991). Also, through the use of simulation, students can visualise and understand complex, abstract and microscopic processes (Sharma, 1999).

Animation allows mathematical concepts of geometry (3-D shapes and their faces in rotation, tiling of an area), distance and speed, among many other areas, to be demonstrated to students with minimal need for extra classroom resources. For some learners, the three-dimensional mathematical shapes in maths software may aid them in their learning process. Objects can be seen from several angles, complex objects can be presented in solid form or wire frame. Object parts can be magnified for showing detail, and learners can see dissected views or object transformations with possible greater ease (Hamel and Ryan-Jones, 1997). Three-dimensional computer animation provides benefits of motion that students may not be able to achieve with teacher-made or student-made objects. Animation can easily depict structural and functional relationships among objects, show a sequence of action and consequences of these actions or manipulations, as well as draw the students' attention to visual aspects of the structures (Hamel and Ryan-Jones, 1997).

Most problem-solving mathematics programmes involve some sort of simulation. Simulations are able to take advantage of the computer's capabilities to allow the user to have control over some variables. The simulation presentation can be dynamic and realistic. There can be control over time (contraction or expansion of time that is not possible in the classroom setting), and the elements of chance can allow the computer to interact differently with students on different occasions (Newby et al., 1996). Simulation programs are also aimed to encourage exploration and investigation, as students form and test strategies to practise problem solving (Akpinar and Hartley, 1996).

2.7 ICT and Teacher's job

The potential impact of ICT on education can be seen through the services which it provides to the teacher, who is an important figure in the teaching and learning processes. Teachers are required to perform a variety of tasks in and outside the school. Introducing ICT can be great help, assisting them with day-to-day tasks that take their time and energy, and reducing workloads through the following uses of ICT.

According to Becta (2001) and Accounts Commission for Scotland (1999), recording data electronically, storing it centrally, and sharing it with colleagues are vital to reducing workloads through ICT. This strategy can apply to a variety of resources, such as:

- Templates and proformas: Having readily available electronic copies of commonly used documents reduces teacher input.
- Student reports: Teachers can complete them when they choose; they can save time, through there is concern over their impersonality.
- Curriculum resources: Teaching materials, produced within schools or downloaded from the web, can save time and improve pedagogy.
- Databases and spreadsheets: Reports and statistics (on attainment, attendance and financial data, for example) can be produced more easily, and data can be used by other applications, for example to inform parents automatically of unauthorised absences.

Research shows other forms of electronic communication can help reduce workloads:

- Electronic data transfer: The amount of data entry needed is reduced when pupils move school (Irving, 1998).
- Video conferencing: Saves time spent in travelling to meetings (Greene et al., 2002).

There is evidence that ICT can reduce the amount of time teachers spend supervising classes, answering questions, and administering tests:

- Dedicated ICT suites with their own technician: These can provide a supervised learning environment for students when their teacher is absent (PWC, 2002).
- Computer-mediated discussion groups: These encourage peer support and reduce repetition in answering questions (Selinger and Yapp, 2001).
- Automated assessement: Web-based tests (DfES, 2001) and computer-based analysis of written work (Holdich, 2002) save time spent in marking.

ICT benefits teachers directly, too, by helping to reduce the amount of time that needs to be spent on administration and preparation. For example, PowerPoint enables the teacher to produce powerful and attractive presentations enriched with animations, sounds, graphs and images. Telecommunications, namely, local area network (LAN), wide area network (WAN) and the Internet, enable teachers to retrieve information from different sources (Fulton, 1993; Johnson et al., 1994; OTA, 1995; Guile, 1998).

The teacher can retrieve current information from the Internet which can be stored and adapted to suit the needs of the students and the goals of the lesson. Also, the teacher can make use of scanners and digital cameras to bring outside resources into the class. For example, the teacher can take an excerpt from a newspaper or a magazine and scan it into the computer for the students to edit and do other exercises based on the scanned text. Moreover, ICT reduce students' dependence on the teacher, and thereby liberates the teacher's time which he or she can use for other tasks (Somekh and Davis, 1997).

In addition, ICT can be used to support teachers' continuing professional development. For example, for teachers to attend training courses, they need to be freed from their teaching, substitute teachers need to be provided, more facilities and resources need to be available, etc.; ICT now provides an alternative approach. Therefore, instead of teachers waiting for a course to be offered by their schools, which might be relevant and adapted to their needs or not, or which might be offered at a time that conflicts with their time schedule, teachers can use communications facilities such as the Internet or electronic mail to get the information required. In

this respect, ICT can increase teachers' range of whom they can turn to with questions and problems (Collis, 1995).

2.8 ICT and Barriers to Adoption

In reviewing the literature that investigated the barriers to successful computer implementation in schools, common themes emerged. These themes can be categorised within three realms: the teacher's, the physical and the social. The role of the teacher was identified by a number of researchers as the most important factor in successful integration (Loveless, 1996; Bitner and Bitner, 2002; Vannatta, 2000; Zhao et al., 2002; Conlon and Simpson, 2003; Guha, 2003). The individual's willingness to adapt to change, his/her comfort and skill level, as well as the ability to deal with the issues of time management were the most common indicators. Within the realm of the physical environment, issues of accessibility and organisational constraints arose (Loveless, 1996). Existing literature revealed that support systems were a critical piece of the puzzle as well (Hruskocy et al., 2000; Schmid et al., 2001; Bitner and Bitner, 2002; Mouza, 2002; Guha, 2003). Within the social realm, teachers who had support systems, including technicians, administrators and peers who could assist when needed, were more likely to successfully integrate technology. An additionally needed support system was effective professional development models, and those models that were designed to incorporate an internal support system also aided in successful integration.

It was the skill and attitude of the teacher that determined the effectiveness of technology integration into the curriculum (Bitner and Bitner, 2002). Once teachers developed skills, they could begin to find ways to integrate technology into their curriculum and demonstrate its use to others. If learning was the impetus that drove the use of technology in the school, teachers and students could be partners in the learning process, altering traditional paradigms of the teacher providing wisdom and the student absorbing knowledge. Motivation to endure the frustration and turmoil of the process of change needed to be intrinsic (Marcinkiewicz, 1994).

Three factors associated with the teacher that contributed significantly to the success of classroom technology innovations were technology proficiency, pedagogical compatibility, and social awareness. Zhao et al. (2002) confirmed that teachers'

technology proficiency plays a major role in classroom technology innovations. Moreover, it added a new dimension to the variable. They suggested that an additional dimension of technology proficiency plays an equally important part, knowing what else is necessary to use a specific technology in teaching. They also confirmed that not only did the teacher's proficiency play a major role in successful implementation, but also a teacher's knowledge of the enabling conditions to implement a specific technology was equally important. Moreover, Zhao et al. (2002) suggest that successful implementation of technology innovation into the classroom is more likely when teachers' beliefs are highly reflective in their teaching practice and goals, and they use technology in a manner consistent with their pedagogical beliefs, and are therefore more likely to yield positive results. As some have argued (Means, 1994), teacher beliefs were paramount in the adoption of technology. If teachers did not believe in an innovation, they would implement it because of pressure to do so, but later discontinue the use of the technology. If teachers did not believe strongly in an innovation, they would see no reason to initially increase their workload. A study conducted by Norton et al. (2000) revealed that most staff had philosophical and educational reasons for rejecting the integration of computers into the classroom. Teachers' non-use is essentially based on their attitudes, perceptions and pedagogical beliefs. They do not feel it is necessary to increase their computer expertise.

Teachers tend to adopt innovations that are in line with their beliefs about how students learn and which teaching methods work best, and teachers who believe that technology and media can improve learning are most likely to use them on a daily basis When teachers choose a technology that is compatible with their pedagogical orientation, the integration goes much more smoothly. However, when teachers' pedagogical beliefs conflicted with the technology they were attempting to incorporate into their classroom, they struggled to accomplish successfully the goals of their proposed project. In these cases, projects were postponed, severely modified, or simply cancelled (Zhao et al.,2002) .

Successful implementation also seemed to be associated with the teacher's awareness of the social dynamics of the school. Teachers who were socially aware, knew where to go for support and resources, and were sensitive to the needs and priorities of their

colleagues, were more likely to have success. According to Zhao et al. (2002), socially aware teachers were more likely to implement their projects successfully. These teachers knew the social dynamics of the school, were aware of where to go for what type of support, and were attentive to their peers. Technology-based classroom innovations require teachers to be more socially sophisticated than do other types of innovations. Today's technology requires resources beyond the teacher's control. Teachers, also, need to interact continuously with technicians and administrators. Thus teachers have to discover which individuals in the school or Local Education Authority can provide the help they need, and they have to know how to work effectively with those individuals.

Barriers associated with ICT integration that fell within the physical realm were beyond the direct control of the teacher. These barriers centred around accessibility and infrastructure, and included decisions about purchasing, location of wiring, and decisions regarding the placement of computers in centralised labs versus placement of computer pods in classrooms. Placing computers in centralised labs may provide students with equitable and efficient exposure to technology, but severely limit the technology's accessibility for classroom instruction (Loveless, 1996). In addition, physical limitations of the classroom, including size and location of desks, often limit choices of room arrangement, and do not provide the space that is necessary to add pods of computers to be used as technology centres. Also, computers are often placed in the lab rather than in the classroom. As a result, teachers and students do not deal with the computers as part of their regular classroom activities, and they do not always have access to the lab any time they need (Pogrow, 1997). Moreover, classroom connectivity, network capacity, scheduling of labs and computers, and availability of equipment and supplies are important components of the physical environment (Sherry, 1998).

Stetson and Bagwell (1999) confirmed that the success of technology integration depends upon accessibility to quality resources; teachers must have access to software and hardware, and they must be trained to use them. However, Whitehead (1993) found some difficulties that made teachers reluctant to use computers for teaching. These difficulties included factors such as the numbers of classroom computers being too small, networking system not working, lack of useful and

updated software, and students could deter successful technology integration in the classroom. The inadequacy and shortage of technology resources is a big problem in technology integration. It cannot take place without computers and appropriate software support (Dias, 1999). The availability of resources such as hardware, software, publications, and audiovisual media are also important conditions (Ely, 1999).

Barriers that fell within the social realm centred around support networks that were available to the teacher, including support from administration, technical services and colleagues, as well as the overall school climate and various models of professional development. While the role of the teacher was crucial in the success of integrating ICT, the success of programmes also depended highly on a support system (Bitner and Bitner, 2002). Support that was both ongoing and onsite needed to be provided in both the technical and curriculum areas. The support environment includes administrative vision, commitment, local education authority policies, planning time, mechanisms for identifying and solving problems, resource and technical support personnel, availability of documentation and troubleshooting assistance, availability of online support, and maintenance of network and equipment (Sherry, 1998).

For a change to be successful, teachers need the benefits of conversation with other teachers and a network of mutual support. Peer coaching and modelling have been most effective in transforming workshop information to classroom application and practice (Kinnaman, 1990; Persky, 1990; Brown and Ritchie, 1991). Little (1990) claimed that joint work involves encouraging teachers to share responsibility, have collective conceptions of autonomy, support other teacher initiatives and leadership, and group affiliations in professional work.

Social support was a highly predictive factor in innovative computer integration activities (Zhao et al., 2002). Providing further support, by having human resources on site who can provide follow-up training, quick responses to questions, and encouragement to try new things can be a significant factor in helping teachers to overcome their fears of technology (King, 1998). Teachers consistently report that having a person who can help them technically makes all the difference in the likelihood of their going further with technology (OTA, 1995).

Another commonly noted barrier to technology integration, which fell within the social realm, is professional development models. Mouza (2002) confirmed that professional development efforts often failed because activities often took place away from the school site, and that there was a lack of follow-up and support. In order for professional development to be effective, in-class assistance and support must be provided, and it must be context-specific. A professional development programme designed to help teachers integrate technology effectively into their classrooms introduced and demonstrated a computer application, continued with hands-on and/or collaborative work, and concluded with a discussion of the implications that demonstrated applications have for teaching and learning.

The quality of staff development is another factor that can inhibit or promote technology integration. Schrum (1999) contends that many traditional staff development models do not take into account the significant and unique qualities of preparing teachers for technology integration. Joyce and Showers (1995) advocate attention to three kinds of effort in staff development: attention to the individual component, the collective component, and the education authority component. Sparks and Hirsch (1997) summarise the major shifts in staff development practice from individual development to individual and organisation development, from fragmented to a strategic plan, from off-site to job-embedded, from frill to necessity. They explain that it no longer affects only the attitudes and practices of individual teachers, it must also alter the culture of the school.

Training should also take into account that, although teachers may be knowledgeable about computer use or other resources, they may not know how to apply technology use to enhance teacher instruction and student learning. Hoffman (1997) and Northrup and Little (1996) showed that teachers need to be trained on equipment and software that they have access to in their schools. This allows teachers to stay in familiar surroundings with people they trust and respect. Besides, training is most effective when it occurs in a natural classroom context. This easy access to technology helps reduce the barriers to using the new ideas and resources available. Figure 2.4 shows the barriers to ICT adoption discussed above.

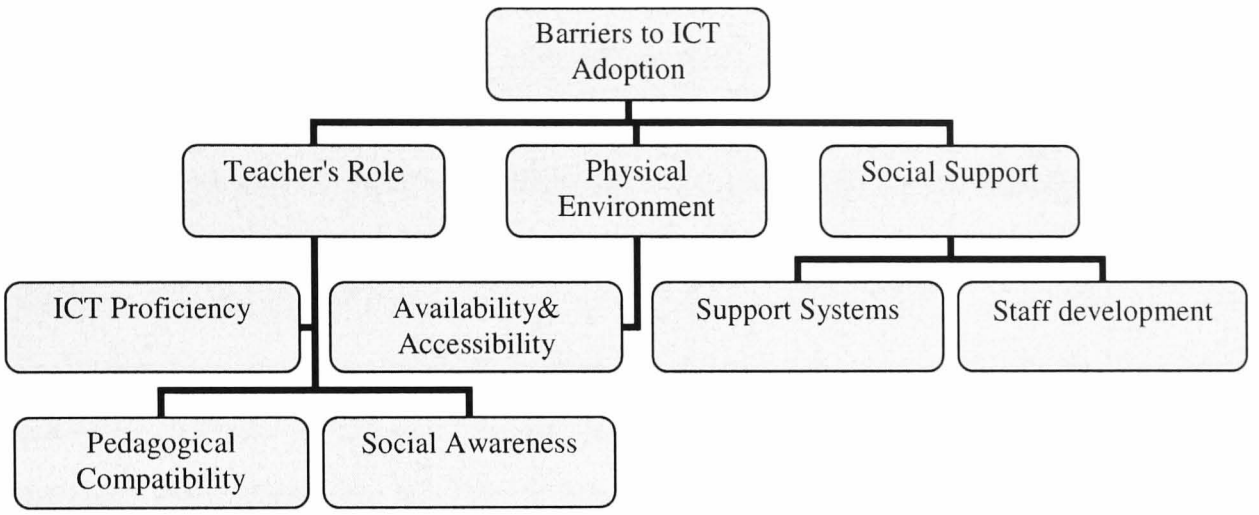

Figure 2-3: Barriers to ICT Adoption

2.9 Conclusion

The literature reviewed, so far, showed that the changing nature of the world of work dictates equivalent changes to learning systems. Educationists must respond to such changes by developing new approaches to curriculum and instruction. Computers have produced significant changes in economic, social and political aspects of our lives. They have contributed to the modification of working procedures and systems, and consequently to the educational qualifications required by people who contribute to the production economy. As computers play a role in many sectors, demands are placed on the educational sector to prepare people in order to survive in a world permeated by computing and information.

The introduction of computers in schools is one of the latest developments that have taken place in education. The available literature in this area has provided a rationale for introduction of computers in schools. Teaching becomes generally positive, with a shift from the traditional direct approaches to a more student-centred approach. It has become evident that computers can help in this positive shift, e.g. when placed in the hands of teachers and students. They can provide unique, effective and powerful opportunities for many different types of instruction and learning.

The literature review also showed that many factors either promoted or inhibited implementation of computer technology. This chapter considered many such factors e.g. unavailability of equipment, insufficient software, and lack of support, as some

of the reasons why teachers have not fully accepted computers as a viable method of instruction. In addition, the culture of an educational institution may actively resist changes. For this reason, several critical variables are needed to support the change process. Teachers should be educated as to the potential of computers, and trained in the skills necessary to work with them. Students should be systematically introduced to computers by trained teachers. Furthermore, school leaders should be fully committed to the use of computers in the classroom. In addition, components of staff development training must be adapted to the increasing stages of learning. Teachers' philosophical and pedagogical beliefs are significant factors in their willingness to embrace technology as an instructional strategy. As the speed of technology applications continues to evolve, re-examination of these factors in current school settings is essential.

Although the current trend in educational reform is towards more technology integration, the literature review indicated that the process had not been implemented effectively. In most schools, integrating technology into the curriculum is not a new field for teachers and administrators. However, technology integration in schools has not been successfully implemented and accepted by teachers and administrators. As a result, various factors that affect integration of technologies should be taken into consideration. Understanding the factors which will affect successful integration of computer technology in the classroom is imperative. It is now clear that there may be some benefit to build a comprehensive model for the ICT use, and identify the barriers to implementing ICT in the middle schools in the State of Kuwait These barriers may include the provision of computers, training teachers, maintenance, and technical support, etc. It is thus necessary to produce a framework (model) for such factors. Incorporating these factors in a framework to develop a model would be helpful in the implementation of technology in schools. Such a useful model will be discussed in detail in Chapter 3.

Chapter 3: Proposed Model for ICT Adoption

3.1 Introduction

This chapter aims to develop a conceptual model for addressing the factors influencing the technology adoption decisions by teachers in middle schools in the State of Kuwait. A review of the relevant literature will be made to investigate the rate of adoption that predicts whether the school members adopt technology for instruction in a traditional classroom setting. Research on innovation adoption and diffusion has long converged on a core set of theoretical frameworks that seek to explain target adopters' attitude and their innovation-related behaviour. The conceptual model will be developed in this research to explain the innovation usage behaviour grounded in several well established theories including the Diffusion of Innovation (DOI) theory and the Theory of Reasoned Action (TRA). As computer technology is a relatively recent technological innovation in Kuwait, the technological innovation literature would be a good place to start identifying the factors that affect the adoption of technology by teachers for teaching and learning purposes.

3.2 Problem Domain

The presence of computers and associated technologies in schools is now commonplace. Indeed, for more than twenty years, schools have responded to the development of new computerised technologies with significant financial outlay by education departments and independent schools. To be sure, there has been a massive outlay of funds to equip schools with computers, and more recently information and communication technologies (ICT), to the point that now they are a routine part of daily school life.

Although the physical presence of these technologies is evident, less apparent is what teachers use these technologies for in the classroom, and how and why this has occurred. Much research has been undertaken distinguishing a variety of facets of computer use, while there appears to be little research on the strategies used by departments to examine the reasons why staff members adopt technology in their

teaching activities. Therefore, this issue needs to be addressed, and that research which can provide an understanding of the process of implementing change or introducing innovations in schools is needed.

The Kuwait government has given computer education a great deal of support and priority. In recent years, it has spent a large amount of money on computer machines and equipment for schools. The main objective is to promote better use of technology in schools. However, despite the Kuwaiti government interest in and support for computer technology, the implementation of such educational technology is never an easy task, on the contrary it is very difficult and complicated. Availability of innovation itself is worthless unless a critical mass of staff members adopts and implements the innovation in their teaching. Thus, to accomplish the most advantageous use of technology, an analysis of the factors affecting the technology integration should be conducted. To date, there is no empirical basis for determining the extent to which teachers in Kuwait have adopted technology, and it is important to better understand the perceptions and use of the fast-evolving communication technology by the teachers. The results of the study will provide additional information and expand the body of knowledge in schools by examining how teachers in Kuwait perceive the technology.

Without knowing the specific reasons for technology adoption by teachers, it would be difficult or even impossible for administrators to develop effective strategic plans to promote technology adoption. It would also be difficult for them to create helpful training and technical support programmes to facilitate staff members to incorporate instructional technologies in their teaching environments. Understanding the needs of staff members, and the reasons for their using computer technology, is the key to successful technology adoption.

To date, increasing attention has been given to the identification of the significant factors contributing to educational innovation implementation. A review of research trends suggests that multiple independent variables operating at different levels affect the implementation process (Fullan, 2001; Rogers, 2003). However, most previous studies have confined the research scope only to examining either the psychological perspective of factors (Marcinkiewicz, 1994), or the environmental variables (Ely, 1999), disregarding other relevant variables. Due to narrowly focusing on a few

variables, depicting and understanding the relationships of the variables that impact on the technology implementation have not yet been satisfied by research.

Staff members, as the school's most valuable human resources, play a key role for the successful adoption and integration of an innovation. Without the support and the commitment of staff members, the potential for the use of technology in education will be seriously diminished. Notwithstanding the importance of staff members as the main factors in successful implementation of an educational innovation, most research studies have not focused primarily on them, but on learners (i.e., learning outcomes, learner characteristics, and learner attitudes) (Dillon and Walsh, 1992). This limitation of studies has left a large void in understanding staff members' perceived attitudes to innovation, and their individual characteristics' support in the extent to which they use technology.

3.3 Technology Innovations Theory Development

Strategies for facilitating the adoption and effective utilisation of technology are an issue of importance to educational administrators around the world. The information revolution has forced most developed economies into an era which encourages effective utilisation of technologies in schools to prepare knowledge workers for the knowledge economy (OECD, 1996; Drucker, 1998; Maeir and Warren, 2000). As a result, educational institutions are placed in a situation requiring reassessment of their methods of practice, and necessitating adopting and improving teaching and learning for the changing needs of a global, digital, and networked economy. While universal spending on information technologies in educational institutions is increasing at unprecedented rates (OECD, 1996), the persistent problem for educational administrators is that the rate of adoption by teachers across different sectors of education has lagged significantly behind that of industry (Leidner and Jarvenpaa, 1995).

Researchers in IS use the theories of innovation diffusion to study implementation problems (Moor and Benbasat, 1991; Prescott, 1995). A major focus of these studies has been on how potential users' perceptions of an IT innovation influence its adoption (Moor and Benbasat, 1991). Rogers' (2003) seminal work, Diffusion of Innovations, is one of the most frequently reviewed of the perceived innovation

characteristics literature. In a survey of several thousand innovation studies, he identified five antecedents: relative advantage, complexity, compatibility, observability, and trialability, as affecting the rate of diffusion of a technology. Rogers' DOI theory is discussed below.

There has been an increased interest in another body of literature that examines factors that predict and explain the adoption of technology. Over the last two decades, considerable research has been conducted into individuals' adoption of new technology in a variety of settings (Davis, 1989, 1993; Moore and Benbasat, 1991; Venkatesh, 1999; Venkatesh and Morris, 2000). This is because such individuals usually directly and/or indirectly dominate decision making in their institutions. Lakhanpal (1994) suggested that characteristics of individuals: innovators, leaders and others in key positions, have been observed to have significant impacts on explaining differences in the degree of innovation adoption.

Much of the research in this field draws on Ajzen and Fishbein's (1980) Theory of Research Action (TRA). TRA posits that an individual's behaviour is a function of both the individual's attitude toward a specific behaviour and the social influences and norms surrounding that behaviour. Davis (1989) introduced a specific adaptation of TRA, called the Technology Acceptance Model (TAM), specifically designed to predict computer usage behaviour. TAM has become one of the basic frameworks that IS researchers can use today, and has been tested empirically by others in general, across gender and cultures (Adams et al., 1992; Venkatesh, 2000; Venkatesh and Davis, 2000; Venkatesh and Morris, 2000).

3.3.1 Technology Acceptance Model (TAM)

Davis (1989) intended the TAM to provide an explanation of the predictors of computer acceptance and usage behaviour across a broad range of computer technologies and user populations. The model (Figure 3.1) is based on TRA, and its main goal is to identify the external variables that impact on personal beliefs, attitudes, and intentions to use computer technologies. Davis focused on two beliefs as the primary predictors of attitudes towards technology acceptance and usage: perceived usefulness, and perceived ease of use. Perceived usefulness is the potential user's subjective belief that the technology application/system will increase or improve job performance. Perceived ease of use is the potential user's belief that the

technology application/system will be effortless or easy to use. These two determinants provide an explanation of IT acceptance that is general and capable of explaining individual behaviour across a broad range of end-user technologies and user populations, while being theoretically justified (Davis, 1989).

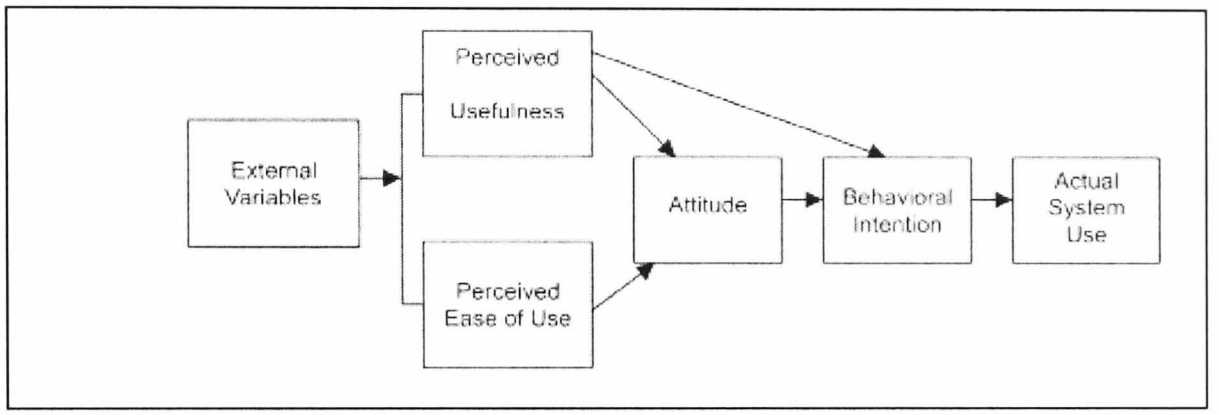

Figure 3-1: Technology Acceptance Model (TAM) (Davis, 1989)

Consistent with the TRA, Rogers (2003) proposed a model of the innovation-decision process that emphasises the role of individual behaviour in the technology adoption process (Figure 3.2). The model relates actions and choices during which an individual evaluates a new innovation, and decides whether or not to incorporate it into an ongoing practice. The perceived advantage of adoption and the associated uncertainty are distinctive aspects of the innovation decision-making process. Individuals would normally decide whether to adopt an innovation. During the decision process, the individuals would gather information from various sources and attempt to determine the innovation's utility. They will assess the proposed innovation's relative advantage, compatibility with existing systems, complexity, trialability, and observability, to decide whether or not to adopt the new innovation (Rogers, 2003; Kendall et al., 2001).

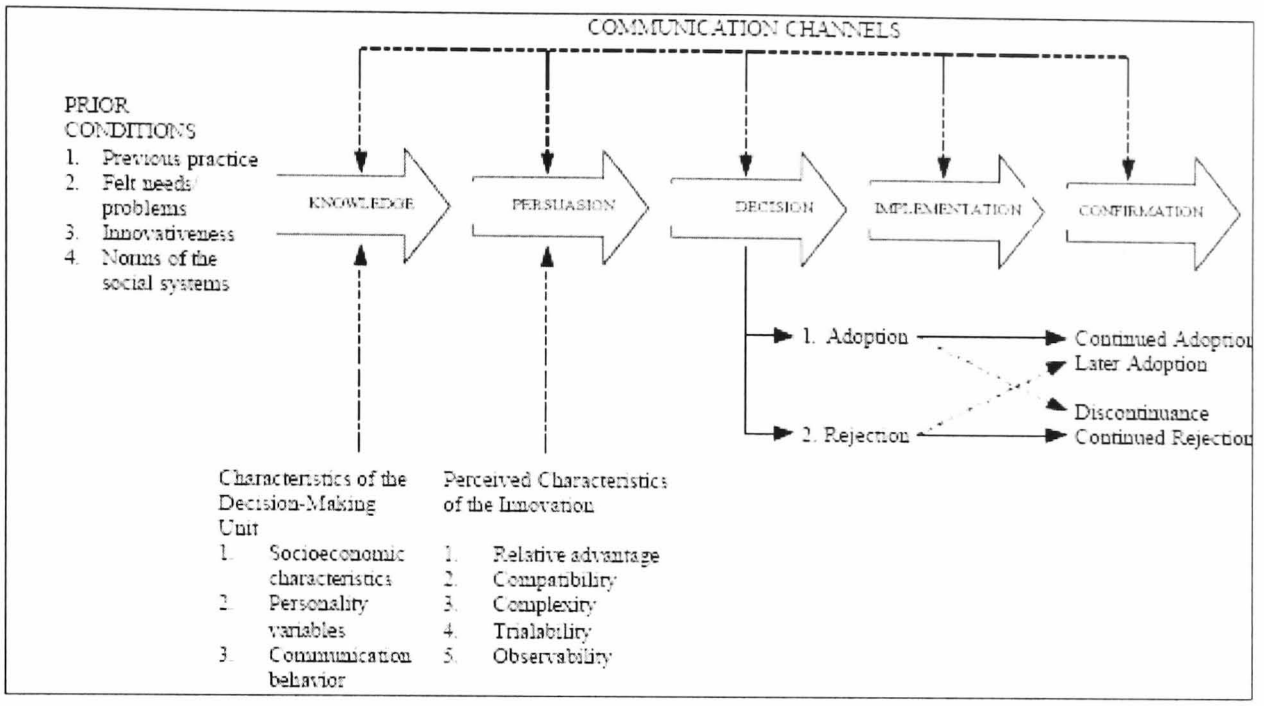

Figure 3-2: Model of Innovation-Decision Process (Rogers, 1983, 1995, 2003)

3.3.2 Rogers' Theory

Rogers' diffusion of innovation theory is widely used as a theoretical framework for various studies of adoption of technological innovation. The perceived characteristics of innovation are one most important explanations of the rate of innovation adoption. Rogers and Shoemaker (1971) constructed five innovation characteristics from the summary of previous research, consisting of relative advantage, compatibility, complexity, trialability, and observability. After additional work, Rogers (2003) further developed these five innovation characteristics, showing that across many studies, generally 49 to 87 % of the variance in rate of adoption is explained by these five characteristics of innovation.

Rogers (2003) suggests that each characteristic is described as being empirically interrelated with the other four, while remaining distinct. Those innovations which are perceived by individuals as having greater relative advantage, compatibility, trialability and observability will be adopted more rapidly than other innovations, and innovations which are less complex will be adopted more rapidly than those which are perceived as more complex. Much research has been done regarding

various other innovation characteristics or perceived characteristics of innovation (Moore and Benbasat, 1991; Spence, 1994; Taylor and Todd, 1995). Nonetheless, Rogers' five innovation characteristics still retain widespread acceptance in research on the characteristics of innovation, and are most widely cited as factors influencing rate of adoption (Gatignon and Robertson, 1985).

To view the adoption of technology by education as an adoption of technological innovation, a research model is constructed using three of Rogers' perceived characteristics of innovation: relative advantage, compatibility, and trialability, to explain adoption of technology. Additional characteristics included are ease of use, results demonstrability, visibility and image, which were developed from Rogers by Moore and Benbasat (1991). Each of these is now examined.

Relative advantage: This is defined as the degree to which an innovation is perceived as being better than the idea it supersedes, and is viewed as an advantage for the organisation over previous ways of performing the same task (Agarwal and Prasad, 1997). Relative advantage has been found to be one of the best adoption predictors, and is positively related to an innovation's rate of adoption (Rogers, 2003; Tan and Teo, 2000).

As noted, there are potential opportunities and benefits of technology for education. These include reaching learners outside classrooms, using time more efficiently, motivating students, individualising instruction, and providing access to unlimited information (Charp, 1996). In addition, using technology allows teachers to design and develop online lessons using re-usable learning components, and integrates different learning tools (audio, video, and chat and discussion room) to enhance learning and the user experience (Kellar et al., 2003). According to Garofalo et al. (2000), technology enables users to explore topics in more depth (e.g., interconnect mathematics topics, write programs, devise multiple proofs and solutions), and in more interactive ways (e.g., simulations, data collection with probes). Technology also makes accessible the study of mathematics topics that were previously impractical, such as recursion and regression, by removing computational constraints. Therefore growing awareness and understanding of the advantages of information and communication technology among teachers can positively influence their desire and interest in adopting technology in their classrooms. While

Compatibility: ICT is more likely to be used if compatible with organisational members' existing values and beliefs, needs and previous experiences regarding computerised technology. Tornatzky and Klein (1982) found that an innovation is more likely to be adopted when it is compatible with individuals' job responsibility and value system. It will be likely to be adopted not only if it is compatible with deeply held cultural values, but also if it is compatible with previous ideas. Compatibility of an innovation with a preceding idea can either speed up or retard its rate of adoption in the organisation. The degree to which innovation meets client needs is another dimension of the compatibility of an innovation. Organisations should seek to determine the needs of their customers, and then recommend innovations that fulfil these needs. When felt needs are met, a faster rate of adoption usually occurs (Rogers, 2003).

In summary, our conceptual definition of compatibility treats it as a construct spanning four dimensions (1) compatibility with existing work practices, reflecting the extent to which a technology fits with a user's current work process, (2) compatibility with preferred work style, capturing the possibility offered by the technology of being consistent with a desired work style, (3) compatibility with prior experience, reflecting a fit between the target technology and a variety of the users' past encounters with technology, and (4) compatibility with values, epitomising the match between the possibilities offered by the technology and the user's dominant value system. A contribution of this study, then, is the multidimensional conceptualisation of compatibility, and its operationalisation.

Ease of use: IT is quite obvious that new technologies or even ideas that are simpler to understand are more readily and rapidly accepted than those that require the adopting organisation to develop new skills and understanding (Rogers, 2003). Ease of use is similar in definition to several studies (Davis, 1989; Agarwal and Prasad, 1997), and the notion of perceived complexity (Adams et al., 1992; Rogers, 2003). New ideas that are easy to understand will be adopted more rapidly than innovations that require the adopters to develop new knowledge, skills, and understanding (Premkumar et al., 1994). Systems that are perceived to be easier to use and less complex have a higher likelihood of being accepted and used by potential users (Agarwal and Prasad, 1997).

Trialability: This is defined as the degree to which an innovation may be experimented with on a limited basis. New ideas that can be tried on the instalment plan are generally adopted more rapidly than innovations that are not divisible (Rogers, 2003). It becomes an important feature for an innovation, because it provides a means for perspective adopters to reduce the uncertainty they feel towards an unfamiliar technology or product (Weiss and Dale, 1998). Rogers argues that potential adopters who have an opportunity to experiment with an innovation before committing to its usage will feel more comfortable with the innovation, and are more likely to adopt it.

Results demonstrability: This refers to the tangibility of outcomes of the use of an innovation. Venkatesh and Davis (2000) state that even though a system produces effective results, if those results are indistinct, users will have difficulty understanding the usefulness of the systems. Results, in contrast, this visibility: pertains to the apparentness of the innovation itself (Moore and Benbasat, 1991). whereas perceived image, which is the degree to which an innovation is seen as enhancing an individual's image, also influences individuals' intentions for adoption.

Image: Moore and Benbasat (1991) defined image as the degree to which use of an innovation is perceived to enhance one's image or status in one's social system. Also, Venkatesh and Davis (2000) demonstrated the effect of image on perceived usefulness to be significant over time. They argued that higher image leads to higher support from the group, which makes it easier to achieve goals only attainable through group membership, resulting in increased productivity and higher performance.

Drawing directly on DOI theory and TRA, Moore and Benbasat (1991) developed an instrument to measure an individual's perceptions concerning the attributes of an ICT innovation. Ease of use, consistent with Davis (1989), reflecting the dominant measurement paradigm in ICT. Image also developed the image construct which they defined the degree to which use of innovation is perceived to enhance one's image or status in one's social system. According to them, Rogers included the essence of the image construct in his definition of relative advantage. However, research indicating that it was separate from relative advantage was strong enough for Moore and Benbasat to decide to measure it as a separate construct. Result demonstrability and

visibility; also, during the process of developing the instrument, Moore and Benbasat found that the construct of observability separated into two constructs: results demonstrability and visibility. Results demonstrability concentrated on the tangibility of using the innovation, including their observability and communicability. Visibility, on the other hand, focused on the physical presence of the innovation in the organisational setting.

Rogers (2003) suggests that the Moore and Benbasat instrument will be a valuable tool for future research on the diffusion of technology innovations. He further recommends that the use of consistent instruments or measures of innovation attributes across various settings will provide a significant contribution to innovation diffusion research. Rogers (2003) also discusses the importance of utilising this approach in various settings, and points out that while much effort has been spent in studying people-related differences in innovativeness, relatively little effort has been devoted to analysing innovation differences (that is, in investigating how the attributes of innovations affect their rate of adoption). In summary, the technology adoption variables measured by the Moore and Benbasat instrument were used in the present study, and include relative advantage, compatibility, image, ease of use, results demonstrability, visibility, and trialability.

3.4 Conceptual Model

Research on the adoption of innovations is concerned with an individual's behaviour during the innovation diffusion process, as opposed to diffusion research by itself, which focuses on the social system as a whole. Consequently, adoption can be viewed as a subset of the diffusion process, but one that takes place at the individual level rather than at the social group level. Of relevance to this present investigation is that Moore and Benbasat (1991) designed their instrument to capture user perceptions about using the innovation, which differs from Rogers' (2003) framework which focuses on the user perceptions of the innovation itself. According to Moore and Benbasat, it is not the potential adopters' perceptions of the innovation itself, but rather their perceptions of using the innovation that are key to whether the innovation diffuses. Therefore, this present study does not much concern teachers'

perceptions of the technology per se, but teachers' perceptions of using the technology in a variety of work-related contexts are more important.

Relative advantage, Compatibility, Image, Ease of use, Results demonstrability, Visibility, and Trialability are factors importantly influencing individuals' IT adoption decisions. However, it should be emphasised that different individuals may perceive these factors differently; people with different education and social background, who work in a different organisation culture, can project a variety of relative advantage and perceived ease of use. Rogers (2003) noted that differences in past experiences with technology also can result in the difference in level of innovativeness and attitude of an individual. Lakhanpal (1994) claimed that an individual's level of education, prior experience with the innovation, and attitude towards innovation, also influence the degree of innovation adoption.

Grunwald (2002) identified individual characteristics, job traits, and experience with and beliefs about technology as significant predictors that influence adoption of technology. Mitra et al. (2001) also found that there were differences in the ways males and females perceive the effects of the innovation attributes on adoption. In addition, Waugh (2002), across fifteen institutions, found discipline and age are significant personal characteristics related to adoption.

These considerations are reflected in the framework of technology adoption shown in Figure 3.3.

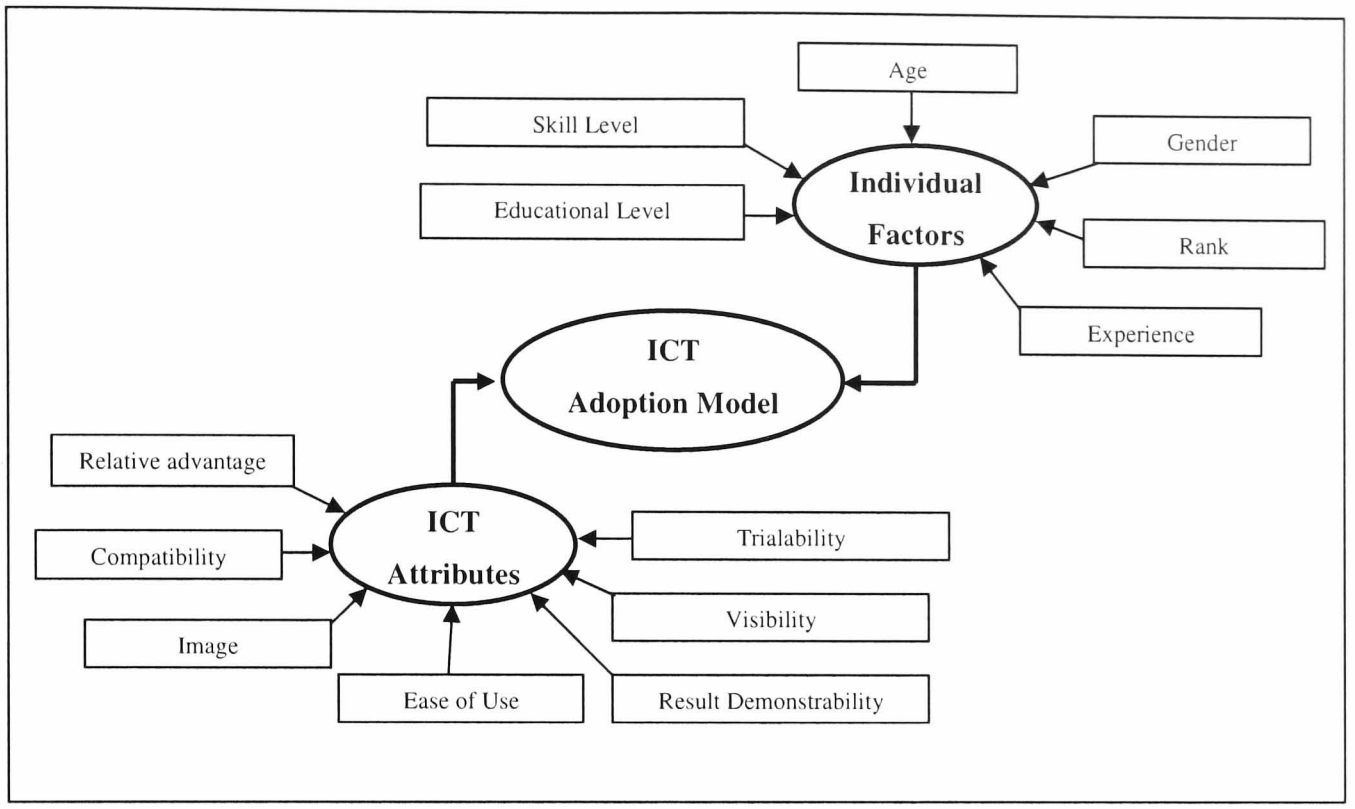

Figure 3-3: Proposed Conceptual Model for Adopting ICT

The proposed framework is expected to help identify and quantify the factors that influence technology-adopting decisions. The model will be used primarily to study individual level factors.

Related educational innovations studies involving educational technology use have addressed a myriad of variables related to staff members' adoption and implementation of technology. Based on a review of previous studies, two different levels of influence affecting the implementation process were identified: 1) staff members' perceived attributes of innovation, and 2) their individual characteristics' support. Thirteen criterion variables known to relate to the level use of technology were identified from the two influences: relative advantage, compatibility, image, ease of use, result demonstrability, visibility, trialability, age, gender, rank, experience, educational level, and skill level. The selection of the variables was substantiated by empirical evidence from previous relevant innovation studies (Davis, 1989; Moore and Benbasat, 1991; Grunwald, 2002; Rogers, 2003).

3.5 Conclusions

Technology is an effective means of increasing teaching and learning effectiveness in an educational setting. However, it must be well planned and organised before any implementation. Identifying client perceptions, and taking care of them, are an important task of change agents during an innovation process. Conducting perception analysis, and detailed plans for the implementation, would guarantee a successful adoption of technology in an education setting.

A theoretical framework is developed which combines Diffusion of Innovation, Theory of Research Action, and the Moore and Benbasat Instrument to explain target adopters' attitudes and their innovation-related behaviour.

A brief examination of these theories has identified a number of factors which can be considered in any new proposed framework. These are relative advantage, compatibility, image, ease of use, results demonstrability, visibility, and trialability. This preliminary model will consider the following individual level independent variables: age, gender, rank, experience, academic discipline, skill level, and educational level.

The initial research objective is to develop and test a model of technology adoption by the Kuwaiti schools. Before embarking on technology implementation projects, a better identification of the factors affecting adoption will be needed, and to understand those factors which would identify potential barriers to achieving successful implementation, and determine problems that the users might encounter. The model includes the significant factors that have influenced the adoption of the technology in a numbers of researches.

To better recognise the barriers to the adoption of technology in education, the conceptual model presented in Section 3.2 and Figure 3.3 will be tested in the Kuwaiti Intermediate schools before committing time and money to help schools achieve a successful implementation. A survey approach is the main method which is used to collect the data, and a sample of principals, teachers, head teachers, and student teachers of mathematics in Intermediate schools in the State of Kuwait are interviewed.

Chapter 4: Research Design and Methodology appropriate for ICT Adoption in Education

4.1 Introduction

Mouly (1978) defined research as a process of arriving at dependable solutions to problems through the planned and systematic collection, analysis, and interpretation of data. Mouly's definition highlights both the purpose of research, which is finding solutions to problems, and the procedures followed in order to arrive at such solutions, i.e., collection, analysis and interpretation of data.

Cohen and Manion (1994) consider research as a combination of both experience and reasoning, the most successful approach which people use on a regular basis for the discovery of truth. In line with Cohen and Manion, Bell (1999) deems that research is not always problem-based, but there are other research purposes, such as seeking information to add to one's own knowledge and to the knowledge of others.

The aim of this chapter is to describe the procedures followed in the collection, analysis and interpretation of the data required for this research. The chapter starts by restating the research purpose. Then it discusses the theoretical framework which will be used to guide the collection, the analysis, and the interpretation of the required data. The chapter then discusses the research strategy and the methods used for the collection of data. The chapter goes on to describe the procedures followed in the analysis of the collected data, and ends by discussing the main issues in research.

4.2 Research Purpose and Research Questions

ICT can be considered an educational innovation, as an innovation is an idea, practice, or object that is perceived as new by the individual, group, or organisation. After receiving information about an innovation, the potential adopter make a decision to either adopt or reject the innovation. Thus, using diffusion of innovation theories as a conceptual guide provides an increased understanding of how and why this innovation has spread into education. Due the correlation between diffusion of innovation and adopters' perceptions of innovation and the subsequent decision to adopt an innovation, the perception of an innovation's attributes by potential

adopters has proven to be a good predictor of the likelihood of adoption. Measuring adopters' perceptions of innovation has been considered a potential key for integrating various findings within diffusion research. And because the purpose of this dissertation is to determine whether the innovation attributes of ICT in mathematics teaching fit into the theoretical framework of perceived innovation attributes established by Moore and Benbasat (1991), which is based on the theories of Rogers (2003) (DOI), and Davis (1989) (TAM), and to determine the importance of those attributes in influencing the rate of ICT adoption in mathematics in the State of Kuwait. The following objectives guided this investigation:

- To determine the common attributes of ICT that influence the adoption of such innovation by mathematics teachers.
- To determine how well the perceived innovation attributes of ICT in mathematics teaching fit with the innovation attributes categories that have been derived in diffusion theories.
- To determine the relative importance of each innovation attribute in influencing ICT adoption.

The present research, also, tries to determine whether factors such as demographic characteristics (age, gender, rank, experience, educational level, skill level) are associated with the adoption of ICT. These factors were predictors of receptivity to change as found in earlier studies (Trumbo, 1958; Rogers and Shoemaker, 1971; Oscarson, 1976; Rogers, 2003; Aneke, 1996; Perry, 1997; Mitra et al., 2001; Grunwald, 2002; Waugh, 2002).

This research aims to identify the factors influencing mathematics teachers' decisions to adopt technology in the intermediate schools in the State of Kuwait. It is to be carried out through examining the perception of principals, mathematics teachers, head teachers, and student teachers regarding various attributes of ICT as a tool in their classrooms and for teaching and learning purposes, and through an investigation of the factors supporting and/or constraining the decisions on ICT adoption in their schools. In an attempt to achieve these objectives by using diffusion of innovation theory to guide the research, the following questions are formulated:

1. Does the set of predictor variables (relative advantage, compatibility, image, ease of use, result demonstrability, visibility, trialability) contribute significantly to the rate of ICT adoption decision?
2. What is the order of importance of the ICT adoption factors?
3. Is there any significant difference between males and females in the ICT adoption factors?
4. Is there any significant difference between age groups in the ICT adoption factors?
5. Is there any significant difference between four ranks: principals, mathematics head teachers, teachers and student teachers, in the ICT adoption factors?
6. To what degree are factors such as individual characteristics (age, gender, rank, experience, educational level, skill level) associated with the adoption of the ICT ?

4.3 Research Framework

One of the most important and fundamental steps a researcher should take in the early stages of his/her study is deciding upon a research design. Croll (1986) proposed that in conducting empirical research, sampling, data collection procedures and data analysis are three aspects of research design. This means that the analysis strategy to be adopted must be decided on before the process of data gathering. Therefore, in order to determine the data needed to answer the research questions listed above, and to guide the processes of analysis and interpretation of the collected data, a framework is developed which identifies the aspects needing investigation. Figure 4.1 illustrates the procedure that the researcher followed in carrying out the research project, and this is analysed in the following sections.

4.3.1 Research Design

The research design is the first independent part of the empirical research methodology. Reviewing the related literature in the previous chapters helped in the development of this framework because it broadened the understanding of the topic

under study and clarified the research aims and questions. It also helped in the identification of the elements needing investigation in order to accomplish the research purpose. This led to a specific research area and, ultimately, identified a research need. In this context, Maxwell (1998) argues that the function of the theory in research design is to enlighten the rest of the design through helping to assess research purpose, develop and select realistic and relevant research questions and methods, and identify potential validity threats to research conclusions.

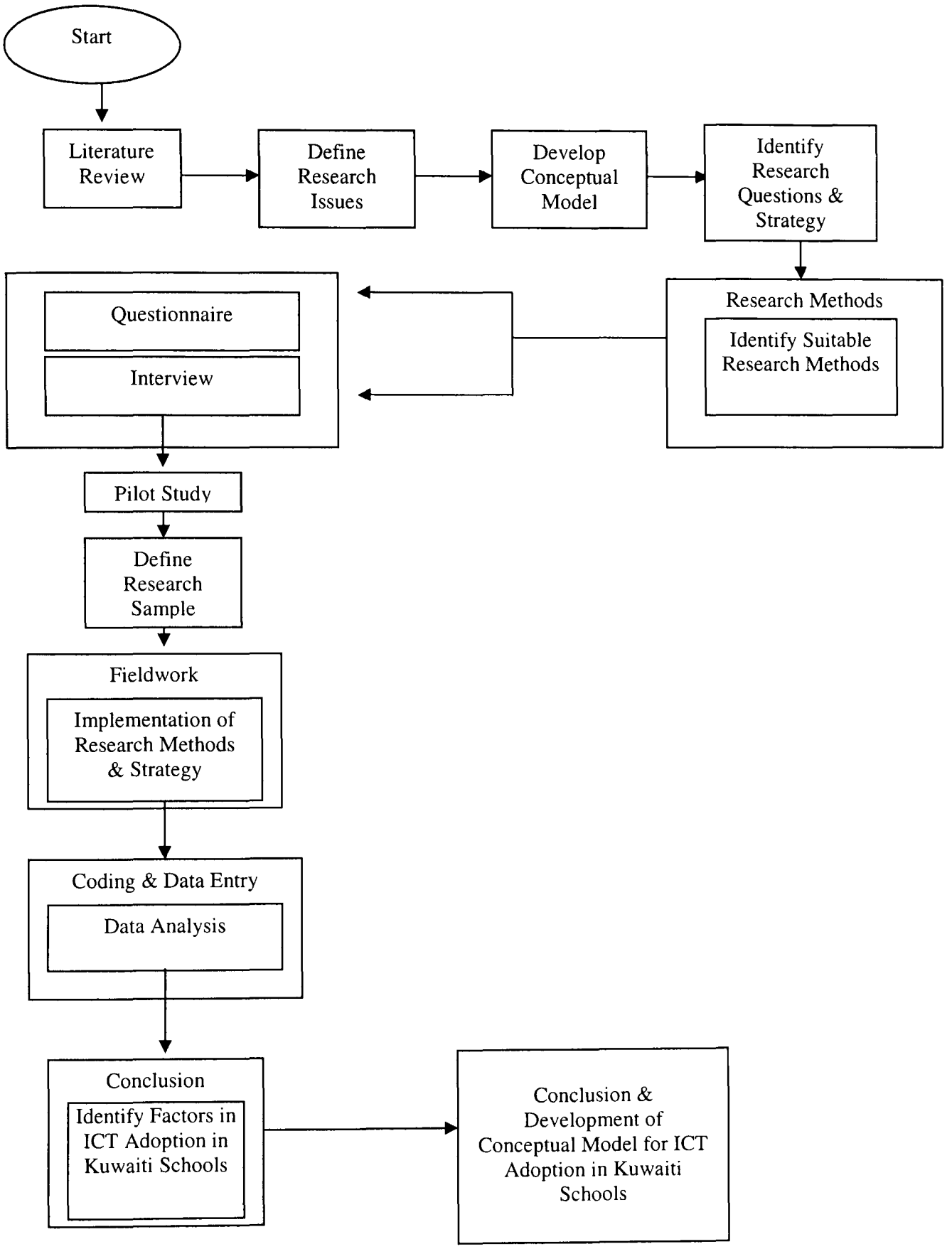

Figure 4-1: Research Design

The researcher used the following procedure in designing the present study:

- Research questions were identified, and thus research methods were decided upon accordingly.
- The design of the questionnaire, which is the primary source of information for this study, was developed.
- A pilot study was carried out by distributing 30 questionnaires to mathematics teachers.
- Questionnaires were modified according to the results of the pilot study.
- Modified questionnaires were then used in the study (a total of 500 questionnaires forms were distributed to Intermediate schools in the six Kuwaiti governorates).

Thereafter, the proposed conceptual model (Figure 3.3) is tested deductively using quantitative and qualitative methods. The aim here is to contribute to knowledge by exploring and identifying the significant factors influencing the ICT adoption decision in school settings, and relate the findings of the investigation to the researche's positivist understanding built from reviewing literature related to the subject area.

To validate this positivist understanding, the proposed conceptual model (Figure 3.3) derived from innovation adoption theories and views related to the subject area is tested. Then, the results of the questionnaire and interview data collection, and their analysis are used to compare these findings with the expected outcomes predicted by the proposed conceptual model. The conceptual model is either validated or else found to be inadequate in some way, in which case it is further refined based on the findings.

4.4 Sampling

Since including the entire population in a study is often impractical, the idea of sampling for the purposes of research was introduced early in the twentieth century, and has become a standard procedure ever since. The main idea of sampling is

selecting a representative sample of a larger population for the purposes of a certain study (Bulmer, 1983).

Sampling can be defined as a process of selecting units (e.g. people, organisations) from a population, so that generalisations can be fairly drawn (Trochim, 2001). Rossi., et al (1983) defines a sample as a subset from a larger population. This would suggest that before thinking about samples, one should already have a clear picture of the universe or population from which the sample is to be selected. Furthermore, Miles and Huberman (1994) suggests that sampling involves decisions, not only about the selection of people to be observed or interviewed, but also about setting, events, and social process.

It has to be noted, as Reeves and Harper (1981) argue, that each type of population presents its own distinctive sampling problems. They further suggest that the basic procedure in establishing the validity of the sample and identifying its limitations is to compare the sample actually obtained with that which was planned at the sampling stage.

Sampling provides a valid alternative. In this respect, one of the purposes of sampling is to reduce the cost of the research in terms of time, effort and money. However, this reduction must not be at the expense of the adequacy of the data which sampling provides (Mouly, 1978). Maxwell (1998) identified another four functions served by sampling: (1) to achieve representativeness or typicality of the settings, individuals, or activities selected; (2) to capture adequately the heterogeneity in the population; (3) to allow for the examination of cases that are critical for the theories the study began with, or that have subsequently been developed; (4) to establish particular comparisons to illuminate the reasons for differences between settings or individuals.

Whatever research methods are used, sampling has to be considered in order to achieve the above-mentioned purposes (Blaxter et al., 1996). Sampling techniques or procedures vary, depending on the purpose of the research, the targeted population, the methods used, and the resources available to the researcher (Cohen and Manion, 1994; Blaxter et al., 1996).

Despite the great variation among sampling techniques, they can be classified into two broad categories: probability and non-probability sampling. According to De

Vaus (2002), in probability sampling, each member of the population has a known, non-zero chance of being selected, and the surest way of providing equal chances is to use the principle of random selection. In a non-probability sample, some members have a greater chance of being selected, and the probability of selection is unknown. Qualitative research relies on purposive sampling (non-probability sampling) in which the samples (context, participants and events) are carefully selected for the important information they can provide (Maxwell, 1998). Quantitative research, in contrast, relies on probability sampling, because this type of sampling yields a very representative sample of the population it is drawn from, and therefore allows researchers to generalise the results of their findings (Cohen and Manion, 1994).

Because the present research deploys methods from both interpretive and scientific paradigms, both probability and non-probability sampling procedures are used. A combination of simple random, convenience, and purposive sampling procedures is used. Definitions of these procedures are provided in Table 4.1 below.

Table 4-1: Sampling Procedures (Cohen and Manion, 1994)

Procedures	Description
Simple Random Sampling	Selecting is entirely independent of next case.
Convenience Sampling	Selecting nearest case as subject
Purposive Sampling	Handpicking cases to be included in sample on basis of researcher's judgment of typicality of these cases. This leads to building up of sample satisfactory to researcher's specific needs.

4.4.1 Sample Size

Regarding sample size, Robson (2002) pointed that the larger the sample, the lower the likely error in generalising. However, it is not yet possible to apply a general rule as to sample size in this case, as this will depend on variations in population with regard to certain characteristics of the study. It has been suggested by De Vaus

(2002) that a sample size of 10% of the population for comparable groups is a requirement for accuracy. However, Ary et al. (1990) state that although this is the belief of most researchers, it is an opinion which is not necessarily accurate. The argument is that the sampling procedure, not the size of the sample, is more indicative of whether or not the sample is representative of the population.

The correct sample size depends on the purpose of the study and the nature of the population under scrutiny. According to Morrison et al. (2000), the required sample size depends to some extent on the style of the research. For example, a survey style usually requires a large sample, particularly if inferential statistics are to be calculated. In qualitative style of research, it is more likely that the sample size will be small. Sample size might also be constrained by cost, time, money, stress, administrative support, number of researchers, and resources. Borg and Gall (1989) suggest that correlational research requires a sample size of no fewer than thirty cases, that causal comparative and experimental methodologies require a sample size of no fewer than fifteen cases, while survey research should have no fewer than 100 cases. Several popular notions about the necessary size of a sample are mentioned by Nachmias and Nachmias (1992). One is that the sample size must be a certain proportion (often put at 5 %) of population.

4.4.2 Study Sample

The State of Kuwait is divided into six educational governorates, each of which includes a number of intermediate schools. The researcher limited the sample to 28% of the number of such schools. Eight schools were to be surveyed in each governorate, thus the total number of intermediate schools to be included in the survey was 48.

The principals, mathematics head teachers, mathematics teachers, and mathematics student teachers from all educational governorates were the target population for the questionnaire. However, a sample of predetermined size was to be selected from the population of interest, keeping in mind the limited resources and time, which frequently constrain a study of the entire population. Care was to be taken to ensure that the sample would represent the total population, so that the data collected from the sample would be representative of the population (Allen and Skinner, 1991).

Having specified the size of the sample, the researcher contacted the Public Authority for Applied Education and Training (PAAET) , the official body responsible for the Cultural Affairs Sector, and obtained an official letter directed to the Ministry of Education. The letter urged the schools to assist the researcher in obtaining the information she was seeking, and directed all schools to co-operate with the researcher and support her endeavour to carry out her study successfully. This process, having procured an official status, helped the researcher achieve excellent results without facing significant response difficulties.

4.4.3 Sampling Method

The schools selected for this study were like most intermediate schools in the State of Kuwait. All schools are run and supervised by the Ministry of Education, all curriculum materials are the same, all have the same resources and facilities, and qualifications of teaching staff are the same, since recruitment is done centrally. Application of the questionnaire was to cover 48 out of 168 intermediate schools, 24 boys' and 24 girls' schools (Ministry of Education, 1998), a sample representing 28% of the intermediate schools in the State of Kuwait. 8 schools were selected in each of the 6 educational governorates, divided equally into 4 boys' and 4 girls' schools in each governorate to capture the heterogeneity of teachers, and thus to examine the effect of this variable (gender) in participants' perception of the decision on ICT adoption.

- The researcher applied the simple random sampling method in the study. This was achieved by observing the following steps:
- Names of schools in each governorate were written on separate pieces of paper put in 12 envelopes corresponding to each type of school in each governorate
- The names of the 4 schools required were drawn from each envelope, and thus the 48 schools to be included in the study were specified.

Due to the limitation in time and support, as a result of teachers' involvement in monitoring examinations as well as administrative work, it was impracticable for the researcher to pick a random sample of mathematics teachers from the name list. It

was much more practical to take samples from a selected number of schools. Thus, although it would be very difficult to arrange a convenient time with teachers, a longer period of time spent at each of a limited number of schools would allow arrangements to be made to distribute the questionnaire to all the participants in particular schools.

Convenience sampling is apparent in the selection of these two particular points. First, due to the exam time, the availability, and the readiness of the potential respondents. Thus, the researcher chose the sample from those to whom she had easy access.

As regards the interviews, a non-probability, purposive sampling was applied. One staff member from a number of convenience schools was selected by handpicking staff members who had some knowledge and experience with ICT, because these would be able to provide the needed information. Also, some of the interviewees were automatically brought into the research, since they are the only people in their positions, the computer coordinators.

4.5 Research Strategy

Having established the research aims, questions, and identified the aspects needing investigation, as highlighted in the previous sections and summarised in Figure 3.3, the next step was to decide which research methodology was most suitable for such investigation. This decision helped in choosing procedures for selecting research participants, data collection methods, and the procedures for analysis and interpretation of the collected data, because each methodology has its own ways of carrying out such processes.

Two research paradigms are widely discussed in the literature: the interpretive paradigm and the scientific paradigm. These two paradigms came into existence as a result of competing views regarding social reality. The ontological assumptions of most social studies posit social reality as either subjective (applies interpretivist epistemology which sees social systems as a result of meaningful human behaviour), then researchers use a qualitative approach, or objective (applies positivist epistemology) and therefore quantitative approaches of inquiry may be used to capture it (Creswell, 1994).

The assumptions have great influence on methodological considerations. Cohen and Manion (1994) summarise some assumptions and their influence on the choice of research methods. According to them, researchers who are adopting an objectivist (or positivist) approach to the social world, and who treat it like the world of natural phenomena as being hard, real and external to the individual, will choose surveys, experiments, and the like. Others favouring the more subjectivist (or anti-positivist) approach, and who view the social world as being of a much softer, personal and humanly-created kind will select from a comparable range of recent and emerging techniques, for example accounts of participant observation, and personal constructs. From the above discussed assumptions emerge the differences between qualitative and quantitative research approaches. Creswell (1994) noted the difference between the two approaches that the qualitative strategy is defined as an inquiry of understanding a social or human problem, based on building a complex, holistic picture, formed with words, reporting detailed views of informants, and conducted in a natural setting. Quantitative study, on the other hand, is an inquiry into a social or human problem, based on testing a theory composed of variables, measured with numbers, and analysed with statistical procedures, in order to determine whether the predictive generalisations of the theory hold true.

It is clear from the above distinction that the qualitative methodology approaches are used to try and understand an individual's perceptions of the world, seeking insight rather than statistical analysis (Bell, 1999). Qualitative approaches are relatively subjective, relying on the personal involvement of the researcher, who is concerned with understanding individuals' specific actions, and the meanings of these actions (Cohen and Manion, 1994). However, researchers adopting a quantitative methodology use scientific techniques that, with the help of statistics, are likely to produce quantified, and if possible, generalisable conclusions (Bell, 1999). The quantitative approach is concerned with identifying and explaining those general, anonymous causes that affect and regulate human behaviour, and thus conducted from outside the research context (Cohen and Manion, 1994).

Creswell's distinction between the two methodologies also shows that qualitative researchers need to be available in the natural setting of the phenomena under investigation and to be close to the people involved, in order to understand the

phenomena through the meanings which those people place on them. In contrast, in quantitative research, researchers may not necessarily need to be available at the scene, as in most cases they collect factual data, and these may be obtained at a distance. It follows that the type of data collected by the two methodologies differs in nature, as well as the number of participants in a given study. While facts can be captured in numeric forms, feeling cannot be. Hence, it is not feasible to include in a qualitative study a large number of participants, as is usually the case in a quantitative study (Blaxter et al., 1996).

Another difference between quantitative and qualitative methodologies relates to the researchers' values and bias. It is argued that, in quantitative studies, researchers try to keep their own values out of the study. They simply report facts and argue closely from the evidence gathered in the study (Creswell, 1994), because they aim to achieve complete objectivity in their findings (Guba and Lincoln, 1994). Qualitative research, however, is more subjective, value-laden, and value-bound in nature. Therefore, researchers' values and biases are reported, as well as the value-laden nature of the information collected from the field (Borg and Gall, 1989; Creswell, 1994).

4.5.1 Justifying Research Strategy

There has been a growing debate in recent years as to whether quantitative or qualitative research methods are better suited to answering the many and varied questions posed in social research. However, both qualitative and quantitative approaches have their own strengths and weaknesses, and each is particularly suitable for a particular context. Thus, the approach adopted and the method of data collection selected are not only determined by the researcher's alignment to one particular research method, but also depend on the nature of the inquiry and the type of information required (Bell, 1999). Consequently, rather than choosing one or other approach, researchers are now often concerned more with a combination of both which makes use of the most valuable features of each (Cohen and Manion, 1994). According to Robson (2002), using more than one method can have substantial advantages, even though it almost inevitably adds to the time investment required. One important benefit of multiple methods is in the reduction of inappropriate

certainty. Using more than one method may point to differing answers which remove specious certainty.

A number of researchers advocate the use of mixed methods. Bell (1999) and Scott (1996) both contend that neither of the two competing paradigms prescribes or rejects any particular methods. Rather, a combination of research methods can be used in a given study. Evidence from social science argues that social researchers require both modes of inquiry to advance their understanding of other human phenomena (Schulze, 2003). Moreover, Mouton and Marais (1990) suggested to combine two research methodologies in order to grasp the breadth, depth, and richness of information, since a single approach cannot succeed in encompassing human beings in their full complexity

In order to arrive at our problem solutions, various strategies are employed to gather data that are to be used as a basis for inference and interpretation, and for explanation and prediction. The researcher used two different research approaches, one quantitative (questionnaire), and the other qualitative (interview). The advantage of using more than one method is that it allows the researcher to explain more fully the richness and complexity of human behaviour by studying it from more than one standpoint, and linking quantitative and qualitative data. Thus, although differing methods have their various deficiencies, these can be partially overcome by researchers' combining different methods of data collection in the same study. This is termed 'triangulation' (Cohen and Manion, 1994).

4.5.2 Triangulation

When a researcher applies different methods to collect data (qualitative method, quantitative method), he/she needs to assess the information gathered, and decide whether it leads to the same conclusions, hypotheses, or set of priorities. The most commonly used practice to achieve this goal is the triangulation technique (Denzin and Lincoln, 2000). Since it has been necessary to use both quantitative (questionnaire) and qualitative (interview) approaches in this research, triangulation has been used to check the validity and reliability of the data.

There are four types of triangulation (Burgess, 1984; Chadwick et al., 1984; Patton, 1990). Data triangulation includes collecting data at different times, in different places, or from different levels (individuals, groups, etc.). Investigation triangulation

uses different observers, who may operate either as a team or as individuals, to collect data. Methodological triangulation involves using different study methods, as well as manipulating different patterns of the same method. The final type is theoretical triangulation, in which a set of data is assessed from different theoretical viewpoints. In this research, therefore, methodological triangulation has been used.

Using triangulation has its advantages and disadvantages. One of the main advantages of this technique is that it provides a tool for increasing the reliability and validity of data. When findings of multiple methods converge, confidence in the validity of conclusions is enhanced; results in agreement indicate that the methods are assessing the same phenomenon, and that the unique bias of each method is reduced, if not eliminated. Furthermore, with triangulation, the strengths of one method add to or even enhance the strengths of the other, thus providing complementary information that gives a more complete and comprehensive explanation or picture of the phenomenon under study. Contradictory results provide the researcher with an opportunity to uncover deviant or unexplored dimensions of a phenomenon; to identify substantive or methodological sources of divergence, thus enriching the understanding of the phenomenon, and potentially leading to synthesis or integration of theories explaining it; and to rethink and reanalyse the problem from a new perspective (Mathison, 1988; Brewer and Hunter, 1989). Triangulation, on the other hand, could involve extra cost and time.

Multiple methods can also be used in complementary fashion to enhance interpretability. For example, in quantitative study, the interpretation of statistical analysis may be enhanced by a qualitative narrative account. Conversely, a qualitative account may be the major outcome of a study, but it can be enhanced by supportive quantitative evidence used to buttress and perhaps clarify the account (Robson, 2002).

The nature of the present research called for the application of the two types of methodologies discussed above. Literature review and analysis presented in Chapters 2 and 3 indicate that there are many factors that affect the adoption of technology in education. These factors appear to be multiple and related to each other. Going back to the research questions, we can notice that most of the questions are for several reasons more suitable for quantitative inquiry. Firstly, quantitative approaches were

seen to provide an overview of individuals' perceptions to adopt ICT. Secondly, it was thought that the use of the questionnaire would allow the researcher to collect the information she needed in a relatively fast manner, and from a large sample which she would not have been able to cover if she used interviews, for example. Therefore, to gather information from a multidisciplinary group of academic staff about integrating technology into teaching and learning, and to understand those factors that influence the adoption of technology. This in turn would allow the researcher to generalise the outcomes of the sample to the whole population of the study.

The first research question is more concerned with the factors affecting the ICT adoption decision in the schools. Thus, explanatory methods are needed. By using qualitative methods such as interviews, the researcher was aiming to come closer to the participants and to elicit their meanings, feelings, justifications, perceptions and their interpretations of the situation, which she thought would explain the situation in schools. Here, the researcher wanted to capture the viewpoints of these people without imposing predetermined views, as would be the case if quantitative procedures were used.

4.6 Research Methods

Methods tend to be classified into two categories: those which are applied in qualitative interpretive research, and those which are applied in quantitative scientific research. All research, whether quantitative or qualitative, is based on some underlying assumptions about what constitutes valid research, and which research methods are appropriate (Myers, 1997). However, it is the phenomena under investigation which dictate the choice of methods, and not the affiliation to a particular paradigm. For instance, the context in which the research takes place, the number of people involved, and the resources available to the researcher in terms of time and money, all influence the choice of research methodology (McNeill, 1990; Bell, 1999; Cohen and Manion, 1994). Many researchers (Creswell, 1994) advocate the integration of methods in a single study because they believe that there is a'false dichotomy' which exists between qualitative and quantitative research. So

researchers should make the most efficient use of both methods in understanding a given social phenomenon.

Moreover, Denzin and Lincoln (2000) call for the use of several methods of data collection. The assumption underpinning this is that one method might not provide a complete picture of the phenomena, because each method reveals different aspects of empirical reality. Applying a wide range of interconnected methods allows the researcher to reconsider the findings of one method together with the findings of the other, as the data which may be left out by one method can be picked up by the other. This will allow the researcher to get a better fix on the researched phenomenon (Denzin and Lincoln, 2000).

In the light of the above arguments, the present study made use of questionnaires, and semi-structured interviews and documentary evidence. These tools appeared to be the most suitable and possible to use for the purpose of the research. The aim of using questionnaires and interviews was to determine from different personnel directly involved the current status of the use of technology as a tool in their particular location. Therefore, the questionnaire seemed to meet this purpose, since (1) a large number of questions could be included, (2) most of the questions required to be only close-ended ones, and (3) a large number of personnel could be covered. On the other side, interviews were found to be suitable to seek information from specific members because most of the questions needing to be asked were about their perceptions, opinions, and future plans, which can be better explained during an interview. At the same time, the number of personnel needing to be covered was limited (10 people). Also, the review of different documents about the introduction of technology in Intermediate education seemed to be a very reliable source of information to provide accurate details.

In order to make the research methods as dependable and reliable as possible under the circumstances and within available means, certain steps were taken. For instance, when designing the questionnaires, similar questions were included in different forms, and some questions were put to different personnel levels, sometimes for cross-verification and sometimes to learn about the situation from a different perspective. The intermediate schools covered by the survey questionnaires were located in different areas in Kuwait, which provided a different combination of social

classes. Fortunately, the survey included almost a similar number of females and males to counter any misrepresentation regarding gender.

4.6.1 Questionnaire

The questionnaire is the primary source of information for collecting data for the purposes of this study. Therefore, it would be advantageous to talk about aspects of the questionnaire in general, and the advantages of using such a method in data collection.

Questionnaires can be defined as a written information supplied directly by people in response to questions asked by the researcher (Denscombe, 2003). According to Blaxter et al. (1996) and Best and Kahn (2003), questionnaires can be handled in three ways: (1) they can be posted or mailed for completion, (2) completed by telephone, or (3) otherwise distributed face-to-face. They can be further classified into two types: those which are designed for self-completion, in which the respondents complete the questionnaire themselves, and those designed for assisted completion, where the researcher asks the questions and completes the questionnaire him or herself (Robson, 2002; Verma and Mallick, 1999). Self-completed questionnaires are one of the most widely used social research techniques (Robson, 2002; Cohen and Manion, 1994; Blaxter et al., 1996; Verma and Mallick, 1999). The current research deployed questionnaires to be self-completed by the participants.

The questionnaires in this research were mainly used to answer the research questions which aimed to identify teachers' perceptions of the influencing factors in an ICT adoption decision. Questionnaires were used at this stage of the research in order to have a wider coverage of participants than that possible through other research methods. In turn, the selection of a large and representative sample of the targeted population allowed the generalisation of the outcome of the questionnaire from the sample to the whole population (Mouly, 1978; Robson, 2002).

Face-to-interviews may put some sort of pressure on the respondent, who feels expected to come up with an immediate and often socially acceptable answer. Using a questionnaire lessens this type of pressure by giving the respondent some time to deliberate before answering a question. Moreover, the questionnaire gives respondents a feeling of anonymity, which they need, especially when answering sensitive questions, and therefore they might be encouraged to provide accurate

answers, even to personal questions. Finally, questionnaires can save time, especially when dealing with a large sample (Cohen et al., 2000).

The use of questionnaires is also stimulated by the advantage they have of taking less time to code and analyse the responses, especially when computer coding or analysis is available (Robson, 2002). For analysing data this way, the most popular is SPSS (the Statistical Package for Social Science) (Babbie et al., 2000), which is used in this research. It is highly impractical to use another method of data collection like the interview when dealing with a sample of 500, for example, whereas the questionnaire is more practical in cases like this, saves an immense amount of time, and also offers relative ease of analysing a large quantity of data.

Furthermore, questionnaires have the feature of being able to elicit more candid replies, especially when respondents do not have to mention their names (Mouly, 1978). When the names are not provided, the researcher (or others) will not be able to identify who says what and, therefore, respondents are more relaxed in giving their answer.

There are some pitfalls associated with the use of questionnaires as a research instrument. One obvious problem is related to the distance between the researcher and his or her subjects, and the lack of interaction between the two parties; the respondents fill in the questionnaire without any verbal exchange between them or the researcher, and without receiving any clarification, especially in mailed questionnaires (Fetterman, 1998). Due to this, the investigator cannot note the reluctance or evasiveness of his/her respondents, or check the honesty and seriousness of their responses (Mouly, 1978; Robson, 2002). This distance between the two parties might also lead to another problem, the misinterpretation of questionnaire items by the respondents. In such a case, the researcher will have a problem to interpret answers if they are inadequate or based on misunderstanding of the question (Mouly, 1978). This underpinned the need to pilot the questionnaire.

There is another problem relating to postal questionnaires. Among the reasons which lead to non-return of questionnaires is the unwillingness of the respondents to co-operate with the researcher (Best and Kahn, 2003). The willingness to return the questionnaire is determined by the interest of the participants in its topic. If the topic is appealing to them, they will put more effort into completing it. Secondly,

respondents might be busy with something else. Normally, what people do when receiving a questionnaire is to prioritise the tasks they have in hand and try to allocate a time for completing the questionnaire, but not at the expense of completing the other tasks; or they may forget it altogether.

Obviously, non-return decreases the sample size and restricts the researcher's ability to generalise the results to the whole population (Mouly, 1978; Best and Kahn, 2003). As a result of a low response rate, the data obtained are often of limited validity because the information in the unreturned questionnaires might have changed the results of the investigation considerably, since the non-respondents may differ significantly from the respondents in terms of feelings, attitudes and interest in the topic (Best and Kahn, 2003; Cohen and Manion, 1994). Proper selection of the problem and the population, being available with participants while filling in the questionnaires, and paying attention to the length, ambiguity and clarity of the questionnaire are some of the ways to ensure high response rate (Mouly, 1978; Cohen and Manion, 1994).

Another problem which leads to a low response rate and can be considered a typical problem in using questionnaires is the format of the questions. Open-ended questions, although useful, are more demanding and time-consuming to answer, and thus respondents may be put off from completing the questionnaires (Tall, 2001).

The advantages of the questionnaire outweigh its disadvantages, and therefore the researcher used it in collecting data to answer her research questions. The previously listed problems were identified and eradicated during the designing, translating and piloting phases of the questionnaire.

4.6.2 Constructing Questionnaire

Before constructing a questionnaire, Sudman and Bradburn (1982) suggest, it is useful to search for questions on the same topic that have been asked by other researchers. Thus, when starting to construct the questionnaire, a decision has to be made regarding the type and the form of questions that would be asked, based on the literature review and the conceptual model. In the light of the nature of this investigation, closed questions were believed to be the appropriate form. This type of question was selected in accordance with the advice of Oppenheim (2000) who

suggested closed questionnaires are easier, quicker to answer, require no writing, and quantification is straightforward

The research followed the three steps of questionnaire construction suggested by Evans (1984): (1) to define clearly the purpose of the questionnaire, (2) to decide exactly what information is required, (3) to analyse it into its component parts.

A large number of items and questions were assembled, and then required reviewing, refining and reducing. For each item, an examination was conducted against the following criteria suggested by Bell (1999, p.88):

- Is there any ambiguity, imprecision or assumption?
- Are you asking respondents to remember? Will they be able to?
- Are you asking for knowledge respondents may not have?
- Are there any double, leading, presuming, hypothetical or offensive questions?

4.7 Questionnaire Validity

Bagozzi (1994) states that a measure or a scale is said to be valid when it measures what it is intended to measure. Moreover, Neuman (1994) argues that validity gives an indicator which captures the meaning of the construct in which researchers are interested.

The researcher applied three procedures to ensure the validity of the questionnaire used in this study: consulting judges, translation of questionnaire, and pilot study.

4.7.1 Consulting Judges

Undoubtedly, it was a difficult process to select the most appropriate items and improve the questions. Therefore, before writing the final version of the questionnaire, the researcher consulted different questionnaires measuring ICT adoption (Rogers, 2003; Moore and Benbasat, 1991). Guidelines on how to design a questionnaire provided by research textbooks were also consulted, namely Bell (1999), Robson (2002) and Cohen and Manion (1994). In addition to the researcher's own refining, there was a great deal of consultation with the researcher's supervisors and with some colleagues who share the same interest. The researcher presented items to outside consultants in order to have their comments and suggestions

regarding the questions, because they are generally more objective and can recognise flaws that the investigator is invariably too close to see (Mouly, 1978).
The original draft questionnaire was written in English, and it was reviewed by the academic supervisors of the researcher, and two postgraduate students whose mother tongue is English. On the basis of their comments and recommendations, important additions and changes were made.

4.7.2 Translation of Questionnaire

In order to be able to apply the questionnaire in Kuwait, it was necessary to translate it into the native language spoken there, which is Arabic. The accuracy of translation was essential. Iyengar (1993) stipulates that validity requires that questions in one language be translated into another language in such a way as to retain their meaning. Validity would be determined simply by the accuracy of translation.
To double-check uniformity, the questionnaire was first translated into Arabic which was checked for Arabic errors, and then retranslated into English by a bilingual (Arabic/English) expert in order to check whether the Arabic version gave a correct interpretation of English. Having double-checked the validity of the translation, the Arabic version was reviewed by a scholar in Arabic at Kuwait University, and necessary changes were made according to his remarks.
The questionnaire and interview schedule were translated into the Arabic language, since the questionnaire was to be administered in Arabic. Brislin and Triandis (1980) recommended four steps for the translation process:

- The original version is translated into the target language.
- The translation must be grammatically checked.
- The target document must be translated back into the original language and checked with the original.
- A pre-test is to be taken before the actual study is conducted.

For translation of the instrument in this study, the researcher followed this 'translation-back-translation' method.

4.7.3 Pilot Study

Before embarking on the main study, it was important to carry out a pilot study to test the validity of the questionnaire, and clarify any ambiguities. Because the questionnaire is impersonal, it is all the more important to take care over its construction. According to Nisbet and Entwistle (1970), the questionnaire must be especially clear in its wording, since there is no interviewer to explain ambiguities or to check misunderstandings. Also, the variety of possible answers to each question must be anticipated more fully than for an interview.

Moreover, Wiersma (2000) indicated that besides eliminating ambiguities and clarifying instructions, a pilot run can avoid results that provide little or no information.

The researcher, however, should be fully aware of the importance of the pilot study, and should not take its significance lightly, because at some point one is no longer doing a pilot study, but has begun the main study, although perhaps on a small scale. Conducting a pilot study, and examining its results, are extremely important, because investigating the results will identify problems in the wording of the questions, construct validity of the recording of data, and will help the researcher to improve the study instruments (Reid and Boore, 1987).

A pilot study may involve testing the questionnaire more than once, until the researcher is sure of its construction and validity. According to Oppenheim (2000), questionnaires have to be composed and tried out, improved, and then tried out again, often several times over, until we are positive that they can do the job for which they are needed.

Accordingly, when the researcher conducted the pilot study, the main goal she had in mind was to check whether the wording of the questionnaire was clear, lucid and easily understood, especially after having it translated from English into Arabic. If not, the necessary modifications would have to be carried out, like improving the wording of the items to clarify any ambiguities. The pilot study served the researcher by indicating the limitations of her instrument, and allowing her to rectify items before commencing the main fieldwork. This step proved to be in keeping with what Kidder (1981) states, that the pre-test provides a means of catching and solving unforeseen problems in the administration of the questionnaire, such as the

phrasing and sequence of questions, or its length. It may also indicate the need for additional questions or the exclusion of others.

After conducting the pilot study, the researcher noticed that many participants expressed their desire to not answer the open-ended questions. After carrying out the main field study, however, it was found that the number of respondents who completed open-ended questions was very small, and therefore their answers could not be generalised, but the main points which recurred in these answers have been mentioned in the study.

After completing the initial draft of the questionnaire, a pilot study was carried in one of the schools and the questionnaire was administered. As a result, it was possible to identify ambiguity in the question concerning the perceived attributes of technology, and rewrite it in an easier format when the actual administration of the questionnaire was to take place. Moreover, the questionnaire was piloted to determine how long it would require for the respondents to complete, which helped in drawing up a workable action plan.

Prior to the administration of the questionnaires, a letter of permission from the Public Authority for Applied Education and Training (PAAET) was obtained to facilitate the administration of questionnaires in the schools. The letter was combined with the questionnaire. Thus, the principals of these schools were prepared to co-operate once the questionnaires were delivered to them. Yet the process of administering questionnaires faced a problem: time constraint.

The time at which the questionnaires were administered was difficult for both the members of the schools' administration and teachers. This was mainly because of the final exams, as they were approaching very soon, and the questionnaires were given for completion only two weeks prior to these. Therefore, the teachers were very busy trying to complete their lessons, and the schools' administration staff were busy planning and preparing for the exams.

4.7.4 Distribution and Collection of Questionnaire

In order to ensure the highest rate of response possible, the researcher relied on distributing and then collecting questionnaire forms, by hand.

As for distributing and collecting the questionnaire for the principals, head teachers, teachers, and student teachers, the researcher took note of Best's (1981) suggestion

that a greater return rate was obtained when the original request was sent to the administrative head of an organisation, rather than directly to the person who had the needed information. There is implied some feeling of obligation when a superior officer turns over a questionnaire to a staff member to fill out.

Accordingly, the researcher visited the principals or head teachers of all participating schools, handed each of them personalised questionnaire forms to distribute to the named teachers and student teachers, together with an envelope for each questionnaire, and fixed a date for the collection of completed questionnaire forms. The reason for distributing envelopes was to enable respondents to answer questions freely, bearing in mind that their answers would be in sealed envelopes when collected by the principals, and that only the researcher would have the chance to read these answers. Finally, the researcher returned to the schools on the date fixed with the principals/head teachers for the collection of completed questionnaires forms.

4.7.5 Questionnaire Limitation

Although the researcher chose the questionnaire to be her primary source of information, she was fully aware of the limitations of this method of data collection. According to Mouly (1978), the major disadvantage of the questionnaire is the possibility of misinterpretation of the questions.

Misinterpretation could occur because of the absence of the researcher at the time when respondents are completing the questionnaire. The researcher has striven to overcome this problem by piloting the questionnaire. Piloting, as mentioned earlier, offers an excellent chance for the researcher to modify and clarify any ambiguous questions. Another possible disadvantage is low response rate (Judd et al., 1991). This problem was also successfully tackled by obtaining the official letter from the Public Authority for Applied Education and Training (PAAET) to facilitate the task of the researcher, and by distributing the questionnaires by hand.

4.8 Study Questionnaire

The researcher, after consulting her academic supervisors, specified the type of questionnaire required for the study and divided it into two main sections. The first

section was intended to elicit demographic information about the participants, mainly age, gender, rank, experience, educational level, and skills level. The second section elicited participants' perceptions of factors influencing their decision on ICT adoption.

The questionnaire included closed-ended questions. The format of these items was a 7-point Likert scale where '1' meant Strongly Agree (SA) and '7' meant Strongly Disagree (SD). The idea behind using a 7-point scale instead of a 5-point one, for example, was to avoid the tendency of respondents to select a response in the middle. In a 5-point Likert scale, 3 means neutral, and it equates to 'no comments'. Because the main study question was to estimate the rate of technology adoption decision by the teachers, it was necessary to give them 7 points to choose from rather than 5, in order to avoid neutral responses.

4.9 Likert Scale

Trochim (2001) suggests that scaling can be simply defined as the designation of objects to numbers according to a specified rule. Scaling is used for a number of purposes, but its main uses are in testing tentative assumptions as well as scoring. The scaling method chosen by the researcher in this study is the Likert scale. This Likert scale is most commonly used in social research, and is particularly useful for situations in which measuring respondents' attitudes or opinions is targeted. In this research, it is the perceptions of principals, teachers, head teachers, and student teachers that are measured, and these will have a cognitive as well as an affective content.

In order to undertake measurement of opinions, a set of statements is selected. Each statement reflects favourably or unfavourably on the opinion or the attribute being measured. The respondents are asked to indicate, on a scale, whether they agree or disagree with each statement. The agreement scale may only have two choices, 'agree' or 'disagree'. However, it may, in some instances, offer more choices, permitting an indication of the strength of agreement or disagreement. According to Forsyth et al. (1999), Likert scales are the popular method of choice, and usually employ five choices expressing different degrees of agreement or disagreement that

yield ordinal measurements (SA = strongly agree, A = agree, N = not sure, D = disagree, and SD = strongly disagree).

In this study, the respondents were asked to mark a 7-point Likert-type scale according to their views, from strongly agree (7 points) to strongly disagree (1 point). Therefore, the highest achievable score for each item was 7 points, whereas the lowest achievable score was 1 point.

The decision to use the Likert-scale format in the formulation of the statement was because of its perceived ability to assess opinions using a series of choices. A person's opinion score is the total of his/her ratings, with a higher score indicating a more favourable opinion. In addition, Likert scale measurements can be performed without a panel of judges, and they yield scores very similar to those obtained by other methods, such as the Thurstone method (1938). Also, as Best and Kahn (2003) observe, a Likert scale takes much less time to construct, and it offers an interesting possibility for the participants in opinion research. Likert scales are also appropriate for opinions measured on one occasion within a limited time scale.

In order to apply the Likert scale, the following procedure should be followed:

1. The concept to be measured should be defined.
2. A set of possible scale items, which could be ranked on a 1-to-7 Disagree-Agree response scale, should be created.
3. A 1-to-7 rating scale is usually used in the following way:
   i. = strongly agree
   ii. = slightly agree
   iii. = agree
   iv. = neither/nor
   v. = disagree
   vi. =slightly disagree
   vii. =strongly disagree
4. The items should then be selected for computation, based on the ratings of the arbitrators.

5. The Likert-scale items can then be administered at this stage. The final score for each participant on the scale is the sum of his/her ratings for all of the items on the scale.

4.10 Interview

The interview is one of the data collection methods applied by the researcher in the process of this study. Jones (1985) defines the interview as a social interaction between two people, in which the interviewer initiates and varyingly controls the exchange with the respondent, for the purpose of obtaining quantifiable and comparable information relevant to stated hypothesis.

As a research tool, an interview can serve three different purposes: (1) as a main procedure for collecting data for the research objectives, (2) as a means of testing hypotheses, generating new hypotheses or exploring relationships between variables, and (3) as a validating instrument confirming and verifying data collected by other research methods (Cohen and Manion, 1994). In the present research, interviews are used to serve for collecting data to answer the research questions, and also to interpret, validate and clarify data collected by the other research method employed (questionnaires). Interviews are used as a supplementary tool to explore in greater detail and in depth some aspects covered in the questionnaire.

The decision to make use of interviews in some parts of this research was made after consideration of their advantages, especially when compared with other research methods. For example, when compared with observation, the advantage of an interview is seen in its provision of a 'short cut' to the required data, because the language which the people use can act as a window to what lies behind their action (Robson, 2002).

Compared with questionnaires, interviews permit the interviewer to pursue leads which appear fruitful, to elaborate points which are unclear or avoided by the respondents, and to clarify questions which have been misunderstood (Mouly, 1978). This is made possible during an interview with the immediate feedback in face-to-face interviews, which allows the interviewer to follow up ideas and probe responses, leading to greater clarity and in-depth responses (Drever, 1995). Furthermore, compared with questionnaires, interviews allow the researchers to be close to their

participants and this, in turn, allows them to observe and use body language and facial expressions and other form of non-verbal cues in interpreting and clarifying the responses provided by the participants (Robson, 2002). Being close to the participants also helps greater rapport to be established, and this is in turn stimulates the participants to give more complete and valid answers and to divulge confidential matters (Mouly, 1978).

The main advantage of a direct interview is that the researcher can easily adjust the questions as he/she deems necessary, clarify doubts, and ensure the answers are plainly understood. The interviewer may also pick up non-verbal cues (stress, discomfort, etc.) from respondents, and this can help him/her compose a better picture of the topic under investigation (Robson, 2002).

Interviews, however, are not problem-free, as they have some disadvantages over other data-collecting tools. One obvious problem relates to the bias of the interviewer (Cohen and Manion, 1994). This stems partly from the subjectivitly of the tool. Subjectivity may create a situation in which the researchers, by projecting their personality, may influence the responses they receive (Mouly, 1978). The interviewers might lead or encourage the interviewees to provide answers which support their 'preconceived notions' (Cohen and Manion, 1994), rather than the answers which the respondents think are right. Or interviewers might manipulate what is said by the interviewee by selecting what serves their preconceptions and purposes, and discarding what contradicts them (Mouly, 1978).

Moreover, bias might occur as a result of misperceptions on the part of the interviewers, of what the respondent is saying (Cohen and Manion, 1994). This kind of bias is attributed to the interviewer, and therefore must be minimised by his/her skills and expertise as a sincere researcher whose aim is to find nothing but the truth.

There are other disadvantages. Interviews are time-consuming, especially when it comes to the stage of transcribing and analysing data (Patton, 1990; Robson, 2002; Cohen and Manion, 1994). Furthermore, unlike a questionnaire, which can be posted to the participants, interviews require permission and making appointments with the intended subjects, who may not be readily available, and therefore the researchers have to amend their schedule to suit the interviewees.

In addition, geographical limitations, for example, can play a part in making the interview hard to conduct sometimes, especially since travelling involves the allocation of extra resources and time on the part of the interviewer (Robson, 2002). Fortunately, this problem did not arise as far as this study is concerned, because all the interviews were conducted in Kuwait which is, geographically speaking, a relatively small country, and no long-distance travel was necessary. Another disadvantage of interviews is that interviewers need to be trained to minimise interviewer bias arising from the way in which questions are phrased or from the interpretation of responses, and this also involves extra training costs. One more disadvantage is that interviewees may tailor their answers in order to impress the interviewer, thus giving misleading answers in some cases.

There are three different types of interview: structured, unstructured and semi-structured (Borg and Gall, 1989; Gilbert, 2001).

4.10.1 Semi-Structured Interview

As regards the format of the interview, in this case, semi-structured interviews with open-ended questions were used. The choice of this type of interview was made because of its advantage over structured and unstructured interviews. Structured interviews with pre-established questions, which are mainly closed questions, and predetermined, do not allow room for modification and probing, and they can be regarded as spoken forms of questionnaires (Fontana and Frey, 1994). On the part of the interviewees, structured interviews do not give the interviewees enough scope to express themselves freely, and this may lead to insufficient data. In the unstructured interview, the interviewer does not work from an interview guide, but works to a general plan (Borg and Gall, 1989). In the semi-structured interview, the interviewer asks a variety of questions, and then probes more deeply, using open-format questions to obtain additional information. Bell (1999) describes the semi-structured interview as somewhere between the structured and unstructured point in the continuum.

The advantage of semi-structured interviews over structured and unstructured is that they allow the interviewer to alter the sequence of questions in the schedule, and add or delete questions as the need arises. It enables the researcher to follow through what may turn out to be very significant ideas, and this in turn might give the

research new dimensions and take it down more productive avenues (Mouly, 1978). In the present study, although the questions were pre-written and given to the interviewees beforehand, they were meant to serve as a guide to the researcher, and to enable the participants to provide fruitful answers.

4.10.2 Interview Sampling

As stated earlier, the researcher applied the semi-structured interview technique as a secondary source for data collection. Having consulted her academic supervisors, she set the size of the interview sample to be six teachers, one principal, one head teacher, and two college lecturers. The main aim of these interviews was to validate the data collected through questionnaires.

4.11 Reliability and Validity in Interview

Validity and reliability are always problematic, and even more so in qualitative research (Burman, 1994; McLeod, 1996; Creswell, 1998; Bryman, 2001). Reliability is defined as the degree of consistency of the tool or procedures, and validity as the ability of the tool and procedures to measure what they are supposed to measure (Best and Kahn, 2003). Because this research has made use of tools from both the scientific and interpretive paradigms, it became necessary to address the issue of validity and reliability from both perspectives, because each paradigm has its own ways of looking at these issues.

In the scientific paradigm (stated in Section 4.6), validity and reliability are methodological issues relating to measurement, experimentation and generalisation, whereas in the interpretive paradigm, they are more personal and interpersonal (Reason and Rowan, 1996; Kumar, 1999). It is argued that the terms are inapplicable in qualitative research (Holloway, 1997), and thus an alternative term was suggested, which is called 'trustworthiness' (Lincoln and Guba, 1985).

According to Lincoln and Guba (1985), trustworthiness comprises four aspects:

- Credibility: the degree to which the participants trust the findings of the research
- Transferability: the degree to which the findings can be transferred to another context or participants

- Dependability: the degree to which the study is accurate and consistent, and
- Confirmability: the degree to which findings are not the result of the researcher's bias.

According to Cohen and Manion (1994), the most practical way for achieving greater validity is to minimise the amount of bias as much as possible. The sources of bias are the characteristics of the interviewer, the characteristics of the respondent, and the substantive content of the questions, while Ratner (1997) considered the validity of qualitative research as a check on the objectivity of observations and concept. Furthermore, Maykut and Morehouse (1994) noted that the validity of findings ultimately rests on whether the participants who know them will see a recognisable reality in the propositions of the study.

Qualitative research focuses on three types of validity: descriptive, interpretive, and theoretical or explanatory (Maxwell, 1992). Descriptive validity determines the obvious existence or occurrence of an act or event; interpretive validity is concerned with identifying the nature, quality, and meaning of an act or event; theoretical validity is established through theoretical constructs or causes that generate and explain the act or events (Maxwell, 1992 , 1996). On the other hand, Bryman (2001) describes two main types of validity: 'internal validity' which refers to the level of congruence between researcher and theoretical framework, and 'external validity' which is concerned with the levels of findings in qualitative research and the degree of generalisability of these findings.

For the purposes of this research, validity is seen as the adequacy with which the researcher understands, interprets, and reports accurately participants' description of their perceptions on the adoption of technology. Obviously, the participants become one of the instruments to establish the validity of the researcher's understanding and explanation of the semi-structured interview study. As Denzin and Lincoln (2000) explained, validity has to do with a description and explanation, and whether or not a given explanation fits a given description. A clear view of validity is given by Gee (1999), that validity does not consist in how one tool of inquiry works on its own, rather, in how various tools of inquiry work together.

In traditional research, reliability is a scientific requirement (Creswell, 1994; Huberman and Miles, 1994; Bryman, 2001). Data obtained in traditional qualitative research methods should have reliability in two senses. Firstly, independent observers should agree in their description of what they find out (Bryman, 2001), which is called internal reliability. Secondly, external reliability refers to the successful replication of a study to determine consistency, stability, and dependability of the finding or observations (Bryman, 2001). Therefore, replication involves exploring the same issue in different events to reinterpret or analyse findings from different points to establish reliability.

However, research emphasises that if there is no intent to develop generalisable results, then the study can address only the thoughts of participants. In fact, the researcher in this study does not intend these findings to be generalised. Rather, this research is only meant to document how the participants identify the factors influencing their decision to adopt technology. As Maykut and Morehouse (1994) explained, what can be discovered by qualitative research are contextual findings, not sweeping generalisations. The contextual findings of this qualitative method are a recognisable reality, which will be combined with the quantitative results, to give the researcher confidence in the validity of her research.

After the interview questions were translated into Arabic, the interviews were reviewed and pre-tested to be sure that none of the questions was misunderstood or ambiguous. This review and pre-testing, as a part of the pilot study, were done with the help of some colleagues from the College of Education at Kuwait University.

The semi-structured interviews were recorded on tape with the permission of the interviewees. Bell (1999) points out the importance of recording, and how it can be useful to check the wording of any statement you might wish to quote, and accuracy of your notes. However, hand-written records are also necessary to use if tape-recording is refused.

4.12 Documentary Evidence

In addition to other sources of information investigated, documentary evidence from primary and secondary sources provided necessary historical background for the study subject matter, and good valid criteria for evaluating the current status of the

experiment compared to what had been planned. These particular sources of information allowed specific information about the educational system aims and objectives concerning the Ministry of Education plan for introducing computers into Intermediate education. Moreover, the intermediate school document was collected in order to identify the goals of the school, with particular reference to ICT and the models offered to students and their distribution in the schedule.

As this information needed to be precise and accurate, and since it did not relate to anyone's views or perceptions, it was decided that it would be better to obtain this information from the most reliable source, which is in this case was the documentation centre. So, the main advantage of this method, besides information accuracy and reliability, was easy and fast access to the information which was available in documents retrieved. However, some difficulty was faced because some of this documentation was written in Arabic. Therefore, to overcome this problem, whatever was believed necessary for the study had to be translated into English.

As Yin (1994) states, except for studies of preliterate societies, documentary information is likely to be relevant to every organisation research topic. The usefulness of types of documents is not based on their necessity or lack of bias. However, the documents must be carefully used and should not be accepted as literal recordings of events that have taken place. Nevertheless, the most important use of documents is to corroborate and augment evidence from other sources.

4.13 Statistical analysis

The study examines the relationship between individual characteristics, perceived innovation, and technology adoption decision. This study therefore uses multivariate analysis of variance (MANOVA) alongside two-way analysis of variance (ANOVA), the latter allowing simultaneous testing of the effect of each two independent variables and the dependent variable. It also identifies any interaction between the independent variables (Pallant, 2001).

Van de Vijver and Leung (1997) pointed out that analysis of variance is the most frequently reported statistical test to test level differences. It is the most popular because of its simplicity and availability in computer packages. In addition, the study also includes categorical variables such as gender, age, rank. Therefore, chi-

square tests would be useful to explore the relation between these categorical variables in order to understand the levels of significance. Further descriptive statistics are used for testing categorical variables for the presence of errors (Pallant, 2001).

4.14 Conclusions

This chapter has examined the study instruments used in this research. The methodology adopted for the investigation of the influencing factors in the technology adoption decision at the Intermediate school level is central to this work. The chapter started by shedding some light on the importance of research design. The different aspects of the quantitative and qualitative techniques have been explained. The purpose of using each method of data collection has been presented in this chapter and the reasons for using a multi-method approach have also been explained and justified, and the main methods that have been used throughout this study: the questionnaire, and interview. Then it moved to define sampling and discuss its types. Two types of sampling were identified: probability, and non-probability sampling. After demonstrating how the sample size was decided, the chapter discussed the study sample and sampling method. The researcher then defined the questionnaire, justified its use as the main source of data collection, and explained the process of its construction. The validity of the questionnaire was considered next, and then the manner of its distribution and collection was shown. Limitations of using the questionnaire as a data collection method were also discussed. The interview was then introduced as a secondary source of information in this study, and divided into three main types: the unstructured interview, the structured interview, and semi-structured interview. It has been adopted as the third type for reasons given in this chapter. The advantages and disadvantages of using the interview as a data collection method were also reviewed, and then the interview sample was introduced. Finally, the SPSS package which has been used in the computation of the data was followed.

Chapter 5: Data Analysis and Findings

5.1 Introduction

The previous chapter introduced various methods used in collecting and analysing data collected for the purpose of this research. The use of quantitative as well as qualitative approaches in this research has had many advantages. First, it has supplied the researcher with useful information that helped broaden the scope of investigation. Second, it has provided the researcher with a valuable tool to verify the validity of the informants' responses, and this has been done through the methods of quantitative and qualitative approaches. Third, using more than one data collection method has helped the researcher avoid the deficiencies of any one method.

This chapter comprises the analysis of all the data collected and will report on the findings. The data used in this chapter were the result of 259 questionnaires administered to principals, mathematics head teachers, teachers, and student teachers at Intermediate schools in Kuwait. The collected data were used to identify the factors relating to teachers' decisions on ICT adoption in their teaching activities. In order to better understand why the teachers were or were not adopting ICT in the classroom, data were collected on both the ICT adoption factors, and the effect of individual characteristics on the ICT adoption.

5.2 Instrumentation

A questionnaire constructed by the researcher to suit the present study was based on the following: information obtained from pertinent literature, studies on the diffusion of innovations, studies related to major barriers that impede teachers from integrating ICT into classroom activities, and the researcher's personal experiences as a staff member at the Basic Education College in Kuwait, and as a mathematics teacher in the Kuwaiti Ministry of Education.

500 questionnaires were distributed to staff members of the mathematics departments in Intermediate schools. The total number of respondents involved in this investigation was 259, reflecting a 51.8% usable response rate. Incomplete answers which were not completed, were not analysed by the researcher. The Likert-type

scale questionnaire developed was used to measure the effect of individual characteristics: Gender, Age, Rank, Teaching experience, Educational level and Technology experience, on ICT Adoption factors: Relative advantage, Compatibility, Image, Result demonstrability, Ease of use, Visibility, and Trialability, by means of 75 statements to be responded to by choosing from amongst the seven options (strongly agree to strongly disagree).

5.3 Reliability

Coefficients of Internal Consistency

Reliability is the extent to which a measure produces consistent results (Rudestan and Newton, 1992). Internal consistency is an indicator of how well different items measure the same issue. It is applied not to single items but to groups of items that are thought to measure different aspects of the same concept (Litwin, 1995). To test the instrument for internal consistency, the questionnaire was assessed using Cronbach's (1951) Alpha coefficient. A value of 0.91 was obtained on the standardisation sample of 35 respondents, which indicated that the questionnaire was reasonably reliable.

5.4 Validity

Construct Validity

Construct validity was measured by correlating the seven ICT Adoption factors with their total, as shown in Table 5.1:

Table 5-1: Pearson Correlations between ICT Adoption Factors and total of all factors

Factor	Total ICT Adoption Factors
Relative advantage	.810**
Compatibility	.430**
Image	.626**
Result demonstrability	.568**
Ease of use	.781**
Visibility	.558**
Trialability	.738**

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

Table 5.1 shows that all the ICT factors correlate significantly at the 0.01 level with the total, which confirms the importance of each of the seven factors in the questionnaire.

5.5 Descriptive Analysis

Survey questionnaires were distributed to 500 staff members in the mathematics departments of the 48 intermediate schools in the State of Kuwait. The final usable response rate was 51.8%, from a total of 259 staff members, as explained in Section 5.2. The following table shows the distribution of this major sample according to district.

Table 5-2: Distribution of School Sample by District

Governorate	Schools	Male/Female
Capital	8	4 / 4
Hawalli	8	4 / 4
Farwania	8	4 / 4
Ahmadi	8	4 / 4
Jahra	8	4 / 4
Mobarak Alkabeer	8	4 / 4

Descriptive statistics and inferential statistics are used to analyse the data of this study. Means and standard deviation are used to report the result of the descriptive

analysis. T-test, one-way ANOVA, and correlation are used to report the results of the inferential statistics.

The following research questions were formulated for this study:

1. Does the set of predictor variables (relative advantage, compatibility, image, ease of use, result demonstrability, visibility, trialability) contribute significantly to the rate of ICT adoption decision?
2. What is the order of importance of the ICT adoption factors?
3. Is there any significant difference between males and females in the ICT adoption factors?
4. Is there any significant difference between age groups in the ICT adoption factors?
5. Is there any significant difference between four ranks: principals, mathematics head teachers, teachers, and student teachers in the ICT adoption factors?
6. To what degree are factors such as individual characteristics (age, gender, rank, experience, educational level, technology level) associated with the adoption of ICT?

5.6 Sample Characteristics

The following sections include descriptive information about the main characteristics of the respondents. The researcher sought answers for the demographic questions related to respondent characteristics which included the number of years the respondent has been working, what position the respondent holds at the school, the highest degree held by the respondent, the number of years of teaching experience, gender, and age. The information in the following tables describes and presents the characteristics of the individual respondents involved in this study.

Table 5-3: Sample by Gender

Gender	Frequency	%
Male	136	52.5
Female	123	47.5
Total	259	100.0

Table 5.3 shows that 52.5% of the sample was male, and 47.5% female.

Table 5-4: Sample by Age

Age	Frequency	%
19-29	125	48.3
31-39	75	29.0
40-49	49	18.9
50-60	10	3.9
Total	259	100.0

Table 5.4 shows 48.3% of the sample in the age range 19-29 years and 29% of them in the range of 31-39.

Table 5-5: Sample by Rank

Rank	Frequency	%
Principal	7	2.7
Head-Teacher	26	10.0
Teacher	146	56.4
Student-Teacher	80	30.9
Total	259	100.0

The teachers represent 56.4% of the sample, while the student teachers represent 30.9%.

Table 5-6: Sample by Teaching Experience

Year	Frequency	%
1-5 (Level 1)	136	52.5
6-10 (Level 2)	40	15.4
11-15 (Level 3)	28	10.8
15- (Level 4)	55	21.2
Total	259	100.0

52.5% of the sample has teaching experience of 1-5 years.

Table 5-7: Sample by Educational Level

Educational level	Frequency	%
High School	80	30.9
Diploma	8	3.1
Bachelor	168	64.9
Master	2	.8
Others	1	.4
Total	259	100.0

64.9% of the sample has a Bachelor degree, and 30.9% of them finished high school.

Table 5-8: Sample by Technology Experience (Using Computer)

Experience	Frequency	%
Yes	259	100.0

100% of the sample has technology experience, and all are using computers.

Table 5-9: Sample by Computer Use

Use of Computer	Frequency	%
Several times a day	55	21.2
Once a day	21	8.1
Few times a week	74	28.6
Few times a month	44	17.0
Rarely	63	24.3
Other	2	.8
Total	259	100.0

28.6% of the sample is using the computer a few times a week, while 24.3% is using it rarely.

Table 5-10: Sample by Computer Features Uses

Uses	Frequency	%
Search Information	62	23.9
Chartrooms /discussion group	1	.4
Requesting Information	7	2.7
Listening to Music	12	4.6
Banking	1	.4
E-mail	10	3.9
Downloading Software	11	4.2
Purchasing Products	11	4.2
Playing Games	6	2.3
Others	13	5.0
Multi-use	125	48.3
Total	259	100.0

A large percentage, 48.3% of the sample, makes multi-use of the computer, while 23.9% of the sample is using the computer to search for information.

Table 5-11: Sample by Home Computer

Answer	Frequency	%
Yes	230	88.8
No	29	11.2
Total	259	100.0

Finally, Table 5.11 shows that 88.8% of the sample have their own computer at home.

5.7 Data Analysis and Results

Data were analysed using the SPSS Statistical Package. Both descriptive and inferential statistics were used to answer the research questions of the study. Means were used to order the ICT Adoption factors with respect to perceived importance for each factor. T-tests were used to compare between males and females on the seven ICT Adoption factors and their total. ANOVA (one-way analysis of variance) was used to test for the significance between age groups, ranks, educational level and teaching experience in seven ICT Adoption factors and their total. MANOVA (multivariate analysis of variance) was used also to test the effect of six independent factors: Gender, Age, Rank, Teaching Experience, Educational Level, and Technology Experience, and their interactions with ICT Adoption total. Correlation coefficients between seven ICT Adoption factors were computed to measure the degree of association between the factors of ICT adoption.

5.7.1 Research Question 1

This section presents the data analysis related to Research question 1 (see Section 5.5): Does the set of predictor variables (relative advantage, compatibility, image, ease of use, result demonstrability, visibility, trialability) contribute significantly to the rate of ICT adoption decision? This research question was answered through the

interviews with 10 interviewees representing three different types of participants mathematics head teachers, mathematics teachers, mathematics student teachers). The purpose of the interviews was to identify common attributes of ICT that influenced staff members' decision on adoption. The interviewees were asked a series of open-ended questions in order to elicit their perceptions of the attributes of ICT that influenced the adoption.

5.7.2 Research Question 2

This section presents the data analysis related to Research question 2: What is the order of importance of the ICT adoption factors?

To answer, Table 5.12 shows the seven ICT adoption factors ordered according to degree of perceived importance, as revealed by the average rating assigned to each factor by all respondents.

Table 5-12: Seven ICT Adoption Factors Ranks

Rank	Factor	Mean	Std. Deviation	Mean Weight*
1	Relative advantage	5.5948	.69506	79.9%
2	Compatibility	5.5268	.91791	78.9%
3	Image	5.0068	.65385	71.5%
4	Result demonstrability	4.9644	.61356	70.9%
5	Ease of use	4.8784	.55990	69.7%
6	Visibility	4.8461	.81807	69.2%
7	Trialability	4.4925	.80760	64.2%

*Mean weight computed by dividing mean of each factor on maximum score (7) * 100

Table 5.12 shows that the Relative advantage factor is ranked first by its 5.59 out of 7 as the maximum degree of the scale, which reflects 79.9% of the importance for this factor, then Compatibility is 2, with 78.9% importance, and Image is number 3 (71.5%), Result demonstrability factor is number 4 (70.9%), Ease of use is number 5 (69.7%), Visibility is number 6 (69.2%), while Trialability is the last factor in importance, with 64.2%.

5.7.3 Research Question 3

This section presents the data analysis related to Research question 3: Is there any significant difference between males and females in the ICT adoption factors?

To answer the question, the T-test was used to compare between the two groups in the ICT adoption factors, and the results of the analysis are shown in Table 5.13.

Table 5-13: T-test Results to Compare between Males and Females in ICT Adoption Factors

Factor	Males		Females		T- value	Sig.
	Mean	Std. Dev.	Mean	Std. Dev.		
Relative advantage	5.5179	.75664	5.6798	.61178	-1.902	Not sig.
Compatibility	4.9382	.60639	4.8122	.49763	1.835	Not sig.
Image	5.5116	.94977	5.5436	.88492	-.281	Not sig.
Result demonstrability	5.0643	.67973	4.9431	.62053	1.501	Not sig.
Ease of use	4.9407	.58098	4.9907	.64907	-.655	Not sig.
Visibility	4.8088	.78231	4.8873	.85719	-.767	Not sig.
Trialability	4.4799	.78840	4.5063	.83133	-.261	Not sig.
Total	5.0312	.45422	5.0634	.44097	-.579	Not sig.

Table 5.13 shows no significant comparison between males and females in the IT adoption factors.

5.7.4 Research Question 4

This section presents the data analysis related to Research question 4: Is there any significant difference between age groups in the ICT adoption factors?

To answer the question, ANOVA was used to compare between age groups in the IT adoption factors, and the results of the analysis are shown in Tables 5.14 and 5.15.

Table 5-14: Means and Std. Deviations for Each Age Group in ICT Adoption Factors

Factor	Age group	N	Mean	Std. Deviation
Relative advantage	19-29	125	5.6098	.65550
	31-39	75	5.5206	.68815
	40-49	49	5.6907	.82513
	50-60	10	5.4923	.54175
	Total	259	5.5948	.69506
Compatibility	19-29	125	4.7984	.55154
	31-39	75	4.9040	.61324
	40-49	49	5.0551	.45601
	50-60	10	4.8200	.57116
	Total	259	4.8784	.55990
Image	19-29	125	5.6046	.76934
	31-39	75	5.3581	1.08171
	40-49	49	5.7580	.82952
	50-60	10	4.6857	1.14444
	Total	259	5.5268	.91791
Result demonstrability	19-29	125	5.0660	.62229
	31-39	75	4.8833	.80364
	40-49	49	5.0612	.47744
	50-60	10	4.9250	.44175
	Total	259	5.0068	.65385
Ease of use	19-29	125	4.9743	.65455
	31-39	75	4.8781	.57321
	40-49	49	5.0292	.57346
	50-60	10	5.1714	.54731
	Total	259	4.9644	.61356
Visibility	19-29	125	4.6994	.80543
	31-39	75	4.8324	.87383
	40-49	49	5.2332	.69540
	50-60	10	4.8857	.52077
	Total	259	4.8461	.81807
Trialability	19-29	125	4.6633	.79689
	31-39	75	4.2473	.79007
	40-49	49	4.4861	.77419
	50-60	10	4.2273	.79628
	Total	259	4.4925	.80760
Total	19-29	125	5.0642	.44238
	31-39	75	4.9497	.46847
	40-49	49	5.1738	.41275
	50-60	10	4.9273	.37719
	Total	259	5.0465	.44740

Table 5-15: ANOVA Results to Compare between Age Groups in ICT Adoption Factors

Factor		Sum of Squares	d. f.	Mean Square	F	Sig.
Relative advantage	Between Groups	.997	3	.332	.686	.562
	Within Groups	123.645	255	.485		
	Total	124.642	258			
Compatibility	Between Groups	2.413	3	.804	2.614	.052
	Within Groups	78.466	255	.308		
	Total	80.879	258			
Image	Between Groups	12.585	3	4.195	5.223	.002
	Within Groups	204.796	255	.803		
	Total	217.381	258			
Result demonstrability	Between Groups	1.793	3	.598	1.405	.242
	Within Groups	108.507	255	.426		
	Total	110.301	258			
Ease of use	Between Groups	1.205	3	.402	1.068	.363
	Within Groups	95.921	255	.376		
	Total	97.126	258			
Visibility	Between Groups	10.063	3	3.354	5.260	.002
	Within Groups	162.600	255	.638		
	Total	172.662	258			
Trialability	Between Groups	8.861	3	2.954	4.725	.003
	Within Groups	159.411	255	.625		
	Total	168.272	258			
Total	Between Groups	1.678	3	.559	2.854	.038
	Within Groups	49.965	255	.196		
	Total	51.643	258			

To investigate the comparison between age groups in the ICT adoption factors, a one-way ANOVA design was used with age groups as the independent variable (four levels), and ICT adoption factors as the dependent variable. Respondents were grouped into four age levels.

Following that, a post-hoc comparison of means of ICT adoption factors across the four age levels was conducted using Scheffe's method. Results of the comparison show that there were four significant differences, as follows:

- The first significant difference was between Level (1) [19-29 years] and Level (4) [50-60 years], in favour of Level (1) in Image factor. This indicates that the younger group has better image.

- The second significant difference was between Level (3) [40-49 years] and Level (4) [50-60 years], in favour of Level (3) in Image factor. This also indicates that the younger group has better image.
- The third significant difference was between Level (1) [19-29 years] and Level (3) [40-49 years], in favour of Level (3) in Visibility factor. This indicates that the older group has more visibility.
- The fourth significant difference was between Level (1) [19-29 years] and Level (2) [31-39 years], in favour of Level (1) in Trialability factor. This indicates that the younger group has more trialability.

5.7.5 Research Question 5

This section presents the data analysis related to Research question 5: Is there any significant difference between four ranks: principals, head teachers, teachers and student teachers in the ICT adoption factors ?

To answer the question, ANOVA was used to compare between ranks in the ICT adoption factors; the results of the analysis are displayed in Tables 5.16 and 5.17.

Table 5-16: Means and Std. Deviations for Ranks in ICT Adoption Factors

Factor	Ranks	N	Mean	Std. Deviation
Relative advantage	Principal	7	5.9011	.68761
	Head-Teacher	26	5.8935	.48263
	Teacher	146	5.5248	.72621
	Student-Teacher	80	5.5986	.67335
	Total	259	5.5948	.69506
Compatibility	Principal	7	5.0286	.63957
	Head-Teacher	26	5.0538	.36467
	Teacher	146	4.8979	.58962
	Student-Teacher	80	4.7725	.53698
	Total	259	4.8784	.55990
Image	Principal	7	5.9184	.55853
	Head-Teacher	26	5.6484	1.09711
	Teacher	146	5.4804	.99214
	Student-Teacher	80	5.5375	.71960
	Total	259	5.5268	.91791
Result demonstrability	Principal	7	5.2500	.35355
	Head-Teacher	26	5.0096	.41522
	Teacher	146	4.9521	.72476
	Student-Teacher	80	5.0844	.59260
	Total	259	5.0068	.65385
Ease of use	Principal	7	4.9898	.94709
	Head-Teacher	26	5.1978	.55413
	Teacher	146	4.9100	.58506
	Student-Teacher	80	4.9857	.64184
	Total	259	4.9644	.61356
Visibility	Principal	7	5.2653	.39922
	Head-Teacher	26	5.0824	.64672
	Teacher	146	4.8386	.89084
	Student-Teacher	80	4.7464	.73513
	Total	259	4.8461	.81807
Trialability	Principal	7	4.7403	.63945
	Head-Teacher	26	4.6329	.83299
	Teacher	146	4.2933	.83030
	Student-Teacher	80	4.7886	.66329
	Total	259	4.4925	.80760
Total	Principal	7	5.2771	.46476
	Head-Teacher	26	5.2430	.35478
	Teacher	146	4.9819	.46458
	Student-Teacher	80	5.0803	.41838
	Total	259	5.0465	.44740

Table 5-17 ANOVA Results to Compare Ranks in ICT Adoption Factors

Factor		Sum of Squares	d. f.	Mean Square	F	Sig.
Relative advantage	Between Groups	3.694	3	1.231	2.596	.053
	Within Groups	120.949	255	.474		
	Total	124.642	258			
Compatibility	Between Groups	1.911	3	.637	2.057	.106
	Within Groups	78.968	255	.310		
	Total	80.879	258			
Image	Between Groups	1.780	3	.593	.702	.552
	Within Groups	215.600	255	.845		
	Total	217.381	258			
Result demonstrability	Between Groups	1.333	3	.444	1.040	.375
	Within Groups	108.967	255	.427		
	Total	110.301	258			
Ease of use	Between Groups	1.890	3	.630	1.687	.170
	Within Groups	95.237	255	.373		
	Total	97.126	258			
Visibility	Between Groups	3.485	3	1.162	1.751	.157
	Within Groups	169.177	255	.663		
	Total	172.662	258			
Trialability	Between Groups	13.753	3	4.584	7.565	.000
	Within Groups	154.520	255	.606		
	Total	168.272	258			
Total	Between Groups	2.076	3	.692	3.560	.015
	Within Groups	49.567	255	.194		
	Total	51.643	258			

To investigate the comparison between ranks in the IT adoptions factors, a one-way ANOVA design was used, with ranks as the independent variable (four ranks) and IT adoption factors as the dependent variables. Respondents were grouped into four ranks.

Following that, a post-hoc comparison of means of ICT adoption factors across the four ranks was conducted, using Scheffe's method. Results of the comparison show that there was only one significant difference as follows:

A significant difference was found between Teachers and Student teachers, in favour of student teachers in the Trialability factor; this indicates that the student teachers have more trialability.

5.7.6 Research Question 6

This section presents the data analysis related to Research question 6: To what degree are factors such as individual characteristics (age, gender, rank, experience, educational level, technology level) associated with the adoption of ICT?

To answer the question, MANOVA was used to test the effect of six independent factors: Gender, Age, Rank, Teaching experience, Educational level, and Technology experience, and their interactions with the ICT Adoption total. The results are shown in Table 5.18.

Surprisingly, none of the individual characteristics discussed earlier (e.g. age, gender, rank, experience, educational level, skill level) in Chapter 3 seems to have a significant correlation with the adoption of ICT. These data will be illustrated later in Chapter 6.

Table 5-18: Effect of Independent Factors on ICT Adoption Total

Source	Sum of Squares	d.f.	Mean Square	F	Sig.
Corrected Model	13.272	45	.295	1.637	.011
Intercept	772.648	1	772.648	4289.110	.000
GENDER	1.887E-03	1	1.887E-03	.010	.919
AGE	.306	3	.102	.567	.637
RANK	1.134	3	.378	2.098	.102
Teaching experience	.780	3	.260	1.443	.231
GENDER * AGE	.714	2	.357	1.981	.140
GENDER * RANK	.189	2	9.427E-02	.523	.593
AGE * RANK	1.353	3	.451	2.504	.060
GENDER * AGE * RANK	.282	1	.282	1.568	.212
GENDER*Teaching experience	.104	3	3.464E-02	.192	.902
AGE * Teaching experience	2.021	5	.404	2.244	.050
GENDER*AGE* Teaching experience	.792	2	.396	2.199	.113
RANK * Teaching experience	1.160E-02	2	5.802E-03	.032	.968
GENDER*RANK*Teaching experience	.142	1	.142	.787	.376

Table 5.18 shows the following results:

- Gender has no significant effect on IT Adoption Total.
- Age has no significant effect on IT Adoption Total.
- Rank has no significant effect on IT Adoption Total.

- Teaching experience has no significant effect on IT Adoption Total.
- There are no significant effects between the interactions of the independent factors on the ICT Adoption Total, except for the interaction AGE * Teaching experience, where the results show its effect on the ICT Adoption Total at the 0.05 level of significance.

5.8 Interview analysis

As stated earlier (Section 4), the interview is the second source of data collection used in this research. Interviews were carried out with 10 staff members. The aims of the interview were to explore more deeply all information gathered through questionnaires.

From the first question of the interview, it is clear that the work experience of mathematics teachers falls between 6 to 14 years. This fact reveals that those interviewees have a very good teaching experience, which helped the researcher in getting a better result from well qualified personnel.

The second part of the interview was about the participants' background information. Although most of interviewees have a little computer experience relating to mathematics teaching, all of them have attended some basic programmes on such as Word, Windows and Excel.

All the indications showed that the respondents were using audiovisual materials in their teaching. Such unanimous agreement on the use of audiovisuals in teaching is not surprising. However, there are two reasons behind such unanimous agreement. First, the teachers' use of audiovisuals proceeds from their strong faith in the role which their use could play in the students' learning process. Second, mathematics is considered to be one of the difficult subjects, and the use of audiovisuals will make this subject more exciting. Whatever the teachers' motivation to use audiovisual equipment teaching, we believe that all of them are very well experienced in using the equipment. Whereas in using computer technology, four teachers said they use computers in designing the methods of teaching and explaining the lessons, six said they use computers in printing their exam questions or in keeping students' files.

In the third part of the interview, the interviewees were asked a series of questions in order to elicit their perceptions of the attributes of ICT that influenced its adoption.

5.8.1 Relative Advantage

Regarding the possible relative advantage of using computer technology as perceived by mathematics teachers over the traditional setting, in this study, the sub-dimensions of relative advantage that emerged from the interviews were instructional advantage and social advantage.

The interviewees indicated that instructional advantage was very important in influencing the adoption of ICT in the educational setting. For example, one stated, "I agree that the use of computers in teaching mathematics is very important, and I urge that mathematics teaching needs computers more than other subjects in education do. The computer helps to simplify concepts for students by embodying the information and making it tangible".

A numbers of interviewees agreed on the benefits of the computer for teachers and students. One of them said, "One of the most important aspects of the computer is its ability to project geometrical shapes in a three-dimensional way, and also it can project various diagrams and pictures. However, one of its drawbacks is the lack of mathematical programs in the Arabic language".

Another teacher stated that, "The mathematics needs a great deal of mental skills supported by immediate explanation of the method for solving problems, which is what the computer is capable of doing. Some of the positive aspects of the computer are excitement, accuracy of information, and time saving".

Another teacher emphasised the necessity of introducing the computer to all mathematics lessons, because mathematics is a practical subject based on computations. He went on to say that, "It would be difficult to predict the advantages without the actual use (of the computer). On the other hand, we could say that many benefits may be obtained from the computer, such as the practical comprehension of the subject and the stimulation of the students' minds".

Also, another participant said, "The computer with all its diagrams graphics will reduce the amount of time and effort in preparing the methods in teaching and explaining the lesson in the daily plan".

For social advantage, one of the interviewees stated, "The use of computers in schools is considered essential for students' future. Computers play an increasing role in our everyday lives, and our children should be educated in their use and in

their principles of operation, in preparation for their encounters with them in the workplace". A second interviewee stated, " It is commonplace to assert that school should make children of the information age computer- literate. The idea of illiteracy has changed from its traditional to a new meaning, which involves the inability to deal with information technology and computers". Another teacher stated, " It is a main task for school to produce students who are technologically literate and prepared to be successful contributors to our society".

5.8.2 Compatibility

The compatibility factor can be sub-categorised in this study as compatibility with the mission of teachers, compatibility with staff expertise and interest, and compatibility with teachers' needs.

Regarding the compatibility of using ICT with teachers' mission, the more compatible ICT is perceived to be with existing teaching styles, the less teachers are required to change themselves, which facilitates acceptance of the new. The compatibility factor is supported by the results of this study. The less the teachers interviewed thought they needed to change their existing teaching styles to accommodate the computer technology as an educational medium, the more positive beliefs they formed regarding its use in the classroom. When ICT is perceived to fit with a teacher's current teaching style, change will be achieved more easily, and ICT will be accepted more readily. Hence, most teachers, seeing ICT as compatible, are not perceiving the need to change themselves much to accommodate the ICT, will much more readily accept it.

Regarding compatibility with staff expertise and interest, teachers nevertheless indicated that they have a long way to go, for example 2 teachers in the 10 felt "very well-prepared" to integrate computer technology in the grade and subject they taught, compared with 4 who were "moderately well-prepared", and 4 who were "somewhat prepared".

Teachers were also concerned with other elements of effective technology use, starting with hardware, software, and inadequate teacher training. Due to the lack of computer use (in teaching mathematics), few teachers have sufficient knowledge of how to use computers in their classroom and, hence, this valuable device tends to be misused or not used at all.

Also, some teachers pointed out that the main issues were insufficient resources for teachers to keep current with the emerging technologies, and limited or inappropriate hardware, due to lack of funding for upgrade and maintenance. The second most commonly cited problem was related to organisational factors like scheduling, lack of time, and class size. Teachers expressed scheduling difficulties, and mentioned that their self-development activities were limited, owing to poor computer access during release times. Moreover, they went on to say that "lack of commitment by a school administrator may be the most critical obstacle to the effective adoption of ICT in school. Principals should possess a clear vision, a strong commitment, and strong motivational skills".

Compatibility with teachers' needs was considered high in terms of importance. Teachers were supporting the need for school improvement from within the existing educational system. For example, one of the interviewees stated, "Students differ in their backgrounds, abilities, and their standpoint of learning, as well as the time required for learning. The general problem in any educational system is how to reach the individual student effectively. This problem is seldom addressed adequately in current educational systems". He went on to say that, "From my teaching experience in classrooms of no less than 30 pupils, the time normally spent individually with each student does not exceed more than a few minutes per week. Hence, it becomes clear that two distinct types of students are not given enough attention: those with low-level achievement and the exceptionally gifted students".

Furthermore, another interviewee stated, "Often, students in the Kuwait educational system are spectators who watch the instructor and follow what he or she does. In an improved educational system, students should be participants, active learners, thereby enjoying the learning process and gaining more. One of the computer's main advantages in learning is its capability to provide an interactive learning experience for students of all ages and abilities".

5.8.3 Trialability

Trialability is the degree to which using a computer may be experimented with on a limited basis. The mean result regarding the importance of the trialability factor indicated that trialability was giving less evidence from the presence of this factor in these data than any of the other factors. The degree to which trialability is important

in influencing adoption may be dependent on the individual school. However, results from all the interviews indicated that trial periods in which computer activities were highly visible to students and staff were necessary to gain administration support and ensure that an academic software would be adopted. One of interviewees stated, "I began teaching some mathematics programs. Through these activity classes, I got a core group of students who were interested in what we were doing. The administrators did not really understand these programs and their benefits. So, I spent some time trying to educate and persuade them to support and provide us with suitable programs".

5.8.4 Visibility

Visibility is the degree to which the results of an innovation are visible to others. Innovations that are perceived as having high visibility are more likely to be adopted than innovations with low visibility. Visibility was indicated as less important in influencing ICT adoption. One of the reasons for low indication is that the lack of appropriate ICT equipment in the classroom presents a major concern with suitable software and programs. For example, most the interviewees stated, "Teachers have limited time and energy, so it is highly important to design programs which are easy for them to understand and which will fit into the classroom routine". They went on to emphasise that, "One important factor that influences how effective implementation will be is the level of support of the leader for the change".

5.8.5 Ease of Use

Ease of use is the degree to which an innovation is perceived as relatively easy to understand, use, and implement. Generally, the more easy an innovation is perceived to be, the more likely it is to be adopted. Ease of use indicated relatively moderate importance in influencing ICT adoption, and was described in this study in terms of ease of implementation. Most interviewees indicated that a computer which is considered easy to implement is more likely to be adopted than one that is considered complex and difficult to implement. However, in order to make computer implementation less complex, interviewees stated that, "Teachers should be provided with intensive training programmes, teachers should be given support, not

just additional resources, but time and assistance to develop and enhance their own understanding and to apply their new knowledge to their teaching".

5.8.6 Results demonstrability

Results demonstrability is the tangibility of the results of using the innovation (computer technology), including their observability and communicability. Even though the innovation produces effective results, if those results are indistinct, users will have difficulty in understanding the usefulness of the innovation. This study showed that results demonstrability is a significant determinant of perceived usefulness of the innovation. This factor was measured by asking interviewees whether they have difficulty in telling others about the results of using technology, whether they could communicate to others the consequences of using computer technology, whether the results of using the technology are apparent to them, and whether they have difficulty to explain why using technology may or may not be beneficial.

Most interviewees agreed that a particular computer technology would enhance his or her job performance, and he/she believed that using a particular technology would be free of effort. However, it incorporates leadership as an important factor that contributes to successful technology adoption.

5.8.7 Image

Image is the degree to which use of an innovation is perceived to inhance one's image or status in one's social system. Enhancing value of computer technology increases teachers' intention of computer adoption. Image scored relatively highly in importance in influencing ICT adoption. In this study, participants who regard the use of technology services as prestigious will have higher intention to adopt technology than those who do not. For example, most interviewees view the adoption of ICT as a way to appear technically aware and politically progressive. For example, one of the interviewees stated, "Using technology improved my image within school and others see me as a more valuable employee".

5.8.8 Leadership

Along with the factors that effect the adoption of ICT noted above, a new attribute that emerged through the interviews is leadership. Leadership refers to the leadership of champions from school/college/department in influencing the adoption process. Regardless of how the innovation champions are defined, it is apparent that they are leaders who play an essential role in their organisation. Without their commitment to educating staff members about ICT benefits, providing support and encouragement, it seems unlikely that ICT would be adopted. The involvement and commitment of the innovation leader has been cited as essential to the success of an innovation in being adopted and implemented in schools. The innovation champion is a charismatic individual who throws his/her weight behind the innovation, thus overcoming the indifference or resistance that a new idea provokes in an organisation.

5.9 Conclusions

The aim of this study, as stated in Chapter 1, was to investigate and identify the main factors that affect participants' perception of the adoption of ICT as an educational medium in mathematics teaching in intermediate schools in the State of Kuwait, and hence might impact on their acceptance and subsequent use. It also examined the influence of individual characteristics on adoption. The main overall findings reveal from research survey (questionnaires and interviews) that through the application of an adoption model, successful implementation could be expected for all levels.

The chapter reported the results of data analysis procedures in this research. First, the results of the survey process were presented. The rank order of the mean score for each factor in adoption of ICT was then given. Next, the response rate and the demographic characteristics of research respondents were reported, and the results of the data analysis to answer the research questions were presented.

Results from the interviews were summarised. The interviews resulted in the generation of a questionnaire that represented the perceived innovation attributes of ICT, which answered Research question 1. The review process resulted in the specific perceived innovation attributes factors that contribute significantly to the

rate of ICT adoption. Also, a new factor emerged through the interviews, wich is leadership, and leadership at all levels is critical to the successful adoption of ICT.

Results from analysis of the completed surveys answered the other five research questions. The model developed by Rogers (2003) was supported. In addition, reliability analysis revealed that the overall instrument demonstrated good reliability. Results from the rank ordering of perceived innovation attributes factors revealed the different level of importance that each factor was perceived to have had in influencing ICT adoption. The study also indicates that there is no substantial correlation between the ICT adoption decision and individual characteristics (gender, age, rank, teaching experience, educational level, technology experience). The next chapter discusses these results and suggested implications, and presents recommendations for the ICT adoption model.

Chapter 6: Application of ICT Adoption Model

6.1 Introduction

There has been much discussion around the acceptance decision for the adoption of ICT. In order for ICT to be diffused in education, as the literature presented in Chapter 3 has emphasised, the factors that influence the adoption process need to be identified. Through empirical evidence reported in Chapter 5, this dissertation has investigated perception concerns, and proposed the identification of factors that influence ICT adoption, thereby contributing towards a better understanding of the process associated with the adoption of ICT in education.

The aim of this chapter is to take into consideration the empirical data derived from the previous chapter and offer revisions to the conceptual model for ICT adoption.

6.2 Revision of Proposed Adoption Model

An outline of the main findings from Chapter 5 is given in this section. A number of factors extrapolated from the empirical data have been identified as major factors that were taken into consideration during the adoption of ICT by teachers for mathematics teaching in the State of Kuwait. Interesting aspects derived from the empirical data are summarised below:

- As reported, our empirical data show that the perceived ICT attributes operationalised in this study were successful in predicting the adoption of ICT and the consequent future use by respondents. The sample presented in Chapter 5 revealed that to adopt ICT in mathematics teaching, the order of importance of factors affecting teachers in our sample was relative advantage, compatibility, image, result demonstrability, ease of use, visibility, and trialability.
- The interview sample presented in Section 5.4 revealed that the interviewees were motivated for implementing ICT in their lessons, and they considered leadership an important factor for adoption. However, leadership was not included in the conceptual model proposed in Chapter 3, and thus an addition is required to the model to reflect these empirical findings.

- The study also found that individual characteristics such as gender, age, rank, experience, educational level, and technology level had no significant influence on respondents. Therefore, they do not have to be taken into account when considering their perceptions regarding the ICT adoption.

Figure 6.1 depicts the conceptual model as derived from the empirical findings, which in turn have suggested changes in the model.

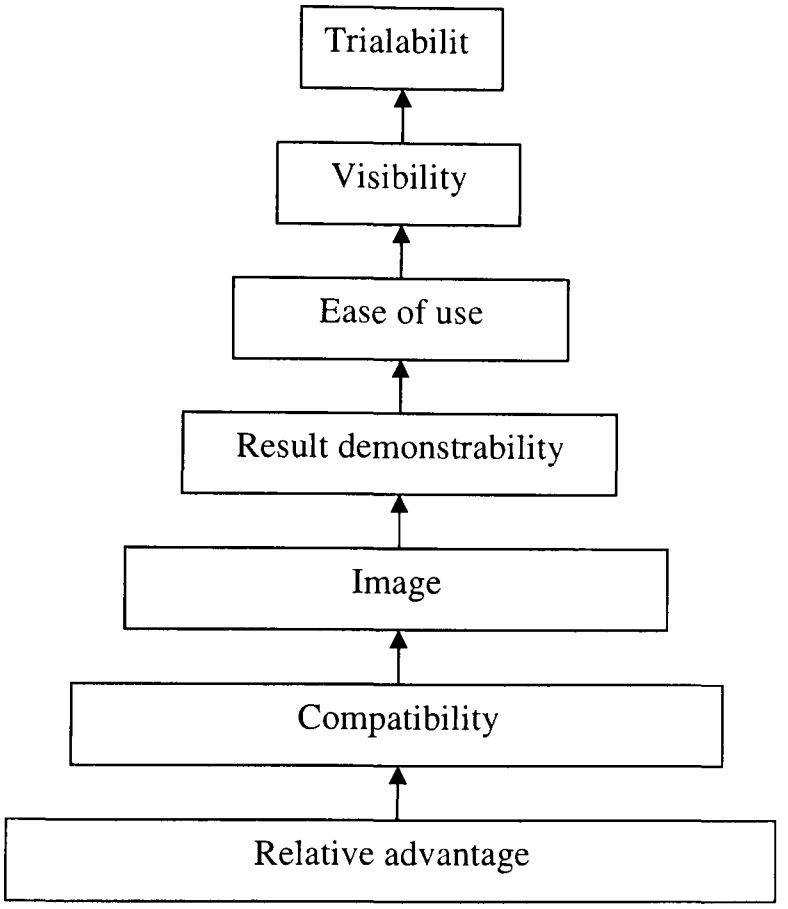

Figure 6-1: ICT Adoption Model

Figure 6.1 illustrates how the perceived ICT attributes were addressed to identify main factors for the adoption of ICT. The model shows the seven factors of the conceptual model proposed in Chapter 3, and how the barriers to adoption can be minimised through the use of the ICT model.

The conceptual model presented in this chapter is structurally similar to the model proposed in Chapter 3 (Figure 3.3), and described in Section 3.3. However, the model presented in Chapter 3 was based on the literature analysis, while the conceptual model presented in this chapter is derived from the empirical analysis presented and discussed in Chapter 5. The revision made to each of the factors is described in the following sections.

6.3 Revision of Conceptual Model for ICT Adoption

In reviewing the literature in Chapter 2 which has investigated the barriers to successful adoption of ICT in schools, the role of the teacher was identified as the most important factor in successful implementation (Loveless, 1996; Bitner and Bitner, 2002; Vannatta, 2000; Zhao et al., 2002; Conlon and Simpson, 2003; Guha, 2003). Individual willingness to adapt to change was the most common indicator. Thus, there is a need to look carefully at the reasons why staff members adopt technology in their teaching activities. Therefore, this issue needs to be addressed, which can provide an understanding of the process of implementing innovation in schools.

The present study goal was to develop a scale for measuring perceptions of principals, head teachers. teachers, and student teachers regarding the adoption of ICT in mathematics education, but we also believe that this scale can be adapted to measure the perceived attributes of other educational interventions.

There are at least two important uses for this type of scale. The first is to determine the perceived attributes of the innovation before it is implemented. With this information, decision makers can modify the innovation so that it will be more likely to diffuse into practice. The second use is to determine the perceived attributes after the innovation is implemented. With this information, the decision makers can determine the most effective dissemination strategies. In doing this, they may choose to highlight attributes people perceive positively, or develop messages to improve perceptions that were negative. This can advance the field of mathematics education by (1) developing new programmes that are more easily diffused into widespread practice, and (2) developing strategies to diffuse innovation effectively based upon known predictors of innovation adoption.

The items for this scale were derived from previous diffusion research (Moore and Benbasat, 1991; Rogers, 2003), as it contained examples of how the seven perceived attributes (i.e. relative advantage, compatibility, ease of use, image, result demonstrability, visibility, and trialability) of an innovation could be operationalised. As illustrated and discussed in Chapter 5, respondents were aware of ICT attributes, and the empirical evidence gathered from 48 schools indicates that perceptions of the selected innovation attributes contribute significantly to the adoption of ICT. Overall, perceptions regarding ICT were favourable towards adoption of the model. Of the 13 items presented, all but individual characteristics had significance for ICT adoption (see Table 4.11). The highest mean scores were found for relative advantage, followed by compatibility, and then image. Thus, when participants perceived greater relative advantage, compatibility, more result demonstrability and less complexity, they were also likely to more fully adopt ICT. For items assessing visibility and trialability, moderate mean scores were found. These finding support the literature reviewed in Chapter 2.

In addition, among the empirical findings, reasons were put forward by interviewees for including a new factor, leadership, which was considered an important factor that influenced their perceptions for adopting ICT.

Based on the empirical findings in Chapter 5, the current study revealed that relative advantage, compatibility, image, results demonstrability, ease of use, visibility, and trialability are an important factors in adoption research. Relative advantage is a significant factor that influences the adoption of ICT. According to the respondents, ICT offered a number of distinct advantages over a traditional setting. Therefore, it seems they believe that ICT is more effective than traditional methods. The construct of relative advantage, which addresses the benefits of ICT adoption, appears to be especially strong in this study. Relative advantage has proven to be one of the best predictors of innovation adoption (Rogers, 2003). Within mathematics education, it has been a significant predictor of adoption for a variety of interventions, including instructional and social benefits. In accordance with empirical findings, in each of these cases (Goldman, 1994; Brink et al., 1995; Parcel et al., 1995; Mesters and Meertens, 1999), the adopter is an organisation, and organisations are likely to be motivated by perceived advantages such as improved job performance, increased

quality of programmes, and increased likelihood of securing additional funds. For reasons such as these, relative advantage is likely to continue to be strongly associated with innovation adoption at the organisational level. The items used to assess relative advantage/ compatibility in this study were positively associated with adoption, internally consistent, and could easily be adapted to examine the adoption of other educational interventions.

Relative advantage that affects ICT adoption is also reported in studies such as Moore and Benbasat (1991), Rogers (2003), and Stevens et al. (2000). They found relative advantage related to Internet adoption among participants in an organisation

Compatibility is the second factor result in our research. Compatibility measures the degree to which adopting ICT is perceived as being consistent with the existing values, needs, and past experiences of users. In the context of the current study, findings in Chapter 5 indicated that compatibility is an important determinant of participants' perception of ICT adoption. Compatibility as a factor that affects the adoption of innovation is reported in studies such as Steinfield (1986), Carter (1997) and Kaminer (1997).

Compatibility is also the second innovation attribute that Rogers (2003) identified. One element of compatibility is the degree to which an innovation is compatible, and if the innovation can be seen as advantageous by the potential adopter or as compatible with an individual's needs, it is more likely to be adopted. However, within the compatibility attribute is also the factor of consistency. Consistency may have an unpredictable effect, but it can speed up an adoption.

In the current study, compatibility was found be highly related to the adoption of ICT among participants. Compatibility is the measure of the degree to which an innovation can be seen to be compatible with existing values, beliefs, experiences and needs of adopters (Moore and Benbasat, 1991; Rogers, 2003). This result is in accordance with sociological studies which have shown that innovations that are consistent with sociocultural values are adopted more rapidly than innovations which conflict with these values (Hassinger, 1959). This is also reported in studies such as Chin and Gopal (1995) and Plouffe et al. (2000).

Results of both questionnaires and interviews presented in Chapter 5 indicated that image had influenced the adoption of ICT by respondents. This is along the same

lines as the theoretical model presented by Moore and Benbasat (1991) which shows image as a factor that affects the adoption of technology. Likewise, the effects of image on ICT adoption is reported in studies such as Plouffe et al. (2000) and Van Slyke et al. (2004), whereas this factor refers to the degree to which the use of the innovation is seen as enhancing to an individual's image or social status (Moore and Benbasat, 1991).

Also, the findings of data in Chapter 5 revealed that respondents have clear evidence regarding the results of using ICT when preparing lessons. Results demonstrability represent the degree to which the results of using an innovation are perceived to be tangible (Moore and Benbasat, 1991). Karahanna et al. (1999) and Van Slyke et al. (2002) support the view that the more an innovation had perceived results demonstrability, the more quickly it would be adopted.

The issue of complexity (inverse of ease of use) was supported by many researchers (Davis, 1989; Goldman, 1994; Rogers, 2003), in finding that the perceived usefulness and ease of use of an application are factors that influence an individual's attitude towards innovation adoption. Complexibility of an innovation, according to Rogers (2003), is negatively correlated with adoption processes. If individuals find an innovation too difficult to understand or to use, they are less likely to adopt it. Zaltman et al. (1973) concurred with Rogers, and found that complexity of a concept or of an implementation can be a deterrent to their adoption. Pelz and Andrews (1985) agreed with Rogers, stating that technically simple innovations are installed with a more discrete succession of stages than are complex ones.

In the current study, empirical findings in Chapter 5 revealed that ease of use (inverse of complexity) also appears to be a significant predictor of adoption in this study. These who perceived greater complexity were less likely to indicate that they had fully adopted ICT. In the context of our sample, ease of use ranked as the fifth factor. The main reason is that using ICT in teaching is relatively new to teachers, and at this stage, they may be unfamiliar with technologies. In the literature, complexity as a factor that affects the adoption of technology is emphasised by a number of studies, such as Al-Najran (1998) and Al-Lehaibi (2001) who indicated that complexity is an obstacle to diffusion of the Internet. Also, Lin (1998), in a

study of PC adoption, noticed that when adopters' perception of computer advantage is high, complexity is not a major concern.

On the other hand, Crandall (1977) cited several large educational studies by the Rand Corporation and others suggesting that the larger the scope and personal 'demandingness' of change, the greater the chance for success. The authors explained the apparent conflict with other findings by indicating that educational studies represent implementation after an adoption decision has been made, rather than prior to the decision. They stated that apparent complexity may initially deter a potential adopter who has to master the innovation alone.

The construct of visibility was also a predictor of adoption in this study. When respondents perceived that they would notice changes upon implementing the innovation, they were more likely to fully adopt the ICT. Visibility has not always been significantly associated with innovation adoption. In fact, this finding is in accordance with the other case study found, in which visibility was an important predictor of adoption (Goldman, 1994). We believe that the construct of visibility will be an important predictor for programmes that provide very tangible outcomes.

Visibility examines how apparent or visible the use of the innovation is in a school context. According to Moore and Benbasat (1991), this is the perception of the actual visibility of the innovation itself, as opposed to the visibility of outputs.

The innovation attribute, visibility, indicates that innovations are more likely to be adopted if they can produce visible results. This attribute, as seen in Rogers' model, is a strong predicator of adoption rate, and is positively correlated as well (Cottrell, 1997). As cited in Claser et al. (1983), also sees visibility of results of an innovation as important under its readiness for use.

In addition, empirical evidence in Chapter 5 identified that trialability is a predictor factor for the adoption of ICT. Nevertheless, it is a lesser factor in the current study of the adoption model. This may be because trialability variables are not often significant in educational technology research, or that trialability is a difficult construct to measure, particularly when assessing a process. In fact, the results in the current study have shown that trialability is the factor that least influences the adoption of ICT in Kuwaiti schools. As reported in Chapter 5, there was a lack of suitable software for mathematics education. This is in contradiction with the

literature, which indicated that trialability is a more important factor for early adopters, who tend to substitute the experience of others for their own trial (Ryan, 1948; Rogers, 2003).

Trialability represents the extent to which participants can trial the use of the ICT in their teaching prior to adoption. If an innovation can be broken down into parts and tried a small portion at a time, the innovation has a greater chance for adoption. Innovations that do not provide for trialability will have a more difficult time in being adopted (Rogers, 2003). Trialability that allows the individual time to experiment with and understand the innovation through a phased approach before full adoption must occur, the more likely the innovation will ultimately be adopted. Studies addressing the importance of users being able to see a demonstration of an innovation or having the opportunity to try it out with minimal risks showed positive correlation with the adoption rate of the innovation (Rogers, 2003). The more an innovation can be partitioned and experimented with, the better the prospects for adoption.

6.4 Individual Characteristics

The empirical outcome contradicts the proposed model in regard to individual characteristics (age, gender, rank, experience, educational level, technological level). These findings confound the widely held assumption of the importance of the adopter's individual characteristics for adoption and use of ICT. Thus, individual factors such age, gender, rank, experience, educational level, and technological level do not have to be taken into account when considering participants' perception for the adoption of ICT. The finding is not consistent with a number of studies, such as Schiller (2000) who concluded that staff members' age, rank, and experience would significantly influence perception for ICT adoption.

Also, individual characteristics were reported to have the highest influence of associated with ICT adoption. According to Rogers (2003), innovative individuals are young, more responsive to new technologies, and reflect higher socioeconomic status in terms of occupational prestige, and education. Also, innovators are thought to be more exposed to interpersonal communication and mass media channels. Gatignon and Robertson (1985) confirmed Rogers' description of innovator

individuals. They reported in their findings that innovators are younger, and commonly have higher education levels and incomes. Individual characteristics as important factors that affect the adoption of ICT are also reported in many studies such as Dutton et al. (1987) Shim and Drake (1990), Madden and Savage (2000), and Stevens et al. (2000). Also, Atkin et al. (1998) reported that age and education were found to be positively related to Internet adoption.

Nevertheless, some other findings on the characteristics of innovators suggest contradictions and inconsistent prediction. For example, a study conducted by Reagan (1987) showed a weak association between demographic variables and technology diffusion. In addition, Stevens et al. (2000) did not find educational level to be a significant predictor of Internet adoption. Other researchers who did not find demographic variables to be important predictors are Kang (2000) and Wright (2000).

6.5 Leadership

Although 'leadership' emerged from the interviews, and was labelled during the interviews review process as a perceived innovation attribute category, previous literature on innovation diffusion has not included it as an innovation attribute, but rather an environmental determinant or prior condition in the diffusion of innovation. Regardless of how 'leadership' is categorised, the results of this research indicate that leadership is an important factor in influencing the adoption of ICT .

Within the context of ICT adoption, the empirical evidence revealed the importance of the leaders in schools, who can provide a balance of pressure and support. It has been identified through the data collected in this study that there has been significant pressure to adopt ICT in teaching mathematics. It appears that, at various times, the balance of pressure and support was uneven. As noted by Leithwood (1992), the goals of leaders were to encourage people to develop and foster a collaborative and professional culture, to encourage and stimulate staff development.

One of the key theoretical constructs adopted by this study was Rogers' (2003) so-called 'rate of adoption categorisation' and his 'critical mass' concept. Being able to identify the rate of adoption of various staff members proved to be a useful tool, and

throughout the data collection and analysis, as it enabled the researcher to make some generalisation about the rate of adoption.

Once the rate of adoption categories was identified for a particular sample, the researcher was able to determine whether critical mass had been reached. For instance, from the survey sample, the researcher was able to identify very early in the study that perception of adoption of ICT in teaching mathematics had reached the critical mass stage. According to Rogers' theory, once a critical mass stage has been reached, then the innovation can be self-sustaining. He also recognised that it was important to target the early adopters' group, as they can trigger the larger group. As participants were beyond the critical mass stage, this particular study found that the innovators were not only the leaders in adopting the technology, but also the leaders in initiating and implementing change within their schools. It is therefore important for schools to recognise and strongly support the early adopters and innovators, as both are crucial to the diffusion process.

This study identified a crucial area which requires attention if ICT is to be effectively integrated into the teaching environment of Kuwaiti schools. As outlined in a number of interviews, leadership is one of the important elements when attempting to develop a professional learning community that will be able to sustain effective technological change. The challenge is for teachers to integrate ICT into the learning process, and this involves changing the ways in which many teachers work. It is argued that principals of schools have a key role as communicator of a vision for teaching and learning in their schools, and through their interventions they can influence the role of ICT. They direct budgets and professional development, and influence teaching and learning. According to Ritchie (1996), lack of commitment by a school principal may be the most critical obstacle to the effective implementation of educational technologies in schools. To ensure success in technology adoption, the leader must be specifically skilled in conceiving technical solutions to educational problems, and then building theoretical, political, and financial support structures (Kearsley and Lynch, 1994). Principals and other school leaders are potentially key transformers of school culture (Maurer and Davidson, 1998).They have considerable impact on the organisational and social culture of the school through the style of their interventions. In a survey of educators in the United Kingdom, 81% indicated that

'more commitment' by leaders was an important component, while only 38% felt as strongly about more hardware and software (Cafolla and Knee, 1996). The innovation inherent in exemplary technology use requires more than hardware, software, and ongoing training. Successful leaders not only challenge the existing educational process and inspire a vision for meaningful change, but also provide the necessary support and modelling strategies to enable teachers to become part of a learning community. Modelling and coaching strategies make the vision clear and more attainable for teachers, and reinforce how others perceive what instructional leaders value (Melissa and Zachariah, 2001) .

A substantial literature identified the school principal as a key factor in bringing about successful change in schools (Fullan, 2001, 2004; Hall and Hord, 2001). While investigating the implementation of educational change, these researchers found that an important factor in successful change was the principal who supported and encouraged those implementing change.

6.6 Conclusions

This chapter presents the rationale behind the development of the conceptual model for influencing the adoption of ICT. The model was proposed as the result of the literature analysis in Chapter 2, and testing the model was based on the empirical evidence presented, analysed and discussed in Chapter 5.

This chapter has concentrated on revising the conceptual model proposed in Section 3.4. Modifications to the model were imposed by empirical findings presented and analysed in Chapter 5. Empirical evidence suggests that apart from the factors reported in the model (Figure 3.3), a new factor is relevant when adopting ICT. This new factor is leadership, and it is reported in interviews as a factor that influences ICT adoption. Leadership can be formulated as a result of the interviews, but it needs further study to be tested.

The empirical data gathered from 48 schools indicate that there is no substantial correlation between adopters' individual characteristics such as age, gender, rank, experience, educational level, and technological level, and the perception of adopting ICT.

The revised conceptual model proposes that only seven factors influence the adoption of ICT in Kuwaiti schools. These factors are in descending order of importance, relative advantage, compatibility, image, result demonstrability, ease of use, visibility, and trialability.

Chapter 7: Conclusions and Further Research

7.1 Introduction

The chapter begins by summarising the dissertation and drawing conclusions from both the literature and empirical research reported. Then, a critical review of the research process is presented. A summary of the research contribution follows. Finally, recommendations for further research are discussed.

7.2 Research Findings

This dissertation started with an overview of the research problem in Chapter 1. It has been identified in the literature and empirically confirmed that the adoption of ICT has been a significant problem for schools. Literature revealed that diffusion of innovation in education has historically been a very slow process. Many researchers discussed a number of potential reasons for this. The results were inconclusive in determining why innovations are adopted so slowly or fail to be achieved in education. A need for more research on the diffusion process was clearly indicated. Previous approaches to diffusion innovation have been proved insufficient, since they lead to non-adoption, effectively. Staff members' behaviours are considered the determining factor of how successful the implementation will be in an educational setting, since staff make the ultimate decision on whether to infuse innovation.

Diffusion of innovation theory provides a useful framework for studying the adoption process. Diffusion studies have found that the way targeted adopters perceive the attributes of an innovation is critical, and represents one of the main issues in innovation literature, but it is rarely studied. Previous research on the relationship between innovation attributes and innovation adoption indicates that 49 to 87 % of the variance can be explained through the Moore and Benbasat model, which is based on Rogers' theory, as represented by the perceived attributes. This research found the perceived attributes of ICT, namely relative advantage, compatibility, image, result demonstrability, ease of use, trialability and visibility were significant predictor of the adoption of ICT.

In the context, innovation diffusion research within education is sparse, with the exclusion of studies regarding innovations in IT. Specific studies regarding the adoption of ICT in mathematics education could be instrumental to those individuals interested in organisational change and innovation within the school system. As stated in Chapter 1, the aim of this research is to investigate and evaluate the current situation for the adoption of ICT in intermediate schools in the State of Kuwait, and in doing so, to lead to the development of a model that can be used to support decision-making.

To meet the aim of this dissertation, Chapter 2 started with a literature review on the rationales for ICT adoption in education. Much of these rationales are empirically confirmed and then reflected in Chapters 5 and 6. In investigating more the adoption of ICT, Chapter 2 reviews the multiple factors that affect the adoption process. Increasing attention has been given to the identification of the significant factors contributing to it. To this end, notwithstanding the importance of staff members as the main actors in successful implementation of an educational innovation, most research studies have not focused primarily on them. This limitation has left large gaps in understanding staff members' perceived attributes of innovation. To prepare for the changes that technology will bring, teachers must remain cognisant of the current educational research findings in computer technology implementation strategies. How teachers perceived the benefits and barriers which new technologies present to education will directly influence the decision to adopt technology innovation

Related educational innovation studies involving educational technology use have addressed a myriad of variables related to staff members' adoption and implementation of technology. Based on a review of previous studies, two different levels of influence affecting the implementation process were identified: 1) staff members' perceived attributes of innovation, and 2) their individual characteristics supports. Thirteen criterion variables known to relate to the level of use of ICT were identified from the two sorts of influences: relative advantage, compatibility, image, ease of use, result demonstrability, visibility, and triability; and age, gender, rank, experience, educational level, and skill level. The selection of the variables was substantiated by empirical evidence from previous relevant innovation studies.

Chapter 3 has concentrated on investigating the research issues that were derived from Chapter 2. In doing so, important factors that influence the rate of adoption have been highlighted in Chapter 3, and a conceptual model proposed for the adoption of ICT. The proposed model (see Figure 3.3) attempts to answer the general research question: What are the key factors that influence mathematics teachers' decision to adopt ICT?. In addition to the innovation attributes, the individual characteristics of the respondents have also been identified in Chapter 3, consisting of seven categories: age, gender, rank, experience, educational level, and skill level. Thereafter, based on the existing literature regarding ICT adoption and acceptance, a conceptual model has been proposed (see Figure 3.3). This meets the aim of this dissertation started in Chapter 1. The conceptual model was then empirically examined and modified in Chapters 5 and 6.

A research methodology was developed and adopted in Chapter 4 to carry out the research that focuses on the issues identified in Chapters 2 and 3. Justification for the research methods is stated in Chapter 4. The research strategies are also described and discussed within this chapter. The research issues were investigated through the application of mixed methods (questionnaires and interviews) in 48 schools. These issues dealt with the factors that influence the adoption of ICT in educational settings. Chapter 5 then presented and analysed empirical evidence, and offered an empirical analysis of the sample perception. In doing so, it described the perceptions regarding the ICT adoption. Empirical evidence derived from the mixed methods also confirmed much of the issues identified in Chapter 3.

Empirical evidence derived from the data analyses has identified a number of modifications to the conceptual model. These findings have been considered in Chapter 6, and resulted in the revision of the proposed model (see Figure 6.1). The revised model supports the seven factors which influence the adoption of ICT in schools:

1. Relative advantage
2. Compatibility
3. Image
4. Result demonstrability

5. Ease of use
6. Trialability
7. Visibility

The conceptual model for the adoption of ICT can therefore be used as an evaluation measurement instrument when schools or educational institutions are taking their decisions for ICT adoption. The present research has thus achieved the aim of this research as identified in Section 1.4.

7.3 Research Limitation

While no scientific research is exempt from some limitations, this section will present the limitations that the present study encountered during the research process. Due to time constraints, those who were absent or outside their schools were not included in the survey. Therefore, researchers should be cautious in extrapolating or generalising the results of this study to the overall population of mathematics teachers. Also, this study has focused on the adoption of ICT in teaching mathematics, to the exclusion of other subjects. This reduces the ability to generalise the results to other classes. Further research can be conducted to investigate results holistically by applying the same model for teaching other subjects.

Another limitation in this study was the reliance on respondent answers to provide information about past and present events. One method that may be helpful in future research is to use more than one source from different levels of the organisation. This may provide a better representation of the various perceptions that may exist regarding an innovation, and also provide a check for information accuracy. Other influences on innovation adoption such as organisational characteristics, adopter characteristics, and communication networks were beyond the scope of this research, but likely play an important role in innovation adoption by schools, and should be addressed in future research.

7.4 Contribution to Research

The most important contribution of this research is the development of a model for ICT adoption in mathematics teaching in Intermediate education (see Figure 6.1). As

described earlier in Chapter 2, ICT adoption was always a problematic issue. In improving our knowledge, Section 3.3 proposes a conceptual model for ICT adoption based on Rogers' conceptual framework (2003). This model is empirically investigated and analysed in Chapter 5. Empirical evidence has resulted in a revision (see Figure 6.1), and has led to the final model for ICT adoption.

Rogers' diffusion of innovation theory (2003) provides an excellent framework for this study. Rogers linked the adoption of new innovations to perceived innovation attributes variables. This study used staff members' responses to determine which of the factors appeared as the most influential among the innovation attributes factor variables.

The model makes a contribution that has incorporated factors identified in previous studies as influencing innovation adoption. The research adapts these factors to the mathematics education area, and this has resulted in the development of a consistent model for the adoption of ICT. Seven variables, relative advantage, compatibility, image, result demonstrability, ease of use, trialability, and visibility were identified in the analysis as the important predictors of innovation adoption. The findings supported previous research (Moore and Benbasat, 1991; Rogers, 2003) on innovation attributes and their effect on the adoption process. In addition, one new factor emerged which was leadership. The results indicated that although leadership had emerged from the interviews, it was nevertheless labelled an important factor in influencing the adoption of ICT. Leadership shows a significant impact on interviewees when considering their perception in the decision stage of the innovation adoption.

Studies of organisations and innovation adoption have often found demographic factors for number of employees or number of the population served have influenced innovation adoption (Rogers, 2003). Interestingly, this study (through questionnaires) did not identify any significant relationships for individual characteristics such as age, gender, rank, experience, educational level, and skills level with staff perceptions towards the adoption of ICT in mathematics teaching, therefore they have been removed from the final model.

A variation of the proposed model has been constructed. ICT ARABIA model (ICT Adoption using Rogers' model And Bringing In Addition) was more particularly

suited to the problem in Intermediate education in the State of Kuwait. Thus, the results of the current study are determined by a set of factors which, on the basis of the study carried out, are:

1. Relative advantage
2. Compatibility
3. Image
4. Result demonstrability
5. Ease of use
6. Trialability
7. Visibility
8. Leadership

Also, this research contributes knowledge to both ICT research and practice. Those interested in research about ICT adoption and subsequent use in the developing countries can benefit from this research in several ways. First, it contributes through its empirical validation of innovation adoption and subsequent use in the context of ICT in the State of Kuwait. Very few empirical studies have examined ICT adoption in the Gulf Cooperation Council Countries, and more specifically in Kuwait, particularly individual level rather than organisational level adoption. As far as the researcher can tell, research such as here is the first of its kind in Kuwait. This can set the foundation for further research on ICT adoption and subsequent use, which should yield benefits to both local and international researchers, especially those who are interested in conducting cross-cultural studies.

This study has also come up with and tested factors pertaining to ICT adoption and use in a region where little prior empirical research has taken place. Although there were prior studies that focused on factors that influence the transfer of technology in developing countries, there was a shortage of literature that assesses the factors associated with a country such as Kuwait. Therefore, this research adds to the body of evidence in support of the importance of studying countries individually, consequently ICT adoption practices that exist can be known and understood, and

new and efficient innovation models developed, such as the one presented in this study, that take into account country- specific factors.

In addition to the contributions to research, this study makes a number of contributions to practice. First, the research should be of great value to ICT implementation in the State of Kuwait. Government officials and decision-makers will be able to use its findings to further advance their knowledge regarding ICT adoption and subsequent use. By understanding the important factors that affect ICT adoption, practitioners will be better able to focus on the factors that are applicable to what is lacking in their organisations. Thus, studies such as this point leaders toward circumstances which can be managed or manipulated to provide more favourable environments for the introduction and use of ICT innovations.

The perceived attributes of innovation have been indicated to be useful in determining adoption of ICT. This is important, because it shows that the perceived attributes can be used to explain not only the adoption of simple, one-time innovations, but also the adoption of multi-component, long-term innovations. Moreover, although the ICT ARABIA model was developed specifically for mathematics departments, it has applicability to other settings. The model is most applicable to K-12 schools, and to other colleges within a university.

This study can also provide practical benefits to schools and educational institutions as regards issues in successful design and adoption of ICT in education. When planning to develop and apply a new innovation, schools and institutions will be able to predict whether the innovation will be acceptable to staff members. At the same time, these schools will be able to diagnose the reasons why a planned innovation may be embraced by members or not. As a result of the benefits gained from the current study, correction or adjustment can be made to increase the rate of ICT adoption.

From a practical perspective, this study contributes to the development history of technology education in teaching mathematics. As new innovations are being adopted every year, this information will need to be updated. However, the information provided in this dissertation provides a starting point for tracking the adoption patterns and trends regarding ICT in education.

Moreover, the findings in this study indicate that school principals and head teachers interested in starting to use ICT may be able to use the information gathered in this research to help them in a number of ways. First, to increase the rate of ICT use by teachers, they should consider the various activities being supported by ICT, and develop separate strategies for each situation. When developing these strategies, principals can use the ICT model and specifically consider teachers' perceptions. Future studies could also utilise the same methodology employed in this study to investigate other applications of ICT in schools. Also, future studies incorporating a longitudinal design may provide deeper insight into the complex underlying interactions involved during the diffusion process. For example, the introduction of a new e-learning technology into a school district could be examined at various stages throughout the implementation process to ascertain the stability or otherwise of teacher perceptions regarding the innovation attributes examined in this study. In summary, the ICT adoption model used in this study provides a rich and potentially fruitful area for further research, and has practical implications for teachers.

7.5 Recommendations for Further Research

Results of this research could serve as baseline data to plot the future progress of efforts to improve the adoption of innovation in general, and the adoption of ICT in mathematics teaching specifically. The study might be repeated every year or two to determine what progress has been made in this direction. These follow-up studies could include a qualitative component to aid in targeting specific areas where ICT availability, attitude, and use are more problematic. Qualitative research methods such as focus-group or in-depth interviews should be considered as a supplement to the quantitative research method used. Also, a case study covering the period before, during, and after the adoption of innovation had taken place in an organisation setting should be conducted. Finally, to validate the findings of the research, a replication of this study in other settings or with different subjects is highly recommended.

Also, the study can serve as a research benchmark to design useful training programmes and encourage the use of ICT where it has been found to be effective. The study as a whole provides information that could be useful for further

investigation on the consensus among staff members about ICT, their attitudes, as well as research focusing on what ICT availability and support are necessary to achieve acceptable use of ICT in teaching. It would also help decision-making to meet the needs of commitment to adopt ICT.

The present research contributes to the body of knowledge about perceived innovation attributes and the importance of those attributes in influencing innovation adoption in a new setting. Since the study was exploratory in nature, many questions were generated. Thus, several possible additional research studies may extend the present study, and a number of these are now discussed.

Although this research was limited in scope to one particular type of innovation, the findings could be generalised to the adoption of other different types of innovations in education or in other settings. Further research would be needed to support or negate such generalisations. However, based on the findings in this research, the following generalisations may hold true for other innovations in education.

Although leadership emerged from the interviews, it was labelled an important factor in influencing the adoption of ICT. In general, the leadership of an innovation champion is an important influence on the adoption of ICT innovation in education. In general, innovations that have the commitment and support of an innovation champion, and also have a high degree of relative advantages and compatibility with the school mission, staff, and students, and also have a low degree of complexity are more likely to be adopted by a school. Therefore, those interested in introducing innovation within education may need to focus on finding strong innovation champions to help in the process. Deciding whether the innovation is compatible with the school mission, the staff members may help in the decision to pursue adoption of the innovation by schools.

The model developed for this study could be modified and refined for further testing and more universal applicability, with innovations in education and other settings. A replication of the instrument development process used in this study, with a different innovation, with a different sample of adopters, could help determine the universality of the perceived innovation attributes categories in a different education setting. Testing the model with a large and different population would make factor analysis an appropriate method of analysis, giving additional evidence regarding the existence

of the perceived innovation attributes categories. Future research in this area can focus on the refinement of the model by sending it to teachers of different subjects (not mathematics), lecturers in colleges, and others interested in change in education. The model will be revised and updated based on the feedback received from these stakeholders. The results of that study will be used to determine the validity and usefulness of the model, as well as its applicability to other settings.

Conducting similar research with a population of adopters and non-adopters of the particular innovation would allow comparison between the two groups. In this case, perceived innovation attributes categories could be used as predictor variables. This type of research would provide information about the attributes that influence the decision to reject an innovation, which is an area of diffusion research that has been neglected.

The influence of the organisational characteristics of the adopting schools, colleges and universities on the adoption of ICT has not been explored. Characteristics such as decision-making structure, size, availability of financial resources, and organisational hierarchy have been shown in past literature to influence innovation adoption in organisations.

In summary, the perceived innovation attributes of ICT have influenced their adoption by schools. The existence of the Rogers, and Moore and Benbasat, perceived innovation attributes categories is supported in a mathematics education setting with this particular innovation. However, new categories emerged in this research that need to be explored further. One new category is leadership. The relative importance of the perceived innovation attributes varied; however, leadership was an important influence on the adoption of ICT by schools, and this is shown in Figure 7.1 as part of the proposed ICT Model for further research.

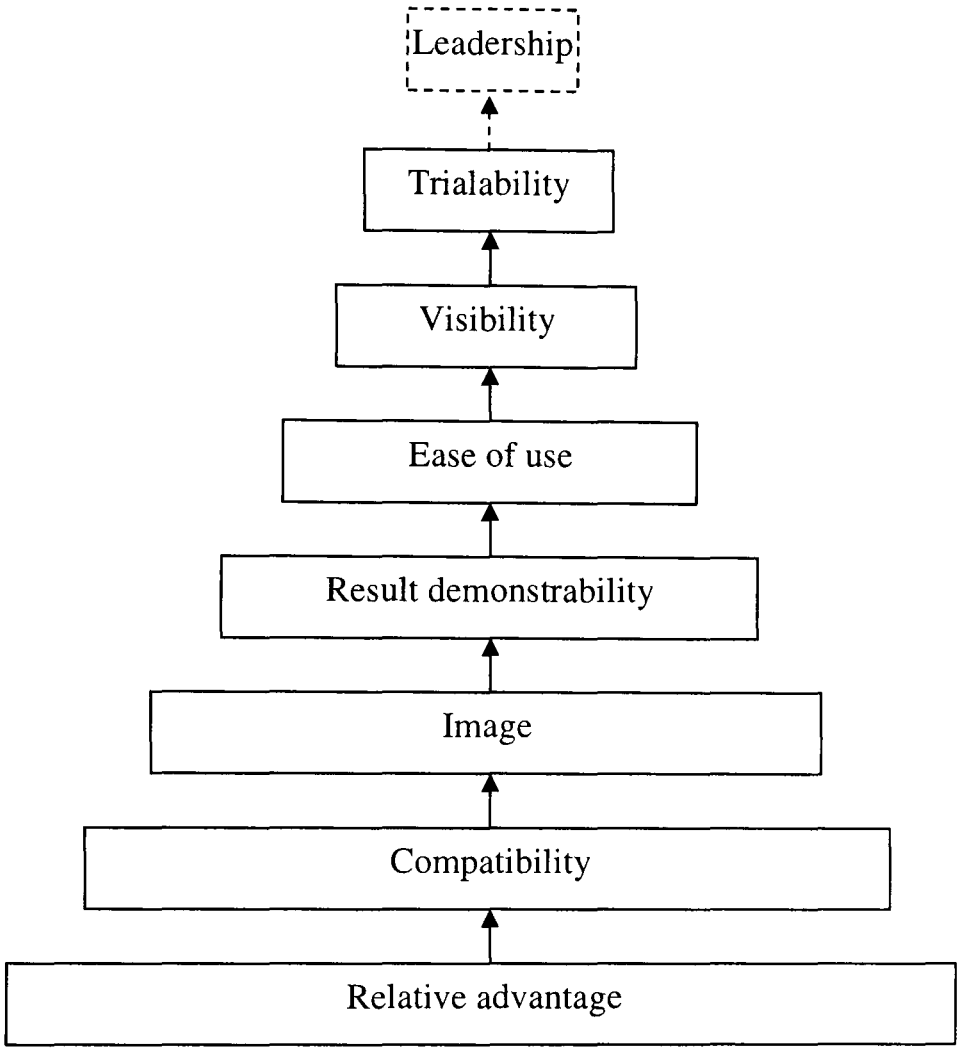

Figure 7-1: Proposed ICT ARABIA Model for Further Research

7.6 Summary

This chapter was dedicated to analysing the results of the findings and the conclusions deduced from these findings. The discussion was divided into two main sections, dealing with the innovation characteristics, and individual characteristics. Some recommendations have been made with regard to perceived innovation attributes, and some further general recommendations were put forward. Suggested future research in this field was reviewed and, finally, the contributions made by the present research were listed.

This study has been a humble but important effort in the field of diffusion innovation work. It is hoped that it will open the door for further research in the same field

because of the importance of ICT in the economic and social life of virtually every society.

7.7 Concluding Remarks: Reflection and Implications

Recently, Kuwait has launched ICT initiatives in educational system, aiming mainly to face the great challenges in the world of work and employment. To this end, it was important to conduct empirical study in the context of Kuwait in order to contribute to a better understanding of the process of adoption and use of ICT. Moreover, the need to understand the process of adoption and use of ICT in the perspective of developing countries has been of interest to different educationalists in the area of Mathematics. Also, this topic is a concern of many Kuwaitis who are involved in applying ICT-related innovations in different sectors as part of the country's development. Furthermore, of ICT professionals, managers and decision-makers in terms of the implementation of ICT that contribute to development.

Besides all the above interests, the choice of this topic for the investigation emerged from the researcher's own interest in facilitating the adoption of innovation. Change is often difficult, not easily accepted, and often resisted. Therefore, much research has been conducted which has produced many descriptions of conditions that seem to facilitate change.

According to Rogers (2003) and Hall and Hord, (1987), because people are affected by change, they should be the centre of attention when a change process is initiated, and this research confirms that identifying staff members' perceptions towards the adoption of ICT would be an important predictor of such innovation. This study provides evidence for effective ICT adoption within mathematics education of. A common view was indicated in the analysis of interviews on whether leadership would facilitate the adoption of innovation. Moreover, participants in this study felt that the proposed ICT model (ARABIA) can help to achieve this, as it focuses on the innovation attributes. It is assumed that the ICT ARABIA Model would also be helpful for measuring the adoption of any other innovation.

Although ICT is not expected to be a solution to all problems that Kuwait education is currently facing, with numerous positive reports on the impact of ICT on learning, there is hope that it will help bringing significant change to the education system.

Most participants in this study, including this researcher, are optimistic about the impact that ICT will have on learning. The infusion of ICT in Kuwait has become an accepted fact of life. As companies, business and government sectors embark on the adventure, the education sector must also change because the those are the domains where students will be looking for work upon completion of their studies.

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Appendices

Appendix

Dear Colleague,

Technology is playing an increasingly important role in education. As teachers, our skills and pedagogy might need to be changed so that we can make effective use of technology in the classroom. Before providing opportunities to integrate the potential of technology, we would like to understand your current technology use, perceptions toward technology integration, and the factors that influence the technology adoption decisions.

We would very much value your co-operation in finding the extent to which technology can be used in the Kuwaiti educational system. Your answer will influence and affect future planning. Please help by filling in and returning this questionnaire in the envelope provided as soon as possible. The survey will take approximately 10 minutes to complete and is voluntary. Your responses will be completely confidential and in any case you need to not put your name on the form.

☐ Please insert 'X' if you want us to keep your response confidential

Name

Educational District _____

Queries

If your enquiry is related to the questionnaire content you can contact Ebtisam Aqeel:

Telephone:

Fax:

Email:

Part 1: Personal information

Please insert 'X' in an appropriate box.

1. Gender

- ☐ Male
- ☐ Female

2. Age

- ☐ 22-29
- ☐ 31-39
- ☐ 40-49
- ☐ 50-60

3. Rank

- ☐ Principal
- ☐ Head teacher
- ☐ Teacher
- ☐ Trainer

4. Teaching experience

- ☐ 1-5
- ☐ 6-10
- ☐ 11-15
- ☐ 15-

5. Highest Educational Level

- ☐ Diploma
- ☐ Bachelor
- ☐ Master
- ☐ Other

The following questions relate to your technology experience

6. Have you had any experience in using a computer?

- ☐ Yes
- ☐ No

7. If yes, please indicate how often you use the computer

- ☐ Several times a day
- ☐ Once a day
- ☐ Few times a week
- ☐ Few times a month
- ☐ Rarely
- ☐ Other
- ☐ Please state:_____

8. Which of the following features do you regularly use (check all that apply)?

- ☐ Searching for information
- ☐ Chatrooms/discussion groups
- ☐ Requesting information
- ☐ Listening to music
- ☐ Banking
- ☐ Email
- ☐ Downloading software
- ☐ Purchasing products
- ☐ Playing games
- ☐ Checking the weather
- ☐ Other. Please specify: _____

9. Do you have a computer available for use at home?

- ☐ Yes
- ☐ No

Part 2: Adoption of the Technology

Relative Advantage (circle the appropriate number)

10. Using the technology enables me to accomplish tasks more quickly

Strongly Agree	Agree	Slightly Agree	Neither Agree Nor Disagree	Slightly Disagree	Disagree	Strongly Disagree
1	2	3	4	5	6	7

11. Using the technology improves the quality of the work I do

Strongly Agree	Agree	Slightly Agree	Neither Agree Nor Disagree	Slightly Disagree	Disagree	Strongly Disagree
1	2	3	4	5	6	7

12. Using the technology enhances my effectiveness on the job

Strongly Agree	Agree	Slightly Agree	Neither Agree Nor Disagree	Slightly Disagree	Disagree	Strongly Disagree
1	2	3	4	5	6	7

13. Using the technology makes it easier to do my job

Strongly Agree	Agree	Slightly Agree	Neither Agree Nor Disagree	Slightly Disagree	Disagree	Strongly Disagree
1	2	3	4	5	6	7

14. Using technology improves my job performance

Strongly Agree	Agree	Slightly Agree	Neither Agree Nor Disagree	Slightly Disagree	Disagree	Strongly Disagree
1	2	3	4	5	6	7

15. Overall, I find using technology to be advantageous in my job

Strongly Agree	Agree	Slightly Agree	Neither Agree Nor Disagree	Slightly Disagree	Disagree	Strongly Disagree
1	2	3	4	5	6	7

16. Using technology would increase my flexibility

Strongly Agree	Agree	Slightly Agree	Neither Agree Nor Disagree	Slightly Disagree	Disagree	Strongly Disagree
1	2	3	4	5	6	7

17. Using technology would make my job more rigid and inflexible

Strongly Agree	Agree	Slightly Agree	Neither Agree Nor Disagree	Slightly Disagree	Disagree	Strongly Disagree
1	2	3	4	5	6	7

18. Using technology require a lot of my mental effort

Strongly Agree	Agree	Slightly Agree	Neither Agree Nor Disagree	Slightly Disagree	Disagree	Strongly Disagree
1	2	3	4	5	6	7

19. Using technology would decrease my productivity

Strongly Agree	Agree	Slightly Agree	Neither Agree Nor Disagree	Slightly Disagree	Disagree	Strongly Disagree
1	2	3	4	5	6	7

20. Using technology would support critical aspects of my job

Strongly Agree	Agree	Slightly Agree	Neither Agree Nor Disagree	Slightly Disagree	Disagree	Strongly Disagree
1	2	3	4	5	6	7

21. Using technology would give me more control over my work

Strongly Agree	Agree	Slightly Agree	Neither Agree Nor Disagree	Slightly Disagree	Disagree	Strongly Disagree
1	2	3	4	5	6	7

22. Using technology would reduce the amount of time I spend on activities

Strongly Agree	Agree	Slightly Agree	Neither Agree Nor Disagree	Slightly Disagree	Disagree	Strongly Disagree
1	2	3	4	5	6	7

Compatibility (circle the appropriate number)

23. Using the technology is compatible with most aspect of my work

Strongly Agree	Agree	Slightly Agree	Neither Agree Nor Disagree	Slightly Disagree	Disagree	Strongly Disagree
1	2	3	4	5	6	7

24. Using the technology fits into my work style

Strongly Agree	Agree	Slightly Agree	Neither Agree Nor Disagree	Slightly Disagree	Disagree	Strongly Disagree
1	2	3	4	5	6	7

25. Using the technology is compatible with my current computer experience

Strongly Agree	Agree	Slightly Agree	Neither Agree Nor Disagree	Slightly Disagree	Disagree	Strongly Disagree
1	2	3	4	5	6	7

26. Using technology is a new experience for me

Strongly Agree	Agree	Slightly Agree	Neither Agree Nor Disagree	Slightly Disagree	Disagree	Strongly Disagree
1	2	3	4	5	6	7

27. Using technology is not appropriate for a person with my values regarding the role of computers.

Strongly Agree	Agree	Slightly Agree	Neither Agree Nor Disagree	Slightly Disagree	Disagree	Strongly Disagree
1	2	3	4	5	6	7

28. Using technology requires a change

Strongly Agree	Agree	Slightly Agree	Neither Agree Nor Disagree	Slightly Disagree	Disagree	Strongly Disagree
1	2	3	4	5	6	7

29. Using technology would change my work habits

Strongly Agree	Agree	Slightly Agree	Neither Agree Nor Disagree	Slightly Disagree	Disagree	Strongly Disagree
1	2	3	4	5	6	7

30. The technology provides capabilities that run counter to my values

Strongly Agree	Agree	Slightly Agree	Neither Agree Nor Disagree	Slightly Disagree	Disagree	Strongly Disagree
1	2	3	4	5	6	7

31. I think that using technology fits well with the way I like to work

Strongly Agree	Agree	Slightly Agree	Neither Agree Nor Disagree	Slightly Disagree	Disagree	Strongly Disagree
1	2	3	4	5	6	7

32. Using technology is completely compatible with my current situation

Strongly Agree	Agree	Slightly Agree	Neither Agree Nor Disagree	Slightly Disagree	Disagree	Strongly Disagree
1	2	3	4	5	6	7

Image (circle the appropriate number)

33. Using technology improves my image within the school

Strongly Agree	Agree	Slightly Agree	Neither Agree Nor Disagree	Slightly Disagree	Disagree	Strongly Disagree
1	2	3	4	5	6	7

34. Because of using technology others in my school see me as a more valuable employee

Strongly Agree	Agree	Slightly Agree	Neither Agree Nor Disagree	Slightly Disagree	Disagree	Strongly Disagree
1	2	3	4	5	6	7

35. People in my school who use technology have more prestige than those who do not

Strongly Agree	Agree	Slightly Agree	Neither Agree Nor Disagree	Slightly Disagree	Disagree	Strongly Disagree
1	2	3	4	5	6	7

36. People in my school who use technology have a high profile

Strongly Agree	Agree	Slightly Agree	Neither Agree Nor Disagree	Slightly Disagree	Disagree	Strongly Disagree
1	2	3	4	5	6	7

37. Using technology would give my school a positive image

Strongly Agree	Agree	Slightly Agree	Neither Agree Nor Disagree	Slightly Disagree	Disagree	Strongly Disagree
1	2	3	4	5	6	7

38. Having a technology is a status symbol in my school

Strongly Agree	Agree	Slightly Agree	Neither Agree Nor Disagree	Slightly Disagree	Disagree	Strongly Disagree
1	2	3	4	5	6	7

39. Advocates of technology are seen as intellectually narrow and inferior

Strongly Agree	Agree	Slightly Agree	Neither Agree Nor Disagree	Slightly Disagree	Disagree	Strongly Disagree
1	2	3	4	5	6	7

Result Demonstrability (circle the appropriate number)

40. I would have no difficulty telling others about the results of using technology

Strongly Agree	Agree	Slightly Agree	Neither Agree Nor Disagree	Slightly Disagree	Disagree	Strongly Disagree
1	2	3	4	5	6	7

41. I believe I could communicate to others the consequence of using technology

Strongly Agree	Agree	Slightly Agree	Neither Agree Nor Disagree	Slightly Disagree	Disagree	Strongly Disagree
1	2	3	4	5	6	7

42. The benefits of using technology are apparent to me

Strongly Agree	Agree	Slightly Agree	Neither Agree Nor Disagree	Slightly Disagree	Disagree	Strongly Disagree
1	2	3	4	5	6	7

43. I would have difficulty explaining why using technology may or may not be beneficial

Strongly Agree	Agree	Slightly Agree	Neither Agree Nor Disagree	Slightly Disagree	Disagree	Strongly Disagree
1	2	3	4	5	6	7

Ease of Use (circle the appropriate number)

44. I find it easy to get the technology to do what I want it to do

Strongly Agree	Agree	Slightly Agree	Neither Agree Nor Disagree	Slightly Disagree	Disagree	Strongly Disagree
1	2	3	4	5	6	7

45. It would be easy for me to become skilful at using the technology

Strongly Agree	Agree	Slightly Agree	Neither Agree Nor Disagree	Slightly Disagree	Disagree	Strongly Disagree
1	2	3	4	5	6	7

46. I believe that technology is easy to use

Strongly Agree	Agree	Slightly Agree	Neither Agree Nor Disagree	Slightly Disagree	Disagree	Strongly Disagree
1	2	3	4	5	6	7

47. Technology is easy to learn

Strongly Agree	Agree	Slightly Agree	Neither Agree Nor Disagree	Slightly Disagree	Disagree	Strongly Disagree
1	2	3	4	5	6	7

48. Using technology is often frustrating

Strongly Agree	Agree	Slightly Agree	Neither Agree Nor Disagree	Slightly Disagree	Disagree	Strongly Disagree
1	2	3	4	5	6	7

49. My interaction with technology is clear and understandable

Strongly Agree	Agree	Slightly Agree	Neither Agree Nor Disagree	Slightly Disagree	Disagree	Strongly Disagree
1	2	3	4	5	6	7

50. I will search for technology that is flexible to interact with

Strongly Agree	Agree	Slightly Agree	Neither Agree Nor Disagree	Slightly Disagree	Disagree	Strongly Disagree
1	2	3	4	5	6	7

51. Learning to operate technology is easy for me

Strongly Agree	Agree	Slightly Agree	Neither Agree Nor Disagree	Slightly Disagree	Disagree	Strongly Disagree
1	2	3	4	5	6	7

52. I believe that technology is cumbersome to use

Strongly Agree	Agree	Slightly Agree	Neither Agree Nor Disagree	Slightly Disagree	Disagree	Strongly Disagree
1	2	3	4	5	6	7

53. It is easy for me to remember how to perform tasks using technology

Strongly Agree	Agree	Slightly Agree	Neither Agree Nor Disagree	Slightly Disagree	Disagree	Strongly Disagree
1	2	3	4	5	6	7

54. Using technology requires a lot of mental effort

Strongly Agree	Agree	Slightly Agree	Neither Agree Nor Disagree	Slightly Disagree	Disagree	Strongly Disagree
1	2	3	4	5	6	7

55. Using technology takes too much time from my normal duties

Strongly Agree	Agree	Slightly Agree	Neither Agree Nor Disagree	Slightly Disagree	Disagree	Strongly Disagree
1	2	3	4	5	6	7

56. Working with technology is so complicated, it is difficult to understand what is going on

Strongly Agree	Agree	Slightly Agree	Neither Agree Nor Disagree	Slightly Disagree	Disagree	Strongly Disagree
1	2	3	4	5	6	7

57. It takes too long to learn how to use technology to make it worth the effort

Strongly Agree	Agree	Slightly Agree	Neither Agree Nor Disagree	Slightly Disagree	Disagree	Strongly Disagree
1	2	3	4	5	6	7

Visibility (circle the appropriate number)

58. I have seen what others can do using technology

Strongly Agree	Agree	Slightly Agree	Neither Agree Nor Disagree	Slightly Disagree	Disagree	Strongly Disagree
1	2	3	4	5	6	7

59. In my institution, one sees computers on many desks

Strongly Agree	Agree	Slightly Agree	Neither Agree Nor Disagree	Slightly Disagree	Disagree	Strongly Disagree
1	2	3	4	5	6	7

60. I have seen technology in use outside my school

Strongly Agree	Agree	Slightly Agree	Neither Agree Nor Disagree	Slightly Disagree	Disagree	Strongly Disagree
1	2	3	4	5	6	7

61. Technology is not very visible in my school

Strongly Agree	Agree	Slightly Agree	Neither Agree Nor Disagree	Slightly Disagree	Disagree	Strongly Disagree
1	2	3	4	5	6	7

62. It is easy for me to observe others using technology in my school

Strongly Agree	Agree	Slightly Agree	Neither Agree Nor Disagree	Slightly Disagree	Disagree	Strongly Disagree
1	2	3	4	5	6	7

63. I have had plenty of opportunity to see technology being used

Strongly Agree	Agree	Slightly Agree	Neither Agree Nor Disagree	Slightly Disagree	Disagree	Strongly Disagree
1	2	3	4	5	6	7

64. I have not seen many others using technology in my department

Strongly Agree	Agree	Slightly Agree	Neither Agree Nor Disagree	Slightly Disagree	Disagree	Strongly Disagree
1	2	3	4	5	6	7

Trialability (circle the appropriate number)

65. I've had a great deal of opportunity to try various technology applications

Strongly Agree	Agree	Slightly Agree	Neither Agree Nor Disagree	Slightly Disagree	Disagree	Strongly Disagree
1	2	3	4	5	6	7

66. I know where I can go to satisfactorily try out various uses of technology

Strongly Agree	Agree	Slightly Agree	Neither Agree Nor Disagree	Slightly Disagree	Disagree	Strongly Disagree
1	2	3	4	5	6	7

67. Facilities were available to me to adequately test run various applications

Strongly Agree	Agree	Slightly Agree	Neither Agree Nor Disagree	Slightly Disagree	Disagree	Strongly Disagree
1	2	3	4	5	6	7

68. Before deciding whether to use any technology applications, I was able to properly try them out

Strongly Agree	Agree	Slightly Agree	Neither Agree Nor Disagree	Slightly Disagree	Disagree	Strongly Disagree
1	2	3	4	5	6	7

69. I was permitted to use technology on a trial basis long enough to see what it could do

Strongly Agree	Agree	Slightly Agree	Neither Agree Nor Disagree	Slightly Disagree	Disagree	Strongly Disagree
1	2	3	4	5	6	7

70. I am able to experiment with technology as necessary

Strongly Agree	Agree	Slightly Agree	Neither Agree Nor Disagree	Slightly Disagree	Disagree	Strongly Disagree
1	2	3	4	5	6	7

71. I can have technology applications for long enough periods to try them out

Strongly Agree	Agree	Slightly Agree	Neither Agree Nor Disagree	Slightly Disagree	Disagree	Strongly Disagree
1	2	3	4	5	6	7

72. I do not have to expend very much effort to try out technology

Strongly Agree	Agree	Slightly Agree	Neither Agree Nor Disagree	Slightly Disagree	Disagree	Strongly Disagree
1	2	3	4	5	6	7

73. I do not really have adequate opportunities to try out different things

Strongly Agree	Agree	Slightly Agree	Neither Agree Nor Disagree	Slightly Disagree	Disagree	Strongly Disagree
1	2	3	4	5	6	7

74. A proper on-the-job tryout of the various uses of technology is not possible

Strongly Agree	Agree	Slightly Agree	Neither Agree Nor Disagree	Slightly Disagree	Disagree	Strongly Disagree
1	2	3	4	5	6	7

75. There are enough people in my school to help me try all the various uses of technology

Strongly Agree	Agree	Slightly Agree	Neither Agree Nor Disagree	Slightly Disagree	Disagree	Strongly Disagree
1	2	3	4	5	6	7

Part 3: Are there any other reasons you can think of to adopt technology for further good and practical uses?

_____

_____

_____

_____

Part 4: Please feel free to make any other comments you feel it would be helpful to this investigation.

_____

حضرة الزملاء المحترمين

إن التكنولوجيا تلعب دورا مهما ومتزايدا في حقل التعليم. وإننا كمعلمين ، فان خبراتنا وممارستنا في علم اصول التدريس قد تحتاج إلى بعض التغيرات لكي نستطيع أن نستغل استعمال التكنولوجيا في الصف المدرسي بصورة فعالة. قبل أن نبدأ بإعطاء الفرص من اجل تكامل الإمكانيات الكامنة في التكنولوجيا ، نود أن نفهم طبيعة استعمالاتكم للتكنولوجيا وملاحظاتكم إزاء فكرة التكامل التكنولوجي والعوامل المساعدة أو المؤثرة على قرارات لتبنى التكنولوجي.ا

إننا نقيم فيكم تعاونكم معنا في دراسة وإدراك مدى استعمالات التكنولوجيا في نظم التدريس في الكويت .كما إن أجوبتكم ستؤثر على خطط التعليم في المستقبل فالرجاء مساعدتنا وذلك بالجواب على الأسئلة المرفقة طيا وإرجاعها لنا بواسطة الظروف المزودة لكم بأقرب وقت ممكن. إن أجوبتكم ستعامل بسرية كاملة ، وعلى اى حال ، فليس هناك داع إلى كتابة اسمكم على الاستمارة .

☐ الرجاء وضع علامة إن أردتم أن نتعامل مع أجوبتكم بسرية .

الاسم

المنطقة التعليمية

إذا كانت لديكم أسئلة تتعلق بدراستنا هذه ، فيرجى الاتصال ب : ابتسام العقيل

تلفون

فاكس

بريد الكتروني

الجزء الأول : معلومات شخصية

الرجاء وضع علامة X في المربع المناسب .

1. الجنس

- ☐ ذكر
- ☐ أنثى

2. العمر

- ☐ 29-22
- ☐ 39-30
- ☐ 49-40
- ☐ 60-50

3. المركز الوضيفى

- ☐ مدير / مديرة مدرسة
- ☐ رئيس/ رئيسة مدرسين
- ☐ مدرس/ مدرسة
- ☐ متدرب/ متدربة في سلك التعليم

4. الخبرة الوظيفية

- ☐ 5 -1
- ☐ 10 - 6
- ☐ 15 -11
- ☐ - 15

5. المؤهل الدراسي

- ☐ الدبلوم
- ☐ البكالوريوس
- ☐ الماجستير
- ☐ أي شهادة أخرى

الأسئلة التالية تتعلق بخبراتكم في استعمال التكنولوجيا

6. هل توجد لديكم خبرة باستخدام الحاسوب (الكمبيوتر) ؟

- ☐ نعم
- ☐ لا

7. إذا كان الجواب " نعم" فالرجاء تحديد بعدد المرات التي تستعمل الكمبيوتر في اليوم أو الأسبوع أو الشهر

- ☐ عدة مرات في اليوم
- ☐ مرة واحدة في اليوم
- ☐ بعض المرات في الأسبوع
- ☐ بعض المرات في الشهر
- ☐ قلما استعمله
- ☐ غير ذلك

الرجاء ، إعطاء بعض التوضيحات ----------

8. اى من هذه الجوانب الاتيه للكمبيوتر تستعملها بصورة دائمة :

- ☐ البحث عن المعلومات
- ☐ غرف التحاور / المناقشة
- ☐ طلب المعلومات
- ☐ الاستماع للموسيقى
- ☐ الاستعمال المصرفي
- ☐ استعمال البريد الالكتروني
- ☐ تحميل المعلومات
- ☐ التسوق
- ☐ التسلية والالعاب
- ☐ تتبع حالة الطقس
- ☐ غير ذلك ، الرجاء التوضيح ----------

9. هل يوجد لديكم جهاز كمبيوتر تستعملوه فى المنزل؟

- ☐ نعم
- ☐ كلا

القسم الثاني : تبنى الكمبيوتر

مدى الافضليه النسبية (الرجاء وضع دائرة حول الرقم المناسب)

10. *استعمال التكنولوجيا يمكنني من إنجاز اعمالى بصورة أسرع*

لا أوافق بالتاكيد	لا أوافق	لا أوافق لحد ما	حيادي (لست بموافق ولا برافض)	أوافق لحد ما	أوافق	أوافق بالتاكيد
7	6	5	4	3	2	1

11. *استعمالى التكنولوجيا يحسن من نوعية عملى*

لا أوافق بالتاكيد	لا أوافق	لا أوافق لحد ما	حيادي (لست بموافق ولا برافض)	أوافق لحد ما	أوافق	أوافق بالتاكيد
7	6	5	4	3	2	1

12. *استعمالي للتكنولوجيا يعزز من فعاليتي في تأدية واجباتى*

لا أوافق بالتاكيد	لا أوافق	لا أوافق لحد ما	حيادي (لست بموافق ولا برافض)	أوافق لحد ما	أوافق	أوافق بالتاكيد
7	6	5	4	3	2	1

13. *استعمالى للتكنولوجيا يسهل في أداء واجباتى*

لا أوافق بالتاكيد	لا أوافق	لا أوافق لحد ما	حيادي (لست بموافق ولا برافض)	أوافق لحد ما	أوافق	أوافق بالتاكيد
7	6	5	4	3	2	1

14. *استعمالي للتكنولوجيا يحسن في أداء واجباتى*

لا أوافق بالتاكيد	لا أوافق	لا أوافق لحد ما	حيادي (لست بموافق ولا برافض)	أوافق لحد ما	أوافق	أوافق بالتاكيد
7	6	5	4	3	2	1

15. *بشكل عام ، أجد أن استعمالي للتكنولوجيا يفيدني في تأدية واجباتى*

لا اوافق بالتاكيد	لا أوافق	لا أوافق لحد ما	حيادي (لست بموافق ولا برافض)	أوافق لحد ما	أوافق	أوافق بالتأكيد
7	6	5	4	3	2	1

16. *استعمالي للتكنولوجيا يزيد في مدى مرونتي في تأدية واجباتى*

لا أوافق بالتأكيد	لا أوافق	لا أوافق لحد ما	حيادي (لست بموافق ولا برافض)	أوافق لحد ما	أوافق	أوافق بالتأكيد
7	6	5	4	3	2	1

17. *استعمالي للتكنولوجيا يجعل من عملي أكثر جمودا وأقل قابلية للمرونة*

لا أوافق بالتأكيد	لا أوافق	لا أوافق لحد ما	حيادي (لست بموافق ولا برافض)	أوافق لحد ما	أوافق	أوافق بالتأكيد
7	6	5	4	3	2	1

18. *استعمالى للتكنولوجيا يتطلب قدرا كبيرا من الجهد الذهني*

لا أوافق بالتأكيد	لا أوافق	لا أوافق لحد ما	حيادي (لست بموافق ولا برافض)	أوافق لحد ما	أوافق	أوافق بالتأكيد
7	6	5	4	3	2	1

19. *استعمالي للتكنولوجيا سيقلل من انتاجى*

لا أوافق بالتأكيد	لا أوافق	لا أوافق لحد ما	حيادي (لست بموافق ولا برافض)	أوافق لحد ما	أوافق	أوافق بالتأكيد
7	6	5	4	3	2	1

20. *استعمالي للتكنولوجيا سيدعم جوانب مهمة من عملي*

لا أوافق بالتأكيد	لا أوافق	لا أوافق لحد ما	حيادي (لست بموافق ولا برافض)	أوافق لحد ما	أوافق	أوافق بالتأكيد
7	6	5	4	3	2	1

21. *استعمالي للتكنولوجيا سيعطيني أكثر سيطرة على أعمالي*

لا أوافق بالتأكيد	لا أوافق	لا أوافق لحد ما	حيادي (لست بموافق ولا برافض)	أوافق لحد ما	أوافق	أوافق بالتأكيد
7	6	5	4	3	2	1

22. *استعمالي للتكنولوجيا سيقلل من الوقت الذي أقضيه في أداء فعالياتي*

لا أوافق بالتأكيد	لا أوافق	لا أوافق لحد ما	حيادي (لست بموافق ولا برافض)	أوافق لحد ما	أوافق	أوافق بالتأكيد
7	6	5	4	3	2	1

الانسجام (الرجاء وضع دائرة حول الرقم المناسب)

23. *استعمالي للتكنولوجيا ينسجم مع معظم جوانب عملي*

لا أوافق بالتأكيد	لا أوافق	لا أوافق لحد ما	حيادي (لست بموافق ولا برافض)	أوافق لحد ما	أوافق	أوافق بالتأكيد
7	6	5	4	3	2	1

24. *استعمالي للتكنولوجيا يتوافق مع أسلوب عملي*

لا أوافق بالتأكيد	لا أوافق	لا أوافق لحد ما	حيادي (لست بموافق ولا برافض)	أوافق لحد ما	أوافق	أوافق بالتأكيد
7	6	5	4	3	2	1

25. *استعمالي للتكنولوجيا يتوافق مع خبرتي الحالية في استعمال الكمبيوتر*

لا أوافق بالتأكيد	لا أوافق	لا أوافق لحد ما	حيادي (لست بموافق ولا برافض)	أوافق لحد ما	أوافق	أوافق بالتأكيد
7	6	5	4	3	2	1

26. *استعمالي للتكنولوجيا تجربة جديدة بالنسبة لي*

لا أوافق بالتأكيد	لا أوافق	لا أوافق لحد ما	حيادي (لست بموافق ولا برافض)	أوافق لحد ما	أوافق	أوافق بالتأكيد
7	6	5	4	3	2	1

27. *استعمالي للتكنولوجيا لا يتناسب مع شخص مثلي يتحلى بقيم خاصة اتجاه دور الكمبيوتر*

لا أوافق بالتأكيد	لا أوافق	لا أوافق لحد ما	حيادي (لست بموافق ولا برافض)	أوافق لحد ما	أوافق	أوافق بالتأكيد
7	6	5	4	3	2	1

28. *استعمال التكنولوجيا يتطلب تغيرات متعددة*

لا أوافق بالتأكيد	لا أوافق	لا أوافق لحد ما	حيادي (لست بموافق ولا برافض)	أوافق لحد ما	أوافق	أوافق بالتأكيد
7	6	5	4	3	2	1

29. *استعمالي للتكنولوجيا سيغير من عاداتي في العمل*

لا أوافق بالتأكيد	لا أوافق	لا أوافق لحد ما	حيادي (لست بموافق ولا برافض)	أوافق لحد ما	أوافق	أوافق بالتأكيد
7	6	5	4	3	2	1

30. *إن التكنولوجيا ستزودني بإمكانيات لا تتماشى مع القيم التي أتحلى بها*

لا أوافق بالتأكيد	لا أوافق	لا أوافق لحد ما	حيادي (لست بموافق ولا برافض)	أوافق لحد ما	أوافق	أوافق بالتأكيد
7	6	5	4	3	2	1

31. *اعتقد أن استعمالي للتكنولوجيا يتوافق بصورة جيدة مع الطريقة التي أفضل أن استعملها في عملي*

لا أوافق بالتأكيد	لا أوافق	لا أوافق لحد ما	حيادي (لست بموافق ولا برافض)	أوافق لحد ما	أوافق	أوافق بالتأكيد
7	6	5	4	3	2	1

32. *استعمالي للتكنولوجيا ينسجم كليا مع وضعي الحالي*

لا أوافق بالتأكيد	لا أوافق	لا أوافق لحد ما	حيادي (لست بموافق ولا برافض)	أوافق لحد ما	أوافق	أوافق بالتأكيد
7	6	5	4	3	2	1

الانطباع (الرجاء وضع دائرة حول الرقم المناسب)

33. *استعمالي للتكنولوجيا يحسن من الانطباع الذي أتركه في المدرسة*

لا أوافق بالتأكيد	لا أوافق	لا أوافق لحد ما	حيادي (لست بموافق ولا برافض)	أوافق لحد ما	أوافق	أوافق بالتأكيد
7	6	5	4	3	2	1

34. *بسبب استعمالي للتكنولوجي فان الأخريين في مدرستي سينظرون إلى باعتباري موظف له قيمة عالية*

لا أوافق بالتأكيد	لا أوافق	لا أوافق لحد ما	حيادي (لست بموافق ولا برافض)	أوافق لحد ما	أوافق	أوافق بالتأكيد
7	6	5	4	3	2	1

35. *الأشخاص الذين يستعملون التكنولوجيا في مدرستي لهم قيمة أعلى من قيمة الأشخاص الذين لا يستعملونه التكنولوجيا*

لا أوافق بالتأكيد	لا أوافق	لا أوافق لحد ما	حيادي (لست بموافق ولا برافض)	أوافق لحد ما	أوافق	أوافق بالتأكيد
7	6	5	4	3	2	1

36. *الأشخاص الذين يستعملون التكنولوجيا في مدرستي لهم دورا ظاهر أكثر من الذين لا يستعملون التكنولوجيا*

لا أوافق بالتأكيد	لا أوافق	لا أوافق لحد ما	حيادي (لست بموافق ولا برافض)	أوافق لحد ما	أوافق	أوافق بالتأكيد
7	6	5	4	3	2	1

37. *استعمالي للتكنولوجيا سيعطى مدرستي انطباع ايجابي*

لا أوافق بالتأكيد	لا أوافق	لا أوافق لحد ما	حيادي (لست بموافق ولا برافض)	أوافق لحد ما	أوافق	أوافق بالتأكيد
7	6	5	4	3	2	1

38. *استعمال التكنولوجيا في مدرستي يضفى قيمة عالية على الشخص الذي يستعمله*

لا أوافق بالتأكيد	لا أوافق	لا أوافق لحد ما	حيادي (لست بموافق ولا برافض)	أوافق لحد ما	أوافق	أوافق بالتأكيد
7	6	5	4	3	2	1

39. *ينظر الى الاشخاص المؤيدين لفكرة استعمال التكنولوجيا باعتبارهم اشخاص ذو افكار متدنية ومحدودة*

لا أوافق بالتأكيد	لا أوافق	لا أوافق لحد ما	حيادي (لست بموافق ولا برافض)	أوافق لحد ما	أوافق	أوافق بالتأكيد
7	6	5	4	3	2	1

إقامة الدلائل على النتائج

40. *ليست لدى أية مشكلة في إخبار الأخريين عن نتائج استعمالي للتكنولوجيا*

لا أوافق بالتأكيد	لا أوافق	لا أوافق لحد ما	حيادي (لست بموافق ولا برافض)	أوافق لحد ما	أوافق	أوافق بالتأكيد
7	6	5	4	3	2	1

41. *اعتقد انه باستطاعتي ايصال نتائج استعمالي للتكنولوجيا إلى الأخريين*

لا أوافق بالتأكيد	لا أوافق	لا أوافق لحد ما	حيادي (لست بموافق ولا برافض)	أوافق لحد ما	أوافق	أوافق بالتأكيد
7	6	5	4	3	2	1

42. *ان الفوائد الناتجة من استعمال التكنولوجيا هي ظاهرة لي*

لا أوافق بالتأكيد	لا أوافق	لا أوافق لحد ما	حيادي (لست بموافق ولا برافض)	أوافق لحد ما	أوافق	أوافق بالتأكيد
7	6	5	4	3	2	1

43. *ساجد بعض الصعوبات في شرح مسالة فيما إذا كان استعمال التكنولوجيا هو عمل مفيد أو غير مفيد*

لا أوافق بالتأكيد	لا أوافق	لا أوافق لحد ما	حيادي (لست بموافق ولا برافض)	أوافق لحد ما	أوافق	أوافق بالتأكيد
7	6	5	4	3	2	1

سهولة الاستخدام

44. *أجد من السهولة بأن أجعل التكنولوجيا قابلة للقيام بالأعمال التي اطلبها*

لا أوافق بالتأكيد	لا أوافق	لا أوافق لحد ما	حيادي (لست بموافق ولا برافض)	أوافق لحد ما	أوافق	أوافق بالتأكيد
7	6	5	4	3	2	1

45. *من السهل على أن أصبح ذا خبرة في استعمال التكنولوجيا*

لا أوافق بالتأكيد	لا أوافق	لا أوافق لحد ما	حيادي (لست بموافق ولا برافض)	أوافق لحد ما	أوافق	أوافق بالتأكيد
7	6	5	4	3	2	1

46. *أعتقد بأنه من السهل استعمال التكنولوجيا*

لا أوافق بالتأكيد	لا أوافق	لا أوافق لحد ما	حيادي (لست بموافق ولا برافض)	أوافق لحد ما	أوافق	أوافق بالتأكيد
7	6	5	4	3	2	1

47. *التكنولوجيا هي شيء من السهل تعلمه*

لا أوافق بالتأكيد	لا أوافق	لا أوافق لحد ما	حيادي (لست بموافق ولا برافض)	أوافق لحد ما	أوافق	أوافق بالتأكيد
7	6	5	4	3	2	1

48. *استعمال التكنولوجيا يؤدى عادة إلى اثباط العزم*

لا أوافق بالتأكيد	لا أوافق	لا أوافق لحد ما	حيادي (لست بموافق ولا برافض)	أوافق لحد ما	أوافق	أوافق بالتأكيد
7	6	5	4	3	2	1

49. *إن تعاملي مع التكنولوجيا هو شيء واضح ومفهوم*

لا أوافق بالتأكيد	لا أوافق	لا أوافق لحد ما	حيادي (لست بموافق ولا برافض)	أوافق لحد ما	أوافق	أوافق بالتأكيد
7	6	5	4	3	2	1

50. *سأبحث عن تكنولوجيا ذات مرونة ومن السهل التعامل معها*

لا أوافق بالتأكيد	لا أوافق	لا أوافق لحد ما	حيادي (لست بموافق ولا برافض)	أوافق لحد ما	أوافق	أوافق بالتأكيد
7	6	5	4	3	2	1

51. *من السهل على تعلم كيفية استعمال التكنولوجيا*

لا أوافق بالتأكيد	لا أوافق	لا أوافق لحد ما	حيادي (لست بموافق ولا برافض)	أوافق لحد ما	أوافق	أوافق بالتأكيد
7	6	5	4	3	2	1

52. *اعتقد بأن التكنولوجيا شيء معقد يصعب استعماله*

لا أوافق بالتأكيد	لا أوافق	لا أوافق لحد ما	حيادي (لست بموافق ولا برافض)	أوافق لحد ما	أوافق	أوافق بالتأكيد
7	6	5	4	3	2	1

53. *انه من السهل على تذكر كيفية استعمال التكنولوجيا للقيام ببعض الاعمال*

لا أوافق بالتأكيد	لا أوافق	لا أوافق لحد ما	حيادي (لست بموافق ولا برافض)	أوافق لحد ما	أوافق	أوافق بالتأكيد
7	6	5	4	3	2	1

54. *استعمال التكنولوجيا يتطلب جهدا فكريا كبيرا*

لا أوافق بالتأكيد	لا أوافق	لا أوافق لحد ما	حيادي (لست بموافق ولا برافض)	أوافق لحد ما	أوافق	أوافق بالتأكيد
7	6	5	4	3	2	1

55. *استعمال التكنولوجيا يأخذ وقتا كثيرا من أعمالي الاعتيادية*

لا أوافق بالتأكيد	لا أوافق	لا أوافق لحد ما	حيادي (لست بموافق ولا برافض)	أوافق لحد ما	أوافق	أوافق بالتأكيد
7	6	5	4	3	2	1

56. إن العمل مع التكنولوجيا هو عمل معقد جدا بحيث يصعب على فهم ما يجرى

لا أوافق بالتأكيد	لا أوافق	لا أوافق لحد ما	حيادي (لست بموافق ولا برافض)	أوافق لحد ما	أوافق	أوافق بالتأكيد
7	6	5	4	3	2	1

57. إن تعلم استعمال التكنولوجيا يتطلب وقتا طويلا بحيث انه يصبح عملا لا يستحق الجهد

لا أوافق بالتأكيد	لا أوافق	لا أوافق لحد ما	حيادي (لست بموافق ولا برافض)	أوافق لحد ما	أوافق	أوافق بالتأكيد
7	6	5	4	3	2	1

وضوح استعمالات التكنولوجيا

58. لقد اطلعت على ما استطاع الأخريين عمله من خلال استعمالهم للتكنولوجيا

لا أوافق بالتأكيد	لا أوافق	لا أوافق لحد ما	حيادي (لست بموافق ولا برافض)	أوافق لحد ما	أوافق	أوافق بالتأكيد
7	6	5	4	3	2	1

59. في مدرستي يمكن ملاحظة توفر عددا من أجهزة الكمبيوتر على الطاولات

لا أوافق بالتأكيد	لا أوافق	لا أوافق لحد ما	حيادي (لست بموافق ولا برافض)	أوافق لحد ما	أوافق	أوافق بالتأكيد
7	6	5	4	3	2	1

60. لقد لاحظت بان التكنولوجيا تستعمل خارج مدرستى

لا أوافق بالتأكيد	لا أوافق	لا أوافق لحد ما	حيادي (لست بموافق ولا برافض)	أوافق لحد ما	أوافق	أوافق بالتأكيد
7	6	5	4	3	2	1

61. *إن التكنولوجيا في مدرستي غير ظاهرة للعيان*

لا أوافق بالتأكيد	لا أوافق	لا أوافق لحد ما	حيادي (لست بموافق ولا برافض)	أوافق لحد ما	أوافق	أوافق بالتأكيد
7	6	5	4	3	2	1

62. *إنه من السهل على أن أرى أشخاصا أخريين يستعملون التكنولوجيا في مدرستي*

لا أوافق بالتأكيد	لا أوافق	لا أوافق لحد ما	حيادي (لست بموافق ولا برافض)	أوافق لحد ما	أوافق	أوافق بالتأكيد
7	6	5	4	3	2	1

63. *لقد سنحت لي فرص كثيرة بمشاهدة التكنولوجيا وهى في حالة الاستعمال*

لا أوافق بالتأكيد	لا أوافق	لا أوافق لحد ما	حيادي (لست بموافق ولا برافض)	أوافق لحد ما	أوافق	أوافق بالتأكيد
7	6	5	4	3	2	1

64. *لم ألاحظ أشخاصا آخرين في مدرستي ممن يستعملون التكنولوجيا*

لا أوافق بالتأكيد	لا أوافق	لا أوافق لحد ما	حيادي (لست بموافق ولا برافض)	أوافق لحد ما	أوافق	أوافق بالتأكيد
7	6	5	4	3	2	1

إمكانيات اختبار التكنولوجيا

65. *لقد سنحت لي فرص كثيرة لاختبار التكنولوجيا وهى في حالة الاستعمال*

لا أوافق بالتأكيد	لا أوافق	لا أوافق لحد ما	حيادي (لست بموافق ولا برافض)	أوافق لحد ما	أوافق	أوافق بالتأكيد
7	6	5	4	3	2	1

66. *أنا أعلم إلى أين اذهب لاختبر بصورة مرضية عددا من استعمالات التكنولوجيا*

لا أوافق بالتأكيد	لا أوافق	لا أوافق لحد ما	حيادي (لست بموافق ولا برافض)	أوافق لحد ما	أوافق	أوافق بالتأكيد
7	6	5	4	3	2	1

67. *تتوفر لدى التسهيلات لأقوم باختبار عدد من تطبيقات التكنولوجيا بصورة كافية*

لا أوافق بالتأكيد	لا أوافق	لا أوافق لحد ما	حيادي (لست بموافق ولا برافض)	أوافق لحد ما	أوافق	أوافق بالتأكيد
7	6	5	4	3	2	1

68. *قبل أن أقرر فيما إذا ساستعمل أيا من تطبيقات اللتكنولوجيا ، أتيحت لي فرصة اختبارهم بصورة صحيحة*

لا أوافق بالتأكيد	لا أوافق	لا أوافق لحد ما	حيادي (لست بموافق ولا برافض)	أوافق لحد ما	أوافق	أوافق بالتأكيد
7	6	5	4	3	2	1

69. *لقد سنحت لي الفرصة باستعمال التكنولوجيا على أساس الاختبار لفترة كافية بحيث أتمكن من معرفة طبيعة عمله*

ا

لا أوافق بالتأكيد	لا أوافق	لا أوافق لحد ما	حيادي (لست بموافق ولا برافض)	أوافق لحد ما	أوافق	أوافق بالتأكيد
7	6	5	4	3	2	1

70. *أنه باستطاعتي القيام باختبارات في التكنولوجيا على قدر احتياجاتى*

لا أوافق بالتأكيد	لا أوافق	لا أوافق لحد ما	حيادي (لست بموافق ولا برافض)	أوافق لحد ما	أوافق	أوافق بالتأكيد
7	6	5	4	3	2	1

71. باستطاعتي الحصول على تطبيقات للتكنولوجيا لفترة طويلة بحيث أستطيع اختباره

لا أوافق بالتأكيد	لا اوافق	لا أوافق لحد ما	حيادي (لست بموافق ولا برافض)	أوافق لحد ما	أوافق	أوافق بالتأكيد
7	6	5	4	3	2	1

72. ليست هناك دواعي تضطرني لبذل اى جهد في اختبار التكنولوجيا

لا أوافق بالتأكيد	لا أوافق	لا أوافق لحد ما	حيادي (لست بموافق ولا برافض)	أوافق لحد ما	أوافق	أوافق بالتأكيد
7	6	5	4	3	2	1

73. في الحقيقة لم تتوفر لدى الفرص الكافية لاختبار استخدامات التكنولوجيا المختلفة

لا أوافق بالتأكيد	لا أوافق	لا أوافق لحد ما	حيادي (لست بموافق ولا برافض)	أوافق لحد ما	أوافق	أوافق بالتأكيد
7	6	5	4	3	2	1

74. ليس من الممكن اختبار التطبيقات المختلفة للتكنولوجيا وهى في حالة الاستعمال

لا أوافق بالتأكيد	لا أوافق	لا أوافق لحد ما	حيادي (لست بموافق ولا برافض)	أوافق لحد ما	أوافق	أوافق بالتأكيد
7	6	5	4	3	2	1

75. هناك عدد كافي من الأشخاص في مدرستي ممن يساعدني في القيام باستعمالات المختلفة للتكنولوجيا

لا أوافق بالتأكيد	لا أوافق	لا أوافق لحد ما	حيادي (لست بموافق ولا برافض)	أوافق لحد ما	أوافق	أوافق بالتأكيد
7	6	5	4	3	2	1

الجزء الثالث

هل هناك أسباب أخرى تعتقدون بأنها تؤثر على تبنى التكنولوجيا من اجل استعمالات أخرى جيدة وعملية

_____

_____

_____

_____

_____

الجزء الرابع

أرجو عدم التردد في ذكر اى ملاحظات قد تساعدنا في هذه الدراسة

_____

_____

_____

خطة المقابلة

اعتمادا على خبرتكم التعليمية ، أود أن أعرف عن وجهة نظركم إزاء فكرة تبنى التكنولوجيا في تدريس علم الرياضيات في المدارس المتوسطة في دولة الكويت .

الأسئلة الآتية وضعت كأساس للخطة ، ولكن ليس من الضروري أن تكون في نفس الترتيب .

1. معلومات خاصة

- العمر
- الجنس
- ما هو مؤهلكم العلمي الذي حصلتم عليها ؟
- ما هو مركزكم الوضيفى في المدرسة ؟
- ما هو عدد سنوات خبرتكم في التدريس ؟
- هل تستعملون التكنولوجيا لاى غرض من الأغراض ؟

2. معلومات خلفية

- ما هي الطرق المفضلة لكم للاستعمال في التدريس
- ما هو مدى إمكانياتكم في استعمال الأجهزة السمعية والمرئية
- هل انتم تستعملون في الوقت الحاضر ، أو كنتم قد استعملتم في الماضي ، تكنولوجية الكمبيوتر كجزء من إطار عملكم في إعطاء الإرشادات للطلاب .
- ما هو رأيكم في استعمال التكنولوجيا في دروس الرياضيات
- هل هناك عوائق ناتجة من استعمال التكنولوجيا في دروس الرياضيات

3. خواص منسوبة إلى التكنولوجيا

- ما هو في رأيكم الخاص أهم العوامل المؤثرة في اتخاذ قرار تبنى التكنولوجيا ؟
- الرجاء تعديد خواص التكنولوجيا التي تساهم في اتخاذ قرار تبنى التكنولوجيا ؟
- هل لكم أن تذكروا لنا عن ماهية الفوائد النسبية المحتملة والناتجة من استعمال طرق التكنولوجيا في تدريس علم الرياضيات على الطرق التقليدية ؟
- هل لكم أن تعددوا بعض هذه الفوائد
- إلى اى مدى تعتقدون بأن طريقة استعمال التكنولوجيا تتماشى مع طريقتكم في التعليم ؟

Brief Background to Educational System in State of Kuwait

1. Introduction

This section will establish the context of the present study by providing geographical information about the State of Kuwait, and discussing its education system, in terms of the main aims and objectives of education, the structure of the system and the elementary school curriculum, in particular the mathematics curriculum. Then, the current position with regard to computers in the education system will be outlined.

2. Geographical Background of Kuwait

The State of Kuwait is located on the Northwest side of the Arabian Gulf. Iraq borders Kuwait to the north; to the east, it is bounded by the Arabian Gulf, and to the south and west, by Saudi Arabia. The territory of Kuwait totals 17,818 square kilometres (6,960 square miles). Kuwait is divided into five governorates, namely the Capital, Hawalli, Farwaniya, Alahmadi and Jahra (see Figure 1).

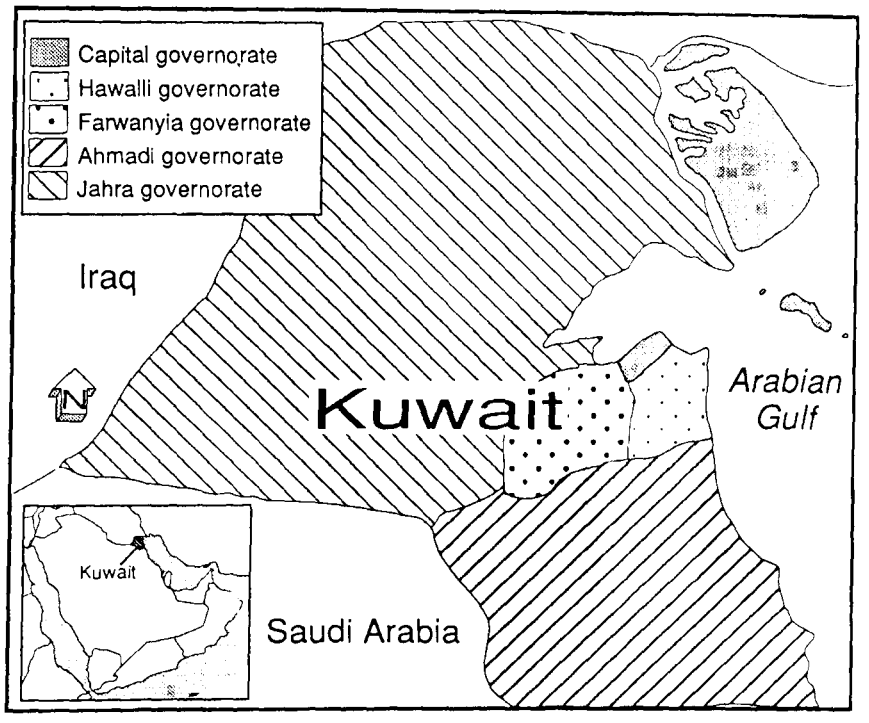

Figure 1: State of Kuwait and its five governorates

3. Population

The first population census, carried out in 1957, estimated the population of Kuwait to be 206,000. Thereafter, a population census has been conducted every 5 years. By 1997, Kuwait's estimated population had risen to 2,208,790, only 40% of whom were Kuwaiti nationals. The main cause of the vast increase in population was the production of oil in 1936 and, hence, Kuwait's demand for migrant workers (Ministry of Planning, 1997).

4. Culture

The Islamic religion is the chief influence on people and their way of life. For example, girls are segregated from boys from the elementary level (age 6) upward. Although religion plays a very important part in most peoples' life and decisions, there is generally no conflict between their scientific learning and their religious belief. In fact, both men and women are encouraged by their religion to be more educated. The Qur'an, the holy book of Muslims, indicates that those who know and understand are not equal to those who do not. Yousuf Ali's translation of the Qur'an (1975) in the Zumar sura, verse 9, reads:

> "Are those equal, those who know and those do not know? It is those who are endowed with understanding that receive admonition". (p.1239)

Prophet Mohammad (peace upon him) also encouraged people to learn and seek knowledge, by what can be translated as:

> "Anyone who follows a road seeking knowledge, God will facilitate for him a way to paradise."(Hadeeth)

5. Educational System in Kuwait

Before the provision of formal education, the mosque was the only place where people could be educated in reading, writing, arithmetic, and religious matters. In 1936, the Council of Education was founded to meet the needs created by the establishment of the new state. However, the progress of education remained slow

until the establishment of the Ministry of Education in 1961. Higher Education started with Kuwait University in the academic year 1966/1967.

5.1 Education Objectives

With the aim of establishing the objectives of the educational system, the Ministry of Education issued a document stating the general objectives of education. The document defined the starting points for the aims of education, its areas and contents, maintaining a balance between the culture of society, the requirement of the age, and the need of continuous development of learning in keeping with the contemporary trends in education. The document, consequently, defined the overall objective of education in the State of Kuwait as follows:

> "To help all learners achieve comprehensive and integrated spiritual, mental, social, psychological and physical growth to the maximum of their abilities and possibilities; to enable them to achieve self-fulfillment and to participate in realizing the programs of Kuwait society in particular and those at the Arab and Islamic world, as well as humanity in general" (M.O.E, 1985).

5.2 Educational Structure

5.2.1 General Education

There are four stages in the general educational system of Kuwait. These are shown in Table 1:

Table 1: Kuwait system of education

Stage	Age	Description
Kindergarten	4-6	Optional
Elementary	6-10	Compulsory
Intermediate	10-14	Compulsory
Secondary	14-18	Optional

The Ministry of Education provides a free pre-school service through its kindergartens for children between the ages of four and six, but compulsory school

attendance begins at age six. The elementary stage covers children up to age ten, and the intermediate stage (also compulsory) lasts until age fourteen. Post- compulsory secondary education lasts four years. Schooling throughout the twelve years is not co-educational. There are schools for boys with male teachers, and schools for girls with female teachers. All stages of state education are free. Article 40 of the Kuwait constitution stipulates

> "Education is a right for all Kuwaitis, guaranteed by the state in accordance with the law and within the limits of public policy and morals. Education in its preliminary stages shall be compulsory and free in accordance with law" (G.O.K, 1962,p.7)

The government body responsible for general education is the Ministry of Education, which oversees both public and private sectors of education until the end of the secondary stage. There are five school districts corresponding with the governorates, namely The Capital, Hawali, Al- Farwaniyah, Al-Ahmadi, and Al-Jahraa. These districts are supervised and governed by the Ministry of Education. After the fourth stage, the student can pursue Higher Education in the various colleges and universities.

5.2.2 Special Education

In the government sector this includes Special Education, Adult and Eradication of Illiteracy Education, and Religious Education.

5.2.3 Private Education

The private sector consists of foreign schools, which do not comply with the system of general Education used in Kuwait. It includes Nursery, Kindergarten, Elementary and Secondary - level establishments.

5.2.4 Applied Education

The Public Authority of Applied Education and Training (PAAET)is responsible for vocational education in applied education institutes and training centres, as follows:

1) Applied Education Institutions: There are four colleges: the College of Basic Education, College of Business Studies, College of Health Sciences, and College of Technological Studies.

2) Training Centres: These centres are concerned with qualifying students who cannot continue their studies in the field of general education. They prepare them for some technical jobs in various fields. They also train some officials to increase their experience and raise their competence in their field of work.

5.2.5 University Education

The University of Kuwait was inaugurated in the academic year 1966/1967 as the national university. It has various colleges in different fields of specialisation (M.O.E, 1996).

6. Computers in Kuwait

The State of Kuwait is a well-developed society with an advanced infrastructure. This has arisen largely from oil wealth. Computers play an important role at the current time in Kuwait. They are found in all areas of society, such as industry, business, health, security, military services, and everyday life.

6.1 Computers in Private Sector

In the private sector, the introduction of computers has progressed rapidly. Many private schools have included a number of computer activities in their curricula. Furthermore, many institutions for computer training have been established in the last few years, their activities include programming, accounting, and word processing.

6.2 Computers in General Education

As a result of the importance of computers in education, in 1986/87 the Ministry of Education introduced computers as part of the curriculum in secondary schools. This module was given the title of "Introduction to Computers". Below is an outline of the aims of this computer curriculum:

- Removing students' fears of computers.

- Preparing students for the future by making them generally aware of the technology available.
- Prompting investigation and scientific ways of thinking.
- Enabling students to cope with changes in society.
- Enabling students to use computers in universities and higher education.
- Enabling students to achieve some skills in computer technology in order to help them in their working life (M.O.E, 1996).

Overall, the main objectives were to abolish students' fears and hesitations about using computers. Instead students would be encouraged to picture this device as a learning tool, helped to get a better understanding of science and information technology and become fully confident about using it, and be prepared for higher education studies and for future employment, where using computers is always expected.